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MEDICATION ERRORS IN PATIENT HEALTHCARE: A COMPREHENSIVE REVIEW

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ABSTRACT

Medication errors are a major concern in primary healthcare, where most patients first receive medical attention. These errors can occur at different stages, including prescribing, dispensing, and administration of medicines. Common causes include lack of proper knowledge, heavy workload, poor communication, and limited resources. Such errors may lead to ineffective treatment, adverse drug reactions, increased healthcare costs, and harm to patients. This review and study aims to understand the types, causes, and impact of medication errors in primary healthcare settings. It also highlights the challenges faced by healthcare professionals in preventing these errors. Various studies show that prescribing errors are the most common, followed by dispensing and administration errors. Inadequate patient counselling and incomplete medical records further increase the risk. The review emphasizes the importance of improving awareness, training, and communication among healthcare providers. Simple strategies such as clear prescription writing, use of standard guidelines, patient education, and digital record systems can help reduce errors. Strengthening primary healthcare systems and promoting a culture of patient safety are essential steps toward minimizing medication errors and improving overall healthcare quality.

KEYWORDS: Medication Errors, Primary Healthcare, Patient Safety, Prescribing Errors, Error Prevention.

INTRODUCTION

A medication error refers to any preventable incident that could result in the incorrect use of medication or harm to a patient during the process of prescribing, dispensing, administering, or monitoring the drug. Such errors may occur because of shortcomings in professional practices, communication, handling of products, or systems within healthcare environments. Approximately 5% of patients worldwide experience medication errors, and 25% of these occurrences result in serious or potentially fatal illnesses. In high-acuity healthcare settings including surgical, intensive care, and emergency units, as well as in older populations, the frequency of these errors is significantly higher. Prescription errors can account for up to 80% of instances in low- and middle-income countries, with over half (53%) of pharmaceutical error-related injury occurring during the prescribing stage and 36% during the reporting stage. With 57.4% of occurrences occurring at the prescribing stage and 15.5% associated with wrong dosages, the African area has the

greatest rates of avoidable pharmaceutical error-related injury.[1,2]

Medication errors have a significant financial impact, costing healthcare systems an estimated US$42 billion yearly. They also cause 2 to 4 million cases of disability and over 400,000 deaths annually. Personal traits (e.g., lack of initiative, exhaustion), institutional structures (e.g., high patient flow, staff shortages), and professional problems (e.g., inadequate training, poor communication) are all contributing reasons to pharmaceutical errors. All of these factors highlight how difficult it is to administer medications in medical settings.[3]

The World Health Organization (WHO) introduced the pharmaceutical Without Harm framework in 2017 with the ambitious objective of halving severe patient harm over a five-year period in order to address the serious problem of pharmaceutical mistakes.[4] Sadly, just 21% of nations have made a commitment to particular goals meant to lessen the catastrophic effects of drug errors. The percentage of medicine administration errors among nurses varies from 28.93 to 89.9%, which is still a serious patient safety concern even though Ethiopia is a part of this worldwide movement.[5, 6]

Figure 1: WHO Strategic Framework on Medication Errors.[4]

CLASSIFICATION OF MEDICATION ERRORS

Prescribing Errors

Errors during the process of selecting or writing a medication order. Examples: wrong drug, incorrect dose, wrong frequency, incomplete instructions.

Transcription / Documentation Errors

Mistakes occurring when interpreting, rewriting, or entering medication orders. Examples: misreading handwritten orders, wrong dose entry.

Dispensing Errors

Errors made during preparation and supply of medication by the pharmacy. Examples: wrong medicine dispensed, incorrect label, wrong strength, look-alike/sound alike drug mix-ups.

Administration Errors

Errors occurring during the actual delivery of medication to the patient. Examples: wrong route, wrong time, wrong patient, wrong dose.

Monitoring Errors

Failure to assess the patient's therapy appropriately. Examples: not identifying adverse effects, missing dose adjustments in renal/hepatic impairment.

Compliance (Adherence) Errors

When patients do not follow the prescribed medication regimen. Examples: skipping doses, double dosing, stopping therapy early.

System/Process Errors
Errors caused by issues in healthcare systems. Examples: heavy workload, inadequate staffing, lack of protocols, poor communication.

CAUSES OF MEDICATION ERRORS
Medication errors may occur due to multiple interacting factors:

- Human Factors
- Environmental and System Factors
- Medication-Related Factors
- Communication Errors
- Patient-Related Factors

Table 1: Factors that are significantly associated with medication errors.[7-9]

Patient-Related Factors	Patient characteristics. Complexity of the clinical case.
Medication-Related Factors	The naming of medicines The labelling and packaging of medications
Healthcare professionals related factors	Insufficient training in therapy. Lack of experience and knowledge of drugs. Limited information of the understanding. Insufficient chance recognition. Overworked or exhausted experts. Physical and enthusiastic wellbeing issues. Ineffective communication inside and between healthcare suppliers and patients
Environmental and System Factors	High workload and time constraints Limited availability of resources Inadequate standardisation of protocols and procedures Disturbances and disruptions from both primary care staff and patients Issues with the workplace environment, like the light, temperature, and air flow.

POLYPHARMACY
Polypharmacy is generally defined as the regular use of multiple medications by a patient, typically five or more drugs. It often occurs in elderly individuals or patients with multiple chronic diseases.

Types of Polypharmacy

- Minor Polypharmacy: Use of 2–4 medications.
- Major Polypharmacy: Use of 5 or more medications (most common definition in research).
- Appropriate Polypharmacy: Use of multiple medicines that are all clinically necessary and beneficial.
- Inappropriate Polypharmacy: Use of unnecessary, duplicate, or high-risk medications without clear clinical benefit

Risks associated with Polypharmacy
Polypharmacy significantly increases the likelihood of:[10, 11]

- Medication Errors: More drugs → higher chance of drug mix-ups, wrong dose or incorrect combinations.
- Adverse Drug Reactions (ADRs): Increased drug interactions and toxicity.
- Drug–Drug and Drug–Food Interactions: Multiple medicines increase the risk of harmful interactions.
- Poor Medication Adherence: Difficult and complicated drug regimens reduce patient compliance.
- Increased Hospitalization: Due to ADRs, falls, confusion, and drug toxicity.
- Higher Healthcare Costs: Because of complications related to inappropriate medication use

MEDICATION ERRORS IN PRIMARY HEALTH CARE
Medication errors are a major challenge in primary health care settings, where most patients first access medical services. Primary care involves high patient volume, limited consultation time, and frequent management of chronic diseases—all of which increase the likelihood of errors. A medication error is defined as any preventable event that may lead to inappropriate medication use or harm to a patient while the medication is in the control of the healthcare professional, patient, or consumer. These errors may occur during prescribing, transcribing, dispensing, administration, or monitoring.[12]

In primary health centers (PHCs), prescribing errors—such as incorrect dose, incomplete instructions, illegible handwriting, or wrong drug selection—are among the most common types. Dispensing errors also occur due to inadequate staffing, insufficient pharmacist involvement, or misinterpretation of prescriptions. Administration errors are frequently observed when patients

misunderstand instructions, especially in rural and low-literacy populations. Because PHCs handle diverse health conditions with constrained resources, medication errors can significantly compromise patient safety, treatment outcomes, and overall quality of care.

IMPORTANCE OF PATIENT UNDERSTANDING IN MEDICATION USE

Patient understanding plays a crucial role in reducing medication errors, especially after the patient leaves the health facility. Many individuals, particularly in primary care settings, have limited health literacy. This creates challenges in interpreting complex medical terms, dosing schedules, and warnings. Misunderstanding instructions can lead to non-adherence, overdosing, under dosing, incorrect timing of therapy and harmful drug interactions.[6]

Improving patient understanding helps in

- Ensuring correct dose and timing
- Preventing duplication or omission of medication
- Reducing adverse drug reactions
- Enhancing adherence to long-term therapy for chronic illnesses
- Promoting safe self-medication practices
- Supporting better patient–provider communication

When patients clearly understand their treatment plan, the risk of avoidable medication related harm decreases significantly. Effective communication strategies are therefore essential to strengthen medication safety in primary care.

IMPACT OF MEDICATION ERRORS IN PEDIATRIC POPULATION

Six factors associated with medication errors (MEs) include: the medication reconstitution working environment, child weight, the qualifications of the medicine chairman, parental involvement in pharmaceutical organization preparation, adherence to medication organization regulations, the duration of hospital stay, and dosage and administration errors.[13]

Mitigation measures to reduce medication errors (ME) in the pediatric population include enhancing patient education through pharmacists, who should develop individualized approaches to convey information about medications. Implementing electronic prescribing systems has shown significant benefits in reducing medication errors, particularly for pediatric patients reliant on weight-based dosing. This involves healthcare professionals initiating treatments with weight-based dosages, utilizing algorithms to identify appropriate drug strengths and dosing schedules. Additionally, empowering clinical trials to facilitate the approval of medications for pediatric use can help bridge the gap between drug approval and prescribing practices.[14, 15]

IMPACT OF MEDICATION ERRORS IN GERIATRIC POPULATION

Polypharmacy among the elderly is influenced by factors such as self-medication with over-the-counter drugs, an increase in comorbidities necessitating more medications, and the appeal of new treatments. Patients often consult multiple physicians, leading to a lack of therapeutic reconciliation. Additionally, the concurrent use of alternative therapies like Ayurveda and herbal medicines contributes to the polypharmacy issue.

Polypharmacy is associated with various negative outcomes, such as frailty, falls, and increased mortality. The concurrent use of multiple medications raises the risk of adverse drug events, particularly in the elderly population, where the chance of falls and fractures is heightened due to numerous medications and potential altered mental states. Additionally, polypharmacy can increase the risk of renal damage in older adults.[16]

Healthcare professionals can improve awareness of the importance of medication review to mitigate the risks associated with inappropriate polypharmacy in geriatric populations. Strategies such as mandatory education on safe medication management in medical schools and understanding the human factors affecting polypharmacy can enhance patient interactions and promote shared decision-making. Improving medication control and adherence is vital, and methodologies must be explored to ensure the correct medication is taken at the right times. Various medication adherence tools, like pill dispensers, show promising results for the elderly. Efforts are also directed towards reducing crosspathy, the combination of allopathic and traditional Indian medicines, which increases the risk of drug interactions due to self-medication practices. Furthermore, self-medication among the elderly, often driven by factors like high treatment costs and limited insurance coverage, is a significant concern that requires attention.[17]

MULTICOMPONENT INTERVENTIONS FOR AVOIDING MEDICATION ERROR

National patient safety is integral to healthcare, defined as the absence of preventable injury or harm during care delivery. It is a key dimension of quality care, which also encompasses accessibility, acceptability, effectiveness, efficiency, and patient-centeredness. Essential elements of patient safety include the secure management of medical devices, blood transfusions, injections, childbirth, surgeries, and the safe transportation and donation of organs, tissues, and cells. Monitoring systems are in place to assess adverse events, such as the Pharmacovigilance Program of India (PVPI) and the Adverse Events Following Immunization (AEFI), aiming to evaluate the overall impact of inadequate healthcare practices in the country.

Patient safety incident surveillance systems for adverse events and near-misses exist at national and sub-national levels, but they are limited to specific occurrences like

needlestick injuries, pharmacovigilance, haemovigilance, and death audits. Currently, root cause analysis is conducted for certain events, including maternal deaths, neonatal deaths, and Adverse Events Following Immunization (AEFI), but there is no comprehensive analysis across all diseases or conditions. Furthermore, a lack of regulatory oversight results in inconsistent adherence to standards among institutions.[18]

Strategies for preventing medication errors

- Uphold the drug administration's five rights.
- Employ appropriate procedures for medication reconciliation.
- Verify processes two or three times.
- Request that the doctor or another nurse read the prescription back.

Strategies for monitoring and evaluating Medication Errors

(a) Reporting Culture

One effective method for identifying potential medical errors is the implementation of a medical error reporting system. Challenges arise as some healthcare professionals may avoid reporting due to lack of management support, an unsupportive work environment, time constraints, or misunderstanding of the situation. Mandatory reporting could result in legal repercussions and damage the doctor-patient relationship, leading to "defensive medicine" practices. Voluntary reporting, on the other hand, is advocated for enhancing medical education and fostering a safety culture, and evidence suggests that participation in such systems has notable benefits. Research indicates that incidence reporting systems have successfully reduced events in aviation, implying a similar effect could occur in healthcare settings. Currently, medical error reporting systems exist as mandatory or optional. Notable models include NASA's anonymous Aviation Safety Report System (ASRS) and its adaptations, such as the Veterans Administration Patient Safety Reporting System (PSRS), the Institute for Safe Medical Practice (ISMP) for medical error documentation, and Data Watch, developed by the US FDA to track adverse events related to medications and therapeutic devices.[19,-21]

(b) Analysis of Medication Error Reports

National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) has developed a medication error taxonomy tool aimed at assisting healthcare providers and organizations in the systematic and logical description, tracking, and analysis of medication errors. This taxonomy serves two primary purposes: building a pharmaceutical error database and creating a reporting form for error collection. Healthcare organizations are encouraged to implement procedures and systems that facilitate the gathering of necessary information to identify and swiftly report drug errors.[22]

Recommendations to Improve Medication Errors Reporting Systems

All medical facilities should implement strategies to prevent medication errors, which includes assessing past and potential errors to proactively eliminate risks. A key strategy is medication reconciliation, defined as aligning a patient's medication list with their doctor's instructions during admission, transfer, and discharge to ensure correct prescriptions throughout hospitalization. The World Health Organization emphasizes the vital role of pharmacists in this process, which includes developing patient-centered procedures, educating healthcare professionals and patients, advocating for patient rights during transitions, and creating policies that integrate medication reconciliation into healthcare workflows. Additionally, medication reviews, either daily or multidisciplinary, are essential for determining the appropriateness of continued therapies.

POTENTIAL SOLUTIONS

Education of health care providers and patient

The majority of pharmaceuticals continue to be prescribed by doctors, although there is an increasing trend of nurses and pharmacists taking on prescription responsibilities. Many medical students and junior doctors believe that the prescription training offered in medical schools is inadequate. Notably, participation in an online course has been shown to enhance doctors' understanding of geriatric prescription compared to those who did not participate.[23]

Electronic prescribing systems

Research indicates that certain measures significantly reduce drug errors, especially in pediatric patients, where weight-based prescribing regulations are critical. Over the last 15 years, extensive research has focused on the impact of computerized prescriber order entry (CPOE) systems on prescription errors. However, a recent systematic review indicates insufficient data to validate CPOE systems as reliable methods for decreasing prescription errors. The review cites limitations such as small sample sizes and inadequate study designs, which undermine the evidence supporting the effectiveness of CPOE in this context.[22]

Personal health records (PHR)

It emphasizes the empowerment of patients in managing their own healthcare through the use of Personal Health Records (PHRs), defined as computer-based tools that enable access to and coordination of lifelong health information. Patients may still opt to maintain paper records and can update and exchange pharmaceutical information with their physicians. To prevent pharmaceutical errors, the text advocates for preserving the five rights of drug delivery and advises meticulous medication reconciliation procedures, including verifying processes multiple times and seeking additional confirmation from healthcare professionals.[24]

CONCLUSION

Due to a lack of clinical pharmacists and insufficient patient and drug counseling, medication errors are common in rural India. Unwanted side effects, poor medication outcomes, and problems with patient compliance result from this. The lack of skilled healthcare workers is a major contributing issue. Clinical pharmacists are crucial for keeping up with current drug availability and avoiding side effects or contraindications. Instead of placing blame, the healthcare system should place a higher priority on methods for recording and averting mistakes in the future.

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