

Research Article

Evaluation of Medication Errors among Chronic Kidney Disease Patients in a Tertiary Care Hospital

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A B S T R A C T

Introduction: Chronic kidney disease (CKD) remains a major global health concern, with its rising prevalence closely linked to an ageing population and the growing incidence of diabetes and hypertension. Patients with CKD are particularly vulnerable to medication errors due to the complexity of their treatment regimens and the need for dosage adjustments based on renal function. These errors may occur at any stage of the medication use process—including prescribing, transcribing, dispensing, administering, and monitoring—and can result in hospitalisations, accelerated disease progression, or even death.

Methodology: An observational study was conducted over three years in a tertiary care hospital. Adult inpatients (18 years or older) diagnosed with any stage of CKD, receiving at least one prescribed medication, and providing informed consent were enrolled in the study.

Results: Medication errors were categorised using the National Coordinating Council for Medication Error Reporting and Prevention (NCC-MERP) classification system. Out of 136 identified errors, 46 occurred during the prescribing stage, 59 during transcription, and 31 during medication administration. The data also revealed a higher incidence of errors among older patients, those with multiple comorbidities, and individuals with advanced stages of CKD, emphasising the need for enhanced vigilance in these subgroups.

Conclusion: Targeted interventions focusing on high-risk patients—particularly the elderly and those with complex health profiles—are essential for reducing medication errors and enhancing overall patient safety in CKD care.

Keywords: Medication Error, Chronic Kidney Disease, NCC-MERP, Patient Safety, Pharmacovigilance

Introduction

Chronic kidney disease (CKD) represents a prominent global health challenge, particularly in low- and middle-income developing countries. Its rising prevalence is primarily attributed to an ageing population and the upsurge in incidence of diabetes and hypertension.¹⁻³ To manage renal impairment and its associated comorbid conditions, patients are often prescribed complex medication regimens. However, diminished kidney function can alter the pharmacokinetics of drugs thereby affecting their absorption, distribution, metabolism, and excretion. This increases the likelihood of adverse drug reactions, toxicity, and suboptimal outcomes.^{4,5} The situation is further complicated by common occurrences of polypharmacy, reduced renal clearance, and the need for careful dose adjustments based on kidney function. As a result, this patient population is particularly vulnerable to medication errors, which can occur at any point in the therapy process, including prescribing, dispensing, and administering medicines. Such errors may lead to hospital admissions, rapid disease progression, or even mortality.⁶ Despite heightened awareness, medication errors often remain underreported and underestimated. This study aims to prospectively monitor and document medication errors in patients with kidney damage and to investigate the contributing factors.

Study Methodology

This research was designed as an observational study conducted over a three-year period (2020-2023) at SAL hospital and Medical Institute, a tertiary care hospital at Ahmedabad city, following approval from the hospital's ethics committee.

Inclusion Criteria

The study included adult patients (≥ 18 years) diagnosed with any stage of kidney disease, who were admitted to the hospital, prescribed at least one medication, and who provided informed consent.

Exclusion Criteria

Patients were excluded if they were in critical stages, or were expected to be discharged within 24 hours, or were unwilling to provide consent.

Sample Size

The total sample size of the study population was 384 patients. The study distinguished drug related problems (DRP's) and medication error and therefore both were reported separately. A total of 136 medication errors were reported among the 384 patients in a duration of 3 years.

Data Analysis

The results obtained were analysed using MS Excel and are presented as numbers and percentages.

Classification of Medication Errors

Medication errors identified during the study were categorised using the NCC-MERP (National Coordinating Council for Medication Error Reporting and Prevention) classification system. According to this system, "the classification of errors into categories A to I is as follows:

- **Category A:** Circumstances with the potential to cause an error
- **Category B:** An error occurred, but did not reach the patient.
- **Category C:** The error reached the patient but caused no harm.
- **Category D:** The error required increased patient monitoring but resulted in no harm.
- **Category E:** The error necessitated treatment or intervention and caused temporary harm.
- **Category F:** The error led to initial or extended hospitalisation with temporary harm.
- **Category G:** The error caused permanent harm.
- **Category H:** The error required intervention to prevent death or resulted in a near-death event (e.g., cardiac arrest, anaphylaxis).
- **Category I:** The error led to the patient's death⁷.

Results

In a comprehensive analysis of a total of 136 identified errors, the breakdown revealed that 46 errors originated from the prescribing phase, 59 were attributed to transcribing, and 31 were linked to the administration of medications (Figure 1).

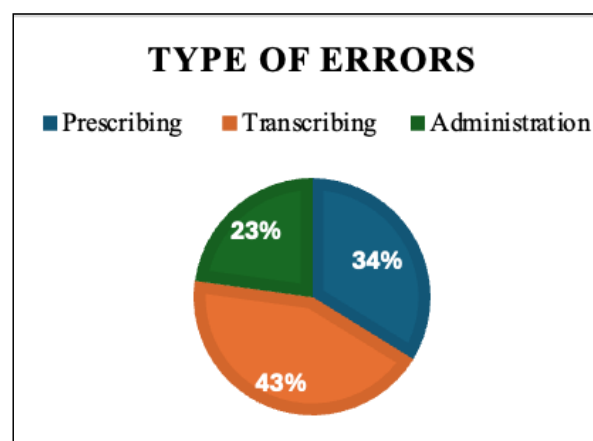


Figure 1. Types of Medication Errors Reported in the Study Population

Utilising the NCC-MERP classification system, it was seen that the majority of these errors fell into category B, accounting for 71 instances or 52.2% of the total. This was followed by category E, which comprised 21 errors, representing 15.4%, and category F, with 15 errors, accounting for 11.02%. Notably, there were 93 potential scenarios where errors could have occurred without resulting in any harm to patients. However, the data also highlighted that 43 errors did lead to patient harm, underscoring the critical need for improved practices in medication management to enhance patient safety (Figure 2).

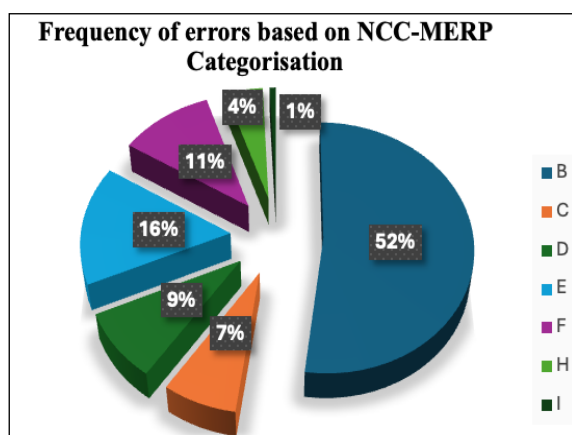


Figure 2. Classification of Errors as per the Categories Based on NCC-MERP Categorisation

Among individuals under 60 years, 47.8% of errors were associated with prescribing medicines, while this figure rose to 52.2% for those over 60. The age group of 60 years was added together with the subjects above 60 as they were classified as older adults and carried the risk of polypharmacy which is a main risk factor for medication errors. Gender differences were notable, with males comprising 69.56% of prescribing errors compared to 30.43% for females. In terms of comorbidities, those with multiple conditions represented 60.86% of prescribing errors, indicating a significant correlation between the number of comorbidities and prescribing errors. Furthermore, the CKD stages revealed that the majority of prescribing errors (39.13%) were for patients in stage V-NDD (stage 5 Non-Dialysis Dependent), while stage V-DD (stage 5 Dialysis Dependent) accounted for 32.60%. This data underscores the complexities in medication management across different demographics and health conditions.

Transcribing errors showed a trend non-similar to prescribing errors. In terms of age, individuals under 60 years accounted for 31 cases (52.5%), while those over 60 represented 28 cases (47.4%). Regarding gender, males

comprised a significant majority with 47 cases (79.66%), whereas females accounted for 12 cases (20.33%). When examining comorbidities, 12 cases (20.33%) had a single comorbidity, 24 (40.67%) had two, and 23 (38.98%) had multiple comorbidities. Lastly, the distribution of CKD stages revealed that stage III had 1 case (1.69%), stage IV had 12 cases (20.33%), stage V without dialysis (NDD) had 21 cases (35.59%), and stage V with dialysis (DD) had 25 cases (42.37%).

In the context of errors related to administration, the age distribution revealed that 13 errors, accounting for 41.9%, were under the age of 60 years, while 18 errors, representing 58.06%, were over 60. Gender representation showed a fairly balanced distribution, with 15 males (48.38%) and 16 females (51.61%). Regarding comorbidities, the data indicated that 3 errors (9.67%) were reported in patients with a single comorbidity, 9 (29.03%) had two comorbidities, and a significant majority of 19 errors (61.29%) were present in patients with multiple comorbidities. When examining the stages of CKD, it was noted that there were no errors reported in stage III, one (3.22%) in stage IV, a predominant 28 errors (90.32%) in stage V-NDD, and 2 errors (6.45%) in stage V-DD (Figures 3–6).

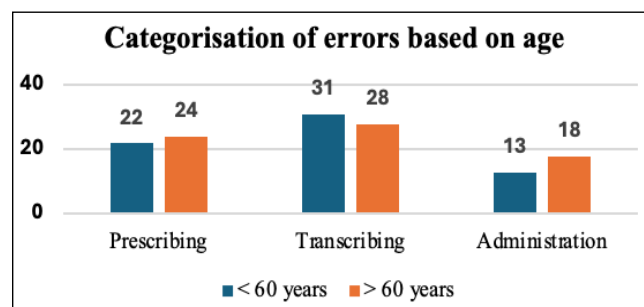


Figure 3. Comparison of Age and Medication Errors in the Study Population. The age group of 60 years were included along with > 60 age group

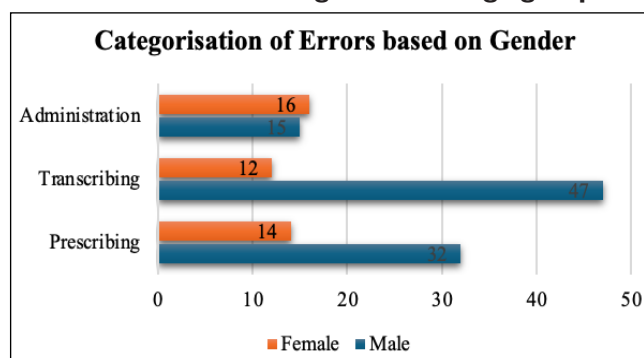


Figure 4. Comparison of Gender and Medication Errors in the Study Population

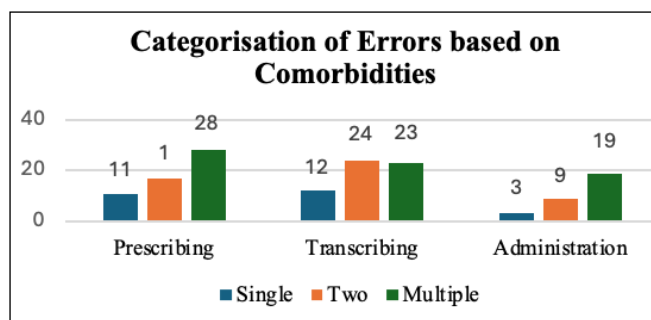


Figure 5. Comparison of Number of Comorbidities and Medication Errors in the Study Population

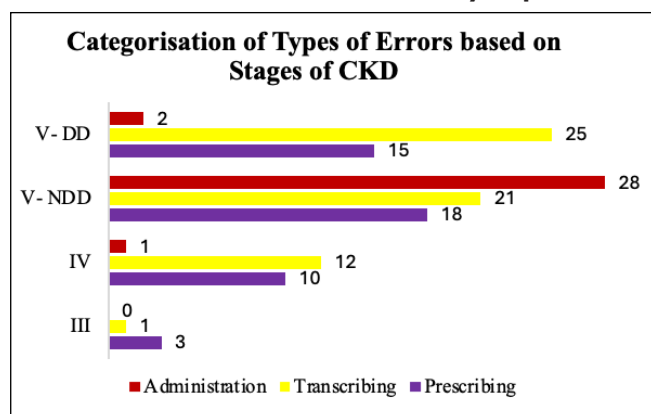


Figure 6. Comparison of Stages of CKD and Medication Errors in the Study Population. The stages of CKD are classified stage III-stage V. DD indicates dialysis dependant and NDD indicates non dialysis dependant

Discussion

The present study provides serious insights into the nature of errors occurring through three different scenarios of a clinical setting i.e. prescribing, transcribing and administration. The findings of the study revealed 46 errors occurring in prescribing, 59 in transcribing, and 31 in administration. This highlights the fact that medication errors are not confined to a single stage, rather constitute a system-based issue that revolves around the entire drug utilisation process. This finding aligns with existing literature that highlights the multifaceted nature of medication errors and the importance of adopting a systems-based approach to prevention.⁸⁻¹⁰

The gravity of these errors, according to the NCC-MERP system, emphasises the likelihood of severe harm to patients. A significant portion of potential errors was prevented, as evidenced by the 52.2% of errors that fell into Category B. However, the clinical significance of these errors is highlighted by the 15.4% of errors falling in Category E and 11.02% in Category F. Notably, 43 mistakes led to patient injury, highlighting the critical need for effective error prevention measures. Our results are consistent with studies from different parts of India that highlight

the importance of prescription and transcription errors. According to a study conducted at a multispecialty hospital in Western India, transcription errors accounted for 24% of errors, and prescription errors for 53%. Similarly, a study conducted in Mandya, Karnataka, showed that the most frequent errors were prescription errors (51.4%), followed by transcription errors (39.1%).^{11,12} These pieces of evidence point out that interventions that focus on the prescribing and transcribing phases alone may substantially reduce medication errors.

Significant demographic and clinical associations can be seen in the prescribing error data. Prescribing errors are more common among people over 60 (52.2%) than among those under 60 (47.8%), which may be due to the higher incidences of polypharmacy and comorbidities in this age group, which are known to make drug management more challenging. The predominant male proportion in prescribing errors (69.56%) compared to females (30.43%) is a notable finding that warrants further investigation to explore if there is an involvement of any potential contributing factors. Although different from prescribing errors, transcribing errors also show alarming patterns. Transcribing errors were marginally more common in patients under 60 (52.5%) than in those over 60 (47.4%), in comparison with prescribing errors. This could imply that transcribing errors may be caused by things like poor communication, inexperience, or the intricacy of younger patients' drug schedules. Males make up the vast majority of transcribing errors (79.66%) compared to females (20.33%), which is consistent with the trend in prescribing errors and calls for further study. This pattern is in line with research from a public teaching hospital in India that found that the highest percentage of medication error (69.1%) occurred in patients over 60 years of age.^{13,14}

The fact that managing patients with complex health issues increases the likelihood of prescribing errors is reinforced by the substantial correlation (60.86%) between multiple comorbidities and prescribing errors. A high rate of prescribing errors among CKD patients, especially those in stages V-NDD (39.13%) and V-DD (32.60%), emphasises how difficult it is to handle treatments in this susceptible group. The pharmacokinetics of drugs are greatly impacted by renal impairment, indicating the need for judicious dosage adjustments and error-prevention monitoring.

Comorbidities and transcribing errors have a different association than prescribing errors. Transcribing errors were more evenly distributed across comorbidity groups, with the highest frequency in patients with two comorbidities (40.67%), whereas prescribing errors increased as the number of comorbidities increased. This could suggest that transcribing errors are more likely to be caused by the sophisticated drug regimens than by the increase in the

number of comorbidities. There is also a difference between prescribing errors and transcribing errors in the distribution of CKD stages. Transcribing errors were most common in stage V-DD (42.37%), followed by stage VNDD (35.59%) and stage IV (20.33%), whereas prescribing errors were concentrated in stage V. As dialysis patients have complex medication regimens and demand regular modifications, the process of transcribing their medications may be highly error prone.

The higher prevalence of prescribing and transcribing errors in our study also highlights the need for targeted interventions, such as implementing electronic prescribing systems, enhancing the legibility of handwritten prescriptions, and providing regular training for healthcare professionals.¹⁵⁻¹⁹

Conclusion

This analysis offers important insights into the patterns and contributing factors of medication errors, emphasising the necessity of addressing mistakes throughout every phase of the medication use process. It also underscores the urgent need for effective strategies to minimise these errors. Prioritising high-risk groups i.e. particularly older adults and patients with multiple health conditions, is essential to enhance medication safety and protect vulnerable populations.

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