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Medication Errors Among Healthcare Professionals: Evidence from Systematic Reviews and Meta-Analyses

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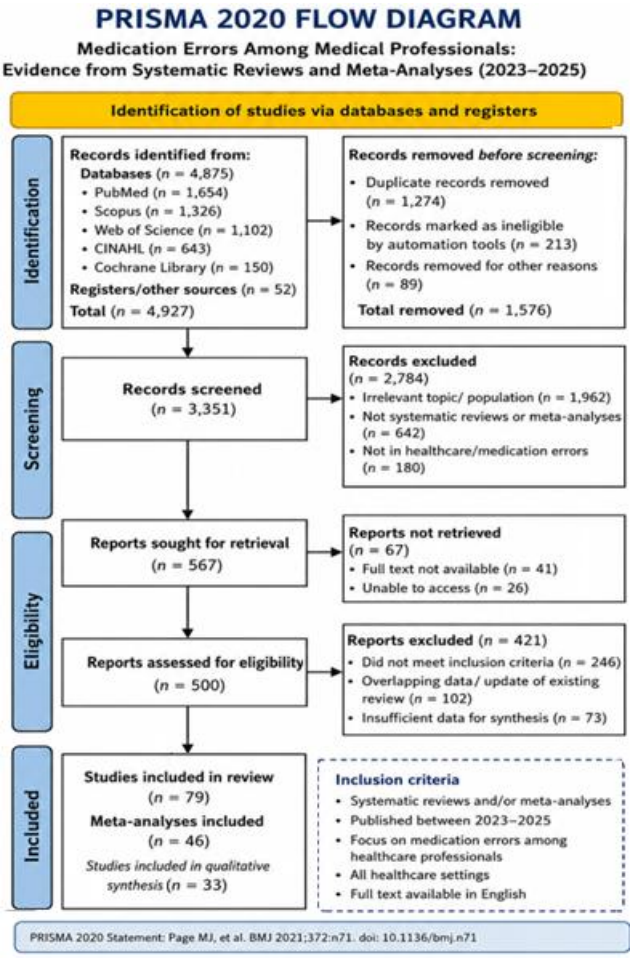
Abstract: ***Background**: Medication errors remain a significant global patient safety concern and contribute substantially to preventable morbidity, mortality, and healthcare costs. **Objective**: The purpose of this review is to summarize recent evidence from systematic reviews and meta-analyses regarding the prevalence, contributing factors, and prevention strategies associated with medication errors among healthcare professionals. **Methods**: A narrative review of recent systematic reviews and meta-analyses published between 2023 and 2025 was conducted. Relevant literature addressing medication errors among nurses, physicians, pharmacists, and other healthcare professionals across various clinical settings was analyzed. **Results**: Healthcare professionals, including nurses, physicians, and pharmacists, are frequently exposed to factors that increase the likelihood of medication-related errors, such as heavy workload, communication failures, inadequate staffing, fatigue, and system-related deficiencies. Recent systematic reviews and meta-analyses have explored the prevalence, causes, and contributing factors associated with medication errors across different healthcare settings. Evidence indicates that medication errors are especially common in intensive care units, emergency departments, paediatric care, and among nursing professionals. Technological interventions, standardized protocols, medication safety education, and non-punitive reporting systems have demonstrated effectiveness in reducing medication-related harm. **Conclusion**: This review summarizes recent evidence from systematic reviews and meta-analyses published between 2023 and 2025 regarding medication errors among healthcare professionals and highlights evidence-based strategies for improving medication safety.*

Keywords: medication errors; patient safety; healthcare professionals; nursing; systematic review; meta-analysis

1. Introduction

Medication errors are recognized as a major challenge to patient safety worldwide. These preventable events may occur during prescribing, transcribing, dispensing, administration, or monitoring of medications and can result in adverse drug reactions, prolonged hospitalization, disability, and death. The World Health Organization (2024) identified medication-related harm as one of the leading causes of preventable patient injury globally.

Healthcare professionals work in increasingly complex clinical environments characterized by high patient acuity, polypharmacy, technological dependence, staff shortages, and heavy workload. Such conditions significantly increase the likelihood of medication-related incidents. Recent systematic reviews and meta-analyses have provided updated evidence regarding the prevalence and causes of medication errors among healthcare professionals. Understanding these findings is essential for developing targeted interventions and improving healthcare quality and patient safety.



Medication Errors Among Nurses

Nurses play a central role in medication preparation, administration, and patient monitoring, making them particularly vulnerable to medication-related errors. A

systematic review and meta-analysis conducted by Fathizadeh et al. (2024) evaluated medication errors among nurses and reported a pooled prevalence of approximately 54%. The most frequently reported errors included incorrect timing, wrong dosage, and omission errors.

The study identified heavy workload, fatigue, nursing shortages, shift work, and inadequate staffing as major contributing factors. Underreporting of medication incidents was also common because of fear of punishment, blame culture, and lack of supportive reporting systems. These findings highlight the importance of supportive organizational policies and continuous professional education to improve medication safety.

Medication Errors in Intensive Care Units

Medication administration in intensive care units (ICUs) is particularly complex because critically ill patients often require multiple high-risk medications, continuous infusions, and rapid dose adjustments. A systematic review by Marznaki et al. (2023) found that dosage errors and administration-related mistakes were the most common medication errors among intensive care nurses.

Several factors contributing to medication errors in ICU settings were identified:

- Stressful working conditions
- Frequent interruptions during medication preparation
- High patient acuity
- Complex medication calculations
- Fatigue and burnout
- Inadequate nurse-to-patient ratios

The review emphasized the importance of continuous nursing education, medication safety training, and technological support systems in reducing medication-related harm in intensive care settings.

Medication Errors in Emergency Departments

Emergency departments are considered high-risk environments for medication errors because healthcare professionals are required to make rapid clinical decisions under significant time pressure. A systematic review and meta-analysis conducted by Nguyen et al. (2024) reported that the pooled prevalence of medication errors in emergency departments was approximately 22.6%.

Common contributing factors included:

- Overcrowding
- Communication failures
- Time constraints
- Incomplete medication histories
- Interruptions during medication preparation
- High patient turnover

Most reported errors were categorized as no-harm or low-severity incidents; however, potentially harmful events were also identified. The findings emphasize the need for effective communication strategies, medication reconciliation processes, and improved staffing support in emergency care settings.

Dispensing Errors Among Pharmacists

Dispensing errors remain an important issue in both hospital and community pharmacy practice. A systematic review and meta-analysis by Um et al. (2024) evaluated dispensing error rates across pharmacy settings and found that incorrect medication dispensing, labelling errors, and wrong dosage strength were among the most common errors.

The review identified several associated factors:

- High prescription workload
- Similar medication packaging and labelling
- Inadequate staffing
- Interruptions during dispensing
- Absence of barcode verification systems
- Inadequate double-checking procedures

Implementation of automated dispensing systems, barcode medication verification, and standardized checking procedures significantly reduced dispensing error rates and improved patient safety.

Medication Errors in Paediatric and Neonatal Care

Paediatric and neonatal patients are highly vulnerable to medication errors because drug dosages are frequently individualized according to body weight, age, and developmental status. Recent systematic reviews have demonstrated that dosage miscalculations and infusion pump programming errors are major causes of medication-related harm in neonatal intensive care units.

The literature emphasizes the importance of:

- Standardized dosing protocols
- Smart infusion pumps
- Paediatric medication safety education
- Clinical decision support systems
- Weight-based medication calculation tools

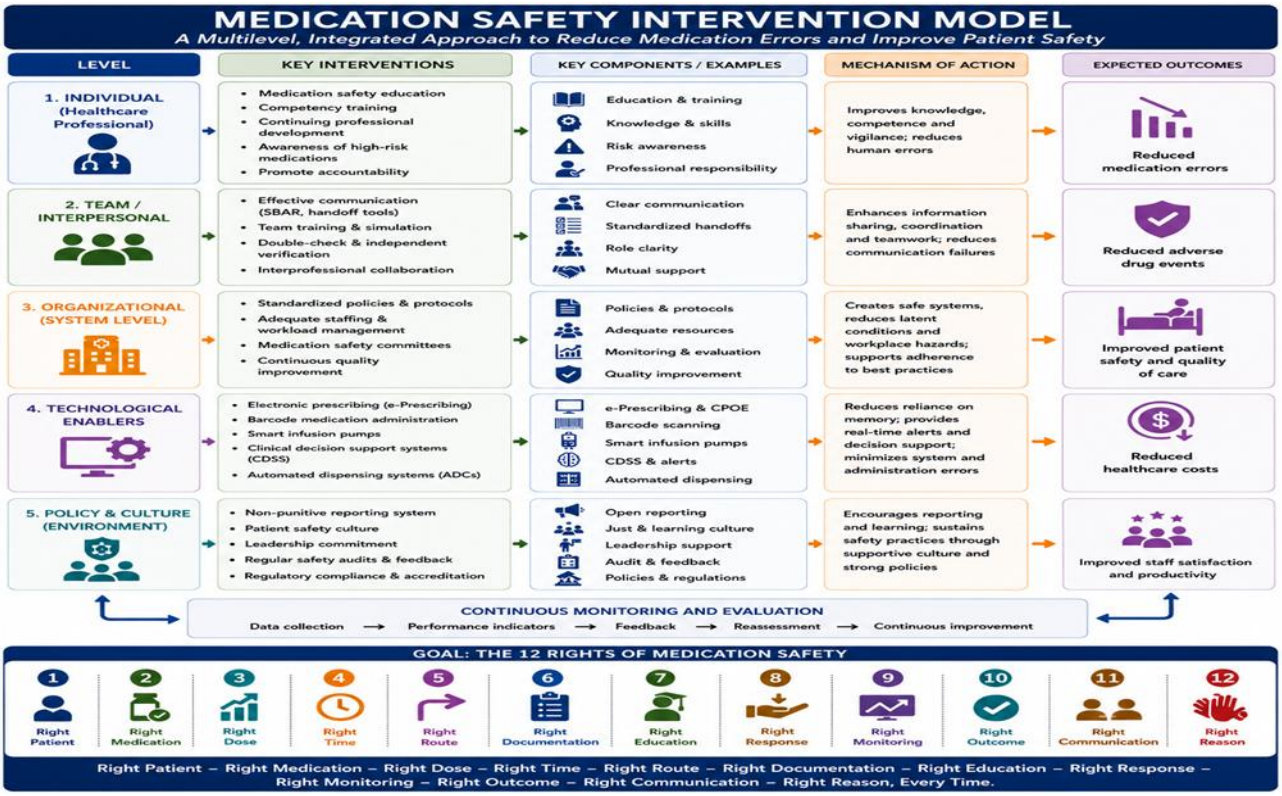
These interventions have demonstrated effectiveness in reducing paediatric medication errors and improving medication safety outcomes.

Organizational Factors Associated with Medication Errors

Recent meta-analyses consistently demonstrate that medication errors are influenced by both individual and system-level factors. Common organizational contributors include:

- Inadequate staffing
- Long working hours
- Burnout and fatigue
- Lack of supervision
- Poor communication systems
- Inadequate medication safety training
- Non-supportive organizational culture
- Excessive workload and time pressure

Studies suggest that healthcare professionals working in stressful and understaffed environments are more likely to commit medication-related errors. Therefore, organizational reforms and workforce support strategies are essential components of medication safety improvement.



Technological Interventions for Medication Safety

Technological advancements have significantly improved medication safety within healthcare systems. Recent literature strongly supports the use of:

- Electronic prescribing systems
- Barcode medication administration
- Smart infusion pumps
- Automated dispensing cabinets
- Clinical decision support systems
- Artificial intelligence-based medication safety systems

Artificial intelligence-assisted systems are emerging as promising tools for identifying high-risk medication events, predicting adverse drug reactions, and supporting clinical decision-making before patient harm occurs. Integration of these technologies into healthcare systems may substantially reduce medication-related incidents in the future.

Reporting Culture and Patient Safety

Underreporting remains a major barrier to medication safety improvement worldwide. Fear of punishment, blame culture, professional stigma, and legal concerns discourage healthcare professionals from reporting medication incidents.

Recent systematic reviews recommend the following strategies:

- Establishment of non-punitive reporting systems
- Promotion of a strong patient safety culture
- Continuous professional education
- Interdisciplinary communication training
- Leadership support for incident reporting

These interventions improve transparency, encourage reporting of near misses, and facilitate organizational learning from medication-related incidents.

2. Conclusion

Recent systematic reviews and meta-analyses demonstrate that medication errors remain a widespread and preventable problem among healthcare professionals worldwide. Nurses, physicians, pharmacists, and emergency care providers are all vulnerable to medication-related errors because of increasing workload, communication failures, fatigue, and system-related deficiencies.

Medication errors are especially common in intensive care units, emergency departments, and paediatric settings. Current evidence suggests that technological interventions, standardized medication protocols, staff education, supportive organizational cultures, and non-punitive reporting systems are effective strategies for reducing medication-related harm and improving patient safety.

Future research should focus on multicentre studies, implementation of artificial intelligence-assisted medication safety systems, and development of global medication error reporting standards to strengthen medication safety practices across healthcare settings.

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