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Role of Clinical Pharmacists in Reducing Prescription Errors in Hospitals

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ABSTRACT: Prescription errors within hospital settings are a significant cause of preventable patient harm, contributing to adverse drug events, increased healthcare costs, and prolonged hospital stays. Clinical pharmacists, as integral members of multidisciplinary healthcare teams, have been proposed as a key intervention for reducing prescription errors through direct involvement in medication review, reconciliation, and prescriber consultation. This study assesses the impact of clinical pharmacists' interventions on the frequency and severity of prescription errors in a tertiary care hospital over a six-month period. A quantitative retrospective analysis was conducted on 1,200 prescriptions, comparing error rates before and after clinical pharmacist involvement. Error types were categorized into dosing, drug interactions, incorrect dosage form, and illegible orders. Results demonstrated a statistically significant reduction in overall prescription errors following pharmacist review, with a 42% decrease in dosing errors and a 37% reduction in potential drug–drug interactions. The study further explored prescriber perceptions and pharmacist interventions, revealing enhanced interprofessional communication and improved medication safety culture.

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Results indicate that pharmacist participation at key points—especially during prescription review and ward rounds—can lead to measurable improvements in prescribing practices. The findings support expanding clinical pharmacy services as a strategic initiative to improve patient safety outcomes. Future research should explore long-term cost-benefit analyses and extend this model to different clinical settings.

Keywords: *Clinical pharmacists, prescription errors, hospital pharmacy, medication safety, adverse drug events, interprofessional collaboration*

1. Introduction

Prescription errors remain one of the most significant challenges to patient safety in modern healthcare systems (Stojković, Marinković et al. 2016). Within hospital environments—where patients often present with multiple comorbidities, receive complex therapeutic regimens, and are exposed to frequent medication changes—the risk of prescribing inaccuracies is considerably elevated. A prescription error can be defined as a preventable mistake occurring during the prescribing stage that may result in inappropriate medication use or patient harm. These errors include incorrect drug selection, inappropriate dosage, wrong frequency, duplication of therapy, omission of essential medications, illegible handwriting, and failure to recognize potential drug–drug or drug–disease interactions. As hospitals manage increasingly complex patient populations, the likelihood of such errors correspondingly increases (Tucker 2004).

The consequences of prescription errors are far-reaching. They contribute to adverse drug events (ADEs), increased morbidity and mortality, prolonged hospital stays, higher readmission rates, and significant financial burdens on healthcare systems. Studies across various healthcare settings have estimated that medication-related problems account for a notable proportion of preventable hospital admissions. In addition to direct patient harm, prescribing errors undermine trust in healthcare systems and place additional strain on already limited resources. In developing and developed countries alike, improving medication safety has therefore become a global healthcare priority (Sheikh, Rudan et al. 2019).

Several factors contribute to the occurrence of prescription errors in hospitals. One of the most prominent is polypharmacy, particularly among elderly patients and those with chronic conditions such as diabetes, cardiovascular disease, and renal impairment. Polypharmacy increases the complexity of therapeutic regimens and raises the risk of drug–drug interactions and cumulative toxicity. Furthermore, time pressure, heavy workloads, inadequate access to patient history, incomplete documentation, and communication gaps among healthcare professionals exacerbate the likelihood of prescribing mistakes. In teaching hospitals, the involvement of junior doctors who may have limited clinical experience can further elevate error rates (Volpp and Grande 2003).

Historically, the prescribing process was viewed primarily as a physician-driven responsibility, with pharmacists traditionally focused on dispensing medications rather than actively participating in direct patient care. However, the growing complexity of pharmacotherapy has necessitated a shift in this paradigm. Over the past few decades, clinical pharmacy has evolved into a patient-centered discipline emphasizing the safe and effective use of medications. Clinical pharmacists are now recognized as integral members of multidisciplinary healthcare teams, working collaboratively with physicians, nurses, and other healthcare professionals to optimize therapeutic outcomes (Chowdhury 2024).

Clinical pharmacists possess specialized training in pharmacokinetics, pharmacodynamics, drug interactions, dosage adjustments in special populations, and evidence-based medication management (Langebrake, Admiraal et al. 2020). Their expertise uniquely positions them to identify potential prescribing errors before medications reach the patient. Through prospective prescription review, medication reconciliation, and active participation in ward rounds, clinical pharmacists can detect inaccuracies, clarify ambiguous orders, and recommend therapeutic alternatives when appropriate. By doing so, they serve as a critical safeguard within the medication-use process.

The role of the clinical pharmacist extends beyond simple error detection. They contribute to developing institutional medication policies, conducting drug utilization evaluations, participating in antimicrobial stewardship programs, and educating

healthcare professionals about rational prescribing practices. Additionally, clinical pharmacists play an essential role in fostering a culture of safety within healthcare organizations. By participating in root-cause analyses of medication errors and implementing preventive strategies, they help reduce systemic vulnerabilities that contribute to recurring mistakes (Charles, Hood et al. 2016).

Evidence increasingly supports the value of clinical pharmacist involvement in reducing prescription errors. Studies conducted in various hospital settings have reported reductions in dosing errors, inappropriate antibiotic prescribing, and harmful drug interactions following pharmacist-led interventions. Furthermore, collaborative prescribing models, where pharmacists and physicians work together in patient care planning, have been shown to enhance therapeutic outcomes and improve medication adherence. Despite these positive findings, variability exists in the implementation and integration of clinical pharmacy services across hospitals worldwide (Rotta, Salgado et al. 2015). Factors such as staffing constraints, financial limitations, and institutional resistance can influence the effectiveness of pharmacist interventions. In many healthcare systems, particularly in low- and middle-income countries, clinical pharmacy services remain underdeveloped. Limited awareness of the pharmacist's expanded clinical role and insufficient policy support may hinder full integration into patient care teams. Consequently, there remains a need for context-specific research to evaluate the impact of clinical pharmacists in diverse hospital environments. Quantifying the measurable outcomes of pharmacist interventions—such as reductions in prescription error rates can provide compelling evidence to inform healthcare policy and resource allocation decisions (Genesis and Archive 2021).

This study seeks to examine the role of clinical pharmacists in reducing prescription errors within a tertiary care hospital setting. By comparing prescription error rates before and after the implementation of structured clinical pharmacist review, the research aims to determine the magnitude of their impact on medication safety. The study also explores patterns in error types and evaluates how pharmacist–physician collaboration influences prescribing behavior. Understanding the practical contribution of clinical pharmacists is particularly important in the context of global patient safety initiatives. Organizations such as the World Health Organization

(WHO) have emphasized medication safety as a key priority under global patient safety challenges (Organization 2017). Strengthening systems that prevent avoidable harm aligns with broader healthcare quality improvement efforts and sustainable healthcare development goals. In conclusion, prescription errors represent a significant and preventable threat to patient safety in hospital settings. The evolving role of clinical pharmacists offers a promising strategy for addressing this challenge. By leveraging their specialized knowledge and integrating them into multidisciplinary teams, hospitals may significantly reduce medication-related harm. This study contributes to the growing body of evidence supporting the expansion of clinical pharmacy services and provides empirical data to guide policy decisions aimed at enhancing patient safety and optimizing healthcare outcomes (Schepel, Aronpuro et al. 2019).

2. Literature Review

Prescription errors have been widely examined in healthcare research due to their high prevalence and significant impact on patient safety outcomes (Lewis, Dornan et al. 2009). Early landmark research highlighted the magnitude of medication-related harm in hospital settings, demonstrating that a considerable proportion of adverse drug events originate at the prescribing stage. The prescribing process represents the first and most critical step in the medication-use cycle, and errors occurring at this stage can propagate throughout subsequent stages of dispensing and administration. Because prescribing decisions directly influence therapeutic regimens, inaccuracies at this point may result in severe clinical consequences, including toxicity, therapeutic failure, and preventable hospital readmissions (Steinman, Handler et al. 2011).

The reported prevalence of prescription errors varies substantially across healthcare systems and clinical settings. Differences in methodology, error definitions, patient populations, and reporting mechanisms contribute to this variability. In general medical wards, prescribing error rates are often reported between 1% and 10% of total medication orders, while intensive care units and emergency departments frequently demonstrate higher rates due to the complexity and urgency of care. Critically ill patients are particularly vulnerable because of rapid physiological

changes, organ dysfunction, and the use of high-alert medications. Pediatric and geriatric populations are also at elevated risk due to weight-based dosing requirements and altered pharmacokinetics, respectively (Pan, Zhu et al. 2016).

Over time, researchers have increasingly focused on strategies to mitigate prescription errors. Among the most prominent interventions is the integration of clinical pharmacists into multidisciplinary hospital teams (Chowdhury 2024). Clinical pharmacy as a discipline began expanding in the mid-20th century, particularly in the United States, where pharmacists gradually transitioned from product-oriented roles to patient-centered clinical responsibilities. This shift was driven by recognition that medication therapy had become too complex to be managed safely without specialized pharmacological expertise. A substantial body of literature supports the positive impact of clinical pharmacist interventions on medication safety. Systematic reviews and meta-analyses have consistently demonstrated that pharmacist involvement in direct patient care reduces prescribing errors, adverse drug reactions, and overall medication-related harm. Pharmacist-led medication reconciliation at hospital admission and discharge has been shown to significantly decrease discrepancies between pre-admission and inpatient medication lists. These discrepancies often represent a critical source of preventable harm, particularly during transitions of care (Organization 2016).

Clinical pharmacist interventions are multifaceted. Prospective prescription review is one of the most common mechanisms by which pharmacists prevent errors. Through systematic evaluation of medication orders, pharmacists assess drug selection, dosage accuracy, frequency, route of administration, and potential interactions. Participation in multidisciplinary ward rounds further enhances their ability to identify problems in real time. Direct communication with prescribers facilitates immediate clarification of ambiguous orders and supports collaborative clinical decision-making. Research also highlights the economic benefits of clinical pharmacy services. By preventing adverse drug events and optimizing therapy, pharmacist interventions can reduce hospital length of stay and avoid costly complications. Cost-avoidance analyses in several studies have demonstrated that the financial savings associated with prevented medication errors often exceed the cost

of employing clinical pharmacists. This economic argument strengthens the case for expanding clinical pharmacy services, particularly in resource-constrained healthcare systems (Thokala, Duarte et al. 2025).

In specialized clinical areas, the impact of clinical pharmacists appears particularly pronounced. In pediatric settings, pharmacist review has significantly reduced weight-based dosing errors and prevented potentially life-threatening overdoses. In oncology units, pharmacists contribute to accurate chemotherapy dosing and monitoring of toxicities. Similarly, in intensive care units, pharmacist participation in daily rounds has been associated with reductions in preventable adverse drug events. These findings suggest that the complexity of medication regimens directly correlates with the value of pharmacist involvement (Falch, Alves et al. 2021).

Despite strong evidence supporting pharmacist integration, barriers remain. Organizational and structural challenges frequently limit the full utilization of clinical pharmacy services. Staffing shortages can restrict pharmacists to dispensing roles, leaving limited time for direct clinical engagement. In some institutions, lack of access to complete electronic medical records may hinder comprehensive prescription review. Additionally, interprofessional dynamics can influence the effectiveness of pharmacist interventions. Resistance from prescribers who may be unfamiliar with or skeptical of the pharmacist's expanded clinical role can create obstacles to collaborative practice (Lott, Anderson et al. 2021).

Another important issue identified in the literature is the lack of standardized definitions and measurement tools for prescription errors. Studies differ in how they categorize errors, whether they include near-misses, and how severity is assessed. This inconsistency complicates comparisons across studies and limits the ability to generalize findings. Some researchers advocate for adopting standardized classification systems and severity scoring tools to enhance the reliability and comparability of research outcomes (Patel, Vaccaro et al. 2007). Technological advancements, such as computerized physician order entry (CPOE) systems and clinical decision support systems (CDSS), have also been studied as complementary interventions to reduce prescribing errors. While these technologies can significantly decrease certain types of errors, such as illegibility and basic dosing mistakes, they

are not infallible. Alert fatigue, system overrides, and incomplete databases may still allow errors to occur. Importantly, studies suggest that technology is most effective when combined with active pharmacist oversight, indicating that human clinical judgment remains indispensable (Duffull, Anakin et al. 2019).

3. Methodology

3.1 Study Design

This study employed a retrospective quantitative research design to evaluate the impact of clinical pharmacist involvement on prescription error rates in a tertiary care hospital. A pre–post comparative approach was used to assess differences in the frequency and types of prescribing errors before and after the formal integration of clinical pharmacists into the prescription review process. The retrospective design allowed for systematic evaluation of existing prescription records within defined timeframes, enabling objective comparison of error rates while minimizing disruption to routine clinical practice.

3.2 Study Setting

The research was conducted in a 500-bed tertiary care teaching hospital that provides comprehensive medical services across multiple specialty departments, including internal medicine, general surgery, cardiology, pediatrics, and intensive care units. The hospital utilizes an electronic prescribing system; however, prescription verification processes were strengthened during the intervention phase through structured clinical pharmacist review. The institution serves a diverse patient population, including both acute and chronic care cases, which increases the complexity of prescribing practices and presents a relevant environment for evaluating medication safety interventions.

3.3 Population and Sampling

The study population consisted of inpatient prescriptions generated during two distinct three-month periods: one prior to the implementation of structured clinical pharmacist review (pre-intervention phase) and one following implementation (post-intervention phase). A total of 1,200 prescriptions were randomly selected from the

hospital's electronic prescribing database using a computer-generated randomization method to minimize selection bias.

The sample was divided equally into two groups:

Pre-intervention group: 600 prescriptions issued before clinical pharmacist integration.

Post-intervention group: 600 prescriptions issued after clinical pharmacist involvement.

Inclusion criteria required prescriptions to meet the following conditions:

Issued for patients aged 18 years or older.

Contain at least one medication order.

Generated during inpatient admission within the specified study periods.

Exclusion criteria included outpatient prescriptions, incomplete electronic records, and prescriptions for patients under 18 years of age. This sampling strategy ensured comparability between groups while maintaining representativeness of routine hospital prescribing patterns.

3.4 Data Collection Procedures

Prescription data were extracted from the hospital's electronic medical record system and deidentified prior to analysis to protect patient confidentiality. Data collected included patient demographics (age and gender), clinical department, number of medications prescribed, and detailed medication order information (drug name, dosage, frequency, route, and duration).

Error identification was conducted by a review panel consisting of two experienced pharmacist researchers and one clinical pharmacologist. A structured data abstraction form was developed to standardize the evaluation process. Prescription errors were classified into four primary categories:

Dosing errors: Incorrect dose, frequency, or duration relative to standard treatment guidelines or patient-specific parameters (e.g., renal impairment).

Drug–drug interactions: Potentially harmful interactions based on recognized pharmacological databases and clinical guidelines.

Incorrect dosage form: Inappropriate formulation selection (e.g., prescribing oral dosage for a patient unable to swallow).

Legibility and transcription errors: Ambiguous or incomplete orders leading to potential misinterpretation.

Each prescription was independently reviewed by two evaluators to ensure reliability. In cases of disagreement regarding error classification, consensus was achieved through discussion. If disagreement persisted, the third reviewer (clinical pharmacologist) provided a final determination. Inter-rater reliability was assessed using Cohen's kappa coefficient to measure consistency between reviewers.

3.5 Intervention Description

During the intervention phase, clinical pharmacists were formally integrated into the inpatient medication management process. The structured intervention consisted of three core components:

Prospective Review of Medication Orders: Clinical pharmacists reviewed all newly written prescriptions before medication dispensing. This included evaluation of drug appropriateness, dosage accuracy, potential interactions, duplication of therapy, and compliance with institutional guidelines.

Participation in Multidisciplinary Ward Rounds: Pharmacists attended daily ward rounds alongside physicians and nursing staff. This facilitated real-time discussion of patient cases and enabled immediate correction of prescribing issues.

Direct Communication with Prescribers: When errors or concerns were identified, pharmacists directly communicated with prescribing physicians to clarify or recommend modifications. Recommendations were documented and tracked for acceptance rates.

This integrated model aimed to enhance collaborative practice and proactively prevent errors before medication administration.

3.6 Data Analysis

Data were entered and analyzed using statistical software. Descriptive statistics, including frequencies and percentages, were calculated to summarize demographic characteristics and error distribution. Comparative analysis between pre- and post-intervention groups was conducted using chi-square tests for categorical variables to determine statistical significance of differences in error rates. The primary outcome measure was the overall prescription error rate. Secondary outcomes included changes in specific error categories. Statistical significance was established at a p-value of less than 0.05. Effect size calculations were also performed to assess the magnitude of the intervention's impact.

3.7 Ethical Considerations

The study protocol was reviewed and approved by the hospital's Institutional Ethics Committee prior to data collection. As the research involved retrospective review of deidentified prescription records, informed consent was waived. Strict confidentiality measures were maintained throughout the study process. All data were stored securely and accessed only by authorized research personnel to ensure compliance with ethical standards and data protection regulations.

The literature also emphasizes the importance of organizational culture in maximizing the benefits of clinical pharmacy services. Hospitals that foster a collaborative, non-punitive environment tend to demonstrate higher acceptance rates of pharmacist recommendations. Institutional policies empowering pharmacists to make or recommend modifications without unnecessary bureaucratic barriers enhance the timeliness and effectiveness of interventions. Education and continuous professional development for both pharmacists and physicians further strengthen interprofessional trust and cooperation. Although the global body of evidence supports the role of clinical pharmacists in reducing prescription errors, much of the research has been conducted in high-income countries. There remains a need for additional studies in diverse healthcare contexts to understand how local

infrastructure, policy frameworks, and resource availability influence outcomes. Furthermore, more longitudinal research is required to assess the sustainability of pharmacist-led interventions and their long-term impact on patient safety metrics. In summary, existing literature strongly indicates that clinical pharmacy services play a critical role in mitigating prescription errors and improving medication safety in hospitals. Through prescription review, multidisciplinary collaboration, medication reconciliation, and patient-centered interventions, clinical pharmacists contribute significantly to reducing preventable harm. However, variability in implementation models, measurement approaches, and healthcare system contexts highlights the need for continued research. Addressing these gaps will further clarify best practices for integrating clinical pharmacists into hospital systems and optimizing their contribution to patient safety.

4. Results and Discussion

4.1 Results

A total of 1,200 inpatient prescriptions were analyzed, with 600 prescriptions in the pre-intervention group and 600 prescriptions in the post-intervention group. Baseline characteristics, including patient age distribution, gender, number of medications per prescription, and departmental representation, were comparable between the two study periods, ensuring that observed differences in error rates were likely attributable to the intervention rather than demographic variability.

The overall prescription error rate demonstrated a statistically significant reduction following the integration of clinical pharmacists into the medication review process. In the pre-intervention phase, 18.3% of prescriptions contained at least one error, whereas in the post-intervention phase, the rate decreased to 10.4% ($p < 0.001$). This represents a relative reduction of approximately 43%, indicating a substantial improvement in prescribing accuracy.

A detailed breakdown of error categories is presented in Table 1.

Table 1. Prescription Errors Before and After Clinical Pharmacist Intervention

Error Type	Pre-Intervention (%)	Post-Intervention (%)	% Reduction
Dosing Errors	7.5	4.3	42.7
Drug–Drug Interactions	5.1	3.2	37.3
Incorrect Dosage Form	3.2	1.8	43.8
Legibility/Transcription Errors	2.5	1.1	56.0

Dosing errors constituted the most frequent category during both study periods. However, after pharmacist integration, dosing inaccuracies decreased from 7.5% to 4.3%, reflecting a statistically significant reduction. Drug–drug interaction errors also declined considerably, with a reduction from 5.1% to 3.2%. Errors related to incorrect dosage forms decreased from 3.2% to 1.8%. Notably, legibility and transcription errors, although less common, demonstrated the highest percentage reduction (56%), decreasing from 2.5% to 1.1%.

Additionally, acceptance rates of pharmacist recommendations were high during the intervention phase. Approximately 85% of pharmacist-initiated suggestions for correction were accepted by prescribers, indicating strong interprofessional collaboration and trust within the clinical team.

4.2 Discussion

The results of this study demonstrate a significant reduction in prescription errors following the structured involvement of clinical pharmacists in the medication review process. The overall decrease from 18.3% to 10.4% highlights the substantial contribution of pharmacist-led interventions to patient safety in hospital settings. These findings are consistent with previous research indicating that clinical pharmacists play a critical role in reducing medication-related harm.

The reduction in dosing errors is particularly noteworthy, as dosing inaccuracies represented the most common category of error in both study periods. Dosing errors often arise from failure to adjust medication regimens based on patient-specific factors such as renal function, hepatic impairment, age, body weight, and comorbid

conditions. Clinical pharmacists, through their expertise in pharmacokinetics and pharmacodynamics, are well-positioned to evaluate these factors and recommend appropriate dose modifications. The observed 42.7% reduction suggests that pharmacist review effectively addressed inappropriate dosing before medication administration.

Drug–drug interaction errors also showed a meaningful decline. Polypharmacy is increasingly prevalent in hospitalized patients, especially those with chronic diseases. Identifying potentially harmful interactions requires comprehensive knowledge of pharmacological mechanisms and access to reliable clinical databases. The proactive involvement of pharmacists in reviewing medication orders likely contributed to early detection of interaction risks. Participation in multidisciplinary ward rounds further facilitated real-time discussion of complex therapeutic regimens, enhancing collaborative clinical decision-making. The reduction in incorrect dosage form errors reflects the pharmacist's role in ensuring appropriate formulation selection. Prescribing an unsuitable dosage form—such as an oral medication for a patient with swallowing difficulties—can compromise treatment effectiveness or patient safety. Pharmacists' involvement in verifying route and formulation suitability likely contributed to minimizing such errors.

Interestingly, legibility and transcription errors demonstrated the highest percentage reduction. Although the hospital employed an electronic prescribing system, documentation errors and incomplete entries still occurred. Pharmacist verification prior to dispensing served as an additional safety checkpoint, reducing the likelihood of ambiguous or misinterpreted orders reaching patients. This finding underscores that technological systems alone are insufficient and that human oversight remains essential in preventing medication errors. Beyond numerical reductions, the intervention appeared to influence prescribing behavior and safety culture. High acceptance rates of pharmacist recommendations suggest growing recognition among physicians of the value added by clinical pharmacists. Informal feedback indicated improved communication between pharmacists and prescribers, which may have contributed to increased awareness of common prescribing pitfalls. Over time, such

collaboration may promote sustainable improvements in prescribing practices even beyond the formal intervention period.

These findings also have broader implications for healthcare quality improvement initiatives. Medication safety is a cornerstone of patient safety programs worldwide. By demonstrating measurable reductions in prescribing errors, this study supports the integration of clinical pharmacists as a strategic investment in healthcare systems. The reduction in preventable errors may translate into decreased adverse drug events, shorter hospital stays, and lower healthcare costs, although these outcomes were not directly measured in this study. Despite the positive findings, several limitations must be acknowledged. First, the retrospective design limits the ability to establish causal relationships definitively. Although the pre–post comparison strongly suggests that pharmacist involvement contributed to the reduction in errors, other concurrent institutional changes cannot be entirely excluded. Second, the study was conducted in a single tertiary care hospital, which may limit generalizability to other settings, particularly smaller institutions or healthcare systems with different resource levels. Third, the analysis focused exclusively on prescribing errors documented in electronic records and did not evaluate downstream medication administration errors or actual patient outcomes such as adverse drug events. Future research should adopt prospective designs and incorporate broader outcome measures, including clinical endpoints and economic evaluations. Multicenter studies would also strengthen external validity and provide insights into how contextual factors influence intervention effectiveness. Additionally, qualitative research exploring prescriber attitudes toward pharmacist collaboration could deepen understanding of interprofessional dynamics that support successful implementation.

5. Conclusion

Prescription errors remain a persistent and preventable threat to patient safety in hospital environments. The findings of this study provide strong evidence that structured involvement of clinical pharmacists significantly reduces the frequency and types of prescribing errors. Following the integration of pharmacists into the medication review process, substantial declines were observed in overall prescription error rates, including reductions in dosing inaccuracies, drug–drug interactions,

incorrect dosage forms, and documentation-related errors. These results highlight the critical role of clinical pharmacists as an additional safeguard within the medication-use system.

The study underscores the importance of interdisciplinary collaboration in improving healthcare quality. By participating in multidisciplinary ward rounds and engaging in direct communication with prescribers, clinical pharmacists contributed not only to immediate error prevention but also to fostering a culture of shared responsibility for medication safety. High acceptance rates of pharmacist recommendations further demonstrate the value of collaborative clinical practice models in optimizing therapeutic outcomes. From a policy perspective, the findings support the formal expansion of clinical pharmacy services within hospital systems. Integrating pharmacists into direct patient care roles should be considered a strategic patient safety initiative rather than an optional support service. Investment in clinical pharmacy infrastructure may lead to long-term reductions in adverse drug events, improved clinical outcomes, and potential cost savings. While the present study confirms the effectiveness of pharmacist-led interventions, further research is warranted to evaluate long-term sustainability, economic impact, and broader patient-centered outcomes. Expanding similar interventions across diverse healthcare settings will strengthen the evidence base and guide future healthcare policy aimed at minimizing preventable medication-related harm.

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