

***DETERMINANTS OF HEALTH WORKERS' DIGITAL COMPETENCE FOR
EMR IMPLEMENTATION***

**FAKTOR-FAKTOR PENENTU KOMPETENSI DIGITAL TENAGA
KESEHATAN UNTUK IMPLEMENTASI EMR (Rekam Medis Elektronik)**

Siswanto^{1*}, Tantri Yanuar Rahmat Syah², Edi Hamdi³, Sandra Dewi⁴

Esa Unggul University, Jakarta, Indonesia^{1,2,3,4}

paksiswanto1707@student.esaunggul.ac.id^{1*}

ABSTRACT

This study aims to regularly identify and synthesize the key factors influencing digital competence among health workers in the implementation of Electronic Medical systems. Using the PRISMA-guided Systematic Literature Review (SLR) method, 84 documents from Scopus and PubMed were initially retrieved and screened, yielding 8 peer-reviewed articles published between 2020 and 2025 that met the inclusion criteria. The findings reveal that digital competence is shaped by five interconnected factors: individual readiness, education system design, institutional policies, continuous digital training, and validated assessment tools. Furthermore, digital competence moderates the effectiveness of emerging technologies such as AI and supports holistic care delivery. The novelty of this study lies in its integrative mapping of empirical and conceptual evidence to address existing research gaps. This review offers theoretical insight and practical implications for educators, healthcare managers, and policymakers committed to advancing digital transformation in health systems.

Keywords: Digital Competence; Health Workers; Electronic Medical Records; Systematic Literature Review; Digital Health; Implementation Strategy.

ABSTRAK

Studi ini bertujuan untuk secara teratur mengidentifikasi dan mensintesis faktor-faktor kunci yang memengaruhi kompetensi digital di kalangan tenaga kesehatan dalam implementasi sistem rekam medis elektronik. Dengan menggunakan metode Tinjauan Literatur Sistematis (SLR) yang dipandu PRISMA, 84 dokumen dari Scopus dan PubMed awalnya diambil dan disaring, menghasilkan 8 artikel yang ditinjau sejawat yang diterbitkan antara tahun 2020 dan 2025 yang memenuhi kriteria inklusi. Temuan menunjukkan bahwa kompetensi digital dibentuk oleh lima faktor yang saling terkait: kesiapan individu, desain sistem pendidikan, kebijakan institusional, pelatihan digital berkelanjutan, dan alat penilaian yang tervalidasi. Lebih lanjut, kompetensi digital memoderasi efektivitas teknologi baru seperti AI dan mendukung pemberian perawatan holistik. Kebaruan studi ini terletak pada pemetaan integratif bukti empiris dan konseptual untuk mengatasi kesenjangan penelitian yang ada. Tinjauan ini menawarkan wawasan teoritis dan implikasi praktis bagi pendidik, manajer perawatan kesehatan, dan pembuat kebijakan yang berkomitmen untuk memajukan transformasi digital dalam sistem kesehatan.

Kata Kunci: Kompetensi Digital; Tenaga Kesehatan; Rekam Medis Elektronik; Tinjauan Literatur Sistematis; Kesehatan Digital; Strategi Implementasi.

INTRODUCTION

Digital transformation in the healthcare sector has grown rapidly in line with the increasing need for efficiency, accuracy, and integration of information in modern medical service systems. One concrete manifestation of this transformation is the implementation of the Electronic Medical Record system, which aims to replace manual record-keeping with an integrated digital information system. This system is not merely an

administrative tool, but also a strategic instrument for improving service quality, patient safety, and the effectiveness of clinical decision-making. However, available technological advances do not automatically guarantee the successful implementation of the Electronic Medical Record system in the field. One key determinant that is a critical point is the digital competence of healthcare workers as the primary users of the system. Digital competence in this context encompasses not only technical

skills in operating software, but also conceptual understanding, attitudes toward technological innovation, and the ability to adapt to digitally transformed work systems.

As defined by Riina et al., (2022) digital competence encompasses an individual's ability to access, assess, and use digital technology effectively, critically, ethically, and safely in various contexts, including healthcare. This competence consists of five main domains: information literacy, digital communication, content creation, digital security, and problem-solving, all of which are highly relevant in the practice of using Electronic Medical Record systems. Furthermore, Ferrari et al., (2020) emphasize that digital competence is an essential 21st-century competency that encompasses not only technical abilities, but also cognitive and social dimensions, such as critical thinking, collaboration, and ethical awareness—dimensions required for healthcare professionals to operate Electronic Medical Record systems optimally.

Unfortunately, although the issue of digital competence has begun to be discussed, many healthcare institutions still face serious obstacles, such as low digital literacy among healthcare workers, a lack of ongoing training, weak integration of digital learning into professional curricula, and the absence of evaluative instruments that can accurately map digital readiness. While various studies have addressed the information technology aspect of healthcare services, few have systematically explored the factors shaping healthcare workers' digital competence, particularly in relation to the implementation of Electronic Medical Record systems. The available literature is generally descriptive and contextual, and does not integrate

findings across studies, making it difficult to formulate a comprehensive digital competence improvement strategy. This creates a research gap that underlies the importance of this review. Previous studies tended to separate individual and institutional aspects, or only highlighted the technological dimension without considering human resource readiness as a key variable for successful digital transformation. Therefore, a comprehensive scientific synthesis is needed to identify the key determinants of healthcare workers' digital competence and its implications for the effectiveness of Electronic Medical Record systems.

This systematic literature review addresses this gap. Its novelty lies in its attempt to synthesize empirical and conceptual evidence through a Systematic Literature Review (SLR) approach based on the PRISMA protocol. Unlike previous, piecemeal reviews, this study holistically maps five key interrelated domains that shape digital competency: individual factors, professional education design, policies and institutions, ongoing digital training, and validated evaluation instruments. Furthermore, this study highlights the role of digital competency not only as a passive skill but also as a moderator that can influence the successful implementation of advanced technologies such as artificial intelligence (AI) in clinical services, as well as its contribution to supporting holistic service practices such as patient spiritual care. Thus, this study not only answers the question "what are the factors that shape digital competency?" but also illustrates how these competencies directly contribute to the effective implementation of Electronic Medical Records systems in various healthcare contexts.

The purpose of this study is to systematically identify and synthesize the factors influencing the digital competence of healthcare workers in the implementation of Electronic Medical Records systems, and to explain the contribution of digital competence to the success of such systems in healthcare institutions. This study is expected to not only strengthen the conceptual foundation in the digital health literature but also provide relevant practical implications for healthcare educators, hospital managers, and public policy makers who are working to accelerate the digitalization of healthcare services in a more structured and sustainable manner.

RESEARCH METHOD

A Systematic Literature Review (SLR) is a methodological approach used to comprehensively and systematically examine literature based on a structured protocol. In Indonesian academia, this method is known as a systematic literature review. A SLR aims to identify, evaluate, and synthesize key findings from relevant studies to answer research questions objectively and evidence-based. Through a transparent and sequential procedure, an SLR minimizes subjective bias and increases the reliability of the review results.

More than simply summarizing, the SLR method helps uncover knowledge gaps (research gaps) and suggests potential directions for future research development. This approach also allows researchers to explore diverse theoretical and empirical perspectives on the issues raised, including identifying theories that underlie and support a deeper understanding of the topic (Van Dinter et al., 2021)

The first stage is problem formulation, the process of identifying

the motivation for this research. Researchers explored this issue by reviewing various scientific journals and previous studies. This study focused on analyzing the factors influencing the digital competence of healthcare workers in the context of implementing Electronic Medical Records in healthcare facilities. This literature review was designed to help answer several established research questions, including:

RQ1: What factors influence the digital competence of healthcare workers in the context of implementing the Electronic Medical Records system?

RQ2: How do the digital competencies of healthcare workers contribute to the effectiveness of the implementation of Electronic Medical Record systems in healthcare institutions?

The second stage is literature search or identification, discussing the search for relevant journals and articles through academic databases such as Scopus and PubMed. Based on the research title, "Determinants of health workers' digital competence for EMR implementation."

The study design used in this research relies on data analysis and synthesis methods, with a primary focus on the results of previous research. This process was carried out to systematically summarize the study's contents and draw relevant conclusions, thus providing a strong foundation for designing further research.

The literature identification stage includes collecting theories, articles, and research journals from various reliable sources, which are used as the main basis in the discussion process in this study.

The third stage is the process of searching for relevant literature, which aims to select whether the information

found is suitable and appropriate to be used as material in this research.

QA1: Are the selected journals published between 2020 and 2025?

This research focuses on various factors influencing the digital competence of healthcare workers in implementing an Electronic Medical Records system. To address this theme, data from journals used in the research process were analyzed based on specific criteria: research published within the last five years (2020–2025), publication types including both scientific articles and review articles, and journals with full accessibility.

The fourth stage, the qualitative feasibility assessment stage, focuses on evaluating the methodological quality of the systematic literature review (SLR). Researchers assess the journal data sources used by referring to several credibility indicators, such as peer-reviewed status, the CiteScore index, the Journal Impact Factor (JIF), the Source Normalized Impact per Paper (SNIP) from the Elsevier Scopus database, and the SCImago Journal Rank (SJR). The application of these criteria aims to ensure that only articles of high scientific quality are included in the further analysis stage.

To ensure the validity of the results of this review, bias mitigation strategies were systematically applied. Article selection followed the PRISMA 2020 guidelines, while the use of Scopus and PubMed databases helped reduce publication bias. Data extraction was performed by two independent researchers, and study quality was assessed using the MMAT, accompanied by inter-rater reliability testing. Results are presented transparently through PRISMA diagrams and synthesis tables, and a discussion covering study limitations and potential residual bias is provided, in accordance with the

Cochrane Handbook guidelines (Chandler et al., 2019)

The final stage of the systematic literature review process involves drafting a conclusion that summarizes the main findings, logically discussing the analysis results, and providing a concise and comprehensive explanation. At this stage, the researcher also provides answers to the previously formulated research questions and demonstrates a thorough understanding of the analyzed literature.

RESULT AND DISCUSSION

Study selection and screening

This research was conducted using a systematic literature review approach referring to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method, which consists of four main stages: identification, screening, feasibility assessment, and determination of final results. In the initial stage, researchers established search criteria for inclusion in the database, focusing on articles and journals discussing factors influencing the digital competence of healthcare workers in the implementation of Electronic Medical Record systems. Subsequently, inclusion and exclusion criteria were applied, including a publication period limitation between 2020 and 2025, to ensure the relevance and currency of the analyzed data.

The data search in this study was conducted by selecting academic databases as the primary source, where relevant scientific journals and articles were obtained to support the systematic literature review process. The article search was conducted through the Scopus database with the keywords "digital competence" and "healthcare", resulting in 70 documents related to the topic of digital competence of healthcare workers in the implementation of the

Electronic Medical Records system. After applying the 2020–2025 publication year filter, the number of documents was reduced to 63. Furthermore, restrictions were made based on the health professions field, leaving 7 documents. Additional filters were applied to ensure only scientific articles, final publications, English language, and academic journals, which all remained, resulting in 7 documents. Of these, 6 articles were open access publications, allowing full access for further analysis in this study.

Next, a literature search was conducted through the PubMed database using the keyword combination "digital competence" AND "healthcare" AND "hospital," resulting in an initial 14 documents spanning the years 2020 to 2025. The screening process was carried out in stages by applying several inclusion criteria. First, only articles providing abstracts and free full-text access were included, reducing the number to 9 documents. Second, the English language restriction maintained this number. Third, after applying the human studies filter, the number of articles was reduced to 5 documents. Finally, after limiting publications to the last five years, 5 articles were still obtained that met all the initial requirements for further analysis.

Inclusion and Exclusion Criteria were established to ensure that the articles analyzed truly align with the study's focus. Inclusion criteria included peer-reviewed scientific articles published between 2020 and 2025. Included studies must explicitly focus on digital competency, including related terms such as digital literacy and digital capability. The study context was limited to the healthcare sector, including hospitals, clinics, and primary and secondary healthcare services, with

primary subjects being healthcare workers, such as doctors, nurses, hospital managers, and other medical staff. Only articles presenting empirical data or systematic reviews were considered, provided they were available in full text and written in English.

Conversely, exclusion criteria for the study included articles that solely discussed technological aspects without addressing the digital competency dimension, or that primarily targeted patients, students, or the general public. Studies conducted outside the healthcare context, such as in the general education sector or industry, were also excluded. Furthermore, articles that had not undergone peer review, including editorials, opinion pieces, research protocols, and non-scientific reports, as well as articles not available in full text or not in English, were excluded from the review.

As part of the selection process for this Systematic Literature Review, 11 scientific articles were evaluated to assess their suitability to the study's focus, namely the digital competence of healthcare workers in the implementation of electronic medical records systems. Eight articles were accepted because they explicitly focused on the digital competence of healthcare workers in hospitals or professional educational institutions, using an empirical approach or instrument validation. Three articles were considered for limited consideration because they only briefly discussed aspects of digital competence or in contexts outside hospitals. No articles were rejected. These results indicate that the majority of selected articles were highly relevant to the study's focus and made significant contributions to the understanding of digital competence in healthcare.

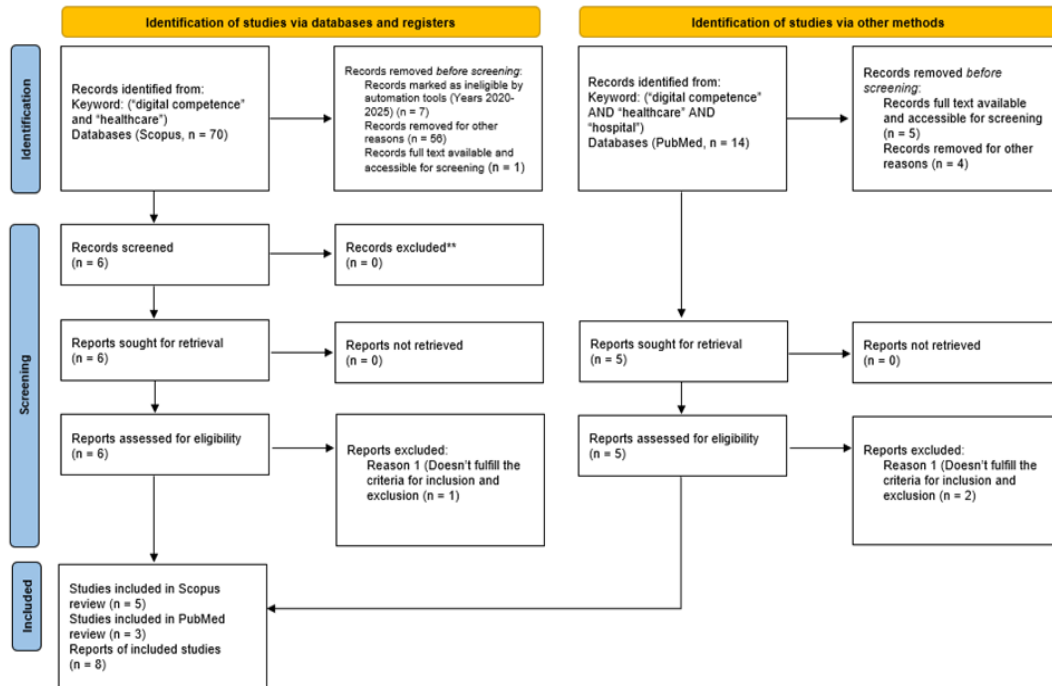


Figure 1. PRISMA flow diagram

Characteristics of included studies

Table 1. Data extraction for included studies

No	Author	Article Title	Study Context	Digital Competence Focus	Method	Key Findings
1	(Laakkonen et al., 2024)	Digital competence in leadership	Hospital management	Digital leadership, digital literacy	Mixed-method systematic review	Digital leadership is essential for the digital health system transition
2	(Pramila-Savukoski et al., 2024)	Generic competence including digital	Health science students	Digital competence as part of generic competence	Cross-country quantitative survey	There is a need to strengthen digital literacy from early education
3	(Zainal et al., 2025)	Digital health competencies in medical education	Hospital organization leaders	Digital competencies in medical curriculum	Qualitative interviews	Hospital leaders rate digital competency as a priority
4	(AlDhaen, 2025)	Digital competence as moderator in AI-healthcare model	Healthcare workers at GCC hospitals	Digital competence as a moderator	Structural model (SEM)	Digital competency increases the effectiveness of AI in improving patient safety
5	(Herrera-Lillo & Urrejola-Contreras, 2025)	Self-perceived digital competence	Health students	Self-assessment of digital competence	Survey and critical analysis	Medium to low digital competency level; curriculum intervention needed
6	(Kaihlalanen et al., 2024)	Continuing education on digital competence	European health workers	Continuing education in digital skills	Mapping analysis	There is a need for a national policy for sustainable digital training.

7	(Burgos et al., 2022)	Digital competencies for spiritual care	Nurse	Digital competence in spiritual care practice	Qualitative study	Digital competencies help integrate spiritual values into patient care.
8	(Karvouniari et al., 2024)	Validation of digital competence indicators	Greek health workers	DIGCOMP-based digital competency indicators	Cross-sectional survey	Valid and usable instruments for measuring digital competence

Quality appraisal of included studies

Table 2. Mixed Methods Appraisal Tool summary

No	Author	Study Design	Screening 1	Screening 2	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	Total Score	Quality Category
			Is the research objective clear?	Is empirical data used?	Design according to the question?	Is the sampling procedure appropriate?	The right analysis method?	Valid/reliable measurement?	Interpretation of results is appropriate?		
1	(Laakkonen et al., 2024)	Mixed Methods	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5	Tall
2	(Pramila-Savukoski et al., 2024)	Quantitative Descriptive	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5	Tall
3	(Zainal et al., 2025)	Qualitative	Yes	Yes	Yes	Yes	Yes	Need consideration	Yes	4	Currently
4	(Aldhaen, 2025)	Quantitative Nonrandomized	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5	Tall
5	(Herrera-Lillo & Urrejola-Contreras, 2025)	Quantitative Descriptive	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5	Tall
6	(Kaihlainen et al., 2024)	Quantitative Descriptive	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5	Tall
7	(Burgos et al., 2022)	Qualitative	Yes	Yes	Yes	Yes	Yes	Need consideration	Yes	4	Currently
8	(Karvouniari et al., 2024)	Quantitative Descriptive	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5	Tall

Publication year distribution

This evaluation indicates that the majority of selected articles align well with the objectives of the SLR and provide strong conceptual and empirical contributions to understanding the

digital competence of healthcare workers within the framework of technology implementation in modern healthcare. Figure 2 shows a diagram of the year of publication in the journal.

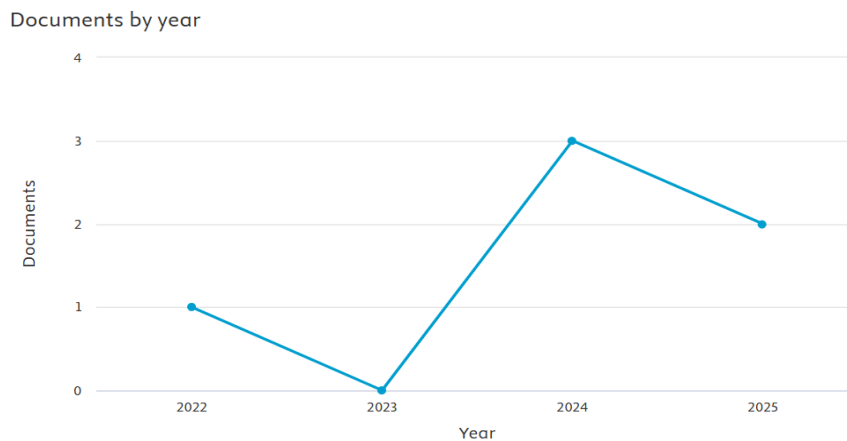


Figure 2. Publication year distribution of included studies

DISCUSSION

The results of a review of eight articles indicate that digital competence is not only determined by individual

technical abilities, but also by the dimensions of education, organization, policies, and the supporting technological systems. A study by

Laakkonen et al., (2024) emphasized the importance of digital competence among healthcare leaders as a key driver of Electronic Medical Record system adoption. Factors such as leadership experience, attitudes toward technological innovation, and institutional readiness determine the extent to which leaders are able to support digital transformation based on Electronic Medical Record systems. From a professional education perspective, studies by Pramila-Savukoski et al., (2024) and Herrera-Lillo & Urrejola-Contreras (2025) indicate that the digital competence readiness of healthcare students is still limited, especially in the context of the use of Electronic Medical Record systems and clinical information technology. This low digital literacy indicates that the integration of technology-based learning into the healthcare education curriculum needs to be strengthened. Institutional and policy factors also emerged in the study by Zainal et al., (2025), which highlighted barriers to implementing digital training in medical educational institutions, such as system fragmentation, lack of supportive policies, and weak synergy between academics and clinicians. This has an impact on the lack of digital competence readiness of young doctors in facing Electronic Medical Record systems in the real world. The aspect of continuous training was raised by Kaihlanen et al., (2024), who found that digital training for healthcare workers in European countries is not yet standardized. The lack of an accreditation system and inequality in access to digital education leads to uneven digital competency across healthcare institutions. In terms of measurement instruments, Karvouniari et al., (2024) successfully validated digital competency indicators based on

the DIGCOMP framework on healthcare workers in Greece. This instrument is highly relevant for use in the context of hospitals that are or will adopt Electronic Medical Record systems, as it is able to comprehensively assess the digital readiness of healthcare workers. AIDhaen, (2025) expands the discussion by showing that digital competence not only influences individual readiness but also acts as a moderator in the effectiveness of digital systems such as Artificial Intelligence (AI). In the context of Electronic Medical Record systems, this means that digital competence not only enables the use of the system but also optimizes its impact on patient safety and service efficiency. Finally, the study by Burgos et al., (2022) highlights the importance of developing digital competence in non-medical services such as spiritual care. This shows that digital competence has a broad spectrum, and in the context of implementing an Electronic Medical Record system, health workers must be able to use technology not only for data input, but also to support a holistic approach to patients.

Determinants of digital competence (RQ1)

The digital competence of healthcare workers in implementing Electronic Medical Records systems is influenced by five main factors. First, individual factors such as experience, education, and attitudes toward technology influence readiness to adopt digital systems (Laakkonen et al., 2024). Second, educational factors indicate that low technology integration in health profession curricula hinders graduate readiness (Pramila-Savukoski et al., 2024) (Herrera-Lillo & Urrejola-Contreras, 2025). Third, institutional and policy factors, including a lack of synergy between educational institutions

and clinical practice, act as structural barriers (Zainal et al., 2025). Fourth, uneven digital training contributes to competency gaps between institutions (Zainal et al., 2025). Fifth, the use of measurement instruments such as DIGCOMP is important for assessing the digital readiness of healthcare workers (Karvouniari et al., 2024). Furthermore, digital competence contributes to the utilization of advanced technologies such as AI AIDhaen (2025) and supports holistic care, including the spiritual aspects of patients (Burgos et al., 2022). Therefore, strengthening digital competence needs to be carried out comprehensively, involving individual, institutional, and overall health system approaches.

Contribution of digital competence to EMR implementation effectiveness (RQ2)

The digital competence of healthcare workers contributes significantly to the effectiveness of Electronic Medical Record (EMR) system implementation in healthcare institutions. This competence encompasses not only technical skills, but also leadership readiness and institutional support. Laakkonen et al., (2024) demonstrated that digitally literate leaders can accelerate the adoption of EMR systems through transformational leadership. However, as noted by Pramila-Savukoski et al., (2024) and Herrera-Lillo & Urrejola-Contreras, (2025), many young healthcare workers still lack adequate digital literacy. Barriers such as a lack of standardized training Kaihlanen et al., (2024), weak institutional policies Zainal et al., (2025) and suboptimal academic-clinical integration also hinder digital readiness. However, instruments such as DIGCOMP Karvouniari et al., (2024) can be used to objectively assess this

readiness. Furthermore, AIDhaen, (2025) emphasized that digital competence also improves the overall effectiveness of digital systems, including their impact on patient safety and service efficiency. Thus, digital competence not only supports the use of EMR systems but also determines the extent to which these systems provide tangible benefits at the clinical and managerial levels. Strengthening these competencies needs to be part of a comprehensive Electronic Medical Records system implementation strategy.

Contextual considerations for developing countries

In the context of developing countries, the implementation of Electronic Medical Records systems faces multidimensional challenges related not only to technological infrastructure but also to human resource readiness. Digital literacy for healthcare workers is often not a priority in professional education curricula, while access to ongoing training remains limited. These challenges are exacerbated by high clinical workloads, budget constraints, and national policies that do not explicitly support digital transformation as a long-term strategy. As a result, digitalization initiatives often stall at the short-term project level without adequate institutional sustainability.

Globally, WHO ZWIELEWSKI (2023) emphasizes the importance of integrating information technology into health systems to improve access, efficiency, and patient safety. However, in many developing countries, the adoption of digital technologies such as Electronic Medical Records systems still faces cultural resistance, gender gaps in technology access, and weak interoperability between systems. Therefore, strengthening the digital

competence of health workers is not only a technical necessity, but also part of the health system reform agenda. Digital transformation in the health sector must be seen as a strategic opportunity to address service disparities and improve the quality of data-driven care, which requires close collaboration between educational institutions, service providers, and policymakers.

CONCLUSION

This systematic literature review concludes that the successful implementation of Electronic Medical Records systems is significantly influenced by the digital competence of healthcare workers. This competence is not only related to technical skills but is also formed through the interaction of individual readiness factors, professional education design, institutional policies and support, ongoing digital training, and the availability of validated assessment instruments. Therefore, strengthening digital competence needs to be a cross-level strategy, from educational curricula and healthcare organization governance to health system policies so that EMR adoption and the use of advanced technologies such as AI can provide tangible benefits for patient safety and service efficiency. Future research is recommended to explore the dynamics of digital competence longitudinally, test contextualized training models, and expand the focus to non-clinical healthcare workers who also interact with EMRs.

SUGGESTION

To broaden and deepen understanding of this topic, further research is recommended to conduct longitudinal studies to capture the dynamics of digital competency changes over time, develop contextual and

participatory training models, and expand the research focus to non-clinical healthcare professionals who also use EMR systems. Furthermore, a mixed-methods approach is highly recommended to obtain a more holistic picture of both quantitative data and qualitative user experiences. Cross-national and cross-cultural studies are also important to enrich the global understanding of digital readiness and EMR implementation strategies across different healthcare systems.

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