

# Impact of Clinical Pharmacist Interventions on the Reduction of Medication Errors in a Tertiary Care Hospital: A Prospective Study

# Naif H. Helman<sup>1</sup>, Abdulaziz D. Alzahrani<sup>2</sup>, Badr I. Alrufaiq<sup>3</sup>, Ahmed G. Alsahli<sup>4</sup>

Health Affairs at the National Guard Hospital

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# Abstract

**Background:** Errors associated with medications (MEs) are a major problem in tertiary health care because they can affect patients negatively and increase their staying periods in the hospital, therefore increasing the overall costs. The role of clinical pharmacists in various healthcare facilities and institutions has been role effective in medication error reduction.

**Objective:** To assess the clinical pharmacist led intervention programs on medication error reduction in a tertiary care hospital.

**Methods:** The study was a prospective interventional study which ran for 6 months in a tertiary hospital in the region of Saudi Arabia. The participants were adult inpatients from the internal medicine and surgical wards. During the daily ward rounds, clinical pharmacists conducted medication reviews and reconciliations and made recommendations to the prescribers. Medication errors were defined and categorized as pre-and post-intervention. Outcome measures were classified as NCC MERP medication error causative classification system.

**Results:** Of the 320 patients, their admission and follow up data were examined. There was a drop in the number of medication errors from 176 pre-intervention to 58 post- intervention accounting for a 67% reduction (p < 0.001) while the acceptance of recommendations posted by the clinical pharmacists was 90.6% severely diminishing the level of documented errors reducing the need for monitoring and harm.

**Conclusion:** Within a tertiary care hospital setting, the integration of clinical pharmacists proactively reduced both the occurrence and severity of medication errors. These conclusions strengthen the rationale for the incorporation of pharmacists into multidisciplinary healthcare teams with an aim to improve medication safety and refine patient care processes.

**Keywords:** Clinical Pharmacist, Pharmacist Intervention, Tertiary Hospital, Saudi Arabia, Medication Errors, Medication Reconciliation, Patient Safety



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# Introduction

Medication errors (MEs) are still a major concern for healthcare systems around the world Today, MEs are especially dangerous when it comes to patient safety in complex settings such as tertiary care hospitals. In tertiary care clinical settings, patients are often dealt with at advanced stages of their illnesses along with multi-drug therapies which adds layers of complexity to the treatment process and increase the chances of medication errors being made (Naseralallah et al., 2020). Errors like dosage miscalculations or inappropriate prescription and administration, leads to adverse drug events (ADEs), increased duration of hospitalization, and escalation in the overall cost of healthcare services (Reddy, 2018).

Given these challenges, clinical pharmacists have been viewed as key players within medication safety frameworks. Through the direct participation in patient care rounds, clinical pharmacists engage in medication reconciliation and staff lifelong education which has proven to reduce prescribing errors and improve medication management practices (Cortejoso et al., 2016).

As reported by Abu-Naser (2021), a number of systematic reviews and intervention studies indicate that pharmacist-led initiatives can decrease medication error rates by as much as 76 percent in high-risk patient populations, such as the elderly or those with significant polypharmacy. Furthermore, George and Supramaniam (2019) demonstrated that pharmacist-led discharge quality improvement initiatives dramatically mitigate medication discrepancies, thereby improving patient outcomes after hospital discharge.

With the world progressing, there is still a gap in localized information, especially from Saudi Arabia, regarding the measurable outcome of clinical pharmacist interventions as provided in tertiary care institutions. The vast number of patients and breadth of clinical situations in Saudi tertiary hospitals makes it important to know what clinical pharmacists do in regard to medication safety. This research intends to assess the impact of clinical pharmacologist interventions on medication errors in a tertiary hospital to help refine pharmacotherapy processes and improve patient safety.

# **Literature Review**

It is widely acknowledged that medication errors (MEs) remain an ongoing problem in the healthcare system, especially in the field of tertiary care which deals with complex patient issues and uses multiple medications along with complicated treatment courses. Such systems are difficult to manage and are therefore, highly prone to errors in prescribing, dispensing, and even administering medications. These complexities require sophisticated methods to minimize these challenges. Tertiary hospitals are widely reported to lack sufficient measures to manage medication errors and this has become a global problem (Naseralallah et al., 2020; Reddy, 2018).

Clinical pharmacists have emerged as vital members of the healthcare team as they directly impact medication safety by providing patient-centered care. Their activities include, but are not limited to,



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medication reconciliation and prescription reviews, providing drug information services, and participation in multidisciplinary rounds. In a systematic review focused on children, it was determined that pharmacists' interventions had substantial impacts on medication error reduction, which highlights their importance in vulnerable populations (Naseralallah et al., 2020).

The positive effects of pharmacist-led initiatives further corroborate their impact in adult and geriatric populations. A prospective study conducted in Germany underscored the impact clinical pharmacists had in the decrement of prescribing errors in older patients, which illustrates the complex role pharmacists play in the care continuum (Cortejoso et al., 2016). In the same manner, Abu-Naser (2021) reported that pharmacist interventions in hospitalized diabetic patients suffering from major polypharmacy increased prescribing error corrections by 76%.

Pharmacist-led health care quality improvement initiatives have also been effective at critical transition points like the hospital's doors, most particularly from the inpatient unit. George and Supramaniam (2019) reported that the structured pharmacist-led quality improvement initiative reduced discrepancies and errors associated with medication orders during the discharge process, an area known for miscommunication and unaccounted-for steps in the process (George & Supramaniam, 2019).

Moreover, other India-based studies have accentuated the active involvement of clinical pharmacists in the prevention of medication errors during the continuum of hospital care. Reddy (2018) demonstrated the impact clinical pharmacists had in medication error prevention and patient safety outcomes in a tertiary care setting (Reddy, 2018).

As a whole, these results strongly support the notion that the incorporation of clinical pharmacists into the working framework of a multidisciplinary healthcare team is one of the most effective measures to reduce medication errors. Still, there is little research of this nature focused on Saudi tertiary care hospitals due to their unique patient populations and healthcare systems. Closing this gap would advance the international discourse surrounding the pharmacy practice and inform local policy and strategies for healthcare improvement.

# Methodology

# Design and Setting of the Study

This is an interventional prospective study that was conducted in one of the tertiary care hospitals in Saudi Arabia over the last six months. The hospital offers integrated healthcare services to a heterogenous group of patients, including services in the critical care units, medical wards and surgical departments.

# Participants of the Study

This study focused on all adult inpatients, 18 years or older, and was restricted to internal medicine and surgical wards during the timeframe of the study. Exclusions were made for those who were admitted for less than 24 hours, patients in palliative care, or those who left the hospital against medical advice.



#### Intervention

Clinical pharmacists were incorporated into the multidisciplinary care teams in a more active manner. Some of these include:

- Medication review and reconciliation for each patient on the following day.
- Identification and recording of potential as well as actual medication errors.
- Prescriber communications for recommend corrective action.
- Involvement in multi-disciplinary ward rounds and planning for discharges.
- Providing healthcare professionals with information and education on medicines.

All interventions were captured through standardized pharmacist intervention forms, which documented the Type of medication error, intervention instituted, and the response or result of the intervention.

#### Assembling the Information

By the clinical pharmacy team, the information was gathered on a prospective basis. Each identified medication error was recorded with the following particulars:

- Details regarding the patient (age, gender, diagnosis)
- Nature and type of the medication error (prescribing, dispensing or administration)

• Severity evaluation according to the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index

• Outcomes of the interventions (accepted, partially accepted, or rejected by the physician).

Furthermore, pre-intervention and post-intervention error rates were computed in order to assess the effectiveness of the pharmacist interventions.

#### **Evaluation Criteria**

Assessment of outcome measures was conducted through evaluation of the pre-defined criteria which included the revised primary outcomes and any consequent secondary outcomes determined.

After the pharmacist intervention, the medication error incidence reduction was the primary outcome of the analyzing outcomes. The error incidence was calculated per 1,000 patient-days. Secondary outcomes included:



• Types and severity of errors prevented (calculated as a total of accepted interventions minus intervened errors)

- Acceptance of the pharmacist interventions by the prescriber.
- Total time taken for the intervention and resolution.

# **Statistical Methods**

Data analysis was performed using SPSS. The software was also used to enter the gathered data. The quantitative information was analyzed using descriptive statistics while the demographic characteristics of patients and type of errors were summarized. The incidence of medication errors before and after pharmacist intervention was tested using Chi-square test. The two-sided p-value was set less than 0.05 to be statistically significant.

#### **Ethical Considerations**

Study ethics were approved by the applicable ethics committee. Throughout the study, confidentiality was observed with regard to the patients' identities. Because the interventions were part of routine clinical practices to enhance patient safety, consent was not sought.

#### Results

# **Study Population**

A total of 320 patients were included in the study during the six-month period. The mean age was  $57.2 \pm 14.8$  years, with a slight predominance of males (54%) over females (46%). The majority of patients were admitted to the internal medicine ward (62%), followed by surgical wards (38%).

Variable	n (%) or Mean ± SD
Total patients	320
Age (years)	57.2 ± 14.8
Gender	
- Male	173 (54%)
- Female	147 (46%)
Ward	
- Internal Medicine	198 (62%)
- Surgical	122 (38%)
Length of hospital stay (days)	8.4 ± 3.1

# **Table 1. Patient Demographics**



# **Medication Errors Identified**

A total of 176 medication errors were identified before pharmacist intervention, corresponding to 27.5 errors per 100 patients. After implementing clinical pharmacist interventions, errors reduced to 58, corresponding to 9.0 errors per 100 patients, reflecting a significant reduction (p < 0.001).

Parameter	<b>Pre-Intervention</b>	<b>Post-Intervention</b>	p-value
Total medication errors	176	58	< 0.001 **
Errors per 100 patients	27.5	9.0	< 0.001 **
Error rate per 1,000 patient-days	32.7	10.4	< 0.001 **

Table 2. Medication	Error Rates	<b>Pre- and Post-I</b>	ntervention
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(\*\*p < 0.05 considered statistically significant)

# **Types of Medication Errors**

Prescribing errors were the most common, accounting for 63.6% of total errors before intervention, followed by administration errors and dispensing errors. The largest reduction was observed in prescribing errors post-intervention.

# **Table 3. Types of Medication Errors Identified**

Type of Error	Pre-Intervention (n=176)	Post-Intervention (n=58)
Prescribing errors	112 (63.6%)	28 (48.3%)
Administration errors	38 (21.6%)	14 (24.1%)
Dispensing errors	26 (14.8%)	16 (27.6%)

# **Severity of Errors**

According to the NCC MERP index:

- Category C (error reached patient but no harm): 62% pre-intervention  $\rightarrow$  40% post-intervention
- Category D (monitoring required to preclude harm): 27% pre-intervention  $\rightarrow$  12% post-intervention
- Category E or higher (temporary harm): reduced from 11% to 5%

# Acceptance of Pharmacist Interventions

Out of 96 pharmacist interventions, 87 were accepted by prescribers (90.6% acceptance rate), indicating high clinical relevance and utility of pharmacist recommendations.

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Intervention Outcome	Number (n=96)	Percentage (%)
Accepted	87	90.6%
Partially accepted	6	6.3%
Rejected	3	3.1%

# **Table 4. Acceptance of Pharmacist Interventions**

# **Summary of Findings**

The implementation of clinical pharmacist-led interventions in a tertiary hospital setting resulted in a **67% reduction** in medication errors, with a high acceptance rate of pharmacist recommendations. The most notable improvement was observed in the reduction of prescribing errors and severity levels of incidents, indicating enhanced patient safety and improved medication management.

# Discussion

The inclusion of clinical pharmacists within a tertiary care hospital system profoundly impacted the implementation of medications errors within the facilities. Specifically, the error rate decreased from 27.5 to 9.0 errors per 100 patients which is a 67% reduction. This further corroborates previous studies on high-risk settings (Abu-Naser, 2021).

Over half of the medication errors in our study were prescribing errors at 63.6% pre-intervention. This agrees with previous studies that prescribing remains the predominant medication error on inpatient wards (Cortejoso et al., 2016; Naseralallah et al., 2020). These errors were substantially reduced after intervention with pharmacists, showcasing the importance of proactively involving pharmacists for order reviews and confirmations.

Moreover, the high rate of acceptance (90.6%) of pharmacist interventions by the physicians served to further demonstrate the level of established trust and cooperation between pharmacists and the medical team surrounding patient safety. Comparable acceptance rates have been noted in other interventional studies, which add to the body of evidence supporting the role of clinical pharmacists in the healthcare team (George & Supramaniam, 2019).

Understanding severity analysis strengthens our findings further. In the post-intervention stage, errors in Category D and above (those requiring supervision and those causing temporary injury) were markedly decreased. This is important from a clinical perspective because these require monitoring errors have a high probability of detrimental health outcomes for patients. In addition, higher severity errors increase costs associated with health care services (Reddy, 2018).

These findings were just as substantiated by international data where pharmacist interventions were documented to have reduced medication errors by 40–76% in the level three and critical care domains (Abu-Naser, 2021; Naseralallah et al., 2020). Most importantly, this study is the first of its kind to provide data from Saudi Arabia. The region lags behind in local research on the topic of medication



safety. Through positioning these findings within the context of the Saudi healthcare system, the study opens new avenues for local health policy and hospital governance geared toward enhancing medication safety protocols.

# **Study Strengths and Limitations**

A notable strength of this study is the prospective approach and real-life clinical environment in which the study was conducted. In addition, the generalizability of the findings is enhanced. Application of one standard error classification system (NCC MERP) on medication error severity also provides added reliability to the study outcomes.

Despite its contributions, this study has limitations. First, the research was undertaken in one tertiary referral hospital, making it less relevant to other healthcare contexts. Second, the study did not assess the patient outcomes long-term, related to the pharmacist interventions, for instance, readmission as well as death. It would be beneficial to perform multicenter studies with longer follow-up durations to fill these gaps.

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