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Barriers and Facilitators to the Implementation of Electronic Prescribing Systems in Healthcare: A Systematic Review Using a Sociotechnical Framework

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Abstrak

Latar Belakang: Peresepan elektronik (electronic prescribing/e-prescribing) dan computerized provider order entry (CPOE) semakin digunakan dalam pengelolaan obat, tetapi keberhasilan implementasinya tidak hanya ditentukan oleh teknologi. Kesesuaian sistem dengan alur kerja, praktik pengguna, kondisi organisasi, dan lingkungan kebijakan turut memengaruhi penggunaannya dalam pelayanan rutin. **Tujuan:** Mensintesis bukti empiris mengenai hambatan, fasilitator, dan faktor lain yang memengaruhi implementasi e-prescribing/CPOE dalam praktik klinis. **Metode:** Tinjauan sistematis dilakukan sesuai PRISMA 2020. PubMed dan Scopus ditelusuri untuk studi empiris yang diterbitkan Januari 2000–Desember 2025. Studi yang memenuhi syarat secara langsung mengevaluasi hambatan, fasilitator, determinan, atau proses implementasi e-prescribing, CPOE, EPMA, atau EMMS dalam praktik klinis. Kualitas metodologis dinilai menggunakan MMAT 2018 pada tingkat kriteria tanpa menghitung skor numerik keseluruhan. **Hasil:** Sebanyak 49 laporan yang mewakili 48 studi unik dimasukkan. Gangguan alur kerja dan beban kerja paling sering ditemukan (46/48; 95,8%). Infrastruktur teknis/usability, persepsi manfaat/keamanan/efisiensi/waktu, penerimaan/resistensi/self-efficacy/kepercayaan, serta kepemimpinan/kesiapan organisasi/keterlibatan pengguna masing-masing ditemukan pada 45/48 studi (93,8%). Pelatihan dan dukungan implementasi ditemukan pada 43/48 (89,6%), komunikasi/interoperabilitas/pemrosesan resep pada 38/48 (79,2%), dan faktor kebijakan/finansial/lingkungan eksternal pada 21/48 (43,8%). **Kesimpulan:** Implementasi e-prescribing/CPOE melibatkan faktor teknis, alur kerja, manusia, organisasi, dan lingkungan eksternal yang saling berkaitan. Kesesuaian alur kerja, kesiapan organisasi, keterlibatan pengguna, dukungan implementasi, serta kondisi kebijakan dan sumber daya perlu diperhatikan ketika sistem diterapkan atau dioptimalkan. Frekuensi tema menunjukkan keterwakilan tema antarstudi dan bukan ukuran efek.

Kata kunci: Peresepan Elektronik; Informatika Medis; Keselamatan Pasien; Difusi Inovasi; Sistem Pengobatan Rumah Sakit

Abstract

Background: *Electronic prescribing (e-prescribing) and computerized provider order entry (CPOE) are increasingly used in medication management, but successful implementation depends on more than technology. How systems fit workflows, user practices, organizational conditions, and the policy environment can influence their use in routine care.* ***Objective:*** *To synthesize empirical evidence on barriers, facilitators, and other factors influencing e-prescribing/CPOE implementation in clinical practice.* ***Methods:*** *This systematic review followed PRISMA 2020. PubMed and Scopus were searched for empirical studies published from January 2000 through December 2025. Eligible studies directly examined barriers, facilitators, determinants, or implementation processes involving e-prescribing, CPOE, EPMA, or EMMS in clinical settings. Methodological quality was assessed at criterion level using MMAT 2018 without an overall numerical score.* ***Results:*** *The review included 49 reports representing 48 unique studies. Workflow disruption and workload were most frequent (46/48; 95.8%). Technical infrastructure/usability, perceived usefulness/safety/efficiency/time, acceptance/resistance/self-efficacy/trust, and leadership/organizational readiness/user engagement were each identified in 45/48 studies (93.8%). Training and implementation support occurred in 43/48 (89.6%), communication/interoperability/prescription processing in 38/48 (79.2%), and policy/financial/external-environment factors in 21/48 (43.8%).* ***Conclusion:*** *E-prescribing/CPOE implementation involves interconnected technical, workflow, human, organizational, and external factors. Workflow fit, organizational readiness, user involvement, implementation support, and policy and resource conditions require attention when systems are introduced or optimized. Theme frequencies indicate study-level presence rather than effect estimates.*

Keywords: *Electronic Prescribing; Medical Informatics; Patient Safety; Diffusion of Innovation; Medication Systems, Hospital*

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1. INTRODUCTION

Electronic prescribing (e-prescribing) and computerized provider order entry (CPOE) have become important components of digital medication management. Their use has been associated with improvements in medication safety, including reductions in prescribing and medication errors, although the extent of these benefits differs across healthcare settings and system configurations [1]. Introducing these systems, however, does not necessarily ensure that they will be used effectively or sustained over time. Implementation studies have described disruptions to established workflows, usability and integration difficulties, workarounds, and technology-related safety concerns during and after implementation [2].

Such difficulties arise because electronic prescribing is embedded within a broader clinical and organizational environment. Health information technologies interact with everyday clinical workflows, professional practices, organizational structures, technical infrastructure, and the wider context in which care is delivered [3]. Misalignment among these elements may prompt adaptations to technology or working practices, sometimes with unintended consequences. Implementation should therefore be examined through their interactions rather than as separate technical or behavioral factors.

Previous research has examined stakeholder experiences, adoption, usability, and workflow in e-prescribing/CPOE implementation [2], but variation in clinical settings, technologies, professional groups, and implementation stages makes recurring issues difficult to identify. Synthesizing studies that directly report barriers, facilitators, and other implementation determinants may clarify these recurring patterns and their interrelationships.

This systematic review therefore aimed to synthesize direct empirical evidence on barriers and facilitators to e-prescribing/CPOE implementation in clinical practice and to organize the findings into higher-order sociotechnical implementation themes.

2. METHODS

Research design

This systematic review examined empirical evidence on barriers, facilitators, and determinants of medication e-prescribing/CPOE implementation in real-world clinical practice. The review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement [4,5].

Identification of sources

PubMed and Scopus were searched for studies published between January 2000 and December 2025. The search combined terms for electronic prescribing, e-prescribing, computerized physician/provider order entry, electronic prescribing and medicines administration (EPMA), and electronic medication management systems (EMMS) with terms related to implementation, barriers, facilitators, determinants, adoption, workflow, and healthcare settings. Reports identified previously through other methods were also assessed and were evaluated using the same eligibility criteria as reports retrieved from the database searches.

Screening

After the review topic had been approved by the supervisory team, titles and abstracts were screened against the predefined eligibility criteria. Reports considered potentially relevant were then assessed in full text. Eligibility decisions and the study-selection process were reviewed periodically with the supervisory team, and their feedback was incorporated throughout the review to maintain consistency with the prespecified criteria.

Eligibility assessment

Primary empirical studies using qualitative, quantitative, or mixed-methods designs were eligible if they were conducted in real-world clinical practice; focused on medication e-prescribing, CPOE, electronic prescribing and medicines administration (EPMA), or electronic medication management systems (EMMS); and provided

extractable evidence on implementation barriers, facilitators, determinants, implementation success or failure, transition, or optimization processes.

Reviews, editorials, commentaries, protocols, non-empirical implementation narratives, and conference abstracts without sufficient report detail were excluded. Studies were also excluded when they focused solely on technical architecture or system design, simulation or student-only settings, nonclinical consumer prescribing, diagnostic/laboratory/radiology CPOE, or narrow disease- or drug-specific decision-support interventions in which medication e-prescribing implementation was not central. Studies reporting only clinical outcomes, prescribing errors, attitudes, satisfaction, or workflow consequences without directly examining implementation determinants were also excluded.

Data extraction, assessment, and synthesis

Methodological quality was assessed using the Mixed Methods Appraisal Tool (MMAT) 2018 at the criterion level, without calculating an overall numerical score [6]. Implementation findings were examined through a structured thematic synthesis informed by a sociotechnical perspective [3]. Extracted barriers and facilitators were coded and compared iteratively across studies to identify recurring implementation determinants. Related codes were first grouped into descriptive domains and were then consolidated into eight higher-order themes based on conceptual similarity and relationships across technical, workflow, human, organizational, communication, and external implementation contexts.

A determinant could function as either a barrier or a facilitator depending on the context in which it was reported. Theme frequency was calculated as the number of included studies contributing evidence to each theme. These frequencies therefore describe study-level presence and were not treated as effect sizes, severity rankings, or estimates of causal importance.

3. RESULTS

The 49 included reports [7–55] represented 48 unique studies. Together, these studies provided direct empirical evidence on barriers, facilitators, and determinants of medication e-prescribing/CPOE/EPMA/EMMS implementation in real-world clinical practice. Figure 1 summarizes the study-selection process, while Table 1 and Figure 2 present the thematic synthesis.

3.1 Study selection

The database searches identified 1,480 records (PubMed, n = 410; Scopus, n = 1,070). After removing 130 duplicates, 1,350 records were screened and 990 excluded. Of 360 reports assessed for eligibility, 312 were excluded, leaving 48 reports representing 47 unique studies. Four reports identified through other methods were assessed; three were excluded and one retained. Overall, 49 reports representing 48 unique studies were included, with one study represented by two companion reports [11,12].

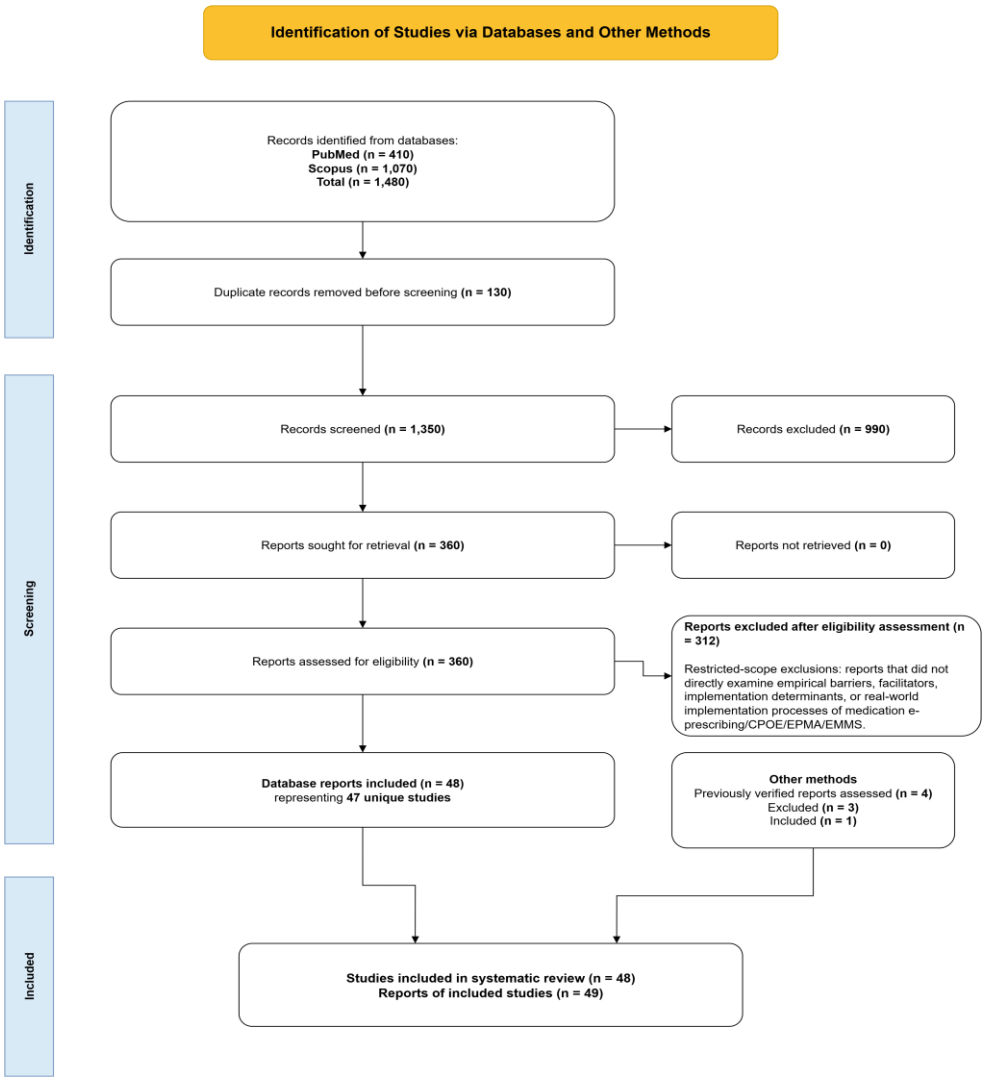

Figure 1. PRISMA flow diagram of study selection.

3.2 Study characteristics

The 48 included studies covered hospital, ambulatory, primary-care, community-pharmacy, and other clinical medication-management settings. Study designs comprised 21 qualitative studies, 12 quantitative descriptive studies, four quantitative non-randomized studies, and 11 mixed-methods studies. The technologies examined included electronic prescribing systems, CPOE, EPMA/EMMS platforms, and medication-ordering systems with implementation-relevant decision-support functionality, with detailed characteristics of all included studies provided in Supplementary Table S1.

3.3 Quality assessment

Methodological quality was assessed at the criterion level using MMAT 2018. All 48 studies were retained because the appraisal was used to characterize the available evidence rather than to establish a post hoc threshold for exclusion. When reporting was insufficient to determine whether a criterion had been met, the assessment remained “Can't tell.” No overall numerical quality score was calculated; criterion-level MMAT 2018 appraisal for all included studies is provided in Supplementary Table S2.

3.4 Final thematic synthesis of implementation barriers and facilitators

Implementation determinants were distributed across several interacting sociotechnical domains. Workflow disruption and workload were identified in 46 of 48 studies (95.8%). Four themes were each identified in 45 studies (93.8%): technical infrastructure and usability; perceived usefulness, safety, efficiency, and time; acceptance, resistance, self-efficacy, and trust; and leadership, organizational readiness, and user engagement.

Training, implementation support, and capability were identified in 43 studies (89.6%), communication, interoperability, and prescription processing in 38 (79.2%), and policy, financial, and external-environment determinants in 21 (43.8%). These frequencies indicate study-level presence, not effect size or causal weight.
Table 1 summarizes the eight higher-order implementation themes, their study-level frequencies, and the dominant barrier and facilitator patterns identified across the included studies.

Table 1. Eight higher-order implementation themes identified across the included studies (N = 48).

Higher-order theme	n/N (%)	Dominant barrier pattern	Dominant facilitator pattern	Interpretation
Workflow disruption & workload	46/48 (95.8%)	Transition burden, slower/complex prescribing, duplication, workflow mismatch.	Workflow mapping/redesign, staged rollout, local configuration, iterative optimization.	Most prevalent theme.
Technical infrastructure & usability	45/48 (93.8%)	Network instability, downtime, limited devices, difficult interfaces, poor integration.	Reliable infrastructure, usable interfaces, interoperability, vendor collaboration.	Core technical implementation condition.
Perceived usefulness, safety, efficiency & time	45/48 (93.8%)	Uncertain benefit, new-risk concerns, extra time.	Visible safety/efficiency gains, better information access, time/effort savings.	Perceived clinical value shapes uptake.
Acceptance, resistance, self-efficacy & trust	45/48 (93.8%)	Resistance, fear of change, low digital confidence, low trust.	Positive attitudes, prior exposure, proficiency, self-efficacy, trust.	Human adaptation condition.
Leadership, organizational readiness & user engagement	45/48 (93.8%)	Weak planning/support, poor readiness, low clinician commitment.	Governance, champions, multidisciplinary teams, co-design, ownership.	Organizational implementation capacity.
Training, implementation support & capability	43/48 (89.6%)	Inadequate/late/generic training, limited go-live support.	Role-specific ongoing training, at-elbow support, feedback.	Capability-building condition.
Communication, interoperability & prescription processing	38/48 (79.2%)	Failed/uncertain transmission, fragmented exchange, pharmacy coordination problems.	Protocols, prescriber-pharmacy collaboration, standards, process redesign.	Cross-boundary process condition.
Policy, financial & external environment	21/48 (43.8%)	Costs, fees, weak incentives, legal/standards constraints.	Funding, incentives, clear regulation/standards, regional support.	External boundary condition.

Workflow and technical determinants

Implementation frequently disrupted established prescribing and medication-management workflows, particularly during transition periods. Reported barriers included increased workload, slower or more complex prescribing processes, duplicated or transcription-related tasks, mismatches between workflows and technology, unstable networks, system downtime, insufficient hardware, difficult interfaces, and incomplete interoperability. Facilitators included workflow mapping and redesign, staged implementation, reliable infrastructure, local system configuration, vendor collaboration, and continued optimization after implementation.

Perceptions of system value were closely linked to users' technical and workflow experiences. Implementation was supported when users perceived improvements in medication safety, access to information, coordination, efficiency, or time. Conversely, uncertain benefits, additional time requirements, and concerns about new technology-related risks could hinder implementation.

Human and organizational determinants

Organizational preparation and participation by intended users were recurring influences on implementation. Resistance to change, low digital confidence, negative previous experiences with technology, weak implementation culture, limited clinician cooperation, and inadequate preparation were reported as barriers. Clinical leadership, visible champions, multidisciplinary implementation teams, organizational readiness, user engagement and co-design, self-efficacy, and trust in system performance were reported as facilitators.

Training and implementation support were also prominent across settings. Inadequate, late, generic, or poorly tailored training and insufficient support during go-live were recurrent barriers. Role-specific training, at-elbow

support, feedback mechanisms, start-up information sessions, and continued capability development supported implementation.

Communication and prescription-processing difficulties often extended across professional and organizational boundaries. Uncertain electronic transmission, inaccurate or incomplete prescriptions, fragmented information exchange, and mismatches between paper and electronic processes hindered implementation. Standardized protocols, pharmacy-prescriber collaboration, interoperability, and redesign of prescription-processing workflows acted as facilitators.

External policy and resource environment

Policy, financial, and external-environment determinants were reported less often than local technical, workflow, human, and organizational factors. Barriers included capital and maintenance costs, transaction fees, limited incentives, inadequate standards, legal restrictions, and resource constraints. Facilitators included funding, reimbursement or fee waivers, clearer regulations and standards, policy alignment, and regional or shared implementation support.

The lower frequency of external-environment determinants (21/48, 43.8%) should not be interpreted as evidence of lower causal importance. Rather, these factors were examined less consistently across the included studies and often operated as boundary conditions that enabled or constrained implementation at the organizational or system level.

3.5 Cross-theme sociotechnical interactions

The findings showed that implementation determinants were interconnected across technology, workflow, users, organizational structures, and the external policy environment. The same determinant could function as either a barrier or a facilitator depending on local circumstances. Training, leadership, infrastructure, workflow design, perceived value, trust, and user engagement were repeatedly reported in both negative and positive forms.

Technical reliability alone did not account for the broader implementation experience. Infrastructure and usability were linked to workload and user confidence; organizational readiness influenced training and problem resolution; communication and interoperability affected prescription processing; and perceived clinical value was linked to acceptance and continued use. Figure 2 summarizes the eight higher-order themes and their study-level prevalence.

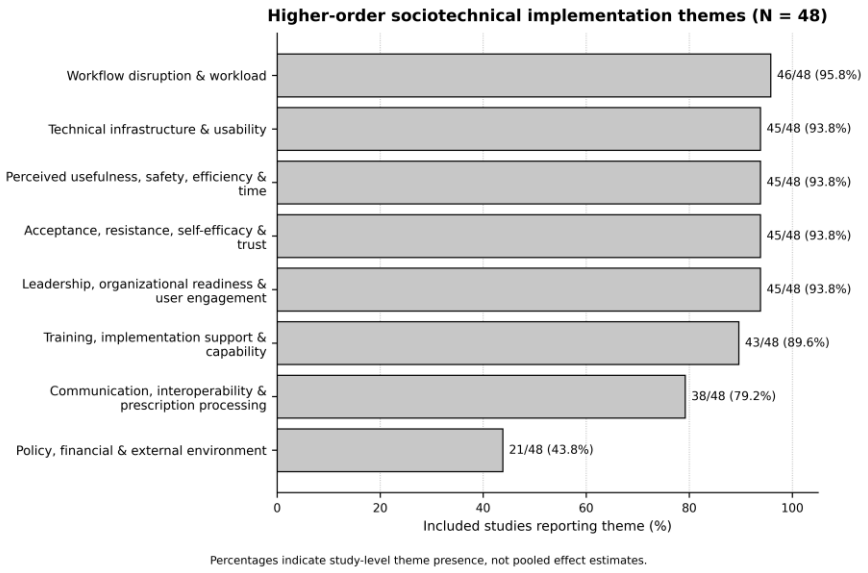

Figure 2. Higher-order implementation themes identified across 48 included studies. Percentages indicate the proportion of included studies contributing evidence to each theme; they do not represent pooled effect estimates.

4. DISCUSSION

This systematic review synthesized 48 unique studies reported in 49 publications examining barriers, facilitators, and determinants of medication e-prescribing/CPOE/EPMA/EMMS implementation. Implementation reflected interactions between technology and its setting, with workflow, user responses, organizational capacity, training and support, communication, and external policy and resource conditions closely connected.

Workflow disruption and workload were the most frequent theme (46/48, 95.8%), reflecting how electronic prescribing can reorganize medication-related work beyond order entry. Additional documentation, duplicated tasks, altered work sequences, and poor alignment with established practice may create burdens despite technical functionality. Conversely, workflow mapping, staged rollout, local configuration, and continued optimization can support integration into routine practice.

Technical infrastructure and usability were identified in 45/48 studies (93.8%). Network instability, downtime, inadequate device access, difficult interfaces, incomplete functionality, and poor interoperability could disrupt workflow and user confidence. Similar challenges in Indonesian primary care included limited human resources, inadequate infrastructure, network instability, and workflow irregularities [56]. Technical readiness therefore involves reliability, usability, integration, and adaptation to local needs.

Human and organizational factors further show that implementation extends beyond technology deployment. Acceptance, resistance, self-efficacy, and trust, as well as leadership, organizational readiness, and user engagement, were each identified in 45/48 studies (93.8%), while training and implementation support appeared in 43/48 (89.6%). Implementation was supported by user preparation and involvement, visible leadership, and continued practical support, suggesting that training should extend beyond preparation before go-live.

Perceived usefulness, safety, efficiency, and time were also identified in 45/48 studies (93.8%). These perceptions provide an important link between users' experience of the system and their willingness to continue using it. Improvements in medication safety, access to information, coordination, or efficiency may reinforce acceptance, whereas additional work or unclear clinical benefit may have the opposite effect. A recent Jurnal Farmasimed systematic review of electronic medical record adoption similarly reported that perceived usefulness and perceived ease of use contribute to technology acceptance, although their relative influence may differ according to adoption phase and healthcare context [57]. The present findings extend this perspective by showing that perceived value is embedded within a wider set of workflow, technical, and organizational conditions.

Communication, interoperability, and prescription processing were identified in 38/48 studies (79.2%), showing that implementation also extends beyond interactions between an individual user and the electronic system. Medication prescribing involves information moving between prescribers, pharmacists, other healthcare professionals, and, in some settings, separate organizations or technical platforms. Problems with transmission, information exchange, or prescription processing can therefore persist even when the local interface performs adequately. This makes interoperability and coordination part of the implementation process rather than solely technical system features.

Policy, financial, and external-environment determinants were identified less frequently (21/48, 43.8%), but this difference should be interpreted cautiously. These factors were examined inconsistently so their lower frequency does not indicate lower importance. Costs, incentives, reimbursement arrangements, legal requirements, standards, and regional support can shape the resources and conditions available to organizations implementing electronic prescribing. Their influence may therefore operate as a broader boundary condition rather than as an issue encountered directly by every user.

Viewed together, the eight themes show how implementation conditions can reinforce or constrain one another. Reliable infrastructure may improve workflow but provide limited benefit when users receive inadequate training or lack confidence in the system. Strong leadership and user engagement may help organizations identify workflow problems and respond to them, while poor interoperability can undermine otherwise usable

local systems. The barrier–facilitator distinction is consequently context dependent: several determinants appeared in negative or positive forms depending on how the system was introduced, supported, and incorporated into clinical work. This interaction across domains is central to interpreting the sociotechnical pattern identified in the review.

Several limitations should be considered when interpreting these findings. The included studies differed in setting, design, participant groups, technology, and stage of implementation, which precluded quantitative pooling. Theme frequencies indicate whether individual studies contributed evidence to a theme; they do not measure effect magnitude, severity, or causal importance. The depth of methodological reporting also varied, and MMAT criteria were therefore retained as "Can't tell" when the available information was insufficient for a definitive judgment. In addition, the eligibility criteria were designed to capture direct empirical evidence on implementation determinants. The findings consequently should not be generalized to literature concerned solely with clinical effectiveness, medication-error outcomes, or general attitudes toward technology.

Within these boundaries, the review synthesizes recurring implementation patterns and their interrelationships across diverse e-prescribing and CPOE contexts. The findings point to several areas that warrant attention during implementation: alignment with clinical workflows, reliable and usable infrastructure, demonstrable value to users, organizational preparation and engagement, sustained role-specific training and support, effective communication and interoperability, and an external policy and resource environment that can support implementation over time.

5. CONCLUSION

Implementation of electronic prescribing and computerized provider order entry systems is shaped by interconnected technical, workflow, human, organizational, communication, and external conditions. Workflow disruption and workload were the most frequently identified implementation issues, while technical infrastructure and usability, perceived value, acceptance and trust, organizational readiness and user engagement, training and support, communication and interoperability, and the external policy and resource environment also influenced implementation across the included studies.

These findings highlight the importance of considering how electronic prescribing systems fit into routine clinical practice and the organizational environment in which they are introduced. Attention to workflow alignment, reliable infrastructure and interoperability, organizational readiness, user involvement, sustained role-specific training and support, and relevant policy and resource conditions may help organizations plan, implement, and optimize e-prescribing/CPOE systems in clinical practice.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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