

NURSE-LED INTERVENTIONS IN THE PREVENTION OF MEDICATION ADMINISTRATION ERRORS: A NARRATIVE REVIEW

Jayesh Pandya*¹, Dr. Rohina Rabecca Francis²

¹*PhD Scholar, Jaipur National University, Jaipur, Rajasthan, India, Email: pandyajayesh079@gmail.com, Orcid ID : 0009-0004-0546-9905

²Professor, Seedling School of Nursing, JNU, Jaipur, Orcid ID : 0009-0000-7148-7416

Abstract

Medication administration errors (MAEs) remain among the most frequently reported nurse-sensitive patient safety events worldwide, contributing to preventable patient harm, prolonged hospitalisation, and substantial healthcare expenditure. Because nurses are the final point of verification in the medication use process, nurse-led strategies are central to reducing MAE incidence. This narrative review synthesises recent evidence (2023-2026) on nurse-led approaches to preventing medication administration errors, including workflow smart technologies such as barcode medication administration (BCMA) and smart infusion pumps, structured double-checking and verification protocols, interruption-reduction strategies, and staff education and competency-based training. Across the reviewed literature, workflow smart technologies emerged as the most consistently effective intervention category, with barcode-supported administration systems associated with error reductions of roughly 40% to 70% in several settings. Educational and multicomponent interventions produced meaningful but more variable reductions, while interruption-focused strategies, including the widely recommended “do not interrupt” vest, showed inconsistent effects on error rates despite reducing interruption frequency in some trials. The review concludes with practice implications for nursing leadership, technology adoption, and future research, emphasising sustained competency-based education, standardised verification protocols, and realistic evaluation of technology-dependent interventions as priorities for sustaining medication safety gains.

Keywords: medication error; medication administration; nurse-led intervention; barcode medication administration; patient safety; quality improvement.

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Introduction

A medication administration error (MAE) is any deviation between the medication a patient actually receives and what was intended by the prescriber, occurring at the point of preparation or administration rather than during prescribing or dispensing. Nurses administer the substantial majority of inpatient medications and are widely regarded as the last safety check before a medication reaches the patient, which places nursing practice at the centre of both error causation and error prevention.

The global burden associated with medication-related harm is considerable. The World Health Organization's Global Patient Safety Challenge on Medication Without Harm estimates that unsafe medication practices and errors cost health systems approximately \$42 billion annually worldwide, and that medication-related harm accounts for nearly half of all preventable harm in medical care, with older adults and patients on multiple medications at greatest risk. Prevalence estimates vary substantially by setting: reviews of acute paediatric and neonatal care have reported administration error rates exceeding 70% of observed doses in some cohorts, while adult inpatient studies typically report lower but still clinically significant rates, with system-level factors such

as staffing, interruptions, and documentation practices repeatedly identified as key determinants.

Because medication administration depends on accurate patient identification, dose verification, timing, and documentation under frequently interrupted conditions, nurse-led interventions have become the primary mechanism through which health systems attempt to reduce MAE incidence. This narrative review examines the recent evidence base for nurse-led interventions in medication administration error prevention, drawing on systematic reviews, meta-analyses, and quality-improvement projects published largely between 2023 and 2026, with the aim of identifying which nursing strategies produce the most consistent and sustainable reductions in error rates.

2. Review Methodology

This is a narrative review rather than a systematic review or meta-analysis. Recent peer-reviewed literature, systematic reviews, and quality-improvement reports addressing nurse-led medication administration error prevention were identified and synthesised thematically. Priority was given to studies and reports published between 2023 and 2026 to ensure the review reflects current practice standards, while foundational systematic

reviews and trials published slightly earlier are included where they remain the primary evidence source for a given intervention. As a narrative synthesis, this review does not follow a PRISMA protocol and does not report a formal risk-of-bias assessment; its purpose is to orient nursing practitioners, educators, and administrators to current intervention themes rather than to provide an exhaustive quantitative synthesis.

3. Nurse-Led Intervention Strategies

3.1 Workflow Smart Technologies

The strongest and most consistent evidence for MAE reduction comes from workflow smart technologies, particularly barcode medication administration (BCMA) systems, which require nurses to scan both the patient identification band and the medication label before administration. A 2025-2026 systematic review and meta-analysis of interventions implemented by nurses to reduce MAEs in hospitalised adult patients, drawing on 26 included studies and pooling effect sizes from 14 of them, found that nurse-led interventions overall significantly reduced medication administration errors, with workflow smart technologies identified as the single most effective intervention category compared with usual care.

Individual BCMA implementation studies have reported similarly favourable results: quality-improvement and evaluation reports have documented error reductions in the range of roughly 40% to 70% following BCMA and electronic medication administration record (eMAR) adoption, including a reported 56% reduction in medication-related errors in one intensive care unit and a 65% relative reduction in an emergency department setting. However, the clinical benefit of BCMA depends heavily on consistent nursing compliance with scanning protocols; quality-improvement projects on units with historically low scan-rate compliance have shown that targeted interventions, including staff education delivered through huddles, public feedback on individual scan rates, and workflow redesign to remove scanning barriers, are often necessary to sustain the technology's protective effect.

3.2 Structured Double-Checking and Verification Protocols

Independent double-checking, in which a second nurse verifies high-alert medications, calculations, or infusion settings before administration, remains a widely recommended nurse-led safeguard, particularly for paediatric, neonatal, and high-alert medication contexts. A systematic review and meta-analysis of nursing interventions in paediatric and neonatal settings identified double-checking as one of seven principal intervention types used to reduce administration errors, alongside education, pharmacist involvement, and smart pump use, with the pooled analysis across all intervention types showing an overall 64% reduction in medication administration errors. Notably, the same review found that bundled, multicomponent interventions did not produce a statistically significant improvement over well-implemented single interventions, suggesting

that the quality and consistency of execution may matter more than the number of components combined.

3.3 Interruption-Reduction Strategies

Interruptions during medication administration are consistently identified as a major contributing factor to MAEs, and several nurse-led strategies have been developed to reduce them, most notably the “do not interrupt” vest or sash worn by nurses during medication rounds. Evidence for this approach is mixed. A 2025 systematic review of interruption-reduction interventions across 14 studies concluded that preventive strategies help reduce interruptions but that a combined approach of preventive and responsive measures is needed, particularly to address nurse-to-nurse disruptions. A large multicentre cluster-randomised controlled trial of the “do not interrupt” vest found no statistically significant impact on either interruption rates or medication administration error rates, contrasting with an earlier before-and-after study that had reported substantial reductions in both interruptions and errors following vest implementation. A separate cluster-randomised feasibility study found that a bundled intervention combining the vest with interruption-diversion strategies, clinician and patient education, and reminders did significantly reduce non-medication-related interruptions, although nurses in that trial reported the vest itself as cumbersome and only around half indicated they would support it becoming permanent policy. Taken together, this body of evidence suggests that interruption-reduction strategies can measurably change interruption frequency but do not reliably translate into fewer administration errors on their own.

3.4 Staff Education and Competency-Based Training

Education remains a foundational nurse-led strategy and is consistently identified as a companion to technology and protocol-based interventions rather than a standalone solution. A 2024 scoping review of predisposing factors to medication errors found that organisational, system-related, procedural, personal, and knowledge-and-training factors all contribute to error risk, and identified educational intervention as a recurring and necessary component of prevention strategies across the included literature. A 2025 integrative review focused specifically on novice registered nurses similarly highlighted knowledge gaps, unfamiliarity with unit-specific workflows, and limited confidence in high-pressure situations as contributing factors, pointing to structured orientation and competency-based training as a particular priority for early-career nurses. Reviews focused on low-income and lower-resource settings, including a 2025 meta-analysis of MAE prevalence among nurses in Ethiopia, have reinforced that training and workforce-related determinants play an outsized role in settings where technology-based safeguards such as BCMA are not yet widely available, underscoring that education-based strategies remain essential even as technology adoption expands elsewhere.

3.5 Special Populations and Settings

Prevention needs vary meaningfully by clinical population and care setting. Paediatric and neonatal patients are disproportionately affected by MAEs, with some reviews reporting that children are up to three times more likely than adults to experience a medication error and that administration error rates in this population can exceed 70% of observed doses, reflecting the added complexity of weight-based dosing and dilution calculations. Emergency department and mental health or substance-use settings present distinct implementation challenges for technologies such as BCMA, including higher rates of workflow interruption, time pressure, and, in psychiatric settings, the need to adapt scanning workflows to units where patients may not consistently wear identification bands; nursing informatics-led quality-improvement projects using structured Plan-Do-Study-Act cycles have demonstrated that these barriers can be addressed through deliberate workflow redesign rather than technology abandonment.

4. Discussion

Taken together, the reviewed literature points to a consistent conclusion: workflow smart technologies, and BCMA in particular, currently offer the most robust and reproducible reductions in medication administration errors among nurse-led interventions, but their protective effect is conditional on sustained nursing compliance, which itself requires ongoing education, feedback, and workflow support rather than one-time implementation. Double-checking protocols and staff education continue to show benefit, particularly in paediatric, neonatal, and resource-limited settings where technology-based safeguards are less available, though the evidence suggests that consistent execution of a single well-implemented strategy may matter more than simply adding additional bundle components.

The evidence on interruption-reduction strategies is the least conclusive of the intervention categories reviewed. While interruptions are plausibly linked to error risk and some interventions measurably reduce interruption frequency, the largest randomised trials of the “do not interrupt” vest have not demonstrated a corresponding reduction in error rates, and nursing acceptability of the intervention itself appears limited. This gap between interruption reduction and error reduction deserves further nursing research attention, as it suggests interruptions may be a marker of, rather than sole cause of, high-risk administration conditions such as heavy workload or inadequate staffing. Finally, the substantial global cost and prevalence burden associated with medication-related harm, combined with the finding that fewer than one in five WHO member states currently maintain a national target for reducing such harm, indicates that nurse-led interventions, however effective locally, need to be matched by system-level and policy-level commitment to be sustained at scale.

5. Implications for Nursing Practice and Education

Prioritise workflow smart technologies such as BCMA as the default nursing standard for medication verification where infrastructure allows, while investing equally in

the education and feedback systems needed to sustain nursing compliance with scanning protocols.

Maintain independent double-checking for high-alert medications and paediatric or neonatal dosing, focusing on consistent execution rather than adding additional bundle components without clear evidence of incremental benefit.

Treat interruption-reduction tools such as “do not interrupt” vests as one component of a broader strategy rather than a stand-alone solution, and evaluate their local acceptability and workload impact before adoption. Embed medication safety education within recurring competency-based training cycles, with particular attention to novice nurses and units without access to electronic verification technology.

Adapt medication safety workflows to setting-specific barriers, including emergency department time pressure and mental health unit identification challenges, through structured quality-improvement cycles rather than generic protocols.

Position nursing leadership and unit-based quality-improvement infrastructure, including compliance audits and feedback loops, as essential to sustaining the protective effect of any single intervention over time.

6. Conclusion

Medication administration errors remain a common but largely preventable threat to patient safety, and nursing practice sits at the centre of effective prevention. Current evidence indicates that workflow smart technologies, most notably barcode medication administration, achieve the most consistent reductions in error rates among nurse-led strategies, while double-checking protocols, competency-based education, and setting-specific workflow adaptation provide complementary and, in technology-limited settings, primary protection. Interruption-reduction strategies, though intuitively appealing, have not yet demonstrated reliable error-reduction benefit and warrant further rigorous evaluation. As nursing education and health-system leadership continue to prioritise medication safety, future research should focus on improving BCMA compliance, clarifying the relationship between interruptions and error causation, and strengthening medication safety infrastructure in low-resource settings.

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