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Association of Knowledge and Attitude on Healthcare Professionals' Readiness Toward Electronic Medical Record Implementation: A Meta-Analysis

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Abstract

The successful implementation of electronic medical records (EMR) is closely linked to the readiness of healthcare professionals. Among various determinants, knowledge and attitude are considered the most essential individual factors. This meta-analysis followed PRISMA guidelines. Studies were systematically searched in PubMed, Scopus, and Google Scholar using Boolean operators. Eligible studies were cross-sectional, reported adjusted odds ratios (aOR), and examined the association of knowledge and attitude with readiness for electronic medical record implementation. Data were analyzed using RevMan 5.3 using fixed-effect models, and publication bias was assessed using funnel plots. A total of 14 studies published between 2014 and 2024 were included, comprising 13 studies from Ethiopia and 1 study from Saudi Arabia. Ethiopia is a low-income nation with varying levels of digital health in terms of digital infrastructure and EMR implementation phases. Meanwhile, Saudi Arabia represents a high-income country with a more advanced digital health infrastructure. A total of 14 cross-sectional studies were included in the meta-analysis. Healthcare professionals with good knowledge were more likely to be ready to implement electronic medical records (pooled aOR = 2.04; 95% CI: 1.73–2.40). Similarly, a favorable attitude was associated with higher readiness for EMR implementation (pooled aOR = 2.15; 95% CI: 1.84–2.51). The findings were consistent across studies, with low to moderate heterogeneity, and visual inspection of funnel plots suggested no substantial publication bias. This meta-analysis confirms that knowledge and attitude significantly influence healthcare professionals' readiness to implement EMR. Efforts to strengthen knowledge through training and capacity building, along with strategies to foster positive attitudes toward EMR, are crucial to ensure the success of digital health transformation in healthcare facilities.

Keywords: electronic medical record; readiness; knowledge; attitude; meta-analysis

Introduction

The current state of global health is characterized by a double burden of disease, namely the increasing prevalence of infectious diseases that remain a threat, accompanied by the dominance of non-communicable diseases. The COVID-19 pandemic has also highlighted the importance of a resilient, adaptive, and digitally-based healthcare system (Vu et al., 2024). This situation has prompted the transformation of healthcare systems in various countries, with a focus on utilizing information technology to ensure effective, efficient, and sustainable access to services.

The digitization of health services has become an important strategy for improving the quality, efficiency, and continuity of services (Hailegebreal et al., 2023). One concrete manifestation of this digitization is the implementation

of Electronic Medical Records (EMR), which function as a system for the digital storage, management, and exchange of patient health data (Janssen et al., 2021; Kasaye et al., 2023).

The application of EMR has experienced steady growth over the past 15 years and a 46% increase globally in the last five years (Hlaing Min Oo et al., 2021). The shift from paper-based medical records to digital systems is not only aimed at improving administrative efficiency, but also at supporting patient safety, service quality, continuity of care, the use of health data for evidence-based decision making, and assisting in managing global health risks (Biruk et al., 2014; Gelchu et al., 2025; Janssen et al., 2021; Valderas et al., 2016; World Health Organization, 2021). The complexity of the disease burden, demands for financing efficiency, and increasing public expectations for fast, personalized, and safe healthcare services further emphasize the urgency of implementing EHRs in the modern era (Vu et al., 2024).

The implementation of electronic medical records (EMR) or electronic health records (EHR) has become one of the priority agendas in the transformation of health systems in various countries. Many developed countries have successfully adopted EMR on a large scale (Collier, 2015; HIMSS, 2023) while developing countries still face various obstacles, ranging from infrastructure limitations to resistance from health workers. One of the determining factors for the successful adoption of EMR is the readiness of healthcare workers, as they are the main users of the system.

The successful implementation of EMR is greatly influenced by the readiness of healthcare workers as the main users (Hlaing Min Oo et al., 2021; Kasaye et al., 2023; Saleh et al., 2016). This readiness is not only about the availability of technical and organizational skills. Knowledge and attitude are the most essential individual readiness factors in determining the success of adopting a new system. Adequate knowledge about the benefits, functions, and how to use EHRs will increase healthcare workers' confidence in operating them (Ibrahim et al., 2025; Ngusie et al., 2022; Oumer et al., 2021) while a positive attitude towards technology will encourage acceptance and openness to change (Kasaye et al., 2023). Therefore, this study aims to systematically analyze and estimate the effect of knowledge and attitudes on the readiness of health workers to implement electronic medical records through a meta-analysis approach.

Methods

1. Study Design

This study followed the PRISMA guidelines for systematic review and meta-analysis. Eligible studies were observational with a cross-sectional design, and examined the association of knowledge and attitude with EMR readiness.

2. Meta-analysis Steps

The meta-analysis was conducted as follows:

a. Literature Identification: Articles were searched through the PubMed, Scopus, and Google Scholar databases using Boolean operator combinations: “electronic medical record” OR “EMR” OR “electronic health record” OR ‘EHR’ OR “digital health record” AND “health professional” OR “healthcare providers” AND “readiness” OR “implementation readiness” OR “willingness” AND “knowledge” AND “attitude”.

b. Eligibility: Full-text articles were reviewed to ensure they met the inclusion and exclusion criteria.

c. Data Extraction: Data extracted included author names, year of publication, country, number of respondents,

study design, knowledge variables, attitudes, readiness, and adjusted odds ratio (aOR) and confidence interval (CI) values. Two reviewers independently selected the studies and extracted the data. After screening titles and abstracts to find potentially pertinent research, the complete text was evaluated in accordance with the predetermined inclusion and exclusion criteria. Until a consensus was formed, any disagreements among the reviewers were settled through conversation. A third reviewer was consulted to reach a decision when an agreement could not be reached. This procedure was consistently used for both study selection and data extraction to reduce subjective bias.

d. Data Analysis: Statistical analysis was performed using RevMan 5.3 software. A fixed-effect model was used when heterogeneity was low ($I^2 < 50\%$), while a random-effect model was used for high heterogeneity ($I^2 \geq 50\%$).

e. Publication Bias Assessment: This was performed using a funnel plot to assess the symmetry of the distribution of research results.

3. Inclusion Criteria

The inclusion criteria for this study were observational studies with a cross-sectional design, using health workers as the main respondents, including doctors, nurses, midwives, and medical support staff. The studies had to assess the relationship between knowledge and/or attitudes and readiness to implement EMR, and report the measure of association in the form of adjusted odds ratio (aOR) with a 95% confidence interval. Accepted articles are publications in English, with a publication date range between 2014 and 2024.

This meta-analysis comprised studies that were published between 2014 and 2024. This period was chosen because, especially in low- and middle-income nations, the adoption of electronic medical record (EMR) systems started to grow significantly during this time. Due to variations in regulatory frameworks, implementation contexts, and technology maturity, which may restrict comparability with modern EMR systems, earlier research were excluded.

4. Exclusion Criteria

Articles were excluded from the analysis if they were classified as literature reviews, editorials, opinion pieces, or commentaries. Articles were also excluded if the available data were incomplete or could not be extracted, did not use health workers as the main respondents, or were published in languages other than English or Indonesian.

5. Definition of Operational Variable

Knowledge: The level of understanding of health workers regarding the concept, benefits, and use of EMR, measured using an original research questionnaire. In this analysis, it is categorized as good and poor.

Attitude: The affective response of health workers to the implementation of EMR, including acceptance, willingness, and positive or negative views of the system. It is categorized as favorable and unfavorable.

Readiness: The level of willingness and ability of healthcare workers to adopt and use EMR in daily clinical practice. The main outcome was measured by adjusted odds ratio (aOR) based on the results of each study's analysis.

6. Potential Selection Bias

There are a number of possible reasons of selection bias in this meta-analysis. First, only papers written in English were considered, which would have left out pertinent research written in other languages. Second, the majority

of the included research were carried out in Ethiopia, which led to a geographic concentration that would restrict the findings' applicability in other countries, especially high-income nations. Third, every study that was included used a cross-sectional design, which limits the ability to reach conclusions about causality and may be impacted by unmeasured confounding variables. Lastly, the inclusion of research that reported adjusted odds ratios (aOR) may have resulted in eliminating of studies that used alternative analytical techniques but had relevant results. These factors should be considered when interpreting the pooled estimates.

Results

The search for primary articles related to the influence of health workers' knowledge and attitudes on their readiness to use electronic medical records in this meta-analysis was conducted in several databases, such as PubMed, Scopus, and Google Scholar.

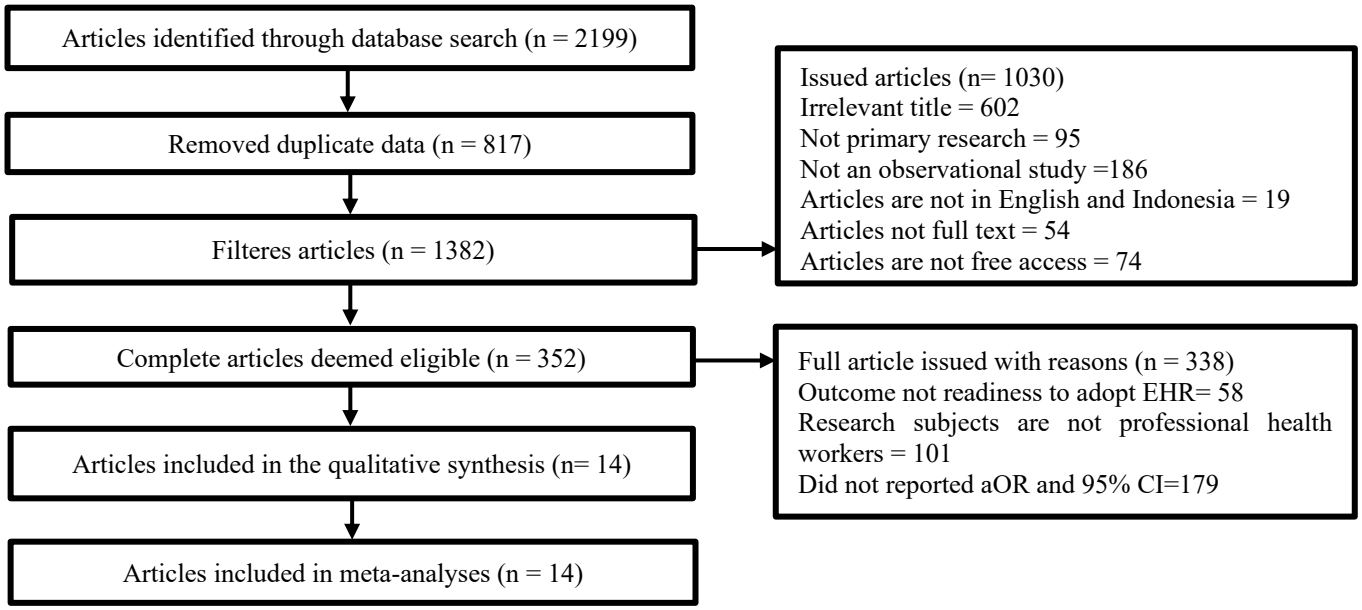

Figure 1. Results of PRISMA flowchart diagrams

Search for articles according to the PRISMA flowchart which can be seen in Figure 1. The total number of articles in the initial search was 2,199. After removing articles that had already been published, the researchers found 1,382 articles, of which 352 met the criteria for full-text review. Subsequently, 14 articles from Ethiopia and Saudi Arabia that met the quality assessment criteria were included in the meta-analysis study.

Table 1. Article Scoring Results Based on Critical Appraisal Skills Programme (CASP) Cross Sectional Checklist

Author (Years)	Question Criteria											Total
	1	2	3	4	5	6	7	8	9	10	11	
Wubante, et al, 2021	2	2	2	2	2	2	2	2	2	2	2	22
Biruk et al., 2014	2	2	2	2	2	2	2	2	2	2	2	22
Abore, et al., 2022	2	2	2	2	2	2	2	2	2	2	2	22
Ngusie, et al., 2022	2	2	2	2	2	2	2	2	2	2	2	22
Gelchu, et al., 2024	2	2	2	2	2	2	2	2	2	2	2	22
Hailegebreal, et al., 2023	2	2	2	2	2	2	2	2	2	2	2	22
Yilma, et al., 2023	2	2	2	2	2	2	2	2	2	2	2	22
Berihun, et al., 2020	2	2	2	2	2	2	2	2	2	2	2	22
Awol, et al., 2020	2	2	2	2	2	2	2	2	2	2	2	22

Senishaw, et al., 2023	2	2	2	2	2	2	2	2	2	2	2	22
Oumer, et al., 2021	2	2	2	2	2	2	2	2	2	2	2	22
Thapa, et al., 2021	2	2	2	2	2	2	2	2	2	2	2	22
Keleb, et al., 2022	2	2	2	2	2	2	2	2	2	2	2	22
Tesfa, et. al, 2021	2	2	2	2	2	2	2	2	2	2	2	22

(Primary data, 2025)

Article quality assessment using the CASP Cross-Sectional Checklist consisting of 11 questions. These questions cover the clarity of the research focus, the appropriateness of the methods, the respondent recruitment procedures, the accuracy of the measurements, the relevance of the data, the adequacy of the sample size, the presentation of the results, the thoroughness of the analysis, the clarity of the findings, the applicability of the findings to the local population, and the value of the research for the advancement of health science and practice. The CASP checklist response scores are described as Yes = 2, Doubtful = 1, and No = 0.

The assessment results show that all articles analyzed have good methodological quality with a maximum score of 22 for each article. All studies show clear and focused research questions, use appropriate techniques, conduct respondent recruitment processes in an acceptable manner, measure variables correctly, and present results with in-depth analysis and clear conclusions. The number of participants was also considered sufficient to reduce the effect of chance. The findings were relevant for use in local and national populations. All articles were deemed eligible for inclusion in the meta-analysis synthesis because they had a high level of reliability and minimal risk of methodological bias.

Table 2. Summary of primary research sources for meta-analysis of the association of knowledge and attitude on healthcare professionals' readiness toward electronic medical record implementation.

Author (Year)	Country	Sample	P	I	C	O
Wubante, et al, 2021	Ethiopia	423	Health Professionals	Good Knowledge, Favorable attitude	Poor Knowledge, Unfavorable attitude	Readiness of EMR
Biruk et al., 2014	Ethiopia	606	Health Professionals	Good Knowledge, Good attitude	Poor Knowledge, Poor attitude	Readiness of EMR
Abore, et al., 2022	Ethiopia	306	Health Professionals	Good Knowledge, Favorable attitude	Poor Knowledge, Unfavorable attitude	Readiness of EMR
Ngusie, et al., 2022	Ethiopia	423	Health Professionals	Good Knowledge, Favorable attitude	Poor Knowledge, Unfavorable attitude	Readiness of EMR
Gelchu, et al., 2024	Ethiopia	392	Health Professionals	Good Knowledge, Favorable attitude	Poor Knowledge, Unfavorable attitude	Readiness of EMR
Hailegebre al, et al., 2023	Ethiopia	416	Healthcare Worker	Good Knowledge, Favorable attitude	Poor Knowledge, Unfavorable attitude	Readiness of EMR
Yilma, et al., 2023	Ethiopia	423	Health Professionals	Good Knowledge, Favorable attitude	Poor Knowledge, Unfavorable attitude	Readiness of EMR
Berihun, et al., 2020	Ethiopia	636	Healthcare Professionals	Good Knowledge	Poor Knowledge	Willingness to Use EMR
Awol, et al., 2020	Ethiopia	414	Health Professionals	Good Knowledge, Favorable attitude	Poor Knowledge, Unfavorable attitude	Readiness of EMR
Senishaw, et al., 2023	Ethiopia	423	Health Professionals	Good Knowledge	Poor Knowledge	Willingness to Use EMR

Oumer, et al., 2021	Ethiopia	525	Health Professionals	Good Knowledge, Good attitude	Poor Knowledge, Poor attitude	Utilization & Determinants, of EMR
Thapa, et al., 2021	Saudi Arabia	864	Phycisians and Nurses	Positive attitude	Negative attitude	Readiness of EMR
Keleb, et al., 2022	Ethiopia	367	Healthcare Professionals	Favorable attitude	Unfavorable attitude	Readiness of EMR
Tesfa, et. al, 2021	Ethiopia	383	Health Professionals	Favorable attitude	Unfavorable attitude	Readiness of EMR

(Primary data, 2025)

Table 2 shows a summary of the primary studies used in this meta-analysis. This study was conducted by considering the eligibility criteria defined using the PICO model. The PICO model is explained as follows: Population: Health workers/health professionals, Intervention: good knowledge and favorable attitude, Comparison: poor knowledge and unfavorable attitude, and the Outcome is readiness/willingness to use electronic medical record. The total sample size used was 6,601 people. The largest research population was found in the study by Thapa et al. (2021) with 864 respondents, while the smallest population was 306 respondents in the study by Abore et al. (2022).

Table 3. Adjusted Odd Ratio (aOR) Data and CI 95% Between Health Worker's Knowledge and Readiness to Implement Electronic Medical Records

Author (Year)	aOR	95% CI	
		Lower Limit	Upper Limit
Wubante, et al, 2021	2.50	1.40	4.60
Biruk et al., 2014	2.12	1.32	3.56
Abore, et al., 2022	3.33	1.662	6.682
Ngusie, et al., 2022	1.20	0.71	2.05
Gelchu, et al., 2024	2.56	1.53	4.29
Hailegebreal, et al., 2023	2.01	1.19	3.39
Yilma, et al., 2023	1.88	1.19	2.97
Berihun, et al., 2020	2.11	1.02	4.37
Awol, et al., 2020	2.64	1.62	4.29
Senishaw, et al., 2023	1.85	1.004	3.409
Oumer, et al., 2021	1.52	0.92	2.51

(Primary data, 2025)

In the table 3 there are aOR values that indicate how much healthcare workers' knowledge influences their readiness to adopt electronic medical records, with aOR values ranging from 1.20 to 3.33. The study with the highest aOR value is Abore et al., 2022 (3.33), showing that knowledge in that study has a very large influence on implementation readiness. All studies show a 95% confidence interval for the certainty of these effect estimates. For illustration, Abore et al. 2022 has a CI range of 1.662 to 6.862, and Ngusie et al. 2022 has a CI range of 0.71 to 2.05. A shorter CI range indicates a more accurate effect estimate.

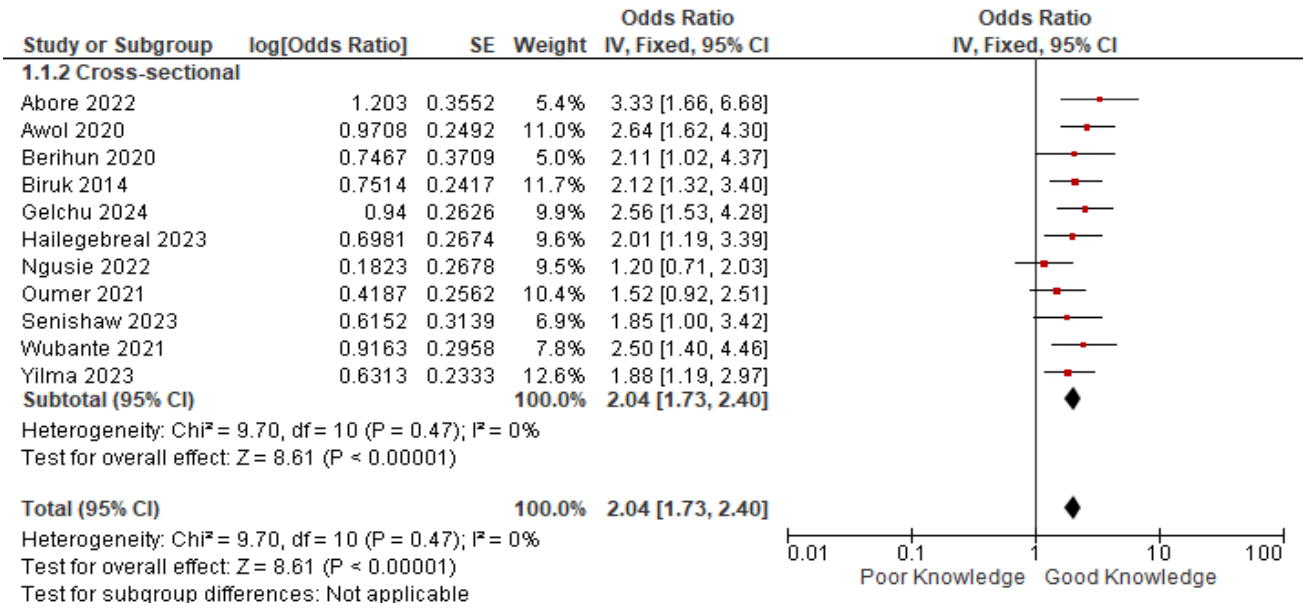

Figure 2. Forest Plot of Health Worker's Knowledge and Readiness to Implement Electronic Medical Records

Knowledge of healthcare workers and their readiness to implement electronic medical records (EMR) showed a consistent positive association, as shown in Figure 2. A total of 11 cross-sectional studies were examined, and almost all of them showed adjusted odds ratios (aOR) higher than 1. The combined analysis found an aOR of 2.04 (95% CI: 1.73–2.40), which means that health workers with good knowledge are twice as likely to be ready to implement EMR compared to those with poor knowledge. The heterogeneity test showed a Chi² value of 9.70 with 10 degrees of freedom ($p = 0.47$) and $I^2 = 0\%$, indicating no heterogeneity between studies. This shows that the research results are relatively consistent. Overall, the combined effect was significant with a p value < 0.00001.

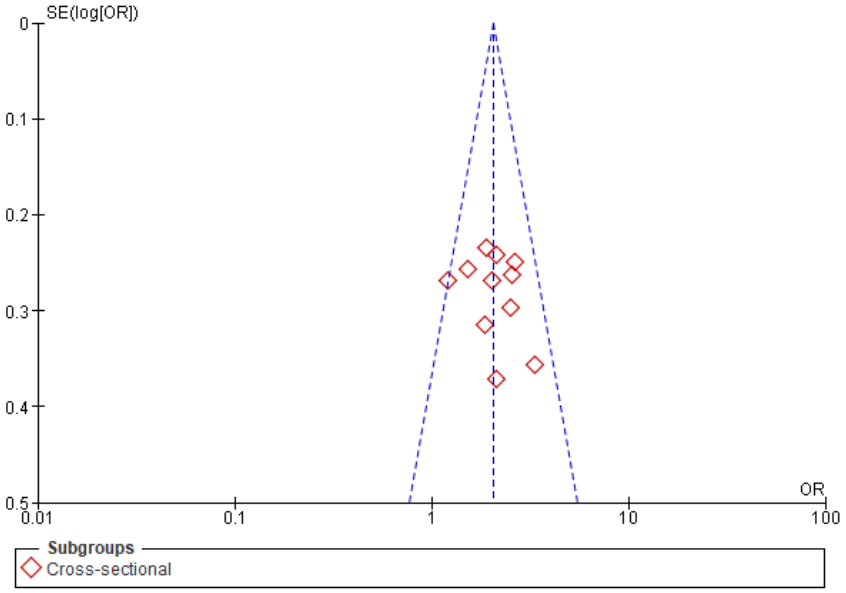

Figure 3. Funnel Plot Health Worker's Knowledge and Readiness to Implement Electronic Medical Records

A relatively symmetrical distribution of study points around the center line of the combined effects is shown in Figure 3 above. There is no evidence of significant public bias; therefore, the results of the analysis can be considered consistent and valid because they are not only statistically significant but also unaffected by public bias.

Table 4. Adjusted Odd Ratio (aOR) Data and CI 95% Between Health Worker's Attitude and Readiness to Implement Electronic Medical Records

Author (Year)	aOR	95% CI	
		Lower Limit	Upper Limit
Biruk et al., 2014	1.56	1.03	2.49
Abore, et al., 2022	2.432	1.146	5.159
Ngusie, et al., 2022	4.60	2.63	8.04
Gelchu, et al., 2024	2.77	1.66	4.63
Hailegebreal, et al., 2023	2.95	1.76	4.97
Yilma, et al., 2023	1.65	1.05	2.59
Awol, et al., 2020	1.63	1.01	2.63
Thapa, et al., 2021	1.96	1.14	3.36
Wubante, et al, 2021	3.20	1.60	6.2
Oumer, et al., 2021	2.41	1.35	4.31
Keleb, et al., 2022	2.30	1.26	4.19
Tesfa, et. Al, 2021	1.29	0.72	2.35

(Primary data, 2025)

Table 4 summarizes the adjusted odds ratios (aOR) and 95% confidence intervals describing the association between healthcare workers' attitudes and their readiness to implement electronic medical records. The association's strength varied among the included studies, as evidenced by the aOR values, which ranged from 1.29 to 4.60. There is variation in how attitude affects readiness in various contexts and demographics, as seen by the higher impact estimates found in some studies and the more minor relationships reported in others.

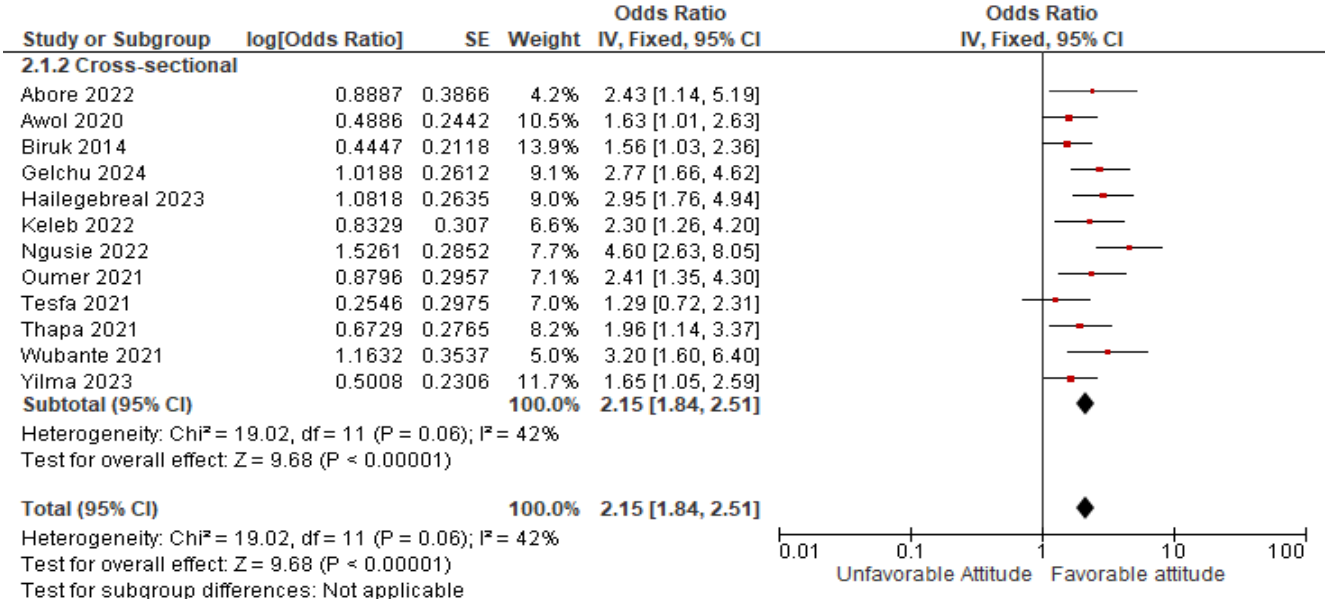

Figure 4. Forest Plot Health Worker's Attitude and Readiness to Implement Electronic Medical Records

The forest plot for attitude indicated that a favorable attitude was consistently associated with higher readiness for EMR implementation across the included studies (Figure 4). Most studies demonstrated effect estimates above the null value. Health workers with favorable attitudes were more than twice as likely to embrace EMR as those with unfavorable views, according to the combined analysis's aOR of 2.15 (95% CI: 1.84–2.51). The pooled analysis showed a stable association despite moderate heterogeneity ($I^2 = 42\%$). The direction of effects was consistent among studies, supporting the robustness of the findings.

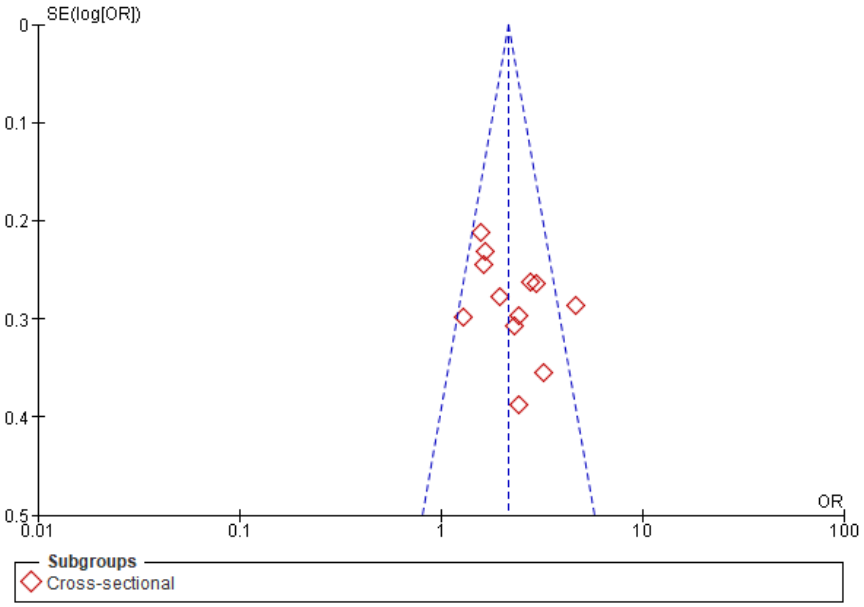

Figure 5. Funnel Plot Health Worker's Attitude and Readiness to Implement Electronic Medical Records

Based on Figure 5 above, the results show that the favorable attitude of health workers does have a consistent effect on their readiness to implement EMR. The distribution of study points appears relatively symmetrical around the center line of the combined effect, which means that there is no significant publication bias.

Discussion

A total of 14 studies from Ethiopia and Saudi Arabia with cross-sectional designs were analyzed in this study. The total number of respondents reached 6,601 health workers, consisting of doctors, nurses, midwives, and medical support staff. All studies assessed the relationship between knowledge or attitudes and the readiness of health workers to implement EMR.

Association of Knowledge and Healthcare Professionals' Readiness to Implement Electronic Medical Records

The meta-analysis results show that healthcare workers with good knowledge are 2.04 times more likely to be ready to implement EMR compared to those with poor knowledge (aOR = 2.04; 95% CI: 1.73–2.40). These results showed low to moderate heterogeneity ($I^2 < 50\%$) and were consistent across the majority of trials. This can be explained by the fact that healthcare professionals are less afraid to embrace the shift from manual to digital medical records when they have a thorough awareness of the advantages, features, and protocols for using EMR.

A number of studies analyzed in this meta-analysis support these findings. For example, research by (Abore et al., 2022; Berihun et al., 2020; Senishaw et al., 2023; Yilma et al., 2023) in Ethiopia found that healthcare workers with good knowledge were more likely to accept the new system and adapt to the technical demands of EMR implementation because they understood how the technology could simplify clinical workflows and improve the quality of patient care. Good knowledge provides a full understanding of EMR's benefits, such as enhanced recording accuracy, decreased data duplication, and real-time access to patient information. This increases healthcare personnel's confidence and ability to see the long-term benefits of utilizing EMR. Healthcare professionals with strong understanding were also able to overcome technological challenges that emerged during the early phases of adoption more rapidly (Ngusie et al., 2022).

In contrast, a lack of expertise is a significant barrier to EMR deployment. Healthcare personnel who do not completely understand the mechanisms and benefits of EMR frequently experience anxiety, worry about data entry errors, or fear that the new system would increase their administrative workload (Nkwenkwezi, 2022). This is similar with previous research, which revealed that a lack of technical and clinical awareness of EMR adds to resistance among healthcare staff, especially in the early phases of system deployment (Ariffin et al., 2018; Nkwenkwezi, 2022).

From an implementation perspective, increasing knowledge involves not only technical understanding but also awareness of how EMR improves service quality, documentation effectiveness, and patient data continuity. To improve the readiness of healthcare personnel, it is essential to organize computer/health information system training programs to enhance their skills and knowledge.

Association of Attitude and Healthcare Professionals' Readiness to Implement Electronic Medical Records

Health workers' readiness to use EMR was also found to be significantly influenced by their attitudes. Favorable attitudes among healthcare professionals were more likely to indicate that they were prepared to use EMR than unfavorable attitudes, according to the combined analysis's aOR value of 2.15 (95% CI: 1.84–2.51). Additionally, these findings demonstrate consistency between trials with low to moderate variability.

Favorable attitude shows healthcare workers' openness to innovation and change in the work system. Evidence from previous studies shows that readiness to implement EMR is positively related (Keleb et al., 2022; Oumer et al., 2021; Yilma et al., 2023). According to (Thapa et al., 2021), a positive attitude is the most important factor in building healthcare workers' motivation to adopt EMR because it has a positive effect on patients and their self-confidence. According to a number of examined studies, including those by (Hailegebreal et al., 2023; Ngusie et al., 2022), respondents who had supportive attitudes were more open to EMR because they perceived it as a way to improve service coordination, decrease administrative workload, and increase recording accuracy. According to the findings of qualitative research, one respondent said that they are personally prepared for the deployment of EMR because its advantages exceed its drawbacks (Awol et al., 2020). On the other hand, negative views are frequently linked to uncertainties, worries about an increasing workload, or mistrust of the system's dependability (Janssen et al., 2021).

Experiences, perceptions of the work environment, and institutional support all influence the attitudes of health workers (Ariffin et al., 2018). If healthcare facilities provide guidance, incentives, and a conducive work environment, favorable attitudes toward EMR tend to increase (Nkwenkwezi, 2022). This indicates that building health workers' readiness requires not only improving technical capacity but also implementing change management strategies that strengthen individual acceptance of the new system.

Generalizability

The results of this meta-analysis should be viewed in light of a number of generalizability-related restrictions. The majority of the included investigations were carried out in Ethiopia, which reflects healthcare environments in low- and middle-income nations that are only beginning to adopt EMRs. These findings may not be as applicable in other areas due to variations in digital infrastructure, health system capacity, workforce training, and regulatory contexts, especially in high-income nations with highly developed health information systems. Furthermore, the cross-sectional design used in all of the included studies limits the ability to draw conclusions about causality. Because of this, even though the

pooled estimates show a consistent relationship between knowledge, attitude, and EMR preparedness, the findings might not be directly applicable outside of comparable situations.

Conclusion

This meta-analysis demonstrates that both knowledge and attitude are significantly associated with healthcare professionals' readiness to implement electronic medical records. Strengthening knowledge through targeted training and fostering positive attitudes toward digital health technologies are essential to support successful EMR implementation, particularly in low- and middle-income country settings. However, the generalizability of these findings should be interpreted with caution, as the evidence is predominantly derived from cross-sectional studies conducted in a limited geographic context.

Future research recommendations include for the use of experimental or longitudinal designs to strengthen the evidence of the causal relationship between health workers' knowledge, attitudes, and readiness for EMR implementation. To make the findings more globally representative, research in different nations and service situations is also required. Additionally, corporate culture and psychosocial elements that affect readiness might be investigated using mixed quantitative or qualitative approaches. Future research priorities should also include efforts to create standardized tools and assess the long-term effects of real implementation.

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Author Contribution and Competing Interest

Fajar Yunita Sari is the principal researcher who selects the topic, seeks, collects research data, and analyzed the data. Bhisma Murti reviewed the research documents and data.

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