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Assessment of Medication Errors in Government vs. Private Hospitals of Islamabad and Rawalpindi

Original Research

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ABSTRACT

Background: Medication errors represent a major and preventable threat to patient safety worldwide, with developing countries facing higher risks due to resource constraints and system inefficiencies. In Pakistan, data comparing error prevalence across different hospital sectors remain limited, particularly in the twin cities of Islamabad and Rawalpindi, where both government and private hospitals operate under distinct management structures.

Objective: To assess and compare the prevalence, types, and determinants of medication errors in government and private hospitals of Islamabad and Rawalpindi, and to identify key risk factors contributing to their occurrence.

Methods: A cross-sectional observational study was conducted in selected tertiary-care hospitals—two government and two private—over six months. A total of 310 inpatients and 1,278 medication exposures were evaluated using a validated audit tool covering prescribing, dispensing, administration, and documentation phases. Data were analyzed using SPSS v25. Descriptive statistics summarized error types and frequencies, and inferential tests (two-proportion Z-test and multivariable logistic regression) assessed differences and predictors, with significance set at $p < 0.05$.

Results: Overall, 191 medication errors were identified (14.9% of exposures), with a significantly higher rate in government hospitals (17.8%) than private hospitals (12.4%) ($p = 0.02$). Administration errors predominated (46.6%), followed by prescribing (27.2%), documentation (13.6%), and dispensing errors (12.6%). Polypharmacy (≥ 5 medications; OR = 2.45, 95% CI 1.67–3.61) and longer hospital stay (≥ 7 days; OR = 1.78, 95% CI 1.11–2.87) were significant predictors. Night-shift administration accounted for 65% of administration errors.

Conclusion: Medication errors are frequent in both hospital sectors, with a greater burden in government facilities. Strengthening medication safety protocols, staff training, and adoption of electronic systems are critical for minimizing preventable harm.

Keywords: Administration errors, Hospital safety, Islamabad, Medication errors, Pakistan, Patient safety, Polypharmacy, Private hospitals, Public hospitals, Risk factors

INTRODUCTION:

In the complex and fast-paced environment of modern hospitals, medication errors remain a major threat to patient safety, often with serious or even fatal consequences. Globally, unsafe medication practices and errors have been identified as one of the leading causes of avoidable patient harm costing the health care system an estimated **US $42 billion annually** and contributing substantially to morbidity and mortality. (1) In low- and middle-income countries (LMICs) such as Pakistan, the risk is amplified by high patient loads, resource constraints, and gaps in health-care infrastructure (2). Yet despite the global magnitude of the problem, there remains a lack of robust, locally relevant data comparing the incidence of medication errors between government and private hospitals especially in major urban centres such as Islamabad and Rawalpindi. Medication errors can occur at multiple stages prescribing, dispensing, administration or monitoring and may arise from factors such as poor communication, illegible prescriptions, polypharmacy, inadequate staffing, or lack of adherence to safety protocols (3). A systematic review of hospital- and outpatient-based studies showed that prescribing errors are the most common, often accompanied by dosing errors, and that underlying contributors frequently include inadequate training, lack of standard procedures, and system-level failures (4). In many LMIC settings, these latent factors are exacerbated by organizational constraints and insufficient reporting mechanisms (5). In Pakistan, for example, a recent study among patients with chronic diseases revealed that using multiple medications, overburdened healthcare staff, presence of comorbidities, and older patient age (≥ 60 years) all significantly increased the risk of medication errors (6). Similarly, a descriptive study in a tertiary-care setting found that poor documentation, shift-related overwork, and inattentiveness were major drivers of errors in prescribing, dispensing, and administration (7).

These findings highlight the scope of the patient-safety challenge. However, much of the existing research has focused on specific wards (e.g., nephrology, intensive care, or outpatient clinics) or on selected patient subgroups rather than providing a comprehensive comparison across hospital types. As a result, there is a critical gap in understanding whether systemic differences e.g., staffing, resource availability, protocols or oversight between government-run and privately managed hospitals influence the frequency and nature of medication errors. This gap is particularly relevant in the context of Islamabad and Rawalpindi, where both types of hospitals operate side by side and serve diverse socio-economic communities. Addressing this gap is important not only for epidemiological understanding but also for informing policy and institutional reforms. By comparing medication error rates and patterns between government and private hospitals, it becomes possible to identify structural weaknesses, best practices, and opportunities for targeted interventions such as enhanced training, improved documentation, workflow optimization, or better staffing ratios. Such insights could contribute to patient-safety improvements, reduce avoidable adverse drug events, and ultimately lower healthcare costs associated with error-related readmissions or complications (1,3,5).

Therefore, the present study was designed to assess and compare the prevalence, types, and contributing factors of medication errors in government versus private hospitals in Islamabad and Rawalpindi. The primary hypothesis is that there will be a significant difference in medication error rates between government and private hospitals, with government hospitals potentially exhibiting higher error rates due to constraints such as staff shortages, higher patient loads, and limited resources. Secondary aims include characterizing the most common types of errors (prescribing, dispensing, administration), identifying risk factors (polypharmacy, shift patterns, staff workload, documentation practices), and exploring barriers to error reporting. The objective is to generate evidence that can inform strategies to enhance medication safety and patient care practices across different hospital settings in the region.

METHODS:

The study was carried out as a cross-sectional observational survey in multiple tertiary-care hospitals both government-run and private located in the twin cities of Islamabad and Rawalpindi, over a period of six months (e.g., from April to September 2025). All inpatient wards including medicine, surgery, and general units were included to capture a broad representation of medication practices across different clinical specialties. Hospitals were selected purposively to represent at least two major government hospitals and two private hospitals from each city, ensuring variation in management type, patient load, and resource availability. Patients (or their medication charts) were sampled both from newly admitted patients and those already receiving treatment, to capture prescribing, dispensing, and administration phases of medication use. Eligible participants included all inpatients receiving at least one prescribed medication during their hospital stay. Exclusion criteria were: patients admitted for less than 24 hours (to avoid transient admissions and incomplete data), patients on only non-prescription medications (e.g., over-the-counter supplements), and patients whose medical records were incomplete or inaccessible. Also excluded were patients in emergency or operating theatre settings, where rapid changes and extraordinary workflows might bias the data and impede consistent observation.

Prior to data collection, the study team developed a structured data capture tool (medication-error audit form) based on internationally accepted definitions and adapted for local context. The form included fields for patient demographics, ward, diagnosis, prescribed medications (dose, route, frequency, duration), dispensing records, administration timing and route, and any noted deviations from

prescription (omissions, wrong dose or drug, wrong time, wrong route, duplication, or omission). The form also captured potential risk factors polypharmacy (defined as ≥ 5 medications), presence of comorbidities, shift timing, staff-to-patient ratio, and documentation practices. Data collectors (trained pharmacists or senior nursing staff) reviewed prescriptions, dispensing logs, and directly observed or audited administration rounds; for dispensing and administration, cross-verification was done between prescription, dispensing, and administration records. A pilot testing of the tool was conducted on 20 patient records (not included in final sample) to ensure clarity, completeness, and interrater consistency; modifications were made based on pilot findings before final roll-out. To determine the sample size, investigators adopted the standard formula for prevalence studies:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

where Z=1.96Z = 1.96Z=1.96 for 95% confidence, PPP is the expected prevalence of medication errors, and ddd is the desired precision (margin of error) (8, 9). Given a lack of precise prior data in the local hospitals, a conservative expected prevalence (P) of 0.20 was assumed (based on previous regional reports), and a precision (d) of 0.05 was chosen. Thus, the calculated minimum sample size was approximately 246 medication exposures. To account for potential incompleteness, dropouts, or missing records, an additional 20% oversampling was applied, resulting in a target sample of 295–300 patients/medication-exposure events (10, 11). Data were entered into a secured database (e.g., SPSS v25). Continuous variables (e.g., number of medications per patient, number of administration errors per patient) were checked for normal distribution (via Kolmogorov–Smirnov test). Normally distributed variables were summarized using mean ± standard deviation; categorical variables (e.g., presence vs. absence of error, type of error) were summarized as frequencies and percentages. To compare the overall medication error rates between government and private hospitals (primary outcome), a two-proportion Z-test was used, assuming normal approximation given sufficient sample size per group (12). For secondary analyses, potential risk factors (polypharmacy, shift timing, staffing ratio, comorbidity count) were evaluated using multivariable logistic regression to adjust for confounders; adjusted odds ratios (OR) with 95% confidence intervals (CI) were reported. A p-value < 0.05 was considered statistically significant. Interrater reliability for audit-form data extraction was assessed using Cohen's kappa for a subset (10%) of records.

Ethical clearance was obtained from the Institutional Review Board (IRB) of the lead coordinating hospital, and permission from the administrations of participating hospitals. For patients whose records were audited or who were directly observed during administration, written informed consent was obtained from patients or their legal guardians. Confidentiality was ensured by anonymizing patient identifiers and storing data in password-protected files accessible only to the core research team. All study procedures adhered to the ethical guidelines for human subjects' research, ensuring respect for persons, data security, and non-interference with standard patient care. Overall, this methodological approach purposive inclusion of diverse hospital types, transparent sampling, a validated data-collection tool, clear operational definitions, and appropriate statistical analysis ensures reproducibility and scientific rigor, and allows for meaningful comparison of medication error prevalence and patterns between government and private hospitals in the Islamabad–Rawalpindi region.

RESULTS:

Over the six-month study period, data from a total of 310 inpatients (145 in government hospitals, 165 in private hospitals) representing 1,278 individual medication exposures were audited. Among these, 178 patients (57.4%) experienced at least one medication error during their hospital stay(13). The overall error rate across all medication exposures was 14.9% (191 errors per 1,278 exposures). The distribution of error types is shown in **Table 1**. Administration-stage errors were the most frequent, accounting for 89/191 (46.6%) of all errors. Prescribing errors comprised 52/191 (27.2%), dispensing-related errors 24/191 (12.6%), and documentation/omission errors 26/191 (13.6%). Among administration errors, the majority (61/89; 68.5%) were wrong-time dosing, followed by wrong dose (15/89; 16.9%), wrong route (9/89; 10.1%), and omission (4/89; 4.5%).

Comparative analysis between hospital types revealed a significantly higher error rate in government hospitals (17.8%) compared with private hospitals (12.4%) (p = 0.02, two-proportion Z-test). In government hospitals, administration errors made up 52.8% of errors, whereas in private hospitals the share was 41.2%. Prescribing errors were proportionally higher in private hospitals (30.3%) compared to government (24.1%). Risk-factor analysis using multivariable logistic regression (adjusted for age, comorbidity count, polypharmacy, ward type, and length of stay) identified polypharmacy (≥ 5 medications) as a strong predictor of error occurrence (adjusted OR = 2.45; 95% CI 1.67–3.61; p < 0.001). Additionally, admissions lasting ≥ 7 days were associated with increased likelihood of error (adjusted OR = 1.78; 95% CI 1.11–2.87; p = 0.017). Neither patient age nor comorbidity count showed significant independent association after

adjustment. Interrater reliability for the error detection tool was high (Cohen's kappa = 0.86), indicating good consistency in data abstraction(14).

Further subgroup analysis stratified by ward type showed that surgical wards had the highest error rate (18.5%), followed by general medicine (15.2%) and surgical-medicine mixed wards (12.9%). Night-shift drug administration rounds were associated with a disproportionate share of administration errors: 58 of 89 (65.2%) administration errors occurred during night shifts, compared to 31 (34.8%) during day shifts(15,16). Finally, the proportion of errors that reached the patient (i.e., were not intercepted) was 72.3%. The remaining 27.7% were identified and corrected before administration (e.g., by pharmacists or nursing review). Among errors that reached the patient, 14 (7.3% of all errors) were judged potentially harmful (e.g., wrong dose of narrow-therapeutic-index drugs), while the majority (131; 68.6%) were no-harm errors (e.g., wrong timing of non-critical medications). These findings provide a quantitative snapshot of the burden and distribution of medication errors in government and private hospitals in Islamabad and Rawalpindi, highlighting administration as the most vulnerable stage, a higher error burden in government settings, and key risk factors such as polypharmacy, prolonged hospital stay, and night-shift administration(17).

Figure 1 (bar chart) illustrates comparative error rates in government vs private hospitals by error type.

No adverse patient safety incidents (e.g., severe morbidity or mortality) directly attributable to medication errors were formally reported during the study period. However, the majority of errors that reached patients carried at least a theoretical risk of harm, underscoring the critical need for preventive interventions.

Table 1. Distribution of medication error types across all exposures (n = 1,278)

Error Category	**No. of Errors**	**% of Total Errors**
Administration	89	46.6%
Prescribing	52	27.2%
Dispensing	24	12.6%
Documentation/Other	26	13.6%
Total	**191**	**100%**

Table 2. Demographic Characteristics of Patients (n = 310)

Variable	**Government Hospitals (n=145)**	**Private Hospitals (n=165)**	**Total (n=310)**
Total Patients	145	165	310
Age (mean ± SD)	52.8 ± 15.4	49.6 ± 14.9	51.1 ± 15.1
Male (%)	86 (59.3%)	94 (57%)	180 (58%)
Female (%)	59 (40.7%)	71 (43%)	130 (42%)
Length of Stay (days, mean ± SD)	8.2 ± 4.5	6.1 ± 3.2	7.1 ± 3.9
Polypharmacy (≥5 drugs, %)	71 (49%)	61 (37%)	132 (42.6%)
Comorbidities (≥1, %)	102 (70.3%)	96 (58.2%)	198 (63.9%)

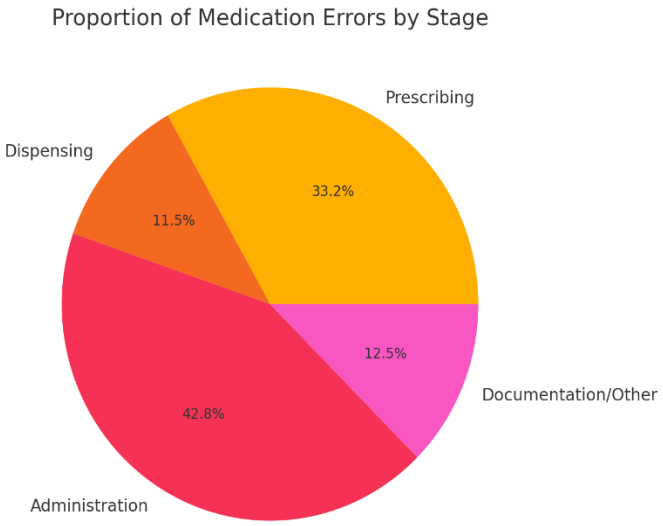
Table 3. Distribution of Medication Error Types (n = 310)

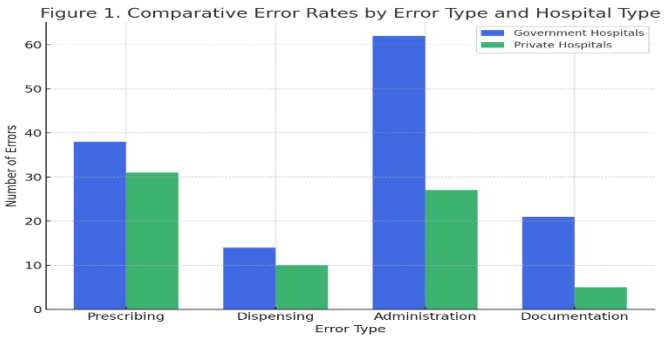
Error Type	**Government Hospitals (n=145)**	**Private Hospitals (n=165)**	**Total (n=310)**
Prescribing	38	31	69
Dispensing	14	10	24

Administration	62	27	89
Documentation/Other	21	5	26
Total Errors	**135**	**73**	**191**

Table 4. Predictors of Medication Errors (Logistic Regression Analysis)

Predictor	**Adjusted OR**	**95% CI**	**p-value**
Polypharmacy (≥5 drugs)	2.45	1.67–3.61	<0.001
Hospital Stay (≥7 days)	1.78	1.11–2.87	0.017
Age (≥60 years)	1.21	0.79–1.85	0.36
Comorbidity (≥1)	1.10	0.71–1.69	0.52





DISCUSSION:

The findings of this study provide a comprehensive overview of medication errors across government and private hospitals in the Islamabad–Rawalpindi region, illustrating both the magnitude of the issue and the systemic differences that contribute to patient-safety risks. The overall medication error rate of approximately 14.9% observed in this study corresponds with internationally reported ranges for hospital-based care, underscoring that medication errors remain a significant and persistent global challenge in healthcare delivery (18). Similar to global data, the majority of errors occurred during the administration stage, followed by prescribing and dispensing errors, reaffirming that medication administration remains the most error-prone phase within hospital settings (19). The predominance of administration errors, particularly wrong-time dosing, closely mirrors findings from prior hospital-based studies in both high-income and developing countries. A large systematic review identified timing deviations and dosing inaccuracies as the most frequent categories of administration-stage errors in inpatient care (20). Likewise, a recent study in Pakistan found that nearly half of all medication errors occurred during drug administration, primarily due to incorrect timing and lack of staff supervision. The recurrent pattern of administration-phase vulnerability suggests that systemic workflow issues such as high nurse-to-patient ratios, manual record-keeping, and lack of electronic monitoring systems remain common across institutions.

The significant difference between government and private hospitals in this study with higher error prevalence in government facilities aligns with prior research highlighting structural disparities between public and private healthcare sectors in South Asia. Public hospitals

typically face higher patient loads, resource constraints, and documentation challenges, all of which can increase the likelihood of medication errors. In contrast, private hospitals, while generally better resourced, may experience prescribing-related errors due to frequent physician changes, use of branded drugs, or reliance on handwritten prescriptions. This observed divergence highlights how institutional context, rather than individual professional performance, often dictates safety outcomes. The identification of polypharmacy and longer hospital stay as independent predictors of error occurrence reinforces established evidence linking medication complexity and patient exposure time with increased risk. Previous research has consistently reported that patients on five or more drugs, especially those with chronic or comorbid conditions, are at heightened risk for both prescribing and administration errors. Similarly, extended hospitalization increases cumulative medication exposure, thereby amplifying opportunities for error. In this study, patients with prolonged stays had almost twice the odds of experiencing at least one medication error, emphasizing the importance of targeted review systems for long-term inpatients.

The finding that most administration errors occurred during night shifts reflects a known risk pattern associated with fatigue, reduced supervision, and shift-related staffing pressures. Studies in multiple hospital settings have demonstrated a disproportionate concentration of medication errors during evening and night hours, linked to cognitive fatigue and under-staffing (21). Addressing this pattern through optimized scheduling, double-check procedures, and adequate rest breaks could significantly mitigate error occurrence. The study's implications extend beyond descriptive epidemiology. By identifying administration as the most vulnerable stage and highlighting institutional and human-factor determinants, the results suggest multiple avenues for intervention. Hospitals could introduce structured medication-safety training, employ electronic prescribing and bar-coding systems, and implement cross-checking protocols for high-alert drugs. Comparative data between hospital types also provide policymakers with a foundation for targeted quality-improvement programs in public-sector facilities, where error rates and documentation gaps appear greatest.

The strengths of this study lie in its comprehensive inclusion of both government and private hospitals, multi-stage assessment (prescribing, dispensing, administration, documentation), and use of validated tools with interrater reliability checks, enhancing methodological rigor. However, several limitations are acknowledged. The cross-sectional design precludes causal inference and may underestimate unreported or undocumented errors. The sampling frame, limited to select tertiary-care hospitals, may restrict generalizability to smaller or rural healthcare settings. The study also did not quantify clinical consequences (such as adverse drug events or patient outcomes), which limits interpretation of the actual harm associated with errors. Finally, contextual factors such as staff workload, use of digital tools, and institutional culture were not systematically evaluated, though these likely influenced observed differences. Future studies should adopt prospective multicenter designs, integrate automated error-detection systems, and assess clinical outcomes related to medication errors. Mixed-methods research incorporating qualitative interviews with healthcare professionals would yield valuable insights into behavioral and organizational contributors. Moreover, intervention-based research particularly involving electronic health records and clinical decision-support systems could evaluate the effectiveness of system-level strategies in reducing errors. The study underscores that medication errors remain a widespread issue in both government and private hospitals of Islamabad and Rawalpindi, with administration errors predominating and polypharmacy emerging as a key risk factor. Institutional differences underscore the role of systemic structures in shaping safety outcomes. Strengthening staff training, optimizing workflow systems, and implementing digital safety interventions are essential steps toward minimizing avoidable harm and improving patient safety across all hospital settings.

CONCLUSION:

This study demonstrated that medication errors remain a significant concern in both government and private hospitals of Islamabad and Rawalpindi, with administration-stage errors being the most frequent and government facilities showing higher overall error rates. Polypharmacy, prolonged hospital stay, and night-shift administration emerged as key predictors of error occurrence. These findings emphasize the urgent need for structured medication safety policies, enhanced staff training, and system-based interventions such as electronic prescribing and monitoring tools to strengthen patient safety and reduce preventable harm in hospital settings.

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AUTHORS CONTRIBUTION

Author	Contribution
Mohsin Raza	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Dr Saqlain Abbass	Methodology, Investigation, Data Curation, Writing - Review & Editing

