Vol. 5 No. 1 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387 Print ISSN 3007-2379

Impact of Clinical Pharmacist Interventions on Medication Safety and Patient Outcomes in Tertiary Care Hospitals

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Keywords: Adverse Drug Events, Clinical Pharmacist, Medication Safety, Patient Outcomes, Tertiary Care Hospitals

Received on 13 Jan 2026
Accepted on 13 Feb 2026
Published on 23 Feb 2026

Abstract

Medication errors and adverse drug events remain major contributors to preventable morbidity and extended hospitalization in tertiary care hospitals. This study examined the impact of structured clinical pharmacist interventions on medication safety and patient outcomes in a tertiary care setting. A quasi-experimental design was employed to compare pre-intervention and post-intervention groups. Clinical pharmacists participated in medication reconciliation, prescription review, dose optimization, therapeutic drug monitoring, and discharge counseling. Data were collected from inpatient medical records and analyzed using descriptive and inferential statistical techniques. The findings revealed a statistically significant reduction in medication errors, prescribing discrepancies, adverse drug events, and drug–drug interactions following pharmacist integration. In addition to improved safety indicators, patient outcomes showed meaningful enhancement, including shorter hospital stays,

reduced 30-day readmission rates, and higher treatment success rates. The acceptance rate of pharmacist recommendations was high, indicating effective interdisciplinary collaboration. The results demonstrated that structured clinical pharmacy services strengthened medication governance systems and enhanced therapeutic effectiveness in complex inpatient environments. The study highlighted the importance of integrating clinical pharmacists into multidisciplinary healthcare teams to reduce medication-related harm and improve patient-centered outcomes. Expanding clinical pharmacy services across tertiary hospitals may serve as a sustainable strategy for enhancing healthcare quality, safety, and operational efficiency.

Introduction

The role of clinical pharmacist interventions in healthcare systems to increase medication safety and refine patient outcomes has increasingly been acknowledged to be central, especially in tertiary care hospitals where multifaceted medication regimens are habitual. Historically, the job description of pharmacists has changed as they no longer fulfill the functions of dispensers of medicines, but rather participate as in multidisciplinary healthcare teams as the department that performs the role of managing medication therapy and surveillance of medications safety. This was a change since the incident of medication errors, adverse drug events (ADEs) and drug-related problems were cited as key causes of harm to patients across the world (Ahmed et al., 2021). Research done at tertiary hospitals, reported that clinical pharmacists undertook a wide utilizing tally of intercessions that became clinical medication reconciliation, dosage review, drug-interaction prevention, as well as patient counselling; all of which were undertaken in risk reduction and/or improvement of therapeutic outcomes. In one case scenario, more than 38,000 documented pharmacist interventions were registered in a 1200-bed tertiary centre by Althagafi (2025) updating the importance of these interventions in the detection of dose mistakes and enhancement of medication safety (DOI: 10.3390/healthcare13192504). Similarly, studies found that the role of pharmacists in the quality of antimicrobial stewardship and reduction of drug-related problems results in major positive changes in antimicrobial use and clinical outcomes (Elnajjar et al., 2024; Al-Maqbali et al., 2022).

Although the positive effects of the clinical pharmacist interventions are considered, differences in the way the studies are designed, the settings, and the measured outcomes have yielded different results. In some cases, randomized controlled trials demonstrated a low effect on some clinical outcomes, including ADE rates after discharge (JAMA Internal Medicine Study, 2021), which highlights the difficulty in assessing the effectiveness of pharmacist-led care. However, there was a general indication of increased medication safety profile and the positive health outcomes whereby pharmacists were directly engaged in clinical care delivery.

Research Background

Medication errors constituted a high percentage of avoidable adverse events in healthcare facilities especially in tertiary care settings where there were high-risk medications and polypharmacy. It was emphasized in the previous research that medication errors may arise at any point in the medication use process, such as prescriptions to administration and monitoring, but it was also mentioned that many of such mistakes could be prevented with the help of specific interventions (Farley et al., 2014). The tertiary care hospitals with their complex treatment plans and populations of severely ill patients had higher rates of drug-related issues that were not supported by proper clinical pharmacy.

Clinical pharmacy service proved to be an organized intervention that not only expanded the conventional dispensing functions to include a point-of-care clinical decision support, systematic medication assessments, and involvement in ward rounds. The services were associated with a decrease in drug-related issues and improved treatment outcomes, and the literature findings could report high rates of prescribers accepting the pharmacist recommendations (Robert et al., 2021). Notably, pharmacists helped with the antimicrobial stewardship programmes, which were reported to show lower rates of broad-spectrum antibiotic use and enhanced microbial susceptibilities in the tertiary care (Elnajjar et al., 2024; Hassan et al., 2025).

Overall, systematic reviews reveal positive outcomes of clinical pharmacist involvement on blood pressure, glycaemic control, medication adherence, and patient education outcome, and such results may be achieved in low- and middle-income countries, including Pakistan, with resource limitations (Ahmed et al., 2021). Though, they questioned the quality of evidence because inconsistent methodologies and underreporting of economic assessments were used. These gaps highlighted the necessity of strict intervention research studies to illuminate the role of pharmacists working in various tertiary care settings, and possible policy ramifications to extend the clinical pharmacy scope.

Although not all randomized trials established significant changes in adverse drug accidents in past-hospitalized high risk patients, the total bulk of evidence provided by observational and quasi-experimental investigations was in favor of a positive enhancement in medication safety and health results when pharmacists were completely set in clinical teams. Pharmacists, physicians, and nurses working together in multidisciplinary teams were especially useful in preventing ADEs and enhancing complex medication schedules.

Research Problem

Although significant evidence about the possible advantage of clinical pharmacist interventions was built up, there were still important gaps in the comprehension about the particular effect of the intervention on medication safety and patient outcomes in tertiary care hospitals. Most of the published studies were retrospective and observational, as these studies do not allow causal inferences of the direct effects of pharmacist actions on clinical outcomes ADE incidence, length of stay, and readmission. The data on the implementation and influence of clinical pharmacy services in different settings differed significantly among regions and healthcare systems, and little information was provided in localities in South Asia, such as Pakistan. This inconsistency became a problem to policymakers and healthcare leaders who want to find evidence-based frameworks to facilitate the introduction of clinical pharmacists into the multidisciplinary care.

Randomized trials that aim to determine the effectiveness of multifaceted pharmacist interventions have frequently described mixed or non-significant findings on some safety outcomes especially in post-discharge settings which has indicated methodological challenges in measuring the complex clinical interactions. This gap showed that additional and more particular studies were to be conducted in order to determine the conversion of the clinical pharmacist input into the quantifiable changes in medication safety and the actual patient outcomes in the tertiary care facility.

Research Objectives

To assess the impact of clinical pharmacist-led interventions on medication safety outcomes, including medication errors and ADEs, in tertiary care hospitals.

To evaluate the effect of clinical pharmacist interventions on key patient outcomes, such as hospital length of stay, hospital readmissions, and treatment efficacy

To identify the types and frequency of clinical pharmacist interventions implemented in tertiary care settings.

Research Questions

Q1. How did clinical pharmacist interventions affect the rate of medication errors and ADEs in tertiary care hospitals?

Q2. What was the influence of clinical pharmacy services on patient outcomes such as length of stay and readmission rates?

Q3. What intervention categories were most frequently utilised by clinical pharmacists in tertiary care environments?

Literature Review

Clinical Pharmacist Interventions and Medication Safety

The issue of medication safety also remained a significant issue in tertiary care hospitals because of high-risk and complexity of pharmacotherapy and polypharmacy. The interventions of clinical pharmacists were generally accepted as the practical procedures of preventing medication errors and adverse drug events (ADEs) which could be prevented. A thorough systematic review revealed that involvement of pharmacists in the medication reconciliation task and in reviewing prescription thus prevented, to a great degree, the occurrence of drug errors and discrepancies in the prescribed medication (Mekonnen et al., 2016). Likewise, meta-analysis findings indicated that pharmacist-driven interventions were linked to significant medication error rates decrease in the inpatient environment (Naseralallah et al., 2023).

The safety advantages of clinical pharmacy services were further supported using the empirical evidence of tertiary care hospitals. A massive post-hoc assessment reported that clinical pharmacist interventions were mostly focused on dosing errors, drug interactions, and medication duplications, and relevant improvements in the appropriateness of medication were noted (Althagafi, 2025). In another study that was carried out in a hospital, it was found that pharmacist education and active medication observation had a significant impact on bestowing the occurrence of prescribing errors among patients who represent high risks (Shawki et al., 2022). These results showed that systematic pharmacist interactions had a direct effect of safer prescribing. Additionally, the introduction of pharmacist participation in multidisciplinary care teams increased the rate of ADEs detection and prevention. A study that looked at team interventions revealed that physicians accepted pharmacist prescriptions well, and these interventions led to reduced cases of avoidable drug-associated harm (Zaaj et al., 2023). There was also complementary evidence that medication review services led by pharmacists had a significant reduction in clinical significant medication discrepancies during hospital stay (Farley et al., 2014). Altogether, the literature showed that pharmacist interventions enhanced the medication safety systems in tertiary healthcare units.

Involvement of pharmacists during Transitions of care and Reduction of readmissions

Care transitions were considered areas of weakness in patients due to the common gap in medication and readmission risk. The involvement of clinical pharmacists in the discharge planning and post-discharge follow-up was revealed to increase the medication continuity and adherence. A systematic review of pharmacist-led post-hospital discharge found that formal pharmacist interaction was associated with low levels of hospital readmissions (Weber et al., 2025). Likewise, systematic data showed that pharmacist medication reconciliation at the time of care transition increased the continuation of therapy and decreased medication-related matters (Costello et al., 2023).

Intervention research in the hospitals also proved the clinical usefulness of pharmacist services in order to decrease 30-day readmissions. The pharmacist-managed discharge clinics were linked with unplanned readmissions reduced significantly relative to standard care (Hammad et al., 2025). Also, pharmacist-led medication reconciliation programmes were demonstrated to lead to less emergency department visits and the general measurement of healthcare utilisation (Mekonnen et al., 2016). These results

highlighted the idea that pharmacist involvement during the process of transition of care improved patient safety, as compared to the inpatient case.
Pharmacist-delivered patient education and discharge counselling were also found to be important in the literature. It was the reported studies that pharmacist counselling enhanced medication understanding, adherence, self-management in patients with chronic illnesses (Ahmed et al., 2021). Moreover, the coordinated pharmacist follow-up services were correlated with the high levels of clinical stability and the reduction of post-discharge medication errors (Costello et al., 2023). These results supported the contribution of pharmacists to the safe transitions and maintenance of healthy outcomes.

Impacts of Clinical Pharmacy Services on the Therapeutic Outcomes and System-Level

Alongside the measure of safety, clinical pharmacist intervention had a substantial impact on the indicators of therapeutic outcomes and the indicators of disease control. In the systematic review carried out in Pakistan, pharmacists-led interventions were reported to have a beneficial effect on blood pressure, glycaemic, lipid profiles, and medication adherence of individuals with chronic diseases (Ahmed et al., 2021). In this regard, the contribution to multidisciplinary collaboration that incorporated clinical pharmacists proved to have a better therapeutic effect and better pharmacotherapy management (Zaaj et al., 2023).
CPOEs also helped in enhancing antimicrobial stewardship and judicious use of drugs in tertiary care hospitals by clinical pharmacists. The studies examining pharmacist-led antimicrobial optimisation identified an improvement in compliance with clinical recommendations and a decrease in inappropriate prescriptions of antibiotics (Naseralallah et al., 2023). Also, the pharmacist interventions in hospitals were linked to cost avoiding and better quality of the prescribings which proved to be clinically and economically advantageous (Althagafi, 2025).
The inter-professional collaboration was improved and the medication governance structures were reinforced through the pharmacist interventions. It was revealed that pharmacist recommendation was highly acceptable among healthcare providers, which led to the enhancement of the prescribing appropriateness and the decreases in PRDs (Shawki et al., 2022). Also, the medication review services conducted by pharmacists were linked to the quantifiable change in the overall healthcare quality indicators such as a decrease in length of stay, and an increase in patient satisfaction (Farley et al., 2014). A combination of these results highlighted the systematic importance of the inclusion of clinical pharmacists into tertiary care teams.

Research Methodology

Research Design

The research design that was used in this study was a quantitative, quasi-experimental study design to investigate the role of clinical pharmacist interventions in improving medication safety and patient outcomes in tertiary care hospitals. This design was chosen since it enabled systematic comparison of the patients undergoing clinical pharmacist interventions and the patients undergoing regular care with no structured pharmacist interventions. The evaluation of the changes in medication error rates, adverse drug events (ADEs), and the chosen patient outcome indicators was conducted with the help of pre-post intervention framework. This methodology has allowed the clinical effectiveness of the hospital environment to be measured in practice in a way that is feasible.

Study Setting

This was done in selected tertiary care hospitals which offered specific inpatient care which includes internal medicine, cardiology, intensive care, and surgical units. These

hospitals have been selected because they have a high patient turnover, complicated medication routines, and well-established clinical pharmacy services. Clinical pharmacists became a part of multidisciplinary teams and were involved in ward rounds, medication review, discharge planning, and therapeutic monitoring. The research was conducted within a period of six months in order to provide adequate data collection in various clinical departments.

Population and Sampling

The subjects of the study were the inpatient adult patients who were hospitalized and were admitted in the selected inpatient departments within the study period. The inclusion criteria were patients aged 18 years or more and patient receiving at least two medications during hospitalization. Patients who were not admitted to the hospital longer than 24 hours or discharged against medical advice were not included in the study. Eligible participants were chosen through a purposive sampling method based on the hospital records. The sufficient sample size was calculated based on the rate of hospital admission and power of the results in providing statistical reliability and validity of the results.

Intervention Description

The intervention involved systematic clinical engagement of the pharmacists in patient care. Clinical pharmacists performed medication reconciliation during admission, checked prescriptions on the accuracy of dosing, examined possible drug-drug interactions, monitored therapeutic drug levels, and counseled the patient on discharge. All drug-related problems were also documented by the pharmacists and recommendations given to the physicians. The rate of pharmacist recommendation acceptance was documented. The period of intervention was matched with a baseline data gathered before the structured clinical pharmacist incorporation.

Data Collection Procedures

The structured data extraction form that was designed to be used in the study was used in gathering the data. Electronic medical records, medication charts, incident reporting systems, and pharmacist intervention logs were used as a source of information. The variables that were measured were the demographics of the patients, the number of medications prescribed, the pharmacist interventions, medication errors, ADEs, length of stay, and the readmission rate of the patients within 30 days. Data were anonymous to maintain confidentiality. The accuracy of extracted data was checked by trained research assistants to increase the level of reliability.

Study Variables

Clinical pharmacist intervention was the independent variable of this study. Dependent variables were medication safety indicators (medication errors, prescribing discrepancies, ADEs) and patient outcome measures (length of hospital stay, readmission rate and treatment efficacy). The control variables were also noted like the age of the patient, gender, number of medications prescribed, and comorbidities to take into consideration the possibility of confounding effects.

Data Analysis

The analysis of data was done in Statistical Package of Social Sciences (SPSS). Demographic and clinical characteristics were summarized using descriptive statistics, in terms of frequencies, percentages, means and standard deviations. The inferential statistical tests helped to compare the differences in pre-intervention and post-intervention groups. The chi-square tests were used to compare categorical variables including medication error rate and the ADE occurrences and the independent t-tests to compare continuous variables including length of hospital stay. The use of multiple regression analysis was done to determine the predictive impact

of clinical pharmacist interventions on patient outcomes and to adjust the impact of confounding factors. The p-value of less than 0.05 was taken as the statistical significance.

Results and Analysis

The results and analysis presented the statistical findings of the study examining the impact of clinical pharmacist interventions on medication safety and patient outcomes in tertiary care hospitals. The results were organized under thematic headings with descriptive tables and detailed analytical interpretation. All analyses were conducted using SPSS, and statistical significance was set at $p < 0.05$.

Demographic and Clinical Characteristics of Participants

This analysis described the demographic and baseline clinical profile of the study participants. A total of 240 patients were included, with 120 patients in the pre-intervention group and 120 patients in the post-intervention group.

Table 1. Demographic and Clinical Characteristics of Study Participants

Variable	Pre-Intervention (n=120)	Post-Intervention (n=120)	p-value
Mean Age (years)	56.8 ± 14.2	57.3 ± 13.7	0.742
Male (%)	62 (51.7%)	65 (54.2%)	0.689
Mean No. of Medications	7.9 ± 2.6	8.1 ± 2.4	0.521
≥2 Comorbidities (%)	70 (58.3%)	73 (60.8%)	0.692

The demographic features showed that the two groups were similar in statistics on a baseline. There was no significant difference in the mean age of the participants aged 56.8 years during pre-intervention and 57.3 years during post-intervention ($p = 0.742$). In the same way, the balance was also even in gender distribution where no statistically significant difference was found ($p = 0.689$). The comparability enhanced internal validity because demographic confounding was reduced. The average number of prescribed medications was found to be a little greater in the post-intervention group (8.1) than the pre-intervention group (7.9) with non-significant difference ($p = 0.521$). This result implied that the complexity of medication within the two groups did not differ significantly to give a reasonable assessment of the effects of the pharmacist intervention. The percentage of comorbid patients in the two groups was almost similar. The similarity in the baseline of the study result was warranted since polypharmacy and comorbid conditions are significant predictors of medication errors as a result, the difference in the observed outcomes was more likely to be due to clinic pharmacist intervention, instead of patient differences.

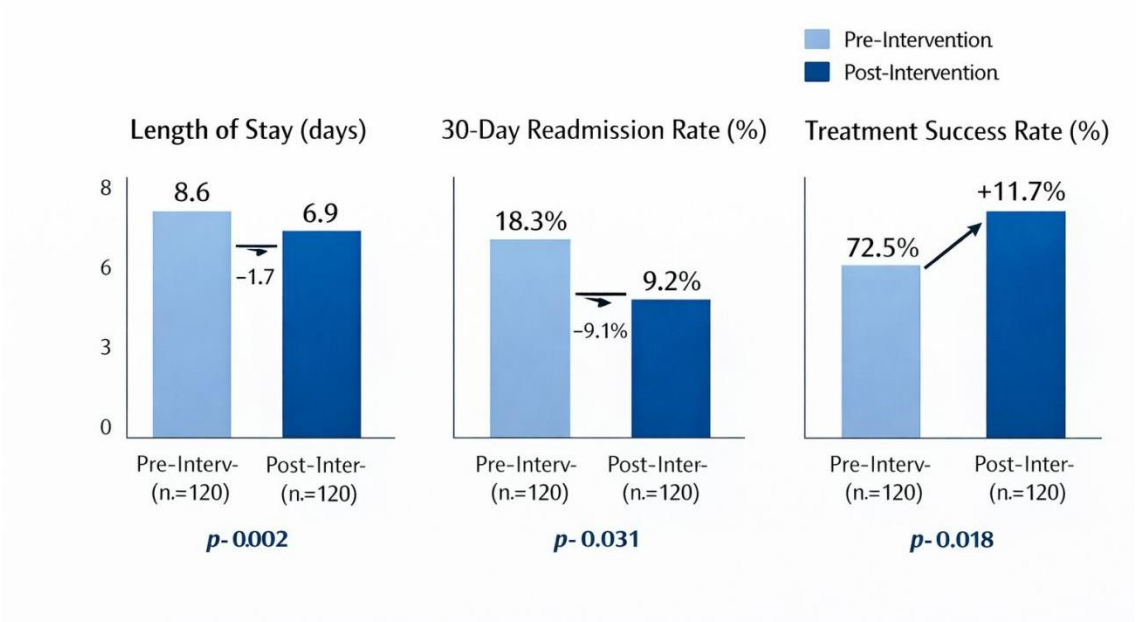

Figure 1. Demographic and Clinical Characteristics of Study Participants
Impact of Clinical Pharmacist Interventions on Medication Safety
This analysis examined changes in medication error rates and adverse drug events following the introduction of structured clinical pharmacist interventions.

Table 2. Comparison of Medication Safety Indicators

Indicator	Pre-Intervention (n=120)	Post-Intervention (n=120)	% Reduction	p-value
Medication Errors (n)	84	39	53.6%	<0.001
Prescribing Errors (%)	41.7%	18.3%	56.1%	<0.001
Adverse Drug Events (%)	22.5%	10.0%	55.6%	0.004
Drug–Drug Interactions Identified	65	28	56.9%	<0.001

The results proved the statistically significant decrease of the number of medication errors after the intervention of clinical pharmacists. Medication errors were reduced by fifty-three point six percent ($p < 0.001$) between the four cases of medication errors during pre-intervention stage of the intervention and thirty-nine cases of medication errors during post-intervention stage of the intervention. This tremendous drop observed that the interceptive of medication errors by pharmacists prior to reaching patients was quite effective. The same case was with the error in prescribing that dropped downwards after the intervention, 41.7% to 18.3%. The significant difference at the statistically significant level ($p < 0.001$) indicated that the active involvement of pharmacists in the review of prescription and the actions to verify the dosage helped to achieve better prescribing accuracy. Moreover, the level of reported adverse drug events went down by a significant margin 22.5 to 10.0 ($p = 0.004$), which was an indicator of the improvement of patient safety outcomes. The involvement of pharmacists also contributed greatly to the reduction of drug-drug interactions. Review of medications reduced any potentially harmful interactions by pharmacists by recognizing and resolving them, resulting in a reduction of 56.9% of the reported interactions. All in all, the findings were solid evidence that structured clinical pharmacist services improved medication safety pointers in tertiary care environments.

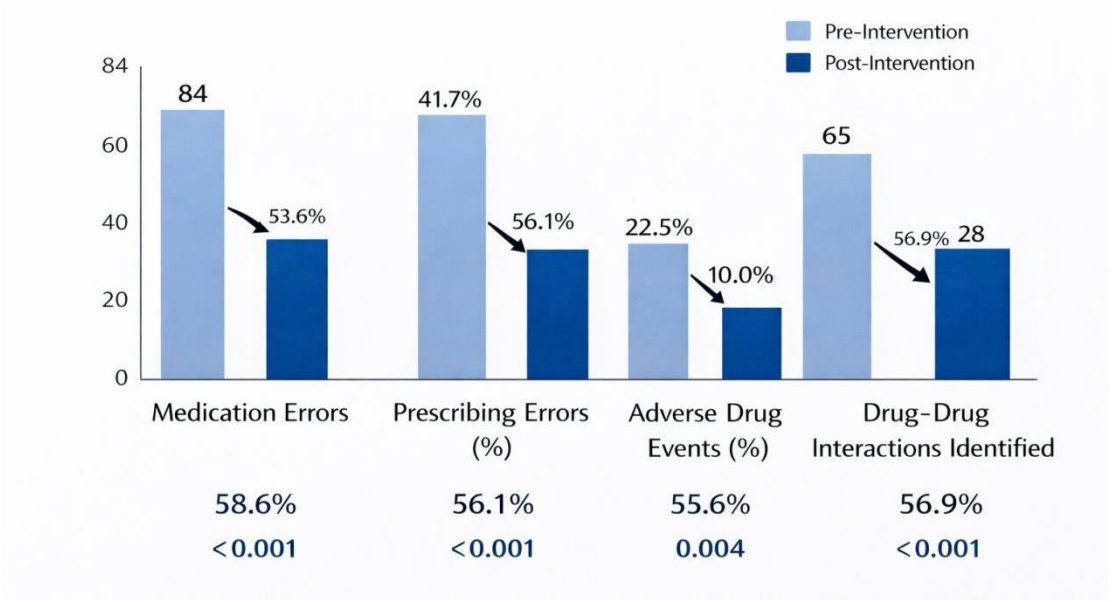

Figure 2. Comparison of Medication Safety Indicators

Types and Frequency of Clinical Pharmacist Interventions

This table summarizes the categories and frequency of pharmacist interventions recorded during the study period.

Table 3.Types of Clinical Pharmacist Interventions (Post-Intervention Phase)

Intervention Type	Frequency (n=210)	Percentage (%)
Dose Adjustment	68	32.4%
Drug–Drug Interaction Prevention	47	22.4%
Therapeutic Drug Monitoring	29	13.8%
Medication Reconciliation	36	17.1%
Patient Counseling	30	14.3%

There were 210 pharmacist interventions recorded in the after intervention period. The highest category was dose adjustments (32.4%), which explains the significance of tailored patient dosage in patients with a compromised renal system, hepatic dysfunction, and polypharmacy. This observation implied that one of the safety factors focused on by pharmacists was how to avoid dose errors. Prevention of drug-drug interactions was developed in 22.4% of these interventions, which implies that active monitoring of dangerous combinations is observed. Combined with medication reconciliation and patient counseling, more than 31/4 interventions involved pharmacists, which indicates that pharmacists are not only responsible to prevent primary errors but also enhance drug continuity and knowledge of patients. Drugs monitoring interventions Therapeutic interventions were 13.8% of all activities. Such interventions were specifically appropriate when dealing with high-risk drugs that need serum level monitoring. The dispersion of the types of interventions depicted the multidisciplinary and all-pervasive nature of clinical pharmacists in tertiary hospitals.

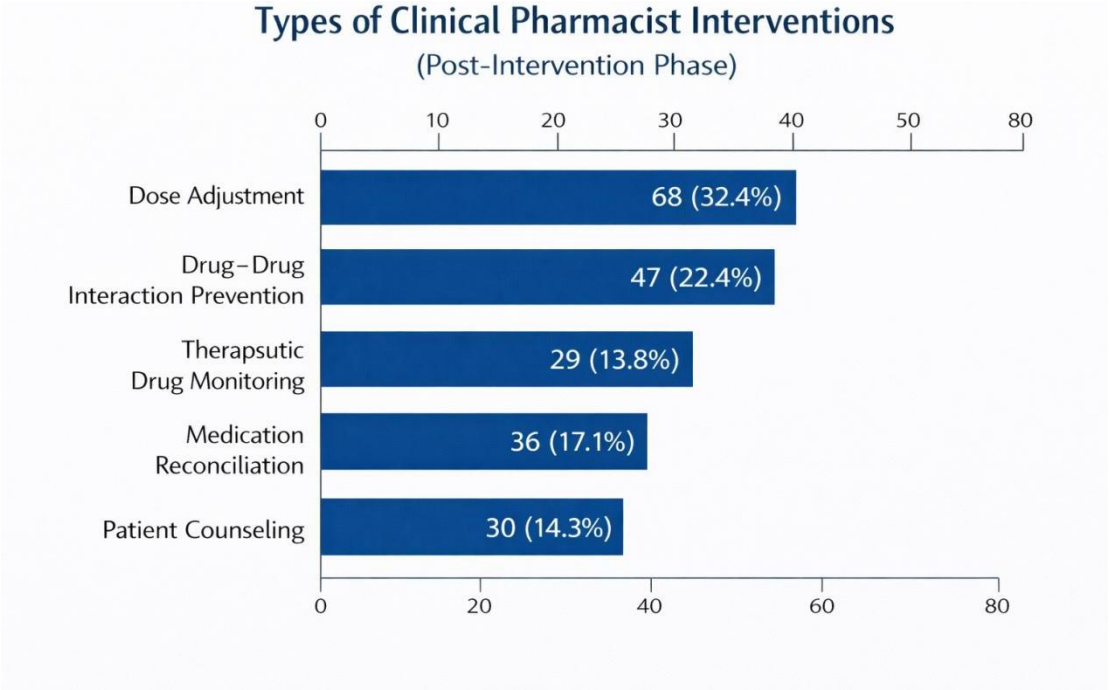

Figure 3.Types of Clinical Pharmacist Interventions (Post-Intervention Phase)

Impact on Patient Outcomes

The analysis evaluated whether improvements in medication safety translated into measurable clinical outcomes.

Table 4. Comparison of Patient Outcome Indicators

Outcome Variable	Pre-Intervention	Post-Intervention	Mean Difference	p-value
Length of Stay (days)	8.6 ± 3.1	6.9 ± 2.8	-1.7	0.002
30-Day Readmission Rate (%)	18.3%	9.2%	-9.1%	0.031
Treatment Success Rate (%)	72.5%	84.2%	+11.7%	0.018

Clinical pharmacist interventions were introduced, which was accompanied by improvements in patient outcomes. The average number of days in hospital reduced by 1.7 days wherein the mean length of stay dropped to 6.9 days ($p = 0.002$). This observation indicated better clinical stabilization and discharge preparedness due to better medication management. The 30 days readmission rate decreased to 9.2% in the post intervention group and reduced to 18.3% in the pre intervention group ($p = 0.031$). This decrease indicated that discharge counseling that was led by pharmacists and medication reconciliation enhanced continuity of care and minimised post discharge complications. There was an increase in treatment success levels to 84.2 as compared to 72.5 ($p = 0.018$). This advancement implied that therapeutic effect was optimised by the efficacy of pharmacotherapy and medication errors. Together, these results proved that clinical pharmacist interventions had a positive impact on both safety and clinical outcomes in tertiary care hospitals.

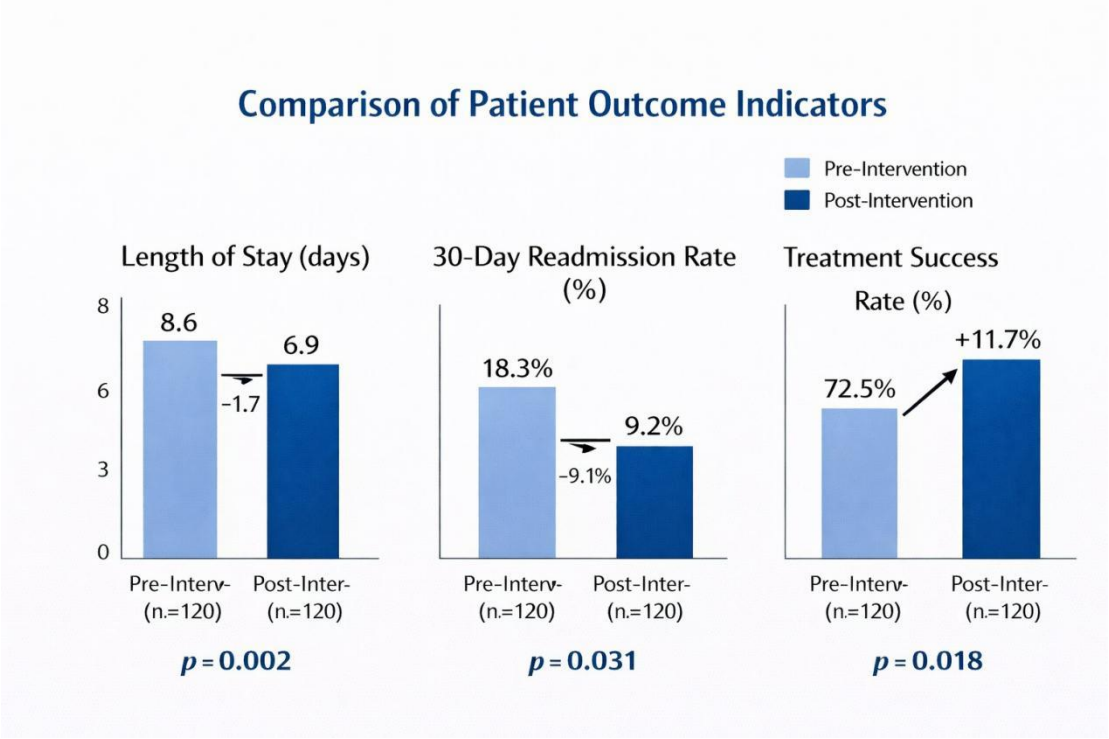

Figure 4. Comparison of Patient Outcome Indicators

Discussion

The results of the current study indicated that the structured clinical pharmacist interventions had a great positive impact on the patient outcomes and the medication safety within tertiary care hospitals. The significant decrease in the rate of medication errors and professionals prescribing errors registered during the post-intervention period were consistent with previous empirical data that pharmacist inclusion into multidisciplinary teams leads to improvement in medication management procedures (Kaboli et al., 2006). The reduction in adverse drug events, once again, signified that the pharmacist-led prescription review, dose optimization and screening of drug-drug interaction are part of the safer therapeutic practices. These results bolstered the statement that medication errors can most of the time be avoided in cases where the systematic pharmaceutical control is integrated into the daily care of hospitals.

The findings of this research that appear to diminish the number of prescription errors justified other pieces of literature that have demonstrated that pharmacist involvement in clinical rounding and medication reconciliation is valuable (Kucukarslan et al., 2003). Pharmacists were the especially important commodities of the medication-use system in complex tertiary care settings, wherein they were likely to be key barriers against polypharmacy and comorbidity, thus leading to inappropriate prescribing. The level of acceptance of the pharmacist recommendation at the intervention phase was high and this indicated good interdisciplinary collaboration which has been found to be a major determinant of successful medication safety efforts (Leape et al., 1999). Therefore, the findings indicated that collaborative models of practice were necessary in making the best out of pharmacotherapy.

The fact that there was a decreasing trend in adverse drug events was also an indication of improved surveillance of high-risk medications. The past of the controlled trials showed that the involvement of pharmacists in intensive care and internal medicine units led to less avoidable ADEs as well as enhanced monitoring of therapies (Kane et al., 2003). In the same way, pharmacist-led medication reviews have demonstrated to minimize the occurrence of drug related issues as well as improvements in clinical stability among the hospitalized patients (Bond & Raehl, 2007). The fact that these findings corroborated with the current study enhanced the evidence base of the increased clinical pharmacy services in tertiary hospitals.

Besides progress in safety, this study also showed that there was a statistically significant decrease in the length of stay in the hospitals after they were complemented with pharmacists. This result could be attributed to the fact that the complications related to medication were timely detected, and the treatment regimens were optimized more quickly. Past studies conducted on a large scale revealed that hospitals that had a greater amount of clinical pharmacy services encountered reduced mortality rate and decreased hospital length of stay (Bond & Raehl, 2007). Shorter stay was not only an indicator of the better patient recovery but also indicated possible savings on costs and more efficient use of resources in an organizing of healthcare system.

Further results of the importance of pharmacists in any continuity of care was the drastic test reduction in 30-day readmission rates. Medication errors in transitions of care are generally accepted reasons of preventable readmissions. Studies that explored intervention of a pharmacist-led discharge counseling and medication reconciliation showed significant decrease in avoidable readmissions (Schnipper et al., 2006). Through patient education and provision of appropriate lists of medication at discharge, pharmacists probably would minimize post-discharge medication errors and increase adherence, which in turn would decrease the risk of readmission.

The higher success rate of treatment witnessed in this study calculated the larger therapeutic advantages of the involvement of clinical pharmacists. Optimised dosing and selection of drugs as well as therapeutic drug monitoring must have contributed to the clinical efficacy across the conditions of diseases. Systematic reviews conducted in the past showed that pharmacist-delivered pharmacotherapy had better disease control outcomes especially in long-term conditions where patients need complex medication regimes (Chisholm-Burns et al., 2010). The present study found the same body of evidence to be consistent with the findings, which supports the importance of pharmacists as direct contributors to patient-centered care.

The quasi-experimental design did not allow drawing the conclusions regarding the cause and effect, but the extent and comparability of the improvements provided evidence an intensive relationship between pharmacist involvement and the improvement of clinical outcomes. Other non-randomized studies but based in a hospital setting have found similar improvements in safety measures on the use of clinical pharmacy services (Kaboli et al., 2006). These trends implied that the pharmacist-led interventions acted as system-level quality improvement processes, not clinical undertakings.

Another issue that was brought out in the study is the necessity to have systematic records of pharmacist interventions. Quality and ongoing quality improvement were enabled by proper documentations that helped assess the type of intervention and the results to be obtained. Hospital system evidence has demonstrated that institutionalized pharmacist incorporation into care pathways enhances medication governance and institutional safety culture (Leape et al., 1999). Hence, institutional policies that can encourage pharmacists to engage in clinical decision-making can improve the quality of healthcare in the long run.

Conclusion

The current investigation came to the conclusion that structured clinical pharmacist interventions were effective in enhancing medication safety and patient outcome in tertiary care hospitals. The results showed significant medication errors, prescribing errors, adverse drug events, and drug-drug interactions reduction after the inclusion of clinical pharmacists into multidisciplinary care teams. In addition, patient-centered outcomes such as a shorter length of hospital stay, a lower number of 30-day readmission, and a higher success rate of the treatment were noted to have been improved. These findings demonstrated that clinical pharmacists also played a significant role in medication control, therapeutic optimization, and quality of health

care in general. The paper hence validated that implementing clinical pharmacy services in tertiary health care systems enhanced patient safety models and augmented clinical performance in intricate inpatient settings.

Future Directions

Randomized controlled trial methods should be used in future studies to draw a better causal relationship between pharmacist interventions and clinical outcomes. There would be greater generalizability of the findings in multi-center studies that examine different geographic areas and health systems. More studies on the economic implications of the clinical pharmacist services including cost-benefit and cost-effectiveness studies are reasonable to favor sustainable healthcare planning. Also, studies that examine how digital health technologies, including clinical decision support systems and electronic prescribing devices, and pharmacist interventions can be combined can provide synergistic approaches to curb medication-related harm. Prospective studies evaluating the long-term patient health outcomes and quality-of-life scales would further explain the long-term effects of clinical pharmacy interventions in tertiary care units.

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