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Review

Implementation Risks and Mitigation Strategies for Electronic Medical Records in Hospitals: A Literature Review

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Abstract

Background: The implementation of Electronic Medical Records (EMRs) has become an essential component of digital transformation in healthcare organizations. EMRs have the potential to improve healthcare quality, patient safety, service efficiency, and data accessibility. However, previous reviews primarily focused on EMR adoption, benefits, or implementation barriers, whereas comprehensive evidence synthesizing implementation risks and corresponding mitigation strategies remains limited. Therefore, understanding these risks and identifying appropriate mitigation strategies are crucial for successful implementation.
Method: This study employed a narrative literature review approach to identify and synthesize evidence regarding the risks and mitigation strategies associated with EMR implementation in hospital settings. A total of 1,542 records were retrieved from the PubMed, Scopus, ProQuest, and ScienceDirect databases for articles published between 2016 and 2026. Study selection followed the PRISMA 2020 guidelines. Articles were screened against predefined inclusion and exclusion criteria, and 15 eligible studies were analyzed using a narrative synthesis approach.
Results: The findings revealed five major categories of risks associated with EMR implementation: human resource risks, documentation and data quality risks, technology and infrastructure risks, information security risks, and organizational and governance risks. The most frequently reported challenges were user resistance, inadequate training, incomplete documentation, limited interoperability, and insufficient organizational support. The effective mitigation strategies identified across the studies included continuous training programs, change management initiatives, infrastructure enhancement, data quality assurance mechanisms, cybersecurity measures, and strong governance frameworks.
Conclusion: EMR implementation involves multidimensional risks that require a comprehensive risk management approach. Integrating technical, human-centered, and organizational mitigation strategies across hospital managers, policymakers, and healthcare organizations can improve system adoption, enhance patient safety, and support sustainable digital transformation in healthcare organizations.

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INTRODUCTION

Digital transformation has become a global priority in healthcare systems, driven by advances in health information technologies and the increasing demand for safe, efficient, and patient-centered care. Electronic Medical Records (EMRs) represent one of the most significant components of this transformation, enabling the digital, integrated, and real-time management of patient health information across healthcare settings. Globally, healthcare organizations have increasingly adopted EMR systems to improve care coordination, enhance clinical decision-making, strengthen patient safety, and support data-driven healthcare delivery. The widespread implementation of EMRs has been further accelerated by national digital health policies and regulatory initiatives in many countries, including Indonesia, which has mandated the adoption of electronic medical records across healthcare facilities as part of its healthcare digitalization agenda.

A substantial body of evidence has demonstrated that electronic medical record (EMR) systems can improve healthcare quality and patient outcomes. Previous studies have shown that EMR implementation enhances the completeness and consistency of clinical documentation [1]. Likewise, research conducted in healthcare facilities in Haiti reported significant improvements in antenatal care documentation and service delivery following the introduction of EMRs [2]. Beyond improving documentation practices, EMRs have also been associated with better patient safety through reductions in medication errors and strengthened clinical monitoring processes [3], [4]. For instance, Austin et al. [3] found that EMR-supported documentation and monitoring contributed to safer anticoagulation management by facilitating more reliable surveillance of patient care. Similarly, Saad et al. [4] demonstrated that the integration of clinical decision support into EMR systems improved the accuracy of stress ulcer prophylaxis prescribing while reducing inappropriate medication use. Taken together, these findings indicate that EMRs serve not only as digital repositories for patient records but also as strategic tools that support high-quality care, enhance patient safety, and improve the efficiency of healthcare delivery across a wide range of clinical settings [1]–[4].

Despite these well-established benefits, implementing EMR systems remains a complex organizational undertaking. The transition from paper-based records to electronic documentation involves a wide range of technical, organizational, and human challenges that may hinder implementation success if not adequately addressed. Previous studies have consistently identified barriers related to human factors, technological constraints, organizational readiness, and information security. De Benedictis et al. [5] highlighted that the success of EMR implementation is strongly influenced by users' perceptions, organizational culture, and an institution's readiness to embrace change. Likewise, Senishaw et al. [6] identified limited computer literacy, insufficient user training, and inadequate familiarity with EMR functionalities as major factors affecting healthcare professionals' willingness to adopt electronic documentation systems. From a technological perspective, inadequate

interoperability, poor system usability, limited infrastructure, and insufficient integration with existing clinical workflows continue to impede effective implementation [7], [8]. In addition, concerns regarding incomplete documentation, cybersecurity threats, unauthorized access to patient information, and weak governance mechanisms remain significant challenges. These findings suggest that successful EMR implementation depends not only on the availability of appropriate technology but also on organizational preparedness, supportive governance, comprehensive user engagement, and continuous risk management to ensure sustainable system adoption [5]–[8].

The complexity of EMR implementation demonstrates that implementation risks are highly interconnected across multiple domains. Human resource limitations may influence documentation quality and user acceptance, technological failures can compromise patient safety and service continuity, while inadequate governance may exacerbate information security vulnerabilities and hinder organizational adaptation. Consequently, hospitals must adopt comprehensive risk mitigation strategies that integrate technical, organizational, and human-centered approaches throughout the implementation process. Failure to appropriately manage these risks may limit the anticipated benefits of EMR systems and undermine sustainable digital transformation initiatives.

Although EMR implementation has been widely investigated, existing reviews have primarily focused on EMR adoption, implementation barriers, facilitators, or system effectiveness. Previous literature has provided valuable insights into user acceptance, technological challenges, and the clinical benefits of EMR systems; however, comprehensive evidence synthesizing implementation risks together with corresponding mitigation strategies across multiple domains remains limited. To date, few studies have integrated human resource, documentation and data quality, technological and infrastructure, information security, and organizational governance risks within a single evidence-based framework for hospital EMR implementation. This limitation creates an important knowledge gap for healthcare organizations seeking practical guidance in managing implementation risks during digital transformation processes.

Therefore, this literature review contributes to the existing body of knowledge by developing a comprehensive synthesis of multidimensional risks associated with EMR implementation in hospital settings and integrating evidence-based mitigation strategies reported across previous studies. By adopting a holistic perspective, this review highlights the interrelationships among implementation risks and proposes practical considerations for strengthening EMR risk management in healthcare organizations. The findings are expected to provide valuable insights for hospital managers, healthcare professionals, policymakers, and information technology teams in designing more effective and sustainable EMR implementation strategies.

Given these circumstances, this study aims to identify the major risks associated with Electronic Medical Record implementation in

hospital settings and to synthesize evidence-based mitigation strategies reported in the literature. The findings are expected to support healthcare organizations in developing comprehensive risk management approaches that enhance patient safety, improve system adoption, and facilitate sustainable digital transformation in healthcare services. The aim of this study was to comprehensively identify and synthesize the multidimensional risks associated with Electronic Medical Record (EMR) implementation in hospital settings and to analyze the evidence-based mitigation strategies reported in the existing literature.

METHODS

Participants and Study Design

This study employed a narrative review design to identify and analyze the multidimensional risks associated with Electronic Medical Record (EMR) implementation in hospital settings, together with the mitigation strategies reported in previous studies. A narrative review was selected because it enables a comprehensive synthesis of heterogeneous evidence across diverse healthcare contexts. Literature searches were conducted in the PubMed, Scopus, ProQuest, and ScienceDirect databases. Studies published between January 2016 and June 2026 were included in order to capture contemporary evidence reflecting the rapid developments in digital health technologies, healthcare digital transformation initiatives, and regulatory changes related to EMR implementation, thereby ensuring the inclusion of recent and relevant evidence for hospital practice.

The inclusion criteria were: (1) original research articles published in peer-reviewed journals; (2) articles written in English; (3) studies addressing EMR implementation in hospitals; and (4) studies reporting risks, barriers, challenges, or mitigation strategies related to EMR implementation. The exclusion criteria were: (1) review articles, systematic reviews, and meta-analyses; (2) conference proceedings; (3) studies conducted outside healthcare settings; and (4) articles for which the full text was inaccessible.

Measurements and Procedure

The literature search was conducted using combinations of the following keywords: “electronic medical record”, “electronic health record”, “implementation”, “risk”, “barrier”, “challenge”, “mitigation”, and “hospital”. Boolean operators (AND and OR) were applied to optimize the search process. The search strategy used was: ("electronic medical record" OR "electronic health record") AND ("implementation") AND ("risk" OR "barrier" OR "challenge") AND ("mitigation") AND ("hospital")

All identified articles were exported to a reference management system for screening, and duplicate articles were removed prior to the selection process. Screening was conducted in three stages: title screening, abstract screening, and full-text review. Articles that met the eligibility criteria were included in the final analysis.

Data extraction was performed using a standardized extraction form that captured the author, publication year, country, study design, study objectives, identified risks, impacts of the risks, and reported mitigation strategies. The selected studies were then critically

reviewed and categorized according to the major risk domains.

Risk categories were developed inductively from the findings and classified into five major domains:

1. Human resource risks.
2. Documentation and data quality risks.
3. Technology and infrastructure risks.
4. Information security risks.
5. Organizational and governance risks.

The study selection process was reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram. The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. The detailed selection process is presented in Figure 1.

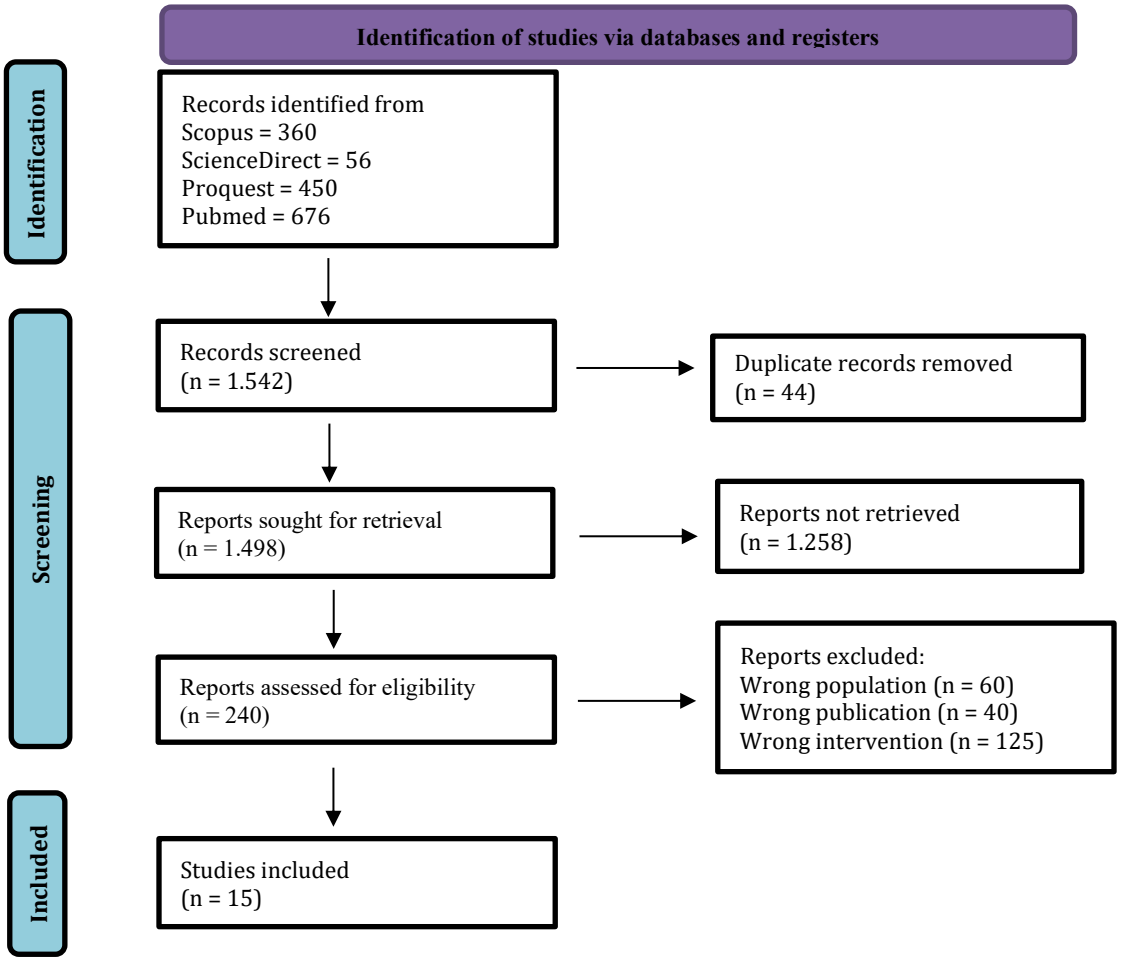


Figure 1. PRISMA Flow Diagram

A total of 1,542 records were identified through database searching. After duplicate removal and screening processes, fifteen studies met the inclusion criteria and were included in the final synthesis.

Data Analysis

Descriptive statistics were used to summarize the characteristics of the included studies, including publication year, country of origin, study design, and the primary focus of the EMR implementation research. The

extracted findings were then synthesized through inductive thematic analysis to identify recurring implementation risks and the evidence-based mitigation strategies reported across the studies.

The thematic analysis followed four stages. First, all extracted data relating to EMR implementation risks, barriers, challenges, and mitigation strategies were reviewed and coded independently by two reviewers. Second, the initial codes were compared and grouped according to their conceptual similarities. Third, the codes were organized into broader themes through an inductive process, allowing the risk categories to emerge from the data rather than being predetermined. Finally, the themes were refined and synthesized into five major domains of EMR implementation risk, namely: (1) human resource risks, (2) documentation and data quality risks, (3) technology and infrastructure risks, (4) information security risks, and (5) organizational and governance risks. Any discrepancies in coding or thematic classification were resolved through discussion until consensus was reached.

To strengthen the rigor of the synthesis, the frequency with which individual risks and mitigation strategies were reported across the included studies was considered during thematic development. A comparative analysis was also undertaken to identify the similarities, differences, and recurring patterns among studies conducted in different healthcare settings. The identified mitigation strategies were then compared and integrated to develop a comprehensive framework for EMR risk mitigation in hospital settings.

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklists appropriate to each study design, including cross-sectional, cohort, qualitative, and quasi-experimental studies [9]. Two reviewers independently appraised the methodological quality of each study using the corresponding JBI checklist. The assessment considered several aspects of methodological rigor, including the clarity of the research objectives, participant selection, data collection procedures, the validity of the outcome measurements, the management of potential sources of bias, and the appropriateness of the statistical analyses. Studies that fulfilled more than 80% of the applicable appraisal criteria were classified as high quality, those meeting 60–79% were considered moderate quality, and those meeting fewer than 60% were categorized as low quality. Any discrepancies between the reviewers were resolved through discussion until consensus was reached [9].

The findings are presented using narrative synthesis, summary tables, and conceptual framework diagrams to facilitate interpretation and comparison across the studies. This approach enabled the integration of multidimensional evidence on EMR implementation risks and mitigation strategies while maintaining methodological transparency and analytical rigor.

Ethical Clearance

This study did not involve human participants, patient data, or experimental interventions, as it was conducted using publicly available published literature; ethical approval was therefore not required.

Nevertheless, all stages of the review process were conducted in accordance with the principles of research integrity, transparency, and academic ethics. Proper citation and acknowledgment were provided for all sources included in this review.

RESULTS

Characteristics of Included Studies

The literature search identified a total of 1,542 records across four electronic databases (PubMed, Scopus, ProQuest, and ScienceDirect). After 44 duplicate records were removed, 1,498 records remained for screening. Of these, 1,258 records were excluded during title and abstract screening because they did not meet the eligibility criteria. A total of 240 full-text articles were subsequently assessed for eligibility. During the full-text review, 225 articles were excluded for the following reasons: wrong population (n = 60), inappropriate publication type (n = 40), and wrong intervention or study focus (n = 125). Ultimately, 15 studies met the inclusion criteria and were included in the final qualitative synthesis (Figure 1).

The included studies were published between 2016 and 2026 and originated from several countries, including Germany, Ethiopia, Italy, Australia, Greece, Nepal, Japan, Saudi Arabia, Finland, Indonesia, United States, France, and Russia. A variety of research designs were represented, including cross-sectional studies, longitudinal analyses, implementation studies, retrospective cohort studies, qualitative studies, validation studies, comparative studies, usability studies, and quality improvement studies. Collectively, the included studies explored diverse aspects of Electronic Medical Record (EMR) implementation, encompassing user readiness, documentation and data quality, patient safety, information sharing, organizational determinants, system usability, technological infrastructure challenges, and implementation barriers.

Tabel 1. Characteristics of Included Studies

Author	Year	Country	Study Design	Main Focus
Ologeanu-Taddei et al. [10]	2016	France	Longitudinal Study	User perception toward EMR
Bologva et al. [11]	2016	Rusia	Human Factors Study	Human-computer interaction challenges in EMR

Tabel 1. Characteristics of Included Studies

Author	Year	Country	Study Design	Main Focus
Katehakis [8]	2017	Greece	Implementation Study	EMR implementation challenges
Raut et al. [12]	2018	Nepal	Implementation Study	Affordable EMR implementation
Lyerla et al. [13]	2018	USA	Usability Study	EMR usability
Saad et al. [4]	2018	Saudi Arabia	Comparative Study	Clinical decision support
Scott et al. [7]	2019	Australia	Checklist Development	Digital transformation readiness
Kaneko et al. [14]	2020	Japan	Retrospective Cohort Study	Impact of EMR
De Benedictis et al. [5]	2020	Italy	Survey Study	Organizational determinants
Senishaw et al. [6]	2023	Ethiopia	Cross-sectional Study	Willingness to use EMR
Wurster et al. [1]	2024	Germany	Longitudinal Study	Documentation completeness
Irwin et al. [15]	2025	Australia	Qualitative Study	Preparing nurse for EMR use
Hakim et al. [16]	2026	Indonesia	Comparative Qualitative Study	EMR risk management
Jamsa et al. [17]	2026	Finland	Retrospective Study	Patient safety using EMR
Zhang et al. [18]	2026	Japan	Longitudinal Analysis	Risk mechanisms EMR error

Quality Assessment of Included Studies

A quality assessment was conducted to evaluate the methodological rigor of the selected studies. Most studies demonstrated moderate to high methodological quality. The reviewed

studies clearly described their objectives, participant characteristics, outcome measures, and analytical approaches. Overall, the included studies were considered suitable for synthesis and interpretation.

Table 1. Quality Assessment of Included Studies

Author	Design	Quality Assessment	Rating
Ologeanu-Taddei et al. [10]	Longitudinal Study	Good	High
Bologva et al. [11]	Human Factors Study	Good	High
Katehakis [8]	Implementation Study	Good	High
Raut et al. [12]	Implementation Study	Moderate	Moderate
Lyerla et al. [13]	Usability Study	Good	High
Saad et al. [4]	Comparative Study	Good	High
Scott et al. [7]	Checklist Development	High	High
Kaneko et al. [14]	Retrospective Cohort Study	High	High
De Benedictis et al. [5]	Survey Study	High	High
Senishaw et al. [6]	Cross-sectional Study	High	High
Wurster et al. [1]	Longitudinal Study	High	High
Irwin et al. [15]	Qualitative Study	Good	High
Hakim et al. [16]	Comparative Qualitative Study	Good	High
Jamsa et al. [17]	Retrospective Study	High	High
Zhang et al. [18]	Longitudinal Analysis	High	High

Synthesis of Identified Risks

The findings of the reviewed studies revealed that Electronic Medical Record (EMR) implementation is associated with multidimensional risks spanning the human, technological, organizational, documentation and data quality, and information security domains. Through inductive thematic analysis, five major risk categories were identified across the 15 included studies: (1) human resource risks, (2) documentation and data quality risks, (3) technology and infrastructure risks, (4) information security risks, and (5) organizational and governance risks. Several studies identified risks that spanned multiple categories, indicating that EMR

implementation challenges are closely interconnected and require integrated risk management strategies rather than isolated interventions.

Although the identified risks were consistently reported across different healthcare settings, variations were observed in their underlying causes and impacts. Human resource-related challenges, including resistance to change, inadequate training, and limited digital literacy, were more prominent in resource-constrained settings and in organizations undergoing large-scale digital transformation [5], [6], [15]. In contrast, technology and infrastructure risks were more frequently associated with interoperability issues, system usability, and integration failures in hospitals implementing more advanced EMR systems [7], [8], [12], [13], [17], [18]. Documentation and data quality risks were commonly linked to incomplete electronic documentation, hybrid paper–electronic workflows, and limitations in clinical decision support that may compromise prescribing accuracy and patient safety [1], [3], [4], [16]–[18]. Information security concerns primarily involved unauthorized access, breaches of data confidentiality, and cybersecurity vulnerabilities [8], [16]. Organizational and governance risks were consistently identified as cross-cutting factors that influence the successful management of other implementation risks through leadership commitment, change management, and strategic planning [5], [7].

A comparative analysis of the included studies further demonstrated that EMR implementation risks are highly interrelated rather than occurring in isolation. For example, inadequate organizational support often contributed to insufficient user training and poor system adoption [5], [6], [15], while technological limitations could adversely affect documentation quality and patient safety outcomes [1], [3], [7], [12]. Despite differences in study design, healthcare setting, and geographical context, the included studies consistently emphasized that successful EMR implementation requires comprehensive risk mitigation strategies that integrate human, technological, organizational, and security considerations [5]–[8], [12]–[18]. These findings underscore the importance of adopting a multidimensional, evidence-based approach to EMR risk management in hospital settings.

Human Resource Risks

Human resource-related risks were the most frequently reported challenges in EMR implementation. Several studies identified resistance to change, inadequate computer skills, lack of training, and limited user readiness as major barriers to successful implementation [5], [6], [10], [11], [15]. Senishaw et al. reported that healthcare professionals who had received computer-based training and possessed better knowledge of EMR systems were more willing to adopt electronic documentation systems [6]. Conversely, insufficient training and low digital literacy significantly reduced readiness for implementation [6]. Similar findings were reported by De Benedictis et al., who highlighted the importance of user engagement and organizational support throughout the implementation process [5].

Documentation and Data Quality Risks

Several studies reported risks related to documentation completeness, data accuracy, the consistency of clinical information, and the effectiveness of clinical decision support [1], [3], [4], [17], [18]. Wurster et al. demonstrated that, although EMR implementation generally improved documentation completeness, certain data elements remained vulnerable to incomplete recording and information loss during the transition from paper-based systems [1]. Austin et al. showed that accurate electronic documentation and monitoring supported safer anticoagulation management [3], whereas Saad et al. reported that integrating clinical decision support into EMR systems improved prescribing accuracy and reduced inappropriate medication use [4]. Jämsä et al. further emphasized that effective EMR use contributes to improved patient safety by supporting accurate clinical information and reducing preventable errors [17]. Collectively, these findings suggest that deficiencies in documentation quality, data accuracy, and decision-support functionality may compromise clinical decision-making, continuity of care, medication safety, and overall patient outcomes [1], [3], [4], [17], [18].

Technology and Infrastructure Risks

Technology-related risks included system downtime, limited interoperability, inadequate infrastructure, usability issues, and software incompatibility with clinical workflows [7], [8], [12], [13], [16]–[18]. Raut et al. identified infrastructure limitations as one of the major implementation barriers in resource-constrained settings [12]. Similarly, Scott et al. emphasized that systems that are not aligned with clinical workflows may increase workload and reduce user acceptance [7].

Information Security Risks

Information security emerged as an important concern in several studies. The identified risks included unauthorized access, confidentiality breaches, cyber threats, and insufficient data protection mechanisms [8], [16]. The increasing volume of digital health information requires healthcare organizations to establish robust security policies and technical safeguards to protect patient information [8].

Organizational and Governance Risks

Organizational factors were also identified as critical determinants of implementation success. The common risks included insufficient leadership support, weak governance structures, inadequate funding, poor change management, and a lack of strategic planning [5], [7], [15]. Studies consistently reported that successful EMR implementation requires strong organizational commitment and effective governance mechanisms [5], [7].

Table 2. Summarizes The Risks Identified and Corresponding Mitigation Strategies Reported in The Reviewed Literature.

Risk Category	Identified Risk	Potential Impact	Recommended Mitigation Strategy	Supporting Studies
Human Resources	Resistance to change	Low user acceptance, delayed implementation, reduced system utilization	Change management programs, user engagement, continuous communication	Ologeanu-Taddei et al. [25]; De Benedictis et al. [5]; Senishaw et al. [6]; Irwin et al. [15]
	Limited digital literacy and computer skills	Data entry errors, inefficient system use	Regular training, competency development, mentoring programs	Senishaw et al. [6]; Irwin et al. [15]
	Inadequate user training	Low readiness and poor adoption rates	Structured training before and after implementation	Senishaw et al. [6]; Scott et al. [7]; Irwin et al. [15]
	Key personnel dependency	Service disruption if key staff leave	Cross-training, succession planning, documentation of system architecture	Hakim et al. [16]
	Slow adaptation among senior staff	Inconsistent EMR adoption and prolonged hybrid paper–electronic workflows	Intensive coaching, peer support, and phased implementation	Hakim et al. [16]
Documentation and Data Quality	Incomplete documentation	Clinical errors, reduced continuity of care	Mandatory documentation fields, documentation audits, and automated reminders	Wurster et al. [1]; Zhang et al. [18]; Kaneko et al. [14]
	Inaccurate or inconsistent data	Poor clinical decision-making and compromised patient safety	Data validation mechanisms and continuous quality monitoring	Wurster et al. [1]; Austin et al. [3]; Zhang et al. [18];

Risk Category	Identified Risk	Potential Impact	Recommended Mitigation Strategy	Supporting Studies
				Kaneko et al. [14]
	Hybrid paper–electronic documentation	Data inconsistency, duplication, and information loss	Clear transition protocols, phased migration, and regular reconciliation	Hakim et al. [16]; Jämsä et al. [17]
	Inadequate clinical decision support	Inappropriate prescribing, medication errors, and reduced patient safety	Integration of evidence-based clinical decision support with routine monitoring and system updates	Saad et al. [4]; Austin et al. [3]
Technology and Infrastructure	System downtime	Service disruption and delayed patient care	Disaster recovery plans, server redundancy, and routine maintenance	Raut et al. [12]; Scott et al. [7]; Hakim et al. [16]
	Poor interoperability	Fragmented patient information and duplication of work	Standardization and integration of health information systems	Katehakis [8]; Jämsä et al. [17]; Zhang et al. [18]
	Poor system usability	Increased workload and user dissatisfaction	User-centered system design and usability testing	Lyerla et al. [13]; Irwin et al. [15]; Bologva et al. [26]
	Integration gaps between EMR subsystems	Data loss, delayed reporting, and misrouted referrals	End-to-end interface testing and code-set harmonization	Jämsä et al. [17]; Zhang et al. [18]
Information Security	Unauthorized access to patient records	Privacy breaches, confidentiality violations, and legal consequences	Role-based access control, authentication protocols, and security monitoring	Katehakis [8]; Hakim et al. [16]

Risk Category	Identified Risk	Potential Impact	Recommended Mitigation Strategy	Supporting Studies
Organizational and Governance	Insufficient leadership support	Weak organizational commitment and delayed implementation	Strong executive leadership and governance oversight	De Benedictis et al. [5]; Scott et al. [7]
	Weak governance structure	Poor coordination and inconsistent implementation	Establishment of an EMR governance committee with clearly defined roles	De Benedictis et al. [5]; Scott et al. [7]
	Poor change management	Low user acceptance and slow system adoption	Structured change management, stakeholder engagement, and continuous communication	De Benedictis et al. [5]; Irwin et al. [15]
	Lack of strategic planning	Unsustainable EMR implementation	Long-term implementation roadmap, monitoring, and periodic evaluation	Scott et al. [7]
	Inadequate funding	Delayed implementation and infrastructure limitations	Sustainable financial planning and phased investment	Irwin et al. [15]

Table 3 summarizes the key risks associated with EMR implementation, together with their potential impacts and the mitigation strategies identified through the synthesis of the reviewed studies. The findings demonstrate that these risks encompass five main domains: human resources; documentation and data quality; technology and infrastructure; information security; and organizational and governance. Across the included studies, the commonly reported challenges involved resistance to change, limited digital literacy, inadequate user training, incomplete or inaccurate documentation, hybrid paper–electronic workflows, system downtime, interoperability limitations, poor system usability, unauthorized access to patient records, and insufficient leadership support and change management. To address these challenges, the reviewed studies consistently emphasized the importance of continuous capacity building, effective organizational governance, standardized documentation practices, system optimization and interoperability, strengthened information security, and

structured change management in facilitating sustainable and effective EMR implementation in hospital settings.

DISCUSSION

Human Resource Risks in EMR Implementation

Human resource factors emerged as one of the most influential determinants of successful EMR implementation. This review found that resistance to change, limited digital literacy, inadequate computer skills, and insufficient user training were consistently identified as barriers to EMR adoption across the included studies. Senishaw et al. [6] reported that healthcare professionals who had received prior computer training and possessed better knowledge of EMR systems were more likely to adopt electronic documentation than those with limited training. Similarly, De Benedictis et al. [5] demonstrated that user acceptance was strongly associated with perceived usefulness, organizational support, and organizational readiness for change.

These findings are consistent with the Technology Acceptance Model (TAM), which proposes that perceived usefulness and perceived ease of use are key determinants of users' intention to adopt new technologies. In healthcare settings, EMR systems are more readily accepted when users recognize their contribution to improving workflow efficiency, communication, and the quality of patient care. Conversely, inadequate preparation, limited user involvement during implementation, and insufficient organizational support may increase resistance and reduce system utilization [5], [6].

The importance of continuous competency development was further highlighted in several recent studies. Irwin et al. [15] showed that simulation-based training enables nursing students to develop EMR competencies before entering clinical practice, thereby reducing cognitive burden and improving confidence in system use. Likewise, Hakim et al. [16] identified slow adaptation among senior staff and dependence on a limited number of IT personnel as important organizational vulnerabilities that may increase the risk of service disruption. Zhang et al. [17] further demonstrated that human errors during EMR use are often influenced by incorrect assumptions, inadequate system understanding, and suboptimal human–computer interaction. Their findings suggest that training alone is insufficient unless it is accompanied by improvements in system usability and decision support functions.

Overall, the evidence indicates that effective EMR implementation requires more than initial user orientation. Continuous training, active user engagement, and structured change management should be integrated throughout the implementation process to strengthen user competency, facilitate adaptation to evolving technologies, and promote the sustainable use of EMR systems in hospital settings.

Documentation and Data Quality Risks

Documentation quality remains a critical aspect of EMR implementation, because clinical decision-making depends on the accuracy, completeness, and accessibility of patient information. This review found that documentation-related risks persist despite the transition from paper-based to electronic

records. Wurster et al. [1] reported that EMR implementation improved the overall completeness of clinical documentation; however, several documentation elements remained incomplete after implementation. Similar findings were reported by Austin et al. [2], who identified documentation inconsistencies during the implementation process, while Saad et al. [3] emphasized that incomplete or inaccurate electronic documentation may compromise the quality and continuity of patient care.

These findings indicate that adopting EMR systems alone does not eliminate documentation errors. Instead, documentation quality is influenced by user competency, workflow design, and the extent to which electronic documentation processes are standardized. Inadequate documentation practices may reduce data reliability, hinder clinical communication, and ultimately affect patient safety and healthcare quality [2], [3], [8]. Previous studies have suggested that standardized documentation templates, mandatory data fields, automated validation rules, clinical decision support, and routine documentation audits can substantially improve data quality and reduce documentation errors [8].

Recent evidence further demonstrates that documentation risks extend beyond incomplete records. Jämsä et al. [12] found that hybrid paper–electronic environments generated substantial information management problems following EMR implementation, with delayed or missing examinations and reports representing the most common non-serious post-implementation incidents. Similarly, Zhang et al. [17] reported that documentation errors were frequently associated with organizational factors, particularly inadequate procedures and a weak patient safety culture, while "no entry/retrieval" and "wrong entry/retrieval" errors remained the predominant categories of human error throughout prolonged system use. Hakim et al. [16] likewise observed that maintaining parallel paper and electronic documentation increased the risk of data inconsistency, duplicated documentation, and workflow inefficiencies, particularly in emergency departments with high patient volumes.

Healthcare organizations should establish standardized documentation practices, strengthen data quality governance, regularly evaluate documentation performance, and gradually eliminate hybrid documentation processes to ensure that EMR systems effectively support clinical decision-making, patient safety, and continuous quality improvement. Organizations should integrate data quality management into EMR governance to ensure that electronic documentation supports accurate clinical decision-making and quality improvement initiatives.

Technology and Infrastructure Risks

Technology and infrastructure challenges emerged as one of the major barriers to effective EMR implementation. This review identified system downtime, limited interoperability, poor usability, fragmented system integration, and inadequate technological infrastructure as the most frequently reported technology-related risks. Raut et al. [9] highlighted infrastructure limitations as a major obstacle in resource-

constrained healthcare settings, whereas Scott et al. [7] emphasized that EMR systems that are poorly aligned with clinical workflows may reduce efficiency and increase users' workload.

The findings also demonstrate that inadequate interoperability and fragmented system integration continue to compromise the effectiveness of EMR implementation. Jämsä et al. [12] reported that integration failures between the Radiant imaging module and external systems resulted in delays in imaging reports for high-risk patients, primarily because of insufficient end-to-end testing before system deployment. Similarly, Hakim et al. [16] found that fragmented databases, recurring system downtime, and incomplete integration between the laboratory, pharmacy, and clinical information systems remained persistent technological challenges in both hospitals examined. Zhang et al. [17] further observed that deficiencies in system functionality, user interface design, and interoperability with other software applications contributed to documentation errors and reduced system performance.

These findings are consistent with previous evidence indicating that technological failures may disrupt clinical workflows, increase documentation burden, and reduce user satisfaction [7], [9]. Poor interoperability is particularly problematic, because fragmented information systems can lead to duplicated documentation, delayed information exchange, and incomplete patient records, thereby affecting the continuity and quality of patient care.

Usability also plays a fundamental role in determining the success of EMR implementation. Lyerla et al. [8] emphasized that systems with poor usability increase cognitive workload and user frustration, potentially reducing the efficiency and accuracy of clinical documentation. Likewise, Kaneko et al. [14] demonstrated that hospitals with limited technological resources and lower organizational readiness experienced greater productivity losses during the early stages of EMR implementation, indicating that infrastructure readiness influences the realization of EMR benefits.

Successful EMR implementation depends not only on system availability but also on the quality of the technological infrastructure, interoperability, and system usability. Healthcare organizations should prioritize user-centered system design, comprehensive interoperability testing before deployment, reliable backup and downtime management mechanisms, and continuous technical support in order to minimize operational disruptions and ensure safe, efficient, and sustainable EMR use.

Information Security Risks

The widespread adoption of EMR systems has increased the importance of information security in healthcare organizations. This review identified unauthorized access, confidentiality breaches, and cybersecurity vulnerabilities as key risks associated with EMR implementation. Katehakis et al. [10] emphasized that the expansion of electronic health information systems requires robust governance and security mechanisms to protect sensitive patient information. Consequently, safeguarding the confidentiality, integrity, and availability of electronic health data has

become an essential component of safe and reliable healthcare delivery.

The findings indicate that effective information security requires both technical and organizational safeguards. Common mitigation strategies include role-based access control, multi-factor authentication, data encryption, regular security audits, and continuous cybersecurity training for healthcare personnel [10]. These measures strengthen data protection while improving user confidence and supporting regulatory compliance in increasingly digital healthcare environments.

The reviewed studies further demonstrate that information security risks vary according to the organizational context and system architecture. Hakim et al. [16] reported that hospitals implemented different security approaches, including isolated offline networks, username and password authentication, secured server rooms, firewalls, and layered access control mechanisms. However, both hospitals continued to face challenges related to the legal validity of electronic signatures, highlighting that regulatory and governance issues remain barriers to fully paperless healthcare services. Zhang et al. [17] similarly identified data management and record migration problems as persistent security-related risks, particularly when patients with similar identities increased the likelihood of data retrieval errors. Although Jämsä et al. [12] did not specifically investigate cybersecurity incidents, their findings showed that failures in information flow and patient data management could indirectly compromise data integrity through misrouted referrals and incorrect patient allocation. Likewise, Irwin et al. [15] emphasized the importance of securing shared mobile computer workstations, noting that appropriate maintenance, user accountability, and infection control practices are necessary to protect both the physical devices and the sensitive patient information stored within them.

Information security should be incorporated into every stage of EMR implementation rather than being addressed solely as a technical concern. Strong governance, comprehensive security policies, continuous staff education, and routine monitoring are essential to protect patient information, strengthen organizational resilience, and support the sustainable implementation of EMR systems.

Organizational and Governance Risks

Organizational readiness and governance emerged as key determinants of successful EMR implementation. This review identified weak leadership support, insufficient funding, inadequate implementation planning, and ineffective change management as the most common organizational barriers. De Benedictis et al. [5] reported that organizational culture, leadership commitment, and readiness for change substantially influenced EMR adoption, while Scott et al. [7] emphasized that successful digital transformation requires strategic leadership, well-defined governance structures, and continuous organizational support.

These findings highlight that EMR implementation should be viewed as an organizational transformation rather than solely as a technological initiative. Hospitals

that focus primarily on system deployment without strengthening governance, stakeholder engagement, and organizational readiness are more likely to experience implementation difficulties. Effective governance supports resource allocation, policy development, performance monitoring, and cross-disciplinary collaboration, all of which contribute to the long-term sustainability of EMR implementation.

The reviewed studies further demonstrate that organizational factors directly influence the effectiveness of EMR implementation. Kaneko et al. [14] reported that EMR adoption was associated with temporary reductions in multi-factor productivity, particularly among late adopters, suggesting that inadequate organizational preparation and resource allocation may delay the realization of the technology's benefits. Similarly, Hakim et al. [16] found that effective EMR risk management depends on multi-level governance, continuous monitoring through Plan–Do–Check–Act (PDCA) cycles, and the organizational capacity to manage uncertainty in complex sociotechnical environments. Zhang et al. [17] also identified organizational factors, particularly ineffective decision-making procedures and weak patient safety culture, as significant contributors to human errors during EMR use. In addition, Jämsä et al. [12] demonstrated that post-implementation monitoring through patient safety incident reporting and root cause analysis is essential for identifying emerging risks and supporting continuous system improvement during the transition to digital health services.

Strong organizational governance is fundamental to sustainable EMR implementation. Active leadership engagement, adequate resource allocation, structured change management, continuous performance evaluation, and systematic risk monitoring should be integrated throughout the implementation process to strengthen organizational resilience and maximize the long-term benefits of EMR systems.

Implications For Risk Mitigation In Hospital Settings

The findings of this review demonstrate that EMR implementation risks are interconnected and extend beyond technological factors alone. Human resource limitations, documentation challenges, infrastructure constraints, information security concerns, and organizational weaknesses collectively influence implementation outcomes. Consistent with previous studies, the evidence suggests that successful EMR implementation requires a comprehensive risk management approach. Effective mitigation strategies include continuous user training, stakeholder engagement, workflow optimization, infrastructure strengthening, data quality assurance, cybersecurity enhancement, and strong organizational governance. Healthcare organizations that proactively identify and address implementation risks are more likely to achieve sustainable digital transformation, improve healthcare quality, enhance patient safety, and maximize the benefits of EMR systems. Therefore, risk mitigation should be incorporated into every stage of EMR implementation, from planning and deployment through to monitoring and continuous improvement.

CONCLUSIONS AND SUGGESTIONS

This literature review identified five major categories of risk associated with Electronic Medical Record (EMR) implementation in hospital settings, namely human resource risks, documentation and data quality risks, technology and infrastructure risks, information security risks, and organizational and governance risks. Among these, user resistance, inadequate training, incomplete documentation, interoperability limitations, and insufficient organizational support were the most frequently reported challenges affecting successful implementation.

The findings indicate that EMR implementation should not be viewed solely as a technological intervention but as a complex organizational transformation that requires the integration of technical, human, and managerial components. Successful implementation depends on the ability of healthcare organizations to proactively identify potential risks and to implement appropriate mitigation strategies throughout the implementation process.

Evidence from the reviewed studies suggests that effective risk mitigation can be achieved through continuous user training, structured change management programs, strengthening of the technological infrastructure, improved data quality management, enhanced information security measures, and the establishment of strong governance frameworks. These strategies can reduce implementation barriers, improve user acceptance, support patient safety, and optimize the benefits of EMR systems.

Therefore, hospitals and policymakers should adopt a comprehensive risk management approach when planning and implementing EMR systems. Future research is recommended to evaluate the effectiveness of specific mitigation strategies in different healthcare settings and to develop standardized frameworks for EMR risk management that support sustainable digital transformation in healthcare organizations.

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CONFLICT OF INTEREST STATEMENT

There is no conflict in the publication of this article.

REFERENCES

[1] F. Wurster *et al.*, "The Implementation of an Electronic Medical Record in a German Hospital and the Change in Completeness of Documentation: Longitudinal Document Analysis," *JMIR Medical Informatics*, vol. 12, no. 1, 2024, doi: 10.2196/47761.

[2] S. Zhang, L. Shen, and X. Gu, "Mechanisms of electronic health record-related patient safety incidents: Errors and risk factors from 15 years of experience in Japan," *Health Policy Technol.*, vol. 15, no. 6, p. 101226, Jul. 2026, doi: 10.1016/j.hlpt.2026.101226.

[3] J. Jämsä, P. Tissari, J. Kovanen, and L. Lehtonen, "Patient safety concerns in the go-live phase of an electronic health record implementation," *Int. J. Med. Inform.*, vol. 218, p. 106539, Sep. 2026, doi: 10.1016/j.ijmedinf.2026.106539.

[4] C. B. Hakim, J. Pornomo, I. N. Aryani, and T. D. Wijayanti, "Evaluation of electronic medical records risk management in Kudus hospitals: A comparative qualitative study," *Intelligent Hospital*, vol. 2, no. 2, p. 100056, Jun. 2026, doi: 10.1016/j.inhs.2026.100056.

[5] P. Irwin *et al.*, "Lesson learned from practice: Informing how to teach the use of simulated electronic medical records to nursing students," *Clin. Simul. Nurs.*, vol. 101, p. 101713, Apr. 2025, doi: 10.1016/j.ecns.2025.101713.

[6] K. Kaneko, D. Onozuka, H. Shibuta, and A. Hagihara, "Impact of electronic medical records (EMRs) on hospital productivity in Japan," *Int. J. Med. Inform.*, vol. 118, pp. 36–43, Oct. 2018, doi: 10.1016/j.ijmedinf.2018.07.008.

[7] F. Lyerla, C. R. Durbin, and R. Henderson, "Development of a Nursing Electronic Medical Record Usability Protocol," *CIN: Computers, Informatics, Nursing*, vol. 36, no. 8, pp. 393–397, Aug. 2018, doi: 10.1097/CIN.0000000000000432.

[8] A. Raut *et al.*, "Design and implementation of an affordable, public sector electronic medical record in rural Nepal," *J. Innov. Health Inform.*, vol. 24, no. 2, p. 186, Jun. 2017, doi: 10.14236/jhi.v24i2.862.

[9] E. V. Bologva, D. I. Prokusheva, A. V. Krikunov, N. E. Zvartau, and S. V. Kovalchuk, "Human-Computer Interaction in Electronic Medical Records: From the Perspectives of Physicians and Data Scientists," *Procedia Comput. Sci.*, vol. 100, pp. 915–920, 2016, doi: 10.1016/j.procs.2016.09.248.

[10] E. Aromataris, C. Lockwood, K. Porritt, B. Pilla, and Z. Jordan, Eds., *JBI Manual for Evidence Synthesis*. JBI, 2024. doi: 10.46658/JBIMES-24-01.

[11] D. G. Katehakis, "Electronic Medical Record Implementation Challenges for the National Health System in Greece," *International Journal of Reliable and Quality E-Healthcare*, vol. 7, no. 1, pp. 16–30, Jan. 2018, doi: 10.4018/IJRQEH.2018010102.

[12] I. A. Scott, C. Sullivan, and A. Staib, "Going digital: a checklist in preparing for hospital-wide electronic medical record implementation and digital transformation," *Australian Health Review*, vol. 43, no. 3, pp. 302–313, Jun. 2019, doi: 10.1071/AH17153.

[13] A. F. Senishaw, B. C. Tilahun, A. M. Nigatu, S. A. Mengiste, and K. Standal, "Willingness to use electronic medical record (EMR) system and its associated factors among health professionals working in Amhara region Private Hospitals 2021, Ethiopia," *PLoS One*, vol. 18, no. 5, p. e0282044, May 2023, doi: 10.1371/journal.pone.0282044.

[14] A. De Benedictis, E. Lettieri, L. Gastaldi, C. Masella, A. Urgu, and D. Tartaglini, "Electronic Medical Records implementation in hospital: An empirical investigation of individual and organizational determinants," *PLoS One*, vol. 15, no. 6, p. e0234108, Jun. 2020, doi: 10.1371/journal.pone.0234108.

[15] E. J. Saad *et al.*, "Benefit of an electronic medical record-based alarm in the optimization of stress ulcer prophylaxis," *Gastroenterología y Hepatología (English Edition)*, vol. 41, no. 7, pp. 432–439, Aug. 2018, doi: 10.1016/j.gastre.2018.04.021.

[16] J. Austin, M. Barras, and C. Sullivan, "Interventions designed to improve the safety and quality of therapeutic anticoagulation in an inpatient electronic medical record," *Int. J. Med. Inform.*, vol. 135, p. 104066, Mar. 2020, doi: 10.1016/j.ijmedinf.2019.104066.

[17] M. Casella Jean-Baptiste, T. M. Vital Julmiste, and E. Ball, "Health Information System Strengthening During Antenatal Care in Haiti: Continuous Quality Improvement Study," *JMIR Form. Res.*, vol. 8, p. e55000, Jun. 2024, doi: 10.2196/55000.

[18] F. Wurster *et al.*, "The Implementation of an Electronic Medical Record in a German Hospital and the Change in Completeness of Documentation: Longitudinal Document Analysis," *JMIR Med. Inform.*, vol. 12, p. e47761, Jan. 2024, doi: 10.2196/47761.