GE HealthCare

White paper

Digital medication ordering in acute and critical care: advancing safety, consistency, and clinical workflow

Executive summary

Steve Tsai, MBA; Marc Wysocki, MD, MMC; David De Haan, Sr Global Product Manager.
All authors are full time GE HealthCare employees.

Medication safety remains a major opportunity to reduce avoidable harm in hospital care.[1] Organisation for Economic Co-operation and Development (OECD) analyses indicate that medication-related harm remains a major burden across OECD and European health systems, with up to 1 in 10 hospitalizations linked to medication-related events and approximately 20% of hospitalized patients experiencing medication-related harm.[2] In that context, digital medication ordering (DMO) should be treated not as a digitized replica of paper prescribing but as an important safety control within a broader medication-management architecture.

Literature supports moving beyond basic computerized order entry. Well-designed systems can reduce prescribing and administration errors, and ICU-focused evidence suggests they may also improve patient outcomes. A 2025 meta-analysis limited to randomized controlled trials found an overall 15% reduction in medication-error risk[3] and a stronger signal for clinical decision support than for electronic alerts or e-learning alone, while also noting heterogeneity and a limited trial base. The implication for health systems is that the next phase of maturity is more than digitized replica of paper prescribing. It is the development of DMO including safety expert systems that standardize orders, automate calculations, preserve pharmacist verification, connect ordering to dispensing and administration, and remain under continuous clinical governance.[5,9,10,11]

Educational content. The evidence summarized here reflects published literature on digital medication ordering as a category and is not intended as a description of, or claim about, any GE HealthCare product. Clinical decisions should be made by qualified professionals based on the totality of available evidence and applicable product labeling.

The case for change

Medication-related harm can arise anywhere between prescribing and administration. AHRQ (Agency for HealthCare Research and Quality) defines a medication error as an error of commission or omission anywhere along the pathway from prescribing to the moment the patient receives the medication, and it distinguishes potential adverse drug events, preventable adverse drug events, ameliorable events, and nonpreventable adverse effects. AHRQ also notes that about half of adverse drug events are considered preventable. WHO frames unsafe medication practices as the product of both system weakness and human factors, which is why medication safety is fundamentally a systems-design problem rather than only an individual performance problem.[1,4]

Figure 1. Adapted from https://psnet.ahrq.gov/primer/medication-errors-and-adverse-drug-events.

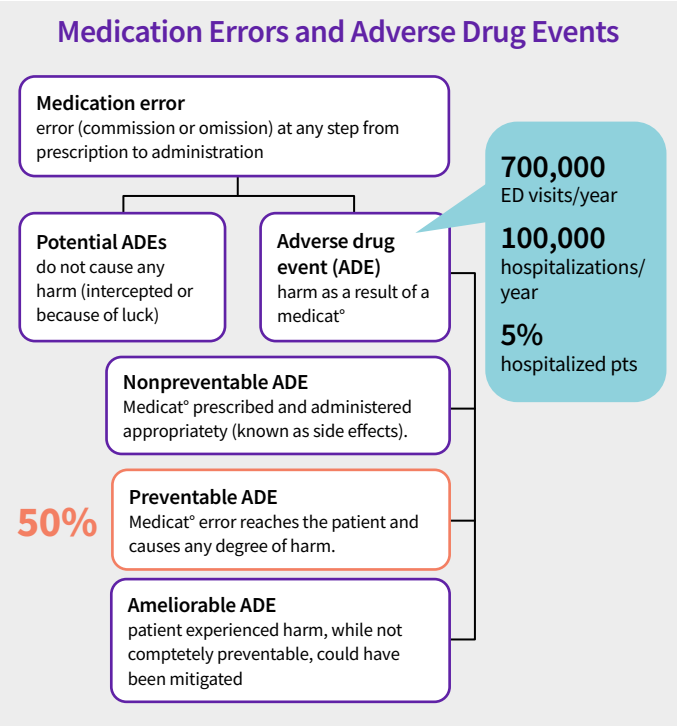
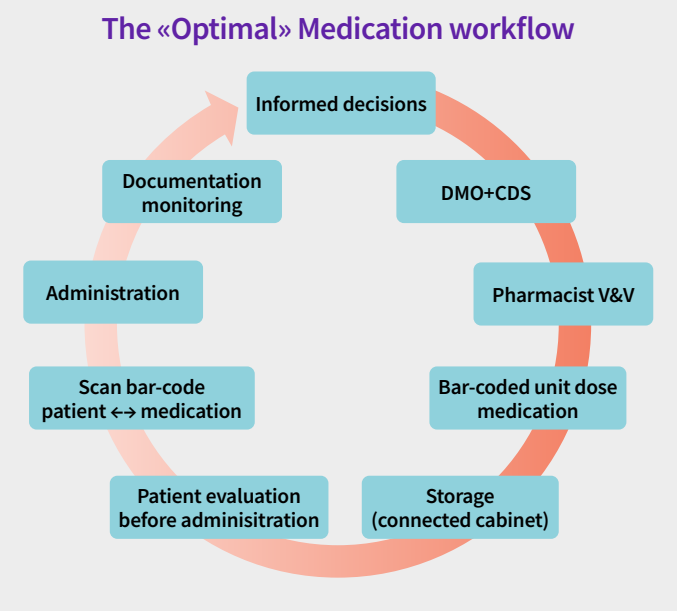


Figure 2. Adapted from Shermock SB, Shermock KM, Schepel LL. Closed-Loop Medication Management with an Electronic Health Record System in U.S. and Finnish Hospitals. International Journal of Environmental Research and Public Health. 2023;20(17):6680. doi:10.3390/ijerph20176680.



Why acute and critical care need more than basic DMO

Critical care exposes the limits of paper and basic e-prescribing because the medication process is iterative, multi-actor, and calculation-intensive. Workflow analysis in pediatric and neonatal intensive care shows that body weight, organ function, fluid balance, and infusion composition can change frequently; clinicians often work with mixed infusions, and dosing calculations that differ markedly from adult routines. Under those conditions, ambiguity, local workarounds, and arithmetic at the bedside can increase risk. The American Academy of Pediatrics likewise argued that pediatric DMO requires dedicated pediatric functionality rather than applying scaled-down adult defaults.[6,7]

Shermock and colleagues describe mature electronic medication management as an integrated process linking ordering, pharmacist order verification, inventory and dispensing, barcode-enabled administration, documentation, and monitoring. In that model, the value of DMO is not simply legibility; its value lies in making the order structured, computable, reviewable, and traceable across the full medication-use process.[5]

What effective digital medication ordering looks like

Published guidance and workflow analysis point toward a consistent set of design requirements. Orders should rely on standardized drug dictionaries and structured fields whenever computable elements are needed; patient demographic and clinical data should flow automatically into the ordering environment; and the system should support rapid dose adjustment as weight, body surface area, renal function, and fluid status change. In high-risk environments, the system should also calculate concentrations and infusion parameters, warn on dose limits and interactions, avoid duplicate prescribing, support order sets and protocols, and communicate cleanly with pharmacy systems and downstream administration tools.[5,6,7]

Evidence also suggests that decision support and workflow integration matter. Early foundational work by Bates and colleagues demonstrated large reductions in serious medication errors following CPOE implementation, establishing the evidence base that more recent studies have refined.[8] At the national level, Radley and colleagues produced a 2013 modeled national-level estimate suggesting that then-current U.S. CPOE adoption was associated with approximately 17.4 million medication errors averted annually.[13] These findings support the argument that DMO safety expert system can be a major safety intervention when implemented with meaningful functionality rather than superficial digitization. More recently, the 2025 RCT meta-analysis found that CDS-based interventions showed the clearest signal of benefit among the electronic interventions studied.[3]

Evidence of impact in ICU and hospital settings

The ICU-specific evidence is particularly relevant. Prgomet and colleagues, in a systematic review and meta-analysis, found that the transition from paper-based ordering to a DMO safety expert system was associated with an 85% reduction in medication prescribing error rates and a 12% reduction in ICU mortality rates across the included studies, with the authors noting significant heterogeneity and a limited number of included studies.[9]

Broader evidence supports similar direction, although the impact varies across settings and study designs. Gates and colleagues found reductions in medication error rates after implementation of electronic medication systems, while the Cochrane review by Ciapponi and colleagues similarly concluded that DMO safety expert system probably reduces medication errors compared with paper-based systems in adult hospital settings.[10,11]

From digital ordering to medication safety expert systems

The caution from the literature is that digitization does not eliminate risk; it changes its form. Koppel and colleagues identified 22 “new” types of medication-error risk facilitated by a widely used DMO system, and more precisely by fragmented displays, inflexible ordering formats, and interface features that obscured a coherent medication view.[12]

That distinction has practical implications. A DMO safety expert system is not just a prescribing screen; it is a governed clinical platform that embeds standardized content, dose logic, interaction checking, pharmacist verification pathways, and order sets aligned to local practice. It may reduce cognitive load by making safer pathway easier to follow, and it may reduce downstream variability by ensuring that a medication order remains coherent from entry through preparation and administration. In practice, this means treating formulary maintenance, protocol ownership, alert tuning, order-set stewardship, and verification testing as ongoing clinical governance responsibilities rather than one-time implementation tasks.[5,6,9,12]

Hospitals should therefore evaluate DMO investments against a higher standard than paperless ordering. The relevant questions are whether the system supports high-risk medications, infusion calculations, pediatric and critical-care workflows, pharmacist review, barcode-enabled administration, and continuous safety monitoring, and whether the interface creates new ambiguity, fragmented displays, or low-value alert burden. In a safety-critical environment, software assurance and clinical assurance need to be jointly considered.[5,6,12]

Conclusion

Literature supports a clear but more demanding conclusion than simple digitalization. Medication harm is common, costly, and often preventable; DMO and related electronic medication management systems can reduce medication errors and may improve outcomes when they are implemented with strong clinical decision support and closed-loop workflow integration. But the same literature also shows that poorly designed systems can create new classes of error. The practical goal, therefore, is not merely electronic ordering. It is the design, implementation, and governance of a medication safety expert system that can support safer and more consistent care.[1,2,5,9,10,11,12]

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