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Critical Illness & Medication Errors

Parmee Gala[1], Darshana Rathod[2], Mayur Patel[2]

[1]Central Hospital Pharmacy Operations, Tata 1mg Healthcare Pvt. Ltd., Mumbai, India
[2]Department of Critical Care Medicine, Sir HN Reliance Foundation Hospital, Mumbai, India

Corresponding Author: Parmee Gala

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ABSTRACT

Medication errors (MEs) in critically ill patients are a significant concern, posing serious risks to patient safety, healthcare costs, and patient outcomes. Despite advances in medical technology and scientific knowledge, MEs remain prevalent due to complex processes involved in the medication use system. These errors can occur at various stages, including prescription, preparation, administration, and monitoring, with the highest frequency noted during administration. Factors contributing to MEs in critical care settings include patient-related variables such as illness severity, age, and prolonged hospital stays, as well as medication-related issues like polypharmacy and drug interactions. Additionally, critical care environments with high-stress conditions, multidisciplinary teams, and challenging working hours exacerbate the risk of errors.

The repercussions of MEs are far-reaching, leading to increased morbidity, mortality, and substantial healthcare costs. Preventing these errors requires a concerted effort from healthcare providers, patients, and management. Strategies to reduce MEs include optimizing medication processes through technology such as computerized physician order entry (CPOE), barcoding, and standardized protocols. Error interception methods, including double-checking high-risk medications and promoting a non-punitive culture for error reporting, are essential in mitigating risks. Education, training, and active patient engagement also play critical roles in preventing errors.

Pharmacists play a pivotal role in critical care by providing comprehensive medication management, ensuring accurate drug dosing, preventing adverse drug events, and contributing to quality improvement initiatives. By incorporating these strategies, healthcare systems can improve patient safety, reduce preventable errors, and enhance overall care in critical care settings.

Keywords: Medication errors, critical care, healthcare costs, medication administration, pharmacist interventions,

INTRODUCTION

The survival of critically ill patients has shown dramatic improvement in last few decades due to scientific and technological advances. In critically ill patients, medications are the most commonly used intervention in supporting and optimising outcomes. However, using medications is not without risk to the patient and its improper use can lead to complications. Medication related problems (medication errors plus adverse drug reactions [ADEs]) are frequently encountered posing serious threat to patient safety.[1] The medication errors are usually acquired due to multiple interwoven processes of drug-usage and

delivery system.

MEs as defined by the National Coordinating Council for Medication Error Reporting and Prevention as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer".[2] Approximately, medical errors cause 44,000–98,000 deaths each year as per the Institute of Medicine's 1999 report "To Err Is Human: Building a Safer Health System".[3]

Recent studies suggest that medication errors contribute to over 3 million preventable hospitalizations annually worldwide, with an economic burden of more than $42 billion USD globally. This emphasizes the need for a systematic, proactive approach to medication safety.[4]

WHAT ARE THE TYPES OF MEDICATION ERRORS?

Medication process in a hospital involves correct execution of 80-200 steps for a single patient for a single drug, and includes following stages: prescription, transcription, preparation, dispensation, storage, administration, and monitoring.[5] MEs can occur during the process of medication, commonly at the stage of administration (median of 53% of all errors), followed by prescription (17%), preparation (14%), and transcription (11%).[6]

MEs can also be classified on the basis of underlying psychological mechanisms: a) knowledge-based errors and b) rule-based errors. Failures of skill can be divided into c) action-based errors ('slips', including technical errors) and d) memory-based errors ('lapses'). Based on how errors occur, it can suggest strategies to reduce their occurrence.[7]

Emerging approaches such as behavioral insights and human factor engineering are being incorporated to analyze and mitigate these errors by addressing the root causes of human limitations.[8]

WHY CRITICAL PATIENTS ARE PRONE TO MEDICATION ERRORS?

Following factors have been attributed to MEs in critical patients:

Patient related[4]

1. Illness Severity: is the single most and strongest predictor of an ADEs in critical patient
2. Extremes of age: patients in these group have increased susceptibility to ADEs
3. Prolonged length of hospital stays: leads to increased exposure and susceptibility to ADEs
4. Sedation: leads to lack of patient participation thereby unable to defend against errors
5. Critical Care Physiology: critical patients have multiple derangements (hemodynamic, metabolic, and biochemical) along with alteration in protein binding of drugs, ionisation and drug volume distribution are known to affect the drug pharmacokinetics and pharmacodynamics leading to challenges in optimisation of drug dosages.[7]

Medication related[5]

1. Medication types: infusions and bolus of drugs are frequently used which are weight based and requires calculations leading to errors. Errors can also occur while setting up infusion pumps
2. Use of multiple medications: multiple medications are used simultaneously increases drug-drug interactions which can lead to errors.
3. Multiple interventions: like organ support increases the risk of complications

Critical care environment[5]

1. Complicated working conditions: the number of errors increases as it is highly stressful to work in deficient environment where there is rapid movement of both patients and healthcare workers

2. Emergent admissions: there is increased risk of adverse events in such cases
3. Multidisciplinary team involved in care: creates a challenge to integrate healthcare plan of the patient leading to adverse events
4. Work schedules of healthcare professionals: improvement in organizational work shifts has been shown to have a positive and protective as regards to error rates.[9]

Studies have shown that poor nurse-to-patient ratios in ICUs can increase the risk of errors by 30%-40%. Implementing evidence-based staffing models can significantly reduce these risks. [10]

REPERCUSSIONS OF MEDICATION ERRORS

Healthcare costs: in United States (US), it has reported that the MEs related estimated cost to be $19.5 billion. Out of that, $17 billion has been attributed to additional medical costs as ancillary service for in-hospital and outpatient care, and prescription drug services. As per a recent report, the US spends yearly more than $40 billion on patients affected by MEs and more than $21 billion yearly in preventing MEs.[11]

Increased morbidity and mortality: in US the third leading cause of death is due to errors in hospitalized patients accounting for approximately 400,000 death/year.[12]

Impact on mental health: the mental health of patients and their family members is also affected as MEs put an additional financial and social burden due to rising costs and prolonged hospitalization. MEs can affect the healthcare providers, as the memories haunt them for a long time.[5]

WHAT CAN BE DONE TO PREVENT MEDICATION ERRORS?

Preventing MEs needs a concerted effort from healthcare workers, patients, and management. By implementing the following strategies, there will be significant reduction in preventable MEs.[5, 13]

Optimising Medication Process

1. Use of Computerized Physician Order Entry (CPOE) with Clinical Decision Support Systems (CDSS) – will reduce errors of transcription, will provide real-time alerts for potential drug interactions, allergies, and dosing errors, and will standardize medication ordering processes
2. Reconciliation of Medications – a thorough reconciliation of medications should be done at each transition of care, which will ensure continuity and accuracy in administration of medications
3. Medication Practices should be Standardized – comply to standardized protocols for prescription, preparation, dispensing, and administration of medications. It also includes using standard concentrations of medications and using standard abbreviations to reduce errors
4. Use of Bar code technology – will ensure that the right patient receives the right medication and dose at the right time. It will enhance the accuracy of administration of medication at bedside
5. Integrated Smart Systems – AI-based clinical decision support tools and machine learning algorithms can proactively identify potential error patterns

Interception of error

1. Double-Checking of High-Risk Medications - independent double-checks by another healthcare professional will help in catching errors before it reaches the patient
2. Monitoring MEs - regular review and analysis of the data helps in identifying trends, establish root causes, and implementing specific interventions to prevent errors in future
3. Minimizing intrusions and interference – during medication process
4. Create a Non-Punitive Culture for Error Reporting - healthcare workers should be encouraged to report MEs without

fear of punishment. This helps to learn from the mistakes by identifying deficiencies in the system and preventive measures can be implemented
5. Involve Pharmacist in ICU care – see below
6. Simulation-Based Training – Use of simulated critical care scenarios to train healthcare workers in error prevention strategies [14]

Education

1. Education and training of healthcare workers - regularly train healthcare workers on safety of medications, new protocols, and the use of healthcare technology
2. Patient Education and Engagement – active participation of patients in their treatment plan by educating them about do's and don'ts will help in mitigating potential MEs
3. Incorporate of quality assurance into academic education

PHARMACIST AS AN ESSENTIAL TEAM MEMBER OF CRITICAL CARE

In critical care, the pharmacist has to play a multifaceted role and ensures that patient care is optimal. As per the Position Paper on Critical Care Pharmacy Services, there are 4 major domains of a pharmacist in critical care[15]

Patient Care

- In conjunction with the critical care team, provides comprehensive medication management for all ICU patients.
- Provides relevant information regarding medications to the critical care team
- Assists in pharmacokinetic monitoring and dose adjustments when a targeted drug is prescribed
- Assists in medication reconciliation process
- Monitors effectiveness of prescribed pharmacotherapeutic regimen for effectiveness and adverse drug events (ADEs), and intervenes as needed
- Provides stewardship activities targeted at anti-infectives and other medications, including those that may be high risk for adverse events, high cost concerns, and inappropriate utilization
- Actively participate in Pharmacy and Therapeutics committee
- Leveraging data analytics to predict patient-specific ADE risks and recommending tailored interventions

Quality Improvement

- Serve as Medication Safety Leader - develop process improvements and improving medication use practices
- Identify local quality metrics for continuous quality improvement
- Implement safe technology in medication management for routine care of critical patients

Training/Education

- Provide education and training to doctors, nurses and other pharmacists as regards prescribing drugs in critical patients, share learning outcomes from medication incidents, guide critical care team in clinical governance process for scheduled drugs,
- and monitoring and drug dosing during organ support

Research

- Participate actively in critical care pharmacotherapy research by developing and reviewing study proposals, screening and/or enrolment of patients, publication of study results
- Contribute to the pharmacy and medical literature

CONCLUSION

Medication errors pose a significant challenge in critical care, affecting patient safety, increasing healthcare costs, and impacting both the mental and physical well-being of patients and healthcare

providers. Addressing these errors requires a multi-faceted approach, emphasizing:

Standardization of Medication Processes: Adoption of tools like CPOE with CDSS, barcoding, and standardized protocols can greatly reduce errors during prescription, administration, and reconciliation stages.

Error Interception and Analysis: Regular monitoring, independent double-checking of high-risk medications, and fostering a non-punitive culture for error reporting are crucial to identify and mitigate errors before they harm the patient.

Empowering Healthcare Workers: Continuous education and training for healthcare professionals in critical care settings, along with engaging patients in their care plans, ensure a collective effort toward medication safety.

Role of the Pharmacist in Critical Care: Pharmacists play a pivotal role in optimizing medication management, monitoring pharmacotherapy, preventing adverse drug events, and contributing to quality improvement and research initiatives. Their involvement enhances the multidisciplinary team's ability to deliver safer, more effective care.

By integrating these strategies, hospitals and healthcare systems can substantially reduce preventable medication errors, improve patient outcomes, and build a culture of safety in critical care settings.

Declaration by Authors

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