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*Letter to Editor*

# *The Role of Electronic-Based System in Minimizing Medication Error*

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## Abstract

Medication errors pose a critical challenge in healthcare systems, often resulting in preventable harm and compromised patient safety. These errors can occur at various stages of medication management, from prescribing to administration. The adoption of electronic-based systems, including Computerized Physician Order Entry (CPOE), Barcode Medication Administration (BCMA), and Automated Dispensing Cabinets (ADCs), has emerged as a transformative strategy to mitigate these risks. This article discusses the roles and benefits of these systems in reducing medication errors by enhancing process accuracy, enabling real-time verification, and supporting clinical decision-making. Although implementation challenges such as cost, staff resistance, and alert fatigue persist, the integration of electronic systems is essential for fostering a safer and more efficient medication delivery environment. Further advancements in artificial intelligence and system interoperability are expected to strengthen these technological interventions in the future.

Dear Editors,

Medication errors remain a significant challenge in healthcare systems worldwide, often leading to adverse patient outcomes, increased hospitalization costs, and even fatalities. These errors can occur at any stage of the medication process, including prescribing, dispensing, administering, and monitoring. The complexity of modern healthcare, combined with human factors such as fatigue and miscommunication, exacerbates the risk of such mistakes. Electronic-based systems, such as Computerized Physician Order Entry (CPOE) and Barcode Medication Administration (BCMA), have emerged as promising solutions to mitigate these risks. By integrating technology into clinical workflows, healthcare providers can enhance accuracy, improve efficiency, and reduce the likelihood of human error. This article explores the pivotal role of electronic systems in minimizing medication errors and their impact on patient safety (Saho et al., 2024).

Medication errors are alarmingly common, with studies indicating that they affect millions of patients annually, contributing to substantial morbidity and mortality. These errors range from incorrect dosages and wrong drug selections to improper administration techniques, often stemming from illegible handwriting or miscommunication among healthcare teams (Putri et al., 2025). The consequences extend beyond patient harm, as they also lead to legal liabilities, financial burdens, and diminished trust in healthcare institutions. In severe cases, medication errors can result in life-threatening conditions such as allergic reactions or toxicity. Given these ramifications, there is an urgent need for systemic interventions to prevent such incidents. Electronic-based systems offer a proactive approach by automating critical processes and reducing reliance on manual documentation (Usnaini & Setyani, 2025).

One of the most effective electronic interventions is the implementation of Computerized Physician Order Entry (CPOE) systems, which allow healthcare providers to enter prescriptions digitally. CPOE systems minimize errors by eliminating handwritten orders, which are often prone to

misinterpretation. Additionally, these systems incorporate clinical decision support (CDS) tools that alert prescribers to potential drug interactions, allergies, or incorrect dosages in real time. By integrating patient-specific data, CPOE ensures that prescriptions are tailored to individual needs, thereby enhancing precision. Studies have demonstrated that hospitals using CPOE systems experience a significant reduction in prescribing errors compared to those relying on traditional methods. Thus, CPOE serves as a cornerstone in the effort to improve medication safety (Suryani et al., 2025).

Another critical innovation in reducing medication errors is Barcode Medication Administration (BCMA), which verifies patient identity and medication accuracy before administration. Nurses scan barcodes on patient wristbands and medication packages, ensuring the "five rights" of medication safety: right patient, right drug, right dose, right route, and right time. This process acts as a final checkpoint, preventing errors that may have escaped earlier detection. BCMA systems also document administration in real time, creating an auditable trail for accountability and quality improvement. Research indicates that hospitals implementing BCMA report fewer administration errors and improved compliance with safety protocols. As such, BCMA represents a vital layer of defense in the medication delivery process (Saleem, 2023).

Automated Dispensing Cabinets (ADCs) further enhance medication safety by streamlining the dispensing process in pharmacies and patient care units. These electronic systems store and track medications, requiring healthcare providers to authenticate their access before retrieving drugs. ADCs reduce the risk of unauthorized or incorrect medication distribution while maintaining accurate inventory records. Some advanced systems also integrate with CPOE and BCMA, creating a seamless workflow from prescription to administration. By minimizing human handling and automating stock management, ADCs help prevent errors such as wrong drug selection or expired medication use. Their adoption has been associated with increased efficiency and reduced dispensing errors in clinical settings (Hänninen et al., 2023).

Despite their benefits, electronic-based systems are not without challenges. High implementation costs, staff resistance to change, and technical issues such as system downtime can hinder their effectiveness. Additionally, overreliance on technology may lead to alert fatigue, where healthcare providers ignore safety warnings due to excessive notifications. Furthermore, interoperability issues between different electronic systems can disrupt data flow and create gaps in patient care. Addressing these limitations requires ongoing training, system optimization, and stakeholder engagement. While electronic systems are powerful tools, their success depends on proper integration into existing workflows and continuous evaluation.

In conclusion, electronic-based systems play a transformative role in minimizing medication errors by introducing automation, real-time verification, and decision support into healthcare processes. CPOE, BCMA, and ADCs have demonstrated significant potential in enhancing patient safety and operational efficiency. However, maximizing their impact necessitates addressing implementation barriers and fostering a culture of continuous improvement. Future advancements, such as artificial intelligence and machine learning, could further refine these systems by predicting errors before they occur. As healthcare evolves, the integration of robust electronic solutions will remain essential in achieving error-free medication management and improving overall care quality.

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## Declaration of conflict of interest
The authors declare no competing interests.

## Declaration on the Use of AI
No AI tools were used in the preparation of this manuscript.

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