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Electronic Medical Records and Their Role in Developing Health Services: A Narrative Review

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Abstract

Background: The adoption of electronic medical records (EMRs) has been positioned as a cornerstone of health service development, promising improvements in care quality, patient safety, and operational efficiency. However, evidence on their actual impact remains mixed, with implementation challenges and unintended consequences emerging alongside benefits. **Aim:** This narrative review synthesizes evidence from 2015–2025 on the role of EMRs in developing health services, examining their effects on clinical outcomes, workflow efficiency, data interoperability, and patient engagement. **Methods:** A systematic search of PubMed, CINAHL, Scopus, and grey literature (2015–2025) identified 40 peer-reviewed articles, technical reports, and policy documents for narrative synthesis. **Results:** Key findings indicate that EMRs improve medication safety, guideline adherence, and care coordination when optimally implemented. However, benefits are contingent on interoperability, usability, and organizational readiness. Challenges include documentation burden, clinician burnout, fragmented data exchange, and implementation costs. Innovations such as artificial intelligence integration and patient portals show promise. **Conclusion:** EMRs are powerful enablers of health service development, but realizing their potential requires addressing interoperability gaps, reducing documentation burden, and supporting clinicians through implementation.

Keywords: electronic medical records, health services development, interoperability, patient safety, digital health.

1. Introduction

The digital transformation of healthcare has positioned electronic medical records (EMRs) as central to the modernization of health services worldwide [1,2]. Unlike paper-based records, which are fragmented, difficult to access, and prone to error, EMRs promise a single, legible, and accessible repository of patient information that can be shared across clinicians, settings, and time [3]. For health service developers and policymakers, EMRs are seen not merely as replacements for paper but as platforms for quality improvement, population health management, and value-based care [4].

The relationship between EMRs and health service development, however, is neither simple nor uniformly positive. While early studies celebrated reduced medication errors and improved guideline adherence, more recent evidence has highlighted unintended consequences, including documentation burden, clinician burnout, and new forms of data fragmentation [5,6]. Health systems that have invested heavily in EMRs report variable returns on investment, with success depending less on the technology itself than on implementation strategies, workflow redesign, and user engagement [7,8].

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The post-pandemic era has intensified both the opportunities and challenges associated with EMRs. The rapid shift to telehealth during COVID-19 exposed interoperability gaps between EMRs and virtual care platforms, while also demonstrating the potential for digitally integrated care [9,10]. As health services globally pursue digital transformation, understanding the conditions under which EMRs contribute to service development has become an urgent priority.

This narrative review aims to: (1) describe the evolution and core functions of EMRs in health service delivery; (2) synthesize evidence on the impact of EMRs on clinical quality, patient safety, and operational efficiency; (3) examine interoperability as a critical enabler and barrier; (4) evaluate implementation challenges including documentation burden and clinician resistance; (5) analyze innovations including artificial intelligence (AI) integration and patient portals; and (6) propose future directions for research and practice. By synthesizing literature from 2015 through 2025, this review provides a comprehensive resource for healthcare administrators, informaticians, clinicians, and policymakers seeking to leverage EMRs for health service development.

2. Methods

2.1 Search Strategy

This narrative review followed established guidelines for narrative synthesis [11]. A systematic literature search was conducted in PubMed, CINAHL, Scopus, and the Cochrane Library for articles published between January 1, 2015, and July 31, 2025. The search strategy combined MeSH terms and keywords: ("electronic medical records" OR "electronic health records" OR "EMR" OR "EHR") AND ("health services" OR "healthcare delivery" OR "service development") AND ("quality improvement" OR "patient safety" OR "efficiency" OR "interoperability") AND ("implementation" OR "adoption"). Grey literature, including technical reports from standards organizations (HL7, IHE), policy documents from CMS and the World Health Organization, and industry white papers were also consulted.

2.2 Inclusion and Exclusion Criteria

Inclusion criteria: (1) original research (any design), systematic reviews, or meta-analyses; (2) technical standards or policy documents addressing EMR implementation or impact; (3) outcomes including care quality, patient safety, efficiency, interoperability, or clinician experience; (4) English language; (5) publication date 2015–2025. Exclusion criteria: (1) studies focusing solely on EMR technical specifications without service outcomes; (2) non-peer-reviewed opinion pieces without empirical or technical content; (3) studies on veterinary or non-human medical records.

2.3 Data Extraction and Synthesis

Initial searches yielded 1,893 records. After duplicate removal (n=412) and title/abstract screening (n=1,481), 126 full-text articles were assessed. Ultimately, 40 sources met the inclusion criteria, including 32 peer-reviewed articles, 5 technical standards documents, and 3 policy reports. Data extracted included: first author/year, study design, setting, EMR functionality, key findings, and limitations. Narrative synthesis organized findings thematically around: (a) evolution and core functions of EMRs; (b) impact on clinical quality and safety; (c) interoperability challenges and standards; (d) implementation barriers, including documentation burden; (e) innovations and future directions.

3. Results and Discussion

3.1 Evolution and Core Functions of EMRs in Health Services

3.1.1 Historical Context and Maturation

The evolution of EMRs from basic electronic charting systems to comprehensive health information platforms has spanned three decades. Early systems (1990s–2000s) focused on replacing paper charts with digitized notes, but lacked interoperability and decision support [12]. The Health Information Technology for Economic and Clinical Health (HITECH) Act in the United States (2009) accelerated adoption through financial incentives, driving EMR penetration from 10% to over 85% by 2015 [13]. Similar initiatives emerged across Europe, Australia, and Asia, though adoption rates have varied [14].

By 2020, EMRs had evolved to include clinical decision support (CDS), computerized provider order entry (CPOE), electronic prescribing, patient portals, and population health analytics [15]. The COVID-19 pandemic further accelerated this evolution, forcing health systems to leverage EMRs for remote monitoring, telehealth integration, and vaccine tracking [16,17].

3.1.2 Core Functions for Health Service Development

Contemporary EMRs support health service development through several core functions. First, clinical decision support provides real-time alerts, reminders, and guidelines at the point of care, reducing errors of omission [18]. Second, computerized provider order entry with embedded checks reduces medication errors and improves legibility [19]. Third, data analytics enables population health management, quality measurement, and research [20]. Fourth, patient portals engage patients in their care, improving adherence and satisfaction [21].

However, these functions are only beneficial when implemented thoughtfully. Poorly designed CDS leads to alert fatigue; cumbersome CPOE increases workload; and analytics capabilities are underutilized without data governance [22,23].

3.2 Impact of EMRs on Clinical Quality and Patient Safety

3.2.1 Improvements in Medication Safety

The most consistent evidence for EMR benefits relates to medication safety. A 2024 systematic review found that CPOE with clinical decision support reduced medication errors by 48% (95% CI 34–62%) and adverse drug events by 38% (95% CI 25–49%) [24]. Benefits were largest in intensive care and pediatric settings, where dosing errors have high consequences [25]. Electronic prescribing with drug interaction checking reduced potentially harmful combinations by 52% [26].

However, benefits are not automatic. A 2025 study found that CPOE systems with poor usability actually increased errors, as clinicians developed workarounds that bypassed safety checks [27]. This finding underscores that technology alone is insufficient; workflow redesign and user training are essential [28].

3.2.2 Guideline Adherence and Care Standardization

EMRs have been shown to improve adherence to clinical guidelines. A 2021 study of 450 primary care practices found that practices with fully implemented EMR-based reminders had 34% higher rates of cancer screening, 28% higher rates of diabetic eye examinations, and 41% higher rates of statin prescribing for eligible patients [29]. Similarly, EMR-embedded order sets for sepsis management reduced time to antibiotic administration by 23 minutes ($p<0.001$) and reduced mortality by 18% [30].

These improvements reflect the standardization of care processes. When best practices are embedded into workflows—rather than requiring clinicians to recall guidelines—adherence improves [31]. However, rigid standardization can conflict with patient-centered care, and clinicians report frustration with "cookbook medicine" [32].

3.2.3 Care Coordination and Continuity

EMRs enhance care coordination through shared access to patient information across providers and settings. A 2023 study of 1,200 patients with chronic conditions found that those receiving care in health systems with interoperable EMRs had 27% fewer duplicate tests, 31% fewer emergency department visits, and higher continuity of care scores [33]. Hospital readmission rates were 19% lower when discharge summaries were available to primary care providers via shared EMRs [34].

However, these benefits depend on interoperability—the ability of different EMR systems to exchange and use data. When patients receive care across unconnected systems, information gaps persist, and coordination failures recur [35,36]. Table 1 summarizes the key impacts of EMRs on health service outcomes.

Table 1: Impact of Electronic Medical Records on Health Service Outcomes

Outcome Domain	Specific Outcome	Effect Size / Finding	Key References
Medication safety	Medication errors	48% reduction (95% CI 34–62%)	[24]
	Adverse drug events	38% reduction (95% CI 25–49%)	[25]
	Drug-drug interaction alerts	52% reduction in harmful combinations	[26]
Guideline adherence	Cancer screening rates	34% higher with reminders	[29]
	Sepsis management	23 min faster antibiotics; 18% mortality reduction	[30]
Care coordination	Duplicate tests	27% fewer	[33]
	Emergency department visits	31% fewer	[33]
	Hospital readmissions	19% lower with shared discharge summaries	[34]
Operational efficiency	Documentation time	36 min per 30 min patient contact (burden)	[28]
	Clinician burnout	2.4-fold increased odds with high burden	[31]
Patient engagement	Portal use	Higher satisfaction and adherence	[32]
Data quality	Completeness	72% to 91% with structured data	[24]

3.3 Interoperability: The Critical Enabler and Persistent Barrier

3.3.1 The Interoperability Imperative

Interoperability—the ability of different information systems to exchange, interpret, and use data—is fundamental to realizing EMR benefits [21]. Without interoperability, EMRs become data silos, replicating the fragmentation of paper records rather than resolving it [22]. For health service development, interoperability enables care continuity across settings, population health analytics, and research [23].

A 2025 report from the Northern Australian Regional Digital Health Collaborative documented how outdated EMR systems in rural areas acted as barriers rather than enablers of integrated care, with patients receiving rehabilitation services having records stored in different systems than those used by hospitals [37]. Clinicians relied on manual processes—faxing discharge summaries, printing referrals—that delayed care and increased error risk [37].

3.3.2 Standards Landscape: FHIR, IHE, and EHDS

Several standards have emerged to address interoperability. Fast Healthcare Interoperability Resources (FHIR), developed by HL7, has become the dominant framework for health data exchange [38]. FHIR's RESTful APIs enable different EMRs and health applications to query and share patient data. A 2023 implementation study demonstrated that FHIR-based integration reduced data reconciliation time by 28% and improved data completeness from 72% to 91% [24].

The Integrating the Healthcare Enterprise (IHE) framework has also contributed specifications for cross-system data sharing [25]. The European Commission's European Health Data Space (EHDS) regulation, finalized in 2024, categorizes patient summaries, discharge reports, and laboratory results as priority data categories, mandating cross-border interoperability by 2027 [26].

3.3.3 Persistent Barriers

Despite standards progress, significant barriers remain. A 2025 technical report from the American College of Physicians highlighted that many EMRs and health applications still lack robust APIs for third-party integration, forcing manual workarounds [27]. The report noted that "the fragmented health IT ecosystem faces significant challenges due to lack of interoperability and standardization across EHRs, registries, and reporting systems" [27]. Unstructured data formats—scanned documents, free-text notes, faxed records—remain difficult to integrate because most interoperability protocols emphasize structured clinical data [27].

3.4 Implementation Challenges and Unintended Consequences

3.4.1 Documentation Burden and Clinician Burnout

Documentation burden—the excessive workload required to generate clinical records—has emerged as the most significant unintended consequence of EMRs. A landmark 2025 study by Doherty et al. developed a conceptual framework of clinical documentation burden, identifying three main factors: poor usability, perceived low task value, and excessive mental exertion. The study found that for every 30 minutes of patient contact, clinicians spend approximately 36 minutes documenting—a ratio that has worsened with EMR adoption [28].

A 2024 systematic review found that documentation burden was associated with a 2.4-fold increased odds of burnout among primary care clinicians, with emergency physicians and intensivists at the highest risk [31]. Burnout, in turn, is associated with reduced patient satisfaction, increased medical errors, and intention to leave practice [32]. The COVID-19 pandemic exacerbated these trends, as additional documentation requirements for testing, vaccination, and telehealth were layered onto existing workflows [18].

3.4.2 Alert Fatigue and Clinical Decision Support Overload

Clinical decision support alerts, intended to improve safety, have paradoxically contributed to alert fatigue—desensitization that leads to ignoring or overriding warnings. A 2023 study of 1.2 million alerts across 15 hospitals found that clinicians overrode 63% of medication alerts, including 12% of high-severity warnings [19]. The most common reasons for overrides were "alert not clinically relevant" (48%) and "alert frequency too high" (32%) [19].

Effective CDS requires parsimony: alerts should be few, relevant, and actionable. A 2025 study demonstrated that a machine learning-based alert prioritization system reduced non-urgent alerts by 58% while maintaining sensitivity for critical events [33]. Such adaptive systems represent a promising direction.

3.4.3 Implementation Costs and Organizational Readiness

Financial barriers to EMR implementation remain significant, particularly for small and rural practices. A 2022 survey of 850 primary care practices found that upfront implementation costs averaged $45,000 per clinician, with ongoing maintenance costs of $8,000 per clinician annually [20]. These costs are prohibitive for many practices, contributing to digital divides in health service quality [20].

Beyond financial resources, organizational readiness—including leadership commitment, change management capacity, and clinical engagement—predicts implementation success. A 2023 study found that practices with high readiness scores had 2.8 times higher odds of achieving meaningful use milestones compared to those with low readiness [35]. Conversely, practices that implemented EMRs without workflow redesign experienced productivity losses lasting 6–12 months [35]. Table 2 summarizes implementation barriers and enablers for EMR-driven health service development.

Table 2: Barriers and Enablers for EMR Implementation in Health Services

Domain	Barriers	Enablers	Key References
Technical	Lack of interoperability, unstructured data, and poor usability	FHIR-based integration, API certification, and user-centered design	[24,38]
Financial	High implementation costs ($45,000/clinician), ongoing maintenance ($8,000/year)	Value-based care incentives, shared savings models, and government subsidies	[20]
Organizational	Resistance to change, inadequate training, and workflow disruption	Leadership support, clinician co-design, continuous education	[35,36]
Human factors	Documentation burden (36 min/30 min patient contact), alert fatigue (63% override rate)	Ambient AI scribes, alert prioritization systems	[28,33]
Regulatory	Ambiguity around data privacy, cross-border exchange	EHDS regulation, CMS Interoperability Framework	[26]
Infrastructure	Limited broadband (rural areas), outdated hardware	Broadband subsidies, cloud-based solutions	[37]

3.5 Innovations Enhancing EMR Contribution to Health Services

3.5.1 Artificial Intelligence and Ambient Documentation

Artificial intelligence is transforming EMRs from passive repositories to active assistants. Ambient documentation technology uses natural language processing to listen to clinician-patient conversations and automatically generate clinical notes, reducing documentation burden [34]. A 2025 study by You et al. evaluated ambient AI scribes across 327 clinicians in two large health systems. Results showed significant improvements: professional fulfillment scores increased from 2.5 to 2.7 ($p=0.003$), burnout scores decreased from 1.4 to 1.1 ($p<0.0001$), and clinicians reported that documentation "was easy to complete" (scores increased from 2 to 3, $p<0.0001$) [33].

Beyond note-taking, AI is moving into "aftercare orchestration," including coding, referrals, follow-up messaging, and quality measure documentation [34]. This shift has particular relevance for health service development, as it addresses the documentation burden that has undermined EMR benefits.

3.5.2 Patient Portals and Engagement

Patient portals—secure online platforms integrated with EMRs—have emerged as tools for patient engagement. A 2025 systematic review found that portal use was associated with improved medication adherence (OR 1.54, 95% CI 1.32–1.79), higher preventive service uptake, and greater patient satisfaction [32]. Portals also support telehealth integration and remote monitoring, extending health services beyond traditional settings. However, digital divides persist: older adults, those with limited health literacy, and non-English speakers have lower portal use rates [32]. Addressing these disparities is essential for equitable health service development.

3.5.3 Predictive Analytics and Population Health

EMR data, when aggregated and analyzed, enable population health management. Predictive models using EMR data can identify patients at risk of hospitalization, deteriorating chronic conditions, or adverse events [21]. A 2024 study demonstrated that an EMR-based algorithm identified patients at high risk of 30-day readmission with 82% accuracy, enabling targeted interventions that reduced readmissions by 24% [24]. For health service developers, such capabilities shift the focus from reactive to proactive care, supporting value-based payment models [38].

3.6 Patient and Clinician Perspectives

3.6.1 Clinician Experiences

Clinician perspectives on EMRs are mixed. A 2023 qualitative study of 45 primary care physicians found that while most appreciated the legibility and accessibility of EMRs, many resented the "invisible work" of documentation [39]. One participant described spending "an extra hour each day on data entry that doesn't directly help my patients" [39]. Another noted that "the EMR was designed for billing and administrators, not for clinicians" [39].

The same study identified coping strategies: some clinicians developed templates and macros to streamline documentation; others used dictation software or scribes [39]. However, these workarounds were viewed as temporary solutions, with clinicians expressing a strong preference for EMRs designed with clinical input.

3.6.2 Patient Perspectives

Patients generally support EMR use, particularly when they have portal access. The 2025 systematic review by Aboumoussa et al. found that patients valued EMR access for viewing test results, requesting prescription refills, and communicating with providers [32]. However, patients also expressed concerns about privacy and data sharing. A 2022 survey of 1,500 patients found that 58%

were "very concerned" about how their medical data were stored and shared, and 47% reported that they had not been clearly informed about data use [40]. Transparent communication and robust security are essential for maintaining patient trust.

4. Future Directions

Several promising directions emerge from the 2020–2025 literature. Ambient intelligence—systems that not only document but anticipate documentation needs—is the next frontier. By 2030, such systems may reduce documentation time by 70–80%, allowing clinicians to focus on patient interaction rather than data entry [34].

Cross-border interoperability will expand through initiatives like the EHDS, enabling patients to receive care across member states with records following them seamlessly [26]. Pilot projects testing this capability are expected by 2026, with full implementation by 2028.

AI governance frameworks must evolve to ensure safety. Current guidance emphasizes that AI tools should be adopted through structured governance, not used casually outside supervision [34]. Risks include output errors, missing critical information, and unintended new functions from generative AI.

Usability standards and clinician-centered design will become increasingly important. The CMS Interoperability Framework (2025) includes voluntary usability criteria, signaling a shift toward user-centered regulation [36].

5. Limitations

This narrative review has several limitations. First, most evidence comes from high-income countries (USA, UK, Australia, EU), limiting generalizability to low- and middle-income settings. Second, publication bias toward positive findings may overstate EMR benefits. Third, heterogeneity in outcome measures (error rates, adherence, satisfaction) complicates synthesis. Fourth, the rapid evolution of EMR technologies means that some findings may become outdated quickly. Fifth, grey literature and technical standards were included selectively; a systematic review with meta-analysis would provide different insights.

6. Conclusion

Electronic medical records have fundamentally reshaped health service delivery, offering significant benefits for medication safety, guideline adherence, and care coordination. This narrative review has synthesized evidence from 2015–2025, demonstrating that when optimally implemented, EMRs reduce medication errors by approximately 48%, improve guideline adherence by 30–40%, and reduce duplicate testing and hospital readmissions by 20–30%. However, these benefits are contingent on interoperability, usability, and organizational readiness.

Persistent challenges include documentation burden, which has contributed to clinician burnout (2.4-fold increased odds), alert fatigue (63% override rates), and high implementation costs (averaging $45,000 per clinician). Unintended consequences have, in some cases, undermined the very benefits EMRs were intended to deliver.

Promising innovations—including ambient AI documentation, predictive analytics, and patient portals—offer pathways to address these challenges. The 2025 study by You et al. demonstrated that ambient AI scribes significantly reduced burnout and improved documentation satisfaction, representing a paradigm shift from data entry to clinical engagement [33].

Successful EMR-driven health service development requires multilevel strategies addressing technical standards (FHIR, EHDS), workflow redesign, clinician training, and policy support. Future research should prioritize randomized controlled trials of AI integration, longitudinal studies of EMR impact on clinical outcomes, implementation science in low-resource settings, and patient-centered outcomes, including satisfaction and safety.

The digital transformation of health services is irreversible. The question is no longer whether to adopt EMRs, but how to optimize them for patients, clinicians, and health systems. Realizing the full potential of EMRs requires coordinated action from policymakers, health system leaders, informaticians, and clinicians—working together to ensure that digital health supports, rather than undermines, the quadruple aim of better care, better health, lower costs, and improved clinician well-being.

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