Sarcouncil Journal of Applied Sciences

ISSN(Online): 2945-3437

Volume- 06| Issue- 06| 2026

Review Article **Received:** 15-05-2026 | **Accepted:** 10-06-2026 | **Published:** 25-06-2026

A Systematic Review of Electronic Medication Administration Records (eMAR) and Their Impact on Medication Error Reduction in Long-Term Care Facilities

Senyah Gad Gershon

School of Business and Healthcare Administration, University of the Potomac, Washington, D.C., United States.

Abstract: In long-term care settings, complex medication regimens and workflow challenges contribute to medication errors, making it a major patient safety issue. Electronic Medication Administration Records (eMAR) have been implemented to improve medication safety, although their broad effectiveness has been inconsistent. This systematic review synthesizes evidence regarding the influence of eMAR systems on medication error reduction within long term care settings. A literature search was conducted across PubMed, CINAHL, Scopus, Web of Science, and Cochrane databases. Due to substantial methodological heterogeneity among the included studies, including differences in study designs, and reporting approaches, findings were synthesized narratively and categorized into subthemes. Of the 16 studies included, eMAR implementation was generally associated with decreases in overall medication administration error rates, with reported reductions between 4.2% absolute to relative reductions greater than 40%. There was a significant reduction in transcription, wrong medication, wrong dose and time associated errors as well as in error severity and drug related adverse events. eMAR systems improved medication safety by allowing interception of errors at the time of delivery, automatically alerting to potential issues, and improving both documentation accuracy and communication. Timing errors and omissions of medication persisted, however, some studies found no significant change in overall error rates. Workflow efficiency results were mixed, demonstrating progress on documentation processes but with variable effects on administration time. In conclusion, eMAR systems improve medication safety in long-term care settings by reducing certain types of errors and strengthening system-based safeguards. But their effectiveness is context-specific and needs optimized implementation strategies that consider human, technical, and organizational factors.

Keywords: Electronic medication administration records; medication errors; long-term care; barcode medication administration; patient safety.

INTRODUCTION

Medication errors continue to be a significant patient safety issue worldwide. The WHO estimates through its third Global Patient Safety Challenge, Medication Without Harm, that the cost of medication errors is around US $42 billion per annum. They also account for nearly 50% of all preventable harm in healthcare (Donaldson *et al*., 2017; Organization, 2021). The phases of medication administration are prone to error, with approximately one-third of all medication errors occurring at this stage (Berdot *et al*., 2016; Oware & Mensah, 2025). In this context, long-term care facilities (LTCFs) are at a high risk for medication-related harm.

LTCFs primarily cater to older adults with multimorbidity requiring complex polypharmacy regimens. Physiological changes relating to aging, such as decrease renal function and altered metabolism of drugs, also increase vulnerability to adverse drug events (Lalic *et al*., 2016; Masnoon *et al*., 2017; Nortey *et al*., 2025). Between 33% and 75% of nursing home residents are reported to be taking at least one potentially inappropriate medication (Ferrah *et al*., 2017; Jokanovic *et al*., 2015), with medicinal harm commonly leading to hospitalization and death (Is-mail & Nortey, 2026). Organizational issues typical in LTCFs such as high turnover, heavy dependence on non-licensed personnel, rapid transitions of care and inconsistent clinical supervision only exacerbate these risks (Zhang *et al*., 2011).

Historically, medication administration in LTCFs has been dependent on paper-based medication administration records (MAR), both establishing the potential of transcription errors and being at risk of illegibility, incomplete documentation, and outdated prescription information (Filani & Opoku, 2025; Fuller *et al*., 2018). The electronic medication administration record (eMAR) is a huge stride forward in medication management. eMAR systems allow real-time documentation, automatic alerts for due or overdue medications, and integration with prescribing and pharmacy systems (Alanazi *et al*., 2018; Filani & Opoku, 2025). Coupling these systems with barcode medication administration (BCMA) allows point-of-care verification of the five rights of medication administration, adding another layer of safety at the point of delivery (DeYoung *et al*., 2009; Poon *et al*., 2010).

Evidence from acute care settings shows that eMAR and BCMA systems can significantly

***Corresponding Author:** Senyah Gad Gershon

DOI- https://doi.org/10.5281/zenodo.20842552

decrease medication administration errors, with decreases reported between 40% to 80% (Bonkowski *et al*., 2013; Helmons *et al*., 2009). A previous systematic review has also reported enhancements in patient safety and care processes post-implementation, although evidence for process efficiency remains equivocal (Pruitt *et al*., 2023). However, the degree to which such advantages extrapolate to LTCFs is uncertain. LTCFs are often resource-constrained with limited digital infrastructure and different staffing models from hospitals, which may affect implementation outcomes.

Data specifically for LTCFs is scarce and inconclusive. A study by Fuller *et al*. found weak evidence for an association between eMAR use and reduction in medication error due to methodological weaknesses (Fuller *et al*., 2018). Similarly, Stolic *et al*. (2023) identified mixed findings across nursing environments, with one study indicating decreased and another increased errors (Stolic *et al*., 2023). Recent evaluations of digital health technologies highlight that outcomes are critically dependent on system design, workflow integration, staff training and organizational readiness (Gesner *et al*., 2022). Despite an increasing policy focus on digitalizing medication management in aged care, there have been few syntheses covering eMAR systems implemented across a wide range of different medication safety outcomes in LTCFs. This is particularly relevant considering the global growth of the long-term care sector.

This systematic review fills this gap by synthesizing existing evidence on how eMAR implementation affects medication error reduction in LTCFs. It covers global and specific error types, error severity, system-enabling safety mechanisms, medication omission surveillance, documentation and communication processes, workflow efficiency, human factors and system-related barriers, along with economic outcomes to inform practice policy and future research in medication safety.

METHODOLOGY

The purpose of this systematic review is to assess the effect of electronic Medication Administration Records (eMAR) on medication error occurrence in long-term care settings. This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page *et al*., 2021). A systematic electronic search was conducted using PubMed, CINAHL, Scopus, Web of Science, and Cochrane databases. Search terms combined controlled vocabulary and keywords related to electronic medication administration records, eMAR, barcode medication administration, medication errors, and long-term care.

Eligible studies comprised interventional, observational and qualitative research assessing eMAR or similar electronic medication management systems in long-term care or equivalent healthcare settings with reported outcomes on medication errors, safety, workflow or documentation. Studies that either did not report medication-related outcomes or were not related to eMAR systems were excluded. Study selection followed a two-stage process (title/abstract screening and full-text review) according to set inclusion criteria. Database search identified 124 records. A total of 102 unique records remained for screening, after removal of 22 duplicates. After screening titles and abstracts, 85 records were excluded on the basis of not pertaining to eMAR systems, medication error outcomes or long-term care settings. Eligibility was assessed for the full text of 17 articles, among which 1 study did not meet the inclusion criteria and was therefore excluded. Sixteen studies were ultimately included in the final synthesis. The study selection process is summarized in a PRISMA flow diagram (**Figure 1**).

A narrative synthesis approach was adopted due to the heterogeneity of study designs, outcome measures and reporting formats. The findings were organized into thematic domains covering the care continuum focusing on reducing medication errors, error type, systems safety mechanisms, workflow and documentation processes, human factors as well as implementation benefits and challenges to allow for complete holistic comparison and integration of evidence from across studies.

Publisher: SARC Publisher

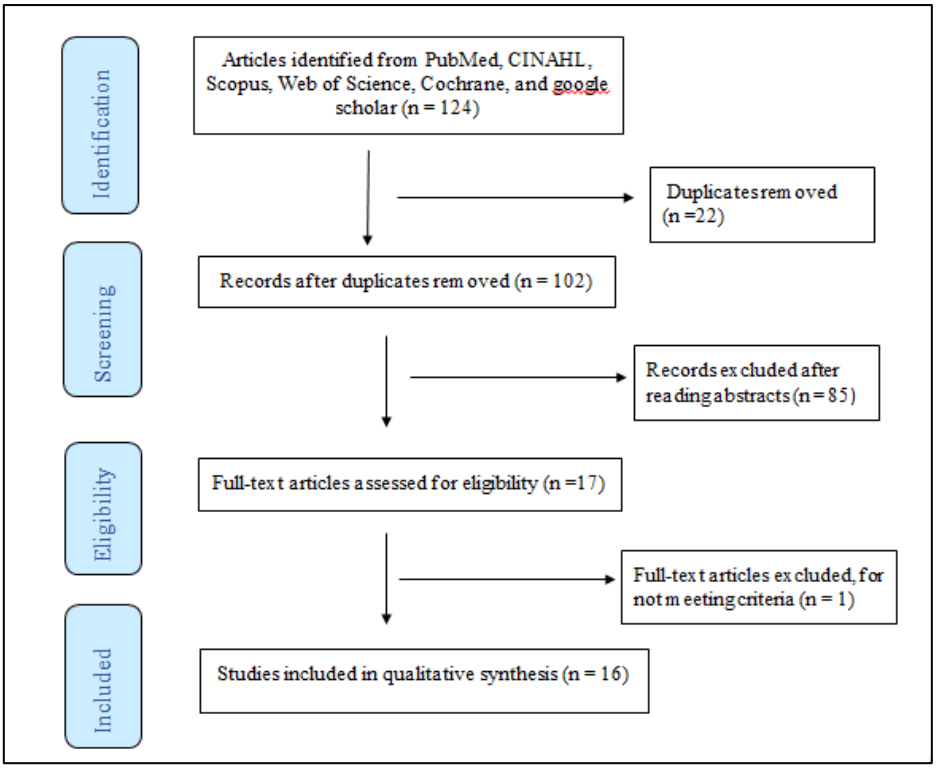

Figure 1: PRISMA Flow diagram showing the article selection process.

FINDINGS

Overview of Included Evidence

Evidence synthesized from the included studies evaluated the effect of electronic Medication Administration Records (eMAR) on medication safety in long-term care and similar healthcare settings including barcode-enabled systems or integrated electronic medication management technologies. The evidence base consisted of interventional, observational and qualitative studies conducted in residential aged care facilities, nursing homes, residential care homes and home healthcare settings. eMAR systems influenced medication error rate, types of errors and severity, detection of medication omissions, workflow processes and accuracy of documentation. To ensure holistic synthesis, findings were conceptually grouped into eight dominant domains.

Overall Medication Error Reduction Associated with eMAR Implementation

The use of eMAR systems was generally associated with decreased rates of overall medication administration errors (MAE), although the degree and consistency of these reductions varied across settings and study designs (Fuller *et al*., 2018; Kruse *et al*., 2021; Poon *et al*., 2010; Pruitt *et al*., 2023; Szczepura *et al*., 2011; Truitt *et al*., 2016; Westbrook *et al*., 2020). Evidence from a scoping review showed that large comparative pre–post implementation studies lead to reductions in medication errors ranging from 192 to 31 errors per year, and in post-implementation years, the number of total errors decreased from 212 to both 20 and 17 (Fuller *et al*., 2018). Other studies reported quantitative reductions in MAE rates to 6.8% from 11.5% (41.4% relative reduction) and from 0.26% to 0.20% (rate ratio: 0.78, 95% CI: 0.67-0.89) (Poon *et al*., 2010; Truitt *et al*., 2016). A controlled before-and-after study also described a statistically significant absolute reduction of 4.2% in MAE prevalence from a baseline level of 30.2% (95% CI 0.2%–8.3%, p = 0.04) (Westbrook *et al*., 2020).

In long-term care, observational data showed 2,289 potential MAEs identified from 188,249 administrations (1.2% error rate), where 90% of residents had at least one potential MAE over a three-month period and an average exposure to 6.6 errors per resident (Szczepura *et al*., 2011). Despite such reductions, there was variation in outcomes. Other studies reported no statistically significant differences in rates of administration error, suggesting that the effect of eMAR on overall rate of errors made may be dependent on contextual factors and influenced by fidelity to implementation and use within the system (Kruse *et al*., 2021; Pruitt *et al*., 2023; Truitt *et al*., 2016; Westbrook *et al*., 2020).

Publisher: SARC Publisher

Reduction in Specific Medication Error Types and Clinical Severity

Transcription and Documentation-Related Errors

Transcription-related errors showed the most consistent reductions when cross-study comparisons were made. One study reported total eradication of transcription errors, dropping from 6.1 per 100 orders to zero as well as associated adverse drug events (Poon *et al*., 2010). A different study documented a decrease from 134 to 66 cases (0.089% to 0.036%; relative risk: 0.40, [95% CI: 0.30–0.54]), with reductions in the wrong-time transcription errors as well (Truitt *et al*., 2016). These improvements were associated with the elimination of handwritten prescriptions and better alignment between prescribing and administration records (Elliott *et al*., 2016; Fuller *et al*., 2018; Kruse *et al*., 2021).

Wrong Medication, Wrong Dose, and Wrong Patient Errors

There were substantial decreases in the rates of medication errors due to wrong medication and wrong dose, which reduced by 57.4% and 41.9%, respectively (Poon *et al*., 2010). Any eMAR system with barcode capability could support patient and medication verification, reduce wrong-patient and wrong-drug errors. Such systems also lead to interception of incorrect or look-alike medications during clinical practice (Fuller *et al*., 2018; Mulac *et al*., 2021; Pruitt *et al*., 2023; Truitt *et al*., 2016).

Timing-Related Errors

Studies reported timing errors as the most common error type. Moderate declines were seen after implementation, including a drop from 16.7% to 12.2% (27.3% relative reduction) and reductions in administration time (Poon *et al*., 2010; Westbrook *et al*., 2020). Nevertheless, time-related errors persisted, accounting for about half of the errors (early administration of 4-hourly medications) and a quarter of timing errors observed in long-term care settings (Szczepura *et al*., 2011).

Procedural and Administration Errors

Overall rates of procedural errors showed little variation. One study found no statistically significant reduction (1.5%, p = 0.400), even though the baseline prevalence was high with 74.1% of administrations resulting in at least one procedural deviation (Westbrook *et al*., 2020). Subsequent analysis after implementation demonstrated improvement or deterioration of procedural elements. This implies risk redistribution rather than overall reduction (Westbrook *et al*., 2020).

Severity of Errors and Adverse Drug Events

Improvements in error severity were reported uniformly. Mean severity scores improved from 4.44 to 3.23 (p = 0.005) and the percentage errors resulting in patient harm were reduced from 36% to 20% (Truitt *et al*., 2016). The proportion of potentially serious MAEs fell from 4.2% to 1.8% (relative reduction 56%, p = 0.003) (Westbrook *et al*., 2020). The rates of major and clinically relevant adverse drug events were reduced by 48.5% and 54.1%, respectively, whereas the rates of life-threatening events showed no statically significant change (Poon *et al*., 2010).

Automatic Safety Control and Real-Time Error Interception

eMAR systems acted as active safety nets for intercepting medication errors for intercepting medication errors between ordering and administration. Approximately 1.2% of administration attempts were prevented by barcode systems. Most were wrong-time errors (88%), while others involved wrong residents and discontinued drug administration (Fuller *et al*., 2018; Szczepura *et al*., 2011). Systems intercepted inappropriate or look-alike medications, including several documented cases of wrong-drug administration that were averted (Mulac *et al*., 2021; Truitt *et al*., 2016). Sustained error interception was documented long after implementation (Poon *et al*., 2010).

Critical safety features included automated alerts for due/overdue medications, prompts for incomplete documentation, and notifications of new or modified prescriptions (Fuller *et al*., 2018; Karnehed *et al*., 2024). Real-time synchronization of medication orders with administrative records updated administration data immediately. This reduced administration of discontinued drugs and shortened delays in initiating therapy (Elliott *et al*., 2016; Poon *et al*., 2010). Alert adherence was high, with override rates under 0.075%. Between 30% to 39% of residents experienced at least one weekly averted potential MAEs (Szczepura *et al*., 2011). Systems also allowed remote tracking of delegated tasks and enabled performance monitoring and feedback based on data generated at the system level (Karnehed *et al*., 2024).

Publisher: SARC Publisher

Medication Omission Detection, Surveillance, and Residual Error Patterns

eMAR systems had the greatest ability to detect, document and analyze medication omissions. In a large-scale study involving 294,718 antimicrobial doses, 3.49% were omitted, approximately one-third clinically relevant (Dalton *et al*., 2015). Systems facilitated structured classification of reasons for omission such as patient refusal, medication not available, no intravenous access, adverse drug reactions or other scheduling conflicts and technical reasons such as delays in discontinuing updates (Dalton *et al*., 2015). The reliability of these classifications was substantial ($k = 0.68$ for omission reasons; $k = 0.75$ for clinical relevance, $p < 0.001$) (Dalton *et al*., 2015).

The rate of omission varied by drug type and context, with oral medications omitted 2–2.5 times more often than intravenous drugs, while lower rates of omission were observed during night shifts (Dalton *et al*., 2015). Usage with omission errors continues to occur, particularly in instances of disruptions in workflow, system non-use or incomplete adherence (Mulac *et al*., 2021; Truitt *et al*., 2016). Evidence was also suggestive of redistribution of error types, with decreases in some errors occurring alongside persistence or emergence of others (Truitt *et al*., 2016; Westbrook *et al*., 2020).

Documentation, Communication, and Medication Information Management

Documentation Accuracy and Compliance

eMAR was linked to improved documentation accuracy and compliance. Practices involving prior documentation of medication administration before actual administration (previously 10.58%–13.19% under systems) were eliminated (Qian *et al*., 2015). High compliance rates were reported, including up to 98% documentation sign-off adherence (Alenius & Graf, 2016).

Automated time-stamping, structured fields, and prompts for missed records improved the completeness and traceability of documentation (Qian *et al*., 2015). However, qualitative findings suggested that tasks could be marked as completed before actual administration and the approach relied on simplified binary indicators (Karnehed *et al*., 2024).

Medication Information Accuracy and Synchronization

Consistency of medication records was supported through the move from handwritten prescriptions to electronic systems with real-time synchronization between prescribing and administration records (Elliott *et al*., 2016; Kruse *et al*., 2021). This minimized discrepancies, delays in updating medication changes, and risk of outdated charts (Elliott *et al*., 2016).

Communication and Coordination

Consistent improvements in communication between healthcare providers were reported. The direct transmission of medication orders between prescribers, nurses and pharmacies had previously been facilitated by eMAR systems that helped reduce manual processes as well as transcription errors and delays (Elliott *et al*., 2016; Kruse *et al*., 2021).

Information Access and Documentation Efficiency

There were significant reductions in time spent on looking for (3.5% versus 5.9%), reading (0.4% vs 0.9%) and documenting (4.6% vs 5.9%) medication information leading to overall lower documentation time (11.7 % vs 14.1 %) (Qian *et al*., 2015).

Workflow Efficiency, Medication Processing, and Task Redistribution

Results regarding workflow efficiency were mixed. Some studies reported improvements in medication preparation and processing efficiency, with more doses stamped (25 to 49 doses, $p = .01$) and processing rates (18.9–51.9 doses per 10-minute interval) (Au-Doung *et al*., 2025). Checking medication increased substantially, but not significantly, while the number of doses administered remained unchanged. This reflects reallocation of work rather than increased administrative output (Au-Doung *et al*., 2025).

Total time spent on medication administration by nurses remained largely unchanged (Kruse *et al*., 2021; Qian *et al*., 2015). Most improvements were in documentation and information management rather than total administration time (Qian *et al*., 2015). Two studies from a systematic review noted greater time spent on medication-related tasks (27.4%–42%) and increased workload beyond the medication round, particularly with poor workflow integration (Pruitt *et al*., 2023). Hybrid systems requiring both electronic and manual processes created duplication and inefficiencies (Elliott *et al*., 2016; Kruse *et al*., 2021; Qian *et al*., 2015).

Publisher: SARC Publisher

Human Factors, System Use, and Staff-Related Influences

System Uptake and Compliance

eMAR effectiveness depends on regular use and adherence. Non-adherence behaviors included failure to scan medications (29%) and patient identification bands (20%), alongside partial or complete non-use of barcode systems (Mulac *et al*., 2021). In some environments, only 25.6% of medication orders were entered electronically, limiting system efficiency (Elliott *et al*., 2016).

Workflow Pressures and Behavioral Factors

Interruptions, workload pressure, and time constraints strongly contributed to medication errors. Approximately half of staff reported stress and pressure to complete medication rounds quickly (Szczepura *et al*., 2011). Errors, including duplicate dosing, were associated with communication breakdowns, especially among agency and rotating staff (Szczepura *et al*., 2011). Unsafe practices, such as relying on memory and not validating prescriptions, were also reported (Bengtsson *et al*., 2021).

Training, Competency, and Knowledge

Lack of proper training and understanding contributed to medication errors. However, eMAR implementation was associated with significant increases in staff competency across all medication management tasks (all p <.001), regardless of demographic characteristics (Au-Doung *et al*., 2025).

Staff Perceptions, Workload, and Work Environment

After implementation, staff reported feeling safer, with reduced anxiety and greater confidence in medication processes (Alenius & Graf, 2016). Work-related stress decreased substantially, from 27.7 mm to 16.6 mm on the visual analogue scale (Alenius & Graf, 2016). However, qualitative findings indicated increased demands for system interaction, reduced autonomy for some staff, and more monitoring and performance evaluation via system data (Karnehed *et al*., 2024).

System-Related Barriers, Design Limitations, and Unintended Consequences

Multiple barriers were identified including technological, organizational, and design related. System limitations included fixed administration schedules, lack of flexibility for non-standard dosing times, dual-entry requirements, and inconsistent terminology and categorization (Tariq *et al*., 2014). Technical challenges, such as system crashes, internet failure, delayed synchronization, and loss of unsynchronized data, disrupted workflows and required paper-based reversion (Qian *et al*., 2015; Tariq *et al*., 2014). Hybrid systems increased workflow fragmentation and risk for discrepancies (Elliott *et al*., 2016; Kruse *et al*., 2021; Qian *et al*., 2015).

Unintended consequences included persistence or emergence of errors, such as omitted doses or incorrect timing and administration after discontinuation (Truitt *et al*., 2016; Westbrook *et al*., 2020). Some procedural behaviors improved, while others, such as patient identification checks and double-checks, declined (Westbrook *et al*., 2020). eMAR adoption varied across facilities (18%–49%), influenced by organizational factors and implementation fidelity (Fuller *et al*., 2018; Pruitt *et al*., 2023).

Cost and Resource Utilization

Economic evaluations suggested that eMAR implementation was associated with lower costs for medication administration. Cost per dose decreased from HKD 2.00 (US $0.25) to HKD 0.74 (US $0.09) in Hong Kong, with projected reductions in human resource expenditure at system level upon full implementation (Au-Doung *et al*., 2025).

DISCUSSION

Study Implications

This review's findings have several important clinical, organizational and policy implications. For clinicians and care teams, this evidence highlights the clinical utility of eMAR systems as medication safety solutions, especially for reducing transcription errors and intercepting administration errors at the point of care using barcode verification (DeYoung *et al*., 2009; Poon *et al*., 2010). However, practitioners and facility managers must understand that the safety advantages gained from eMAR are not built in, they rather depend on high rates of system fidelity, good staff training, and workflow-based implementation (Carayon & Hoonakker, 2019; Iqbal *et al*., 2021). Evidence from this review demonstrates how non-adherence behaviors, such as not scanning patient identification bands (20%) and medication barcodes (29%), significantly diminish system effectiveness, negating the safeguards provided by the technology (Mulac *et al*., 2021). Investing in optimization of human and organizational factors is thus at least as important as the technology itself.

Publisher: SARC Publisher

From a policy perspective, the differences in fidelity and adoption rates found in this review (18%–49%) reinforce the need for standardized implementation frameworks and/or statutory requirement regarding eMAR use within LTCFs. The Center for Medicare & Medicaid Services in the United States is increasingly recognizing electronic medication record keeping as a key contributor to safe medication management standards (McGreevey III *et al*., 2020). As highlighted by Gesner *et al*. (2022), national digital health strategies should also consider the relevant infrastructural challenges to LTCFs, such as internet connectivity, device availability and information technology support capacity that may hinder successful adoption of digital technologies (Gesner *et al*., 2022). The economic findings from this review offer strong evidence underpinning the assumption that even resource-limited environments have strong justification for supporting investment towards eMAR (Fuller *et al*., 2018). Design constraints identified will inform future systems design that prioritizes adaptive dosing schedules integrated into the pharmacy dispensing process, user interface designs that are intuitive to use and effective alert management (Blijleven *et al*., 2017; Iqbal *et al*., 2021).

STRENGTHS, LIMITATIONS AND FUTURE DIRECTIONS

There are several methodological strengths of this review. The diversity of outcomes explored across overall error rates, individual types and severity of error, real-time safety interception mechanisms, missed medication surveillance, documentation quality and efficiency in workflow, human and organizational factors, as well as system-related barriers to change along with economic considerations provides a more comprehensive multidimensional picture of eMAR implementation. This was not previously reported in other less broad studies (Fuller *et al*., 2018; Stolic *et al*., 2023). The mix of both quantitative and qualitative evidence allows for exploration into the contextual and mechanistic drivers of implementation outcomes, critical to transferring evidence into practice. The review was also carried out and reported according to the PRISMA 2020 guidelines (Page *et al*., 2021), which provided a transparent and reproducible synthesis framework. Including a variety of study designs additionally allows for assessment of reproducibility across different methodological approaches.

However, few limitations must be acknowledged. The included studies were found to exhibit considerable methodological heterogeneity as there was variability in definitions and measurement of outcomes, study populations and design and configuration of eMAR systems. This precluded meta-analysis for pooled estimates comparisons and limits the precision of comparative conclusions (Stolic *et al*., 2023). Also, the observed dominant use of pre-post observational designs without contemporaneous control groups raises a serious risk of bias due to secular changes and co-interventions which severely limits causal inference (Page *et al*., 2021). This is a well-known weakness of the health information technology evaluation literature more widely, where randomized controlled trials are still rare (Carayon & Hoonakker, 2019). In addition, the majority of included studies were conducted in acute hospital or combined care settings, and relatively few specifically examined long-term care facilities. This limits the direct generalizability of findings to LTCFs, which have unique staff composition, regulatory environments and organizational features.

Future research should focus on methodologically robust study designs, such as cluster-randomized controlled trials and interrupted time-series analyses with appropriate control conditions, performed specifically in LTCF populations (Najjemba & Solomon, 2026). Having standard definitions for drug error types, and severity classification systems, as well as transparent reporting of rates of system adoption and fidelity in implementation are necessary for meaningful cross-study comparisons and evidence synthesis (Mulac *et al*., 2021; Stolic *et al*., 2023). There is also a need for long-term follow-up studies which evaluate sustained error minimization and behavioral adjustment, as early performance data may not be indicative of steady-state system performance (Fuller *et al*., 2018). Research that uses health system-level data to assess the economic implications of eMAR will significantly complement the existing body of literature, as would studies on the impact of eMAR implemented in low- and middle-income countries and settings to help inform equitable policy development.

CONCLUSION

This comprehensive evidence synthesis suggests that eMAR and barcode-enabled medication administration systems are correlated with lower

Publisher: SARC Publisher

overall rates of medication errors plus specific types of medication errors, including transcription, wrong medicine, wrong dose and timing, as well as reductions in error severity and adverse drug events. This is combined with real-time safety systems, better documentation accuracy, improved communication and organized medication management processes. However, results also show heterogeneity in the effectiveness of epidemiological data across settings, persistence of certain error types such as timing and omissions, and the introduction of new procedural risks. Human factors, workflow integration, system design, technical reliability, training and organizational implementation fidelity were identified to affect system effectiveness in long-term care environments.

To maximize the safety benefits of eMAR systems, policymakers and healthcare organizations should implement regulatory frameworks supporting comprehensive staff training, full integration of dispensing, prescribing and administration processes as well as investment into a robust technical infrastructure to minimize system failures and workflow disruptions. Moreover, implementation strategies should also include continuous monitoring, user-centered system design improvements and organizational policies that are compatible with adherence and minimize workarounds so as to enhance medication safety outcomes in long-term care settings.

REFERENCES

1. Alanazi, A., Alomar, M., Aldosari, H., Shahrani, A., & Aldosari, B. "The Effect of Electronic Medication Administration Records on the Culture of Patient Safety: A Literature Review." *ICIMTH* (2018): 223-226.
2. Alenius, M., & Graf, P. "Use of electronic medication administration records to reduce perceived stress and risk of medication errors in nursing homes." *CIN: Computers, Informatics, Nursing* 34.7 (2016): 297-302.
3. Au-Doung, P. L. W., Chau, H. C., Wong, C. H., Lau, K. C., Chan, Y. Q., Yip, H. L., & Cheung, Y. T. "Implementation of an Electronic Medication Management System in 41 Residential Care Homes in Hong Kong: Pre–Post Interventional Study." *JMIR aging* 8.1 (2025): e79262.
4. Bengtsson, M., Ekedahl, A. B. I., & Sjöström, K. "Errors linked to medication management in nursing homes: an interview study." *BMC nursing* 20.1 (2021): 69.
5. Berdot, S., Roudot, M., Schramm, C., Katsahian, S., Durieux, P., & Sabatier, B. "Interventions to reduce nurses' medication administration errors in inpatient settings: a systematic review and meta-analysis." *International journal of nursing studies* 53 (2016): 342-350.
6. Blijleven, V., Koelemeijer, K., Wetzels, M., & Jaspers, M. "Workarounds emerging from electronic health record system usage: consequences for patient safety, effectiveness of care, and efficiency of care." *JMIR human factors* 4.4 (2017): e7978.
7. Bonkowski, J., Carnes, C., Melucci, J., Mirtallo, J., Prier, B., Reichert, E., & Weber, R. "Effect of barcode-assisted medication administration on emergency department medication errors." *Academic Emergency Medicine* 20.8 (2013): 801-806.
8. Carayon, P., & Hoonakker, P. "Human factors and usability for health information technology: old and new challenges." *Yearbook of medical informatics* 28.01 (2019): 071-077.
9. Dalton, B. R., Sabuda, D. M., Bresee, L. C., & Conly, J. M. "Use of an electronic medication administration record (eMAR) for surveillance of medication omissions: results of a one year study of antimicrobials in the inpatient setting." *PLoS One* 10.4 (2015): e0122422.
10. DeYoung, J. L., VanderKooi, M. E., & Barletta, J. F. "Effect of bar-code-assisted medication administration on medication error rates in an adult medical intensive care unit." *American Journal of Health-System Pharmacy* 66.12 (2009): 1110-1115.
11. Donaldson, L. J., Kelley, E. T., Dhingra-Kumar, N., Kieny, M. P., & Sheikh, A. "Medication without harm: WHO's third global patient safety challenge." *The Lancet* 389.10080 (2017): 1680-1681.
12. Elliott, R. A., Lee, C. Y., & Hussainy, S. Y. "Electronic prescribing and medication management at a residential aged care facility." *Applied clinical informatics* 7.01 (2016): 116-127.
13. Ferrah, N., Lovell, J. J., & Ibrahim, J. E. "Systematic review of the prevalence of medication errors resulting in hospitalization and death of nursing home residents." *Journal of the American Geriatrics Society* 65.2 (2017): 433-442.

Publisher: SARC Publisher

14. Filani, A., & Opoku, J. A. "Protecting electronic health records (EHRs): Advances and challenges in data security and privacy." *Sarcouncil Journal of Engineering and Computer Sciences* 4 (2025): 1-9.
15. Fuller, A. E., Guirguis, L. M., Sadowski, C. A., & Makowsky, M. J. "Electronic medication administration records in long-term care facilities: A scoping review." *Journal of the American Geriatrics Society* 66.7 (2018): 1428-1436.
16. Gesner, E., Dykes, P. C., Zhang, L., & Gazarian, P. "Documentation burden in nursing and its role in clinician burnout syndrome." *Applied clinical informatics* 13.05 (2022): 983-990.
17. Helmons, P. J., Wargel, L. N., & Daniels, C. E. "Effect of bar-code-assisted medication administration on medication administration errors and accuracy in multiple patient care areas." *American Journal of Health-System Pharmacy* 66.13 (2009): 1202-1210.
18. Iqbal, A. R., Parau, C. A., Kazi, S., Adams, K. T., La, L., Hettinger, A. Z., & Ratwani, R. M. "Identifying electronic medication administration record (eMAR) usability issues from patient safety event reports." *The Joint Commission Journal on Quality and Patient Safety* 47.12 (2021): 793-801.
19. Is-mail, M., & Nortey, R. "Family Caregivers' Role in Hypertensive Medication Adherence: A Systematic Review and Synthesis of Evidence." *International Journal For Multidisciplinary Research*. (2026).
20. Jokanovic, N., Tan, E. C., Dooley, M. J., Kirkpatrick, C. M., & Bell, J. S. "Prevalence and factors associated with polypharmacy in long-term care facilities: a systematic review." *Journal of the American Medical Directors Association* 16.6 (2015): 535-e1.
21. Karnehed, S., Pejner, M. N., Erlandsson, L. K., & Petersson, L. "Electronic medication administration record (eMAR) in Swedish home healthcare—Implications for Nurses' and nurse Assistants' Work environment: A qualitative study." *Scandinavian Journal of Caring Sciences* 38.2 (2024): 347-357.
22. Kruse, C. S., Mileski, M., Syal, R., MacNeil, L., Chabarria, E., & Basch, C. "Evaluating the relationship between health information technology and safer-prescribing in the long-term care setting: a systematic review." *Technology and Health Care* 29.1 (2021): 1-14.
23. Lalic, S., Sluggett, J. K., Ilomäki, J., Wimmer, B. C., Tan, E. C., Robson, L., & Bell, J. S. "Polypharmacy and medication regimen complexity as risk factors for hospitalization among residents of long-term care facilities: a prospective cohort study." *Journal of the American Medical Directors Association* 17.11 (2016): 1067-e1.
24. Masnoon, N., Shakib, S., Kalisch-Ellett, L., & Caughey, G. E. "What is polypharmacy? A systematic review of definitions." *BMC geriatrics* 17.1 (2017): 230.
25. McGreevey III, J. D., Mallozzi, C. P., Perkins, R. M., Shelov, E., & Schreiber, R. "Reducing alert burden in electronic health records: state of the art recommendations from four health systems." *Applied clinical informatics* 11.01 (2020): 001-012.
26. Mulac, A., Mathiesen, L., Taxis, K., & Gerd Granås, A. "Barcode medication administration technology use in hospital practice: a mixed-methods observational study of policy deviations." *BMJ quality & safety* 30.12 (2021): 1021-1030.
27. Najjemba, M., & Solomon, D. "Systematic Review of the Effectiveness of Multidisciplinary Care-coordination Models for US Citizens with Co-occurring Disorders." *Journal Of Internal Medicine And Public Health* 5.1 (2026): 21-29.
28. Nortey, R. T., Egbunu, A. S., & Oware, E. "Barriers to Social Support Access in Urban vs. Rural Older Adults U.S Populations: A Scoping Review." *Sarcouncil Journal of Medicine and Surgery*, 04.11 (2025): 1-10.
29. World Health Organization. "Global patient safety action plan 2021-2030: towards eliminating avoidable harm in health care." *World Health Organization*, (2021).
30. Oware, D. A., & Mensah, S. "Developing Advanced Predictive Models for Patient Flow Forecasting in Healthcare Facilities: A Systematic Review and Analysis." *International Journal of Frontline Research in Life Science*. (2025).
31. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., & Moher, D. "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews." *bmj* 372 (2021).
32. Poon, E. G., Keohane, C. A., Yoon, C. S., Ditmore, M., Bane, A., Levtzion-Korach, O., & Gandhi, T. K. "Effect of bar-code technology on the safety of medication

Publisher: SARC Publisher

administration." *New England Journal of Medicine* 362.18 (2010): 1698-1707.
33. Pruitt, Z. M., Kazi, S., Weir, C., Taft, T., Busog, D. N., Ratwani, R., & Hettinger, A. Z. "A systematic review of quantitative methods for evaluating electronic medication administration record and bar-coded medication administration usability." *Applied Clinical Informatics* 14.01 (2023): 185-198.
34. Qian, S., Yu, P., & Hailey, D. M. "The impact of electronic medication administration records in a residential aged care home." *International Journal of Medical Informatics* 84.11 (2015): 966-973.
35. Stolic, S., Ng, L., & Sheridan, G. "Electronic medication administration records and nursing administration of medications: An integrative review." *Collegian* 30.1 (2023): 163-189.
36. Szczepura, A., Wild, D., & Nelson, S. "Medication administration errors for older people in long-term residential care." *BMC geriatrics* 11.1 (2011): 82.
37. Tariq, A., Lehnbom, E., Oliver, K., Georgiou, A., Rowe, C., Osmond, T., & Westbrook, J. "Design challenges for electronic medication administration record systems in residential aged care facilities." *Applied clinical informatics* 5.04 (2014): 971-987.
38. Truitt, E., Thompson, R., Blazey-Martin, D., Nisai, D., & Salem, D. "Effect of the implementation of barcode technology and an electronic medication administration record on adverse drug events." *Hospital pharmacy* 51.6 (2016): 474-483.
39. Westbrook, J. I., Sunderland, N. S., Woods, A., Raban, M. Z., Gates, P., & Li, L. "Changes in medication administration error rates associated with the introduction of electronic medication systems in hospitals: a multisite controlled before and after study." *BMJ health & care informatics* 27.3 (2020): e100170.
40. Zhang, Y., Flum, M., Nobrega, S., Blais, L., Qamili, S., & Punnett, L. "Work organization and health issues in long-term care centers: Comparison of perceptions between caregivers and management." *Journal of Gerontological Nursing* 37.5 (2011): 32-40.

Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:
Gershon, S. G. “A Systematic Review of Electronic Medication Administration Records (eMAR) and Their Impact on Medication Error Reduction in Long-Term Care Facilities." *Sarcouncil Journal of Applied Sciences* 6.6 (2026): pp 39-48.

Publisher: SARC Publisher