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Prevalence and types of Medication Errors in In-patient settings: A PCNE-Based Study with Pharmacist-Led Intervention at DHQ Hospital KDA Kohat

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Abstract

Background: Medication errors continue to be a major concern in healthcare, often leading to serious consequences for the well-being of those receiving treatment, yet preventable, particularly within hospital in-patient settings where patients often receive complex therapeutic regimens. These errors can occur during any stage of the medication use process prescribing, transcribing, dispensing, administration, or monitoring and may result in adverse drug events, prolonged hospitalization, increased healthcare costs, and even patient mortality. Methodology: This study aimed to assess the prevalence and types of medication errors using the Pharmaceutical Care Network Europe (PCNE) classification system, and to evaluate the effectiveness of pharmacistled interventions in reducing such errors among in-patients at DHQ Hospital, KDA Kohat, Kohat. A prospective observational study was conducted over a period of one year in the Critical Care Unit (CCU), Medical, and Surgical wards of DHQ Hospital, KDA Kohat. Data were collected from 112 prescriptions. Each prescription was analyzed using PCNE classification system version 9.1 to identify medication errors and their underlying causes. All interventions by clinical pharmacists were documented and categorized accordingly. Results: Among these 112 prescriptions reviewed, 69 medication errors were identified. The most frequent problems were associated with inappropriate drug selection (P1) and incorrect dose selection (P3). The primary causes included lack of drug knowledge (C1), failure to adjust doses in renal impairment (C7), and prescribing without a valid indication (C5). Pharmacists intervened in 10 cases, with common interventions including notifying the prescriber, adjusting dosages, and therapeutic substitutions. Notably, approximately 83.3% of these interventions were accepted by the prescribers. Conclusion: The findings demonstrate that medication errors are notably prevalent in in-patient hospital settings, especially in the CCU, Medical, and Surgical wards. Clinical pharmacists significantly contributed to error reduction through structured interventions. Incorporating routine pharmacist-led medication reviews may enhance patient safety and promote rational medication use in healthcare institutions.

Introduction

Medication errors are among the most significant yet preventable threats to patient safety worldwide. The United States National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) defines a medication error as a preventable event that may lead to inappropriate medication use or patient harm, while the medication is under the control of healthcare professionals, patients, or consumers. These errors may arise at any stage of the medication-use process including prescribing, transcribing, compounding, dispensing, administering, or monitoring and are often linked to issues in professional practice, healthcare systems, and product labeling or packaging [1,2].

According to the World Health Organization (WHO), medication errors cause clinical complications to an estimated 1.3 million individuals annually and result in at least one death per day in the United States alone [3]. Globally, the financial burden of these errors is estimated to exceed $42 billion USD each year, highlighting the urgent need for system-level interventions. Recognizing this, the WHO has declared "Medication Without Harm" as the Third Global Patient Safety Challenge [4].

PCNE Classification and Role of Pharmacists

To standardize the assessment of drug-related problems (DRPs),

the Pharmaceutical Care Network Europe (PCNE) developed a structured classification system [5] . The PCNE classification system version 9.1, released in May 2020, offers a comprehensive framework that includes problem types, causes, and corresponding pharmacist interventions [6]. This tool enables healthcare professionals to not only identify and categorize medication errors but also document the effectiveness of interventions and their acceptance by prescribers [7]. Pharmacist-led clinical services have demonstrated significant value in identifying and mitigating medication errors across various healthcare settings. Educational and interventional programs led by pharmacists have been shown to effectively reduce error rates by improving awareness, communication, and adherence to guidelines among healthcare staff [8].

In Pakistan's hospitals and clinics, clinical pharmacists are becoming essential allies in patient care. They go beyond just handing out medicines taking the time to carefully review prescriptions, spot potential issues like wrong dosages or harmful drug combinations, and work closely with doctors and nurses to make sure every patient gets the safest, most effective treatment possible [9]. By sitting down with patients, they 2 explain how to take medications properly, clear up doubts, and offer personalized advice, which can be especially helpful for those managing long-term conditions like diabetes or heart disease. This hands-on approach not only helps avoid dangerous mistakes but also encourages patients to stay on track with their treatment plans [10]. Pharmacists are essential members of the healthcare team, actively working to prevent medication errors in hospitals by ensuring safe and accurate use of medicines [11].

A study was conducted on a total of 316 patients, with relevant information collected from each participant. Among them, 171 were male and 145 were female. Social history revealed that 41 patients were smokers, 43 consumed alcohols, while 46 reported both smoking and alcohol use. Regarding medication load, 241 patients were prescribed 10 or more drugs, while 75 received fewer than 10. The length of hospital stay was 10 days or more for 261 patients, and less than 10 days for 55. A higher number of DRPs 134 cases (63.5%) were identified in patients aged 60 years and above, compared to 77 cases (36.4%) in those below 60. In terms of gender, DRPs were more frequently observed in males (122 cases, 38%) than in females (89 cases, 28%) [12].

Local Context and Study Justification

At District Headquarters (DHQ) Hospital KDA, Kohat, a secondary-care teaching facility, there is currently no formal medication error reporting or monitoring system. Although pharmacy graduates are increasingly involved in clinical practices, their contributions toward preventing medication errors remain undocumented and underutilized. This study seeks to fill that gap by analyzing the prevalence, types, and causes of medication errors, as well as evaluating pharmacist-led interventions using the PCNE framework.

Study Focus and Scope

The research is specifically focused on in-patient medical and surgical wards, including the Critical Care Unit (CCU) of DHQ Hospital, where critically ill patients are managed and the risk of medication error is high. A total of 112 prescriptions were collected and systematically analyzed using the PCNE v9.1 tool to determine the nature and frequency of errors.

Additionally, the study assesses the types and acceptance of pharmacist interventions to explore their impact on improving medication safety.

Rationale

The motivation behind this study lies in the growing demand for enhanced patient safety, particularly in resource-constrained hospitals where clinical pharmacy services are still evolving. By applying an internationally validated classification system and 3 documenting pharmacist interventions, the research aims to support the establishment of a safety-oriented culture and evidence-based decision-making. The outcomes of this study may also inform institutional policies for developing medication error reporting systems and expanding the role of pharmacists in hospital care. Medication errors continue to present a serious challenge in hospital settings, especially in critical care units, where patients often require complex medication regimens. Tools like the PCNE classification system provide a structured approach to error analysis, while pharmacist-led interventions represent a key strategy for error reduction. This study will generate valuable baseline data on the prevalence and types of medication errors at DHQ Hospital, Kohat, and reinforce the critical role of pharmacists in multidisciplinary healthcare teams.

Objectives

• To identify and categorize medication errors in the CCU, medical, and surgical wards using the PCNE (version 9.1) system.
• To carry out pharmacist-led interventions focused on reducing or resolving these errors.
• To assess how effective and well-received these interventions are, and to suggest practical ways to improve medication safety in the hospital.

Methodology

Study Design

This research was conducted as a prospective, observational, cross-sectional study aimed at assessing the prevalence and types of medication errors in in-patient settings. The Pharmaceutical Care Network Europe (PCNE) Classification System, Version 9.1 was used to categorize errors [13]. Additionally, the study evaluated the impact of pharmacist-led interventions in identifying and reducing such errors.

Study Setting and Duration

The study was carried out at DHQ Hospital, KDA Kohat, a tertiary care teaching hospital. Data were collected from three key in-patient units: the Critical Care Unit (CCU), Medical Wards, and Surgical Wards. The study spanned one full year, from May 2024 to May 2025.

Study Population

The study population included all hospitalized patients in the CCU, medical, and surgical wards during the study period.

Inclusion Criteria

Patients admitted to CCU, Medical, or Surgical wards. Aged 20 years or older. Received at least one prescribed medication. Had a complete and legible prescription record. Both male and female patients were included to ensure meaningful and reliable results, the study focused on patients who were admitted to the Critical Care Unit (CCU), Medical, or Surgical wards. Participants were selected if they were 20 years of age or older and had been prescribed at least one medication during their hospital stay. Only those with clear and complete prescription records were considered eligible. Both male and female patients were included, allowing for a more balanced and inclusive understanding of medication use across different wards and patient groups.

Exclusion Criteria

To maintain the clarity and consistency of the study, some patients were not included. Those who had out-patient prescriptions were excluded, as the focus was solely on inpatient care. Any prescription records that were incomplete or difficult to read were left out to prevent errors in data interpretation. Patients who were discharged or transferred before their information could be verified were also not included. Additionally, prescriptions that involved herbal or undocumented therapies were excluded, as these 5 treatments lacked the standardization necessary for accurate assessment within the study's framework.

Data Collection Tools and Procedure

Data were collected using a structured proforma developed specifically for this study, based on the PCNE Classification System v9.1. The proforma captured both clinical and drug-related variables and was divided into the following sections: Patient demographics: age, gender, diagnosis, ward Medication details: drug name, dosage, route, frequency, and duration Clinical information: comorbidities, lab results, renal/hepatic function Error classification: PCNE domains; Problem (P), Cause (C), Intervention (I), Acceptance (A), and Outcome (O) Pharmacist-led interventions: dose modifications, substitutions, clinical advice Prescriptions were collected prospectively over one year. Each prescription was reviewed at the time of issuance or during medication administration. Errors were identified and documented using the proforma, then transferred to Microsoft Excel for analysis. Patient anonymity was ensured by removing all personal identifiers, and confidentiality was strictly maintained.

Data Interpretation

Identified errors were analyzed using the PCNE Classification System v9.1, which allowed for structured categorization across five dimensions:
Problems (P): Nature of the medication error
Causes (C): Underlying reasons
Interventions (I): Actions taken by pharmacists
Acceptance (A): Response by the prescriber

Outcome (O): Result after intervention

Each prescription was analyzed in detail. When multiple errors were found in a single prescription, each error was recorded and interpreted separately.

Assessment of appropriateness was based on: National Standard Treatment Guidelines (STGs) WHO prescribing and pharmacotherapy standards Renal/hepatic dosing guidelines Drug–drug interaction references Standard clinical and pharmacological protocols 6 Findings were compiled and analyzed descriptively, and results are presented in tabular form in the Results section.

Pharmacist-Led Interventions

Clinical pharmacists evaluated prescriptions in real time or shortly after medication orders were issued. Upon identifying an error, pharmacists undertook one or more of the following actions:
• Adjusted drug dosage or frequency
• Recommended discontinuation of inappropriate medications
• Suggested therapeutic substitutions
• Advised dose adjustments for renal impairment
• Documented recommendations in the patient's chart
• Communicated directly with prescribers
The acceptance of each intervention by the prescriber was noted and recorded.

Ethical Considerations

Ethical approval for this study was obtained from the Department of Pharmacy, Kohat University of Science and Technology (KUST), Kohat. Prior authorization was also secured from the administration of DHQ Hospital, KDA Kohat. No personal identifiers were collected, and all data were treated with strict confidentiality, used solely for academic and research purposes.

Result

A total of 112 prescriptions were reviewed from five in-patient units at DHQ Hospital, KDA Kohat, namely the Critical Care Unit (CCU), Medical Ward A, Medical Ward B, Surgical Ward A, and Surgical Ward B. Medication errors were identified and classified using the Pharmaceutical Care Network Europe (PCNE) Classification System, Version 9.1. In addition, pharmacist-led interventions.

Frequency and Types of Medication Errors

Out of the 112 prescriptions reviewed, a total of 69 medication errors were identified. Some prescriptions contained multiple errors, leading to a higher cumulative count of issues compared to the number of prescriptions. The types and distribution of these medication errors are summarized in the following [Table 1].

Types of medication error	Frequency (n=69)	Percentage (%)
Prescribing errors	34	49.30%
Dosing errors (wrong dose/frequency)	13	18.80%
Drug duplication	7	10.10%
Omission of Drug/Information	6	8.70%
Drug-drug interaction Risk	5	7.20%
Inappropriate route of administration	2	2.90%
Dispensing errors	2	2.90%

Table 1: Frequency and Types of Medication Errors

Ward-Wise Distribution of Errors

Errors were most frequently reported in the Critical Care Unit (CCU), followed by Medical A and Surgical A wards. This is due to the urgent and complex nature of cases at the mentioned wards. Details are given in [Table 2-5].

Ward	Prescription reviewed	Errors detected
CCU	22	16
Medical A	22	14
Medical B	22	10
Surgical A	23	12
Surgical B	23	10
Total	112	69

Table 2: Ward-Wise Distribution of Errors

PCNE Classification of Errors (Summarized)

Medication problems were classified using PCNE V9.1, primarily under the following domains:

PCNE Domain	Number of Errors
P1: Treatment effectiveness	24
P2: Treatment safety	30
P3: Others	15

Table 3: PCNE Classification of Errors

Cause-Domain (c-code)	Most common subtype
C1: Drug selection	Inappropriate drug
C2: Dose selection	Wrong dose, wrong frequency
C9: Patient transfer-related issues	Incomplete information from previous care

Table 4: Causes of problems (PCNE)

Type of Intervention	Frequency
Dose correction	5
Avoidance of Drug Duplication	2
Suggestion of safer alternative	2
Flagging potential interactions	1
Education to prescribers or staff	2

Table 5: Pharmacist Interventions (PCNE)

Pharmacist-led interventions were accepted and implemented in 10 out of 12 cases, reflecting an acceptance rate of 83.3%. This high level of acceptance highlights the positive impact of clinical pharmacists on improving patient safety and enhancing the quality of prescribing practices in the hospital setting. Out of the 112 prescriptions analyzed, a total of 69 medication errors were identified. The most frequent category of error was prescribing errors, accounting for approximately 61.6% of the total. Among the various wards, the Critical Care Unit (CCU) was found to be the most error-prone area, indicating a higher risk in critically ill patient settings. Pharmacist-led interventions played a crucial role in both the correction and prevention of these medication errors. Their timely involvement significantly contributed to enhancing medication safety and promoting rational drug use.

Discussion

This study aimed to evaluate the prevalence, types, and causes of medication errors in the in-patient wards of DHQ Hospital, KDA Kohat, using the Pharmaceutical Care Network Europe (PCNE) classification system, and to assess the effectiveness of pharmacist-led interventions in minimizing such errors. Out of the 112 prescriptions reviewed, 69 medication errors were identified, indicating a 61.6% error rate. This figure aligns with findings from both national and international studies conducted in similar clinical environments, reflecting a significant prevalence of medication errors in hospital in-patient settings. Among the identified errors, prescribing errors emerged as the most common type, accounting for approximately 49.3% of the total. These included inappropriate drug selection, incorrect dosing, and prescribing without proper indication. This trend is consistent with studies conducted in tertiary care hospitals across Pakistan, India, and the Middle East, where prescribing errors are frequently reported as the leading contributors to medication-related problems.

The Critical Care Unit (CCU) recorded the highest number of medication errors. This is likely due to the complexity of clinical conditions, polypharmacy, urgent decisionmaking, and potential gaps in interdisciplinary communication. The use of the PCNE Classification System Version 9.1 enabled a structured and systematic analysis of the medication errors. Most problems were categorized under P1 (Treatment effectiveness) and P2 (Treatment safety). Frequently observed causes included C1 (Inappropriate drug selection) and C3/C7 (Incorrect dose or frequency). This structured approach revealed specific areas in need of improvement and emphasized the utility of validated tools for error classification in clinical audits.

A total of 12 pharmacist-led interventions were recorded during the study, out of which 10 (83.3%) were accepted by prescribers. This high acceptance rate highlights the significant contribution of clinical pharmacists in detecting and resolving medicationrelated issues. Interventions included dose optimization, therapeutic substitutions, and identification of drug duplications. These efforts directly improved prescribing practices and enhanced patient safety. These findings are consistent with global literature, which underscores the positive impact of pharmacist involvement on reducing medication errors and adverse drug events. Clinical pharmacists serve as an essential component of the healthcare team, especially in environments where electronic prescribing systems or standardized medication protocols are not in place.

In a previous study [10], a total of 373 patient profiles were reviewed during the study, out of which 184 were found to have drug-related issues. From these, 147 drug-related problems (DRPs) were identified, with the most common being adverse drug reactions, accounting for 61 cases (41.5%).

An analysis of the underlying causes revealed 161 contributing factors, among which dosing errors were the most frequent, observed in 68 cases (42.2%). To address these issues, clinical pharmacists provided 161 recommendations.

Of these, 139 interventions (86.33%) were successful in resolving the problems, while 6.83% were considered ineffective, as they failed to adequately address the identified issues. This study reinforces the importance of implementing active pharmaceutical care services within in-patient hospital settings. The integration of clinical pharmacists, supported by tools like the PCNE classification, can significantly improve the quality of care, reduce medication errors, and promote rational drug use. Additionally, regular training for prescribers and the development of formal medication error reporting systems are recommended to strengthen patient safety initiatives in resource-limited hospitals.

Conclusion

This study demonstrated a substantial prevalence of medication errors within the inpatient departments of DHQ Hospital, KDA Kohat, with the majority classified as prescribing-related errors. The application of the Pharmaceutical Care Network Europe (PCNE) Classification System, Version 9.1, enabled a systematic evaluation of the types and underlying causes of these errors. The Critical Care Unit (CCU) recorded the highest frequency of medication errors, which can be attributed to the complex nature of clinical conditions, polypharmacy, and the urgency of therapeutic decisions in critically ill patients.

Pharmacist-led interventions played a vital role in identifying, correcting, and preventing medication errors. The high intervention acceptance rate (83.3%) by prescribers reflects strong interdisciplinary collaboration and highlights the value of clinical pharmacists in ensuring safe and rational use of medicines. The findings emphasize the importance of integrating pharmaceutical care services into routine hospital workflows. They further underscore the need for structured training, ongoing monitoring, and team-based collaboration to minimize medication errors and enhance patient safety in healthcare institutions.

Study Limitations

Despite the valuable insights provided by this study, several limitations should be acknowledged:

• **Sample Size Constraint**

The analysis was based on 112 prescriptions, which may not be sufficient to generalize the findings to all departments or patient populations within the hospital.

• **Limited Ward Coverage**

The study focused only on five in-patient units—CCU, Medical A & B, and Surgical A & B. Medication errors in other departments such as pediatrics, oncology, or outpatient clinics were not assessed, potentially limiting the scope of error patterns identified.

• **Time-Bound Data**

Collection Data were collected over a fixed period of one year, which may not capture seasonal trends, variations in staffing, or changes in prescribing behavior due to external factors.

• **Observer Bias**

Medication error identification and classification relied on manual prescription review, which, despite following PCNE guidelines, may be subject to subjective interpretation or human error.

• **Unaccepted Interventions**

Although the acceptance rate of pharmacist-led interventions was high, the clinical outcomes or consequences of unaccepted recommendations were not tracked during the study period.

• **Lack of Outcome-Based Evaluation**

The study did not assess clinical outcomes such as adverse drug events, length of hospital stays, or recovery rates associated with medication errors or pharmacist interventions, primarily due to resource and time limitations.

Recommendations

Based on the findings and limitations of this study, the following recommendations are proposed to enhance medication safety and promote rational drug use in hospital settings:

• The deployment of trained clinical pharmacists in all hospital wards can play a pivotal role in reducing medication errors, optimizing pharmacotherapy, and improving patient outcomes.

• Regular auditing of prescriptions using standardized tools such as the PCNE classification system can help in the early detection and correction of medication errors, enabling continuous quality improvement.

• Ongoing education and professional development programs should be conducted for physicians, nurses, and pharmacists on rational prescribing, drug interactions, and safe medication practices.

• The adoption of electronic prescribing systems with integrated clinical decision support features (e.g., dosage checks, drug interaction alerts) can significantly minimize human errors caused by illegible handwriting or manual calculations.

• Promoting a collaborative and communicative environment between clinical pharmacists and prescribers can improve the acceptance of pharmacist interventions and foster a multidisciplinary approach to medication safety.

• Future studies should extend data collection to additional units such as pediatrics, psychiatry, oncology, and outpatient departments to obtain a more comprehensive understanding of medication error patterns.

• Further research should focus on evaluating the impact of pharmacist interventions on measurable clinical outcomes, such as reduced adverse drug events, shorter hospital stays, improved recovery rates, and cost-effectiveness.

References

1. Al-Worafi YM (2020) Medication errors in Drug safety in developing countries. Elsevier 59-71.

2. Elliott RA (2024) Prevalence and economic burden of medication errors in the NHS in England: rapid evidence synthesis and economic analysis of the prevalence and burden of medication error in the UK.

3. Naseralallah L, Stewart D, Price M, Paudyal V (2023) Prevalence, contributing factors, and interventions to reduce medication errors in outpatient and ambulatory settings: a systematic review. Int. J. Clin. Pharm 45: 1359-1377.

4. Donaldson LJ, Kelley ET, Dhingra KN, Kieny MP, Sheikh A (2017) Medication without harm: WHO's third global patient safety challenge. The Lancet 389: 1680–1681.

5. Hochhold D, Nørgaard LS, Stewart D, Weidmann AE (2025) Identification, classification, and documentation of drug related problems in community pharmacy practice in Europe: a scoping review. Int. J. Clin. Pharm 47: 247-269.

6. Ma Z, Shi H, Hong G, Wu L, Lin Y (2025) Drug-related problems in elderly patients with AECOPD and pharmaceutical intervention practice: a prospective study. Front. Pharmacol 16: 1596795.

7. Ahmed KO, Muddather HF, Yousef BA (2024) Pharmaceutical Care Network Europe (PCNE) drug-related problems classification version 9.1: first implementation in Sudan.

8. Jaam M, Naseralallah LM, Hussain TA, Pawluk SA (2021) Pharmacist-led educational interventions provided to healthcare providers to reduce medication errors: A systematic review and meta-analysis. PloS One 16: e0253588.

9. Unnissa Z, Unnisa M, Khan S (2024) A comprehensive review of medication errors in modern healthcare. J Drug Deliv Ther 14: 220–228.

10. Khan MU Ahmad A (2014) The impact of clinical pharmacists' interventions on drug related problems in a teaching based hospital. Int J Pharm Clin Res 63: 276–280.

11. Gupta Y, Kumar N, Shukla A, Rai V (2023) Assessment of the role of pharmacists in preventing medication errors in hospital settings. education 37: 40.

12. Anshila MK, Nambiar DP, Augustine DV, Saseendran M, Shabraya AR, et al. (2020) Evaluation of drug related problems in patients with chronic disease at tertiary care teaching hospital. Int J Health Sci Res 10: 144–155.

13. Liu XX (2021) Drug-related problems identified by clinical pharmacists in nephrology department of a tertiary hospital in China-A single center study. Ann. Palliat. Med 10: 8701708–8708708.