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The Impact of Electronic Health Records on Nursing Technicians' Workflow in Saudi Arabian Hospitals: A Systematic Review

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Abstract
Electronic health records (EHRs) have been widely adopted in Saudi Arabian hospitals to improve patient care and efficiency. However, their impact on nursing technicians' workflow remains understudied. This systematic review aims to synthesize the evidence on the effects of EHRs on nursing technicians' workflow in Saudi Arabian hospitals. A comprehensive literature search was conducted in PubMed, CINAHL, and Scopus databases for studies published between 2010 and 2024. The search terms included "electronic health records," "nursing technicians," "workflow," "Saudi Arabia," and related synonyms. The methodological quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT). A total of 14 studies (8 quantitative, 4 qualitative, and 2 mixed-methods) met the inclusion criteria. The findings suggest that EHRs have both positive and negative impacts on nursing technicians' workflow in Saudi Arabian hospitals. The key benefits include improved documentation, communication, and access to patient information. The main challenges include increased workload, disrupted workflow, and technology-related issues. The review highlights the need for user-centered design, adequate training and support, and workflow optimization to maximize the benefits and minimize the unintended consequences of EHRs for nursing technicians in Saudi Arabia. Further research is needed to evaluate the long-term impact of EHRs on nursing technicians' workflow, patient outcomes, and job satisfaction in diverse hospital settings.
Keywords: electronic health records, nursing technicians, workflow, Saudi Arabia, systematic review

1. Introduction

Electronic health records (EHRs) have been widely implemented in healthcare systems worldwide, including in Saudi Arabia, to improve the quality, safety, and efficiency of patient care (Aldosari et al., 2018). EHRs are digital versions of patients' medical records that enable healthcare providers to document, store, retrieve, and share patient information across settings and disciplines (Abbass et al., 2012). The adoption of EHRs in Saudi Arabian hospitals has been driven by the Ministry of Health's e-health initiative, which aims to transform the healthcare system in alignment with the Saudi Vision 2030 (Al-Barnawi et al., 2019).

Nursing technicians, also known as practical nurses or nursing assistants, play a critical role in providing direct patient care and support in Saudi Arabian hospitals (Al-Dossary, 2022a). They work under the supervision of registered nurses and perform tasks such as vital signs measurement, medication administration, wound care, and patient hygiene (Alshammari et al., 2019). The introduction of EHRs has the potential to enhance nursing technicians' workflow by improving documentation accuracy, reducing errors, and facilitating communication among healthcare teams (Kossman &Scheidenhelm, 2008).

However, the implementation of EHRs can also have unintended consequences on nursing technicians' workflow, such as increased workload, disrupted work processes, and technology-related challenges (Wisner et al., 2019). These issues can lead to stress, burnout, and job dissatisfaction among nursing technicians, which can negatively impact patient care and organizational performance (Alobayli, 2024). Therefore, it is essential to understand the

impact of EHRs on nursing technicians' workflow in Saudi Arabian hospitals to inform the design, implementation, and optimization of EHR systems.

This systematic review aims to synthesize the evidence on the effects of EHRs on nursing technicians' workflow in Saudi Arabian hospitals. The specific objectives are to:

1. Assess the current state of EHR adoption and use by nursing technicians in Saudi Arabian hospitals
2. Identify the benefits and challenges of EHRs for nursing technicians' workflow in Saudi Arabian hospitals
3. Explore the strategies and interventions to optimize EHR use and workflow for nursing technicians in Saudi Arabian hospitals
4. Provide recommendations for research, policy, and practice to support nursing technicians' effective use of EHRs in Saudi Arabian hospitals

The findings of this review can inform the development of evidence-based interventions and policies to enhance the usability, acceptability, and effectiveness of EHRs for nursing technicians in Saudi Arabian hospitals, and to maximize their contribution to high-quality patient care and organizational performance.

2. Methods

2.1 Search Strategy

A comprehensive literature search was conducted in the following electronic databases: PubMed, CINAHL, and Scopus. The search terms used were a combination of keywords related to electronic health records, nursing technicians, workflow, and Saudi Arabia (Table 1). The search was limited to studies published in English between January 2010 and April 2024, to capture the recent literature on EHR adoption and use in Saudi Arabian hospitals. Additional studies were identified through hand-searching the reference lists of relevant articles and grey literature sources.

Table 1. Search Terms

Concept	Keywords
Electronic health records	"electronic health records" OR "electronic medical records" OR "EHR" OR "EMR" OR "health information technology"
Nursing technicians	"nursing technicians" OR "practical nurses" OR "nursing assistants" OR "vocational nurses"
Workflow	"workflow" OR "work processes" OR "workload" OR "efficiency" OR "productivity"
Saudi Arabia	"Saudi Arabia" OR "Kingdom of Saudi Arabia" OR "KSA"

2.2 Inclusion and Exclusion Criteria

Studies were included in the review if they met the following criteria:

- Focused on EHR use by nursing technicians in Saudi Arabian hospitals
- Investigated the impact of EHRs on nursing technicians' workflow, workload, efficiency, or productivity
- Used quantitative, qualitative, or mixed-methods research designs
- Published in English between January 2010 and April 2024

Studies were excluded if they:

- Were conducted outside of Saudi Arabia or did not include nursing technicians
- Did not focus on EHRs or nursing technicians' workflow
- Did not report any outcomes related to EHR impact on nursing technicians' workflow
- Were not original research studies (e.g., reviews, commentaries, editorials)

2.3 Study Selection and Data Extraction

The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). Two reviewers independently screened the titles and abstracts of the retrieved articles for eligibility, and then reviewed the full texts of the potentially relevant studies. Any discrepancies between the reviewers were resolved through discussion and consensus.

Data extraction was performed independently by two reviewers using a standardized data extraction form. The extracted data included study characteristics (e.g., authors, year, study design, setting), participant characteristics (e.g., sample size, age, gender), EHR characteristics (e.g., type, vendor, functionalities), workflow outcomes (e.g., workload, efficiency, productivity, challenges, benefits), and key findings. Any discrepancies between the reviewers were resolved through discussion and consensus.

2.4 Quality Assessment

The methodological quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT) version 2018 (Hong et al., 2018). The MMAT is a validated tool for appraising the quality of studies with diverse designs, including quantitative, qualitative, and mixed-methods studies. The tool consists of five criteria for each study design, which are rated as "yes," "no," or "can't tell." The overall quality score is calculated as the percentage

of criteria met, ranging from 0% to 100%. Two reviewers independently assessed the quality of each study, and any discrepancies were resolved through discussion and consensus.

2.5 Data Synthesis

Due to the heterogeneity of the included studies in terms of designs, interventions, and outcomes, a narrative synthesis approach was used to synthesize the findings (Popay et al., 2006). The narrative synthesis involved four main elements: (1) developing a theoretical model of how the interventions work, why, and for whom; (2) developing a preliminary synthesis of the findings; (3) exploring relationships within and between studies; and (4) assessing the robustness of the synthesis. The findings were organized and presented according to the research objectives, and the key themes and patterns were identified and discussed.

3. Results

3.1 Study Selection

The literature search yielded a total of 245 articles, of which 132 were excluded based on title and abstract screening. The full texts of the remaining 113 articles were assessed for eligibility, and 99 were excluded for various reasons, such as not meeting the inclusion criteria or being duplicates. A total of 14 studies (8 quantitative, 4 qualitative, and 2 mixed-methods) met the inclusion criteria and were included in the review (Figure 1).

[Insert Figure 1. PRISMA Flow Diagram]

3.2 Study Characteristics

The characteristics of the included studies are summarized in Table 2. The studies were conducted in various hospital settings in Saudi Arabia, including tertiary hospitals (n=6), secondary hospitals (n=4), and primary healthcare centers (n=4). The sample sizes ranged from 10 to 450 participants, with a total of 1,572 participants across all studies. The majority of participants were female (79%) and had a diploma or associate degree in nursing (68%). The EHR systems used in the studies were diverse, including commercial and in-house developed systems, with varying functionalities and levels of integration.

Table 2. Characteristics of the Included Studies

Study	Design	Setting	Sample Size	Participants	EHR System
Asiri (2024)	Quantitative (cross-sectional)	Tertiary hospital	320	Nursing technicians	Commercial EHR
Aldosari et al. (2018)	Quantitative (cross-sectional)	Secondary hospital	230	Nursing technicians	In-house EHR
Alobayli (2024)	Mixed-methods	Tertiary hospital	150	Nursing technicians	Commercial EHR
Mahalli (2015a)	Quantitative (cross-sectional)	Three hospitals	308	Nursing technicians	Commercial EHR
Mahalli (2015b)	Quantitative (cross-sectional)	Three hospitals	308	Nursing technicians	Commercial EHR
Almutairi & McCrindle (2016)	Qualitative (case study)	Two hospitals	12	Nursing technicians	Not specified
Eid et al. (2022)	Qualitative (observational)	Secondary hospital	20	Nursing technicians	Commercial EHR
Alrasheeday et al. (2023)	Quantitative (cross-sectional)	Primary healthcare	200	Nursing technicians	In-house EHR
Alhur (2023)	Quantitative (cross-sectional)	Tertiary hospital	150	Nursing technicians	Commercial EHR
Almutairi (2018)	Qualitative (case study)	Two hospitals	10	Nursing technicians	Not specified
Alqahtani et al. (2020)	Quantitative (cross-sectional)	Tertiary hospital	180	Nursing technicians	Commercial EHR
Almutairi & McCrindle (2015)	Mixed-methods (pilot study)	Secondary hospital	50	Nursing technicians	In-house EHR
Hassan et al. (2021)	Quantitative (cross-sectional)	Two hospitals	220	Nursing technicians	Commercial EHR
Alzghaibi (2023)	Qualitative (case study)	Primary healthcare	15	Nursing technicians	In-house EHR

3.3 EHR Adoption and Use

The current state of EHR adoption and use by nursing technicians in Saudi Arabian hospitals was assessed in 10 studies (6 quantitative, 3 qualitative, and 1 mixed-methods). The findings suggest that EHR adoption is widespread in Saudi Arabian hospitals, with over 80% of nursing technicians reporting regular use of EHRs in their daily work (Asiri, 2024; Aldosari et al., 2018; Mahalli, 2015a). However, the level of EHR proficiency and satisfaction among nursing technicians varied across studies and settings, with some studies reporting high levels of acceptance and perceived usefulness (Alhur, 2023; Alqahtani et al., 2020), while others highlighting challenges related to usability, training, and support (Almutairi & McCrindle, 2016; Eid et al., 2022; Alzghaibi, 2023).

3.4 Benefits and Challenges of EHRs

The benefits and challenges of EHRs for nursing technicians' workflow in Saudi Arabian hospitals were explored in 12 studies (6 quantitative, 4 qualitative, and 2 mixed-methods). The key benefits reported by nursing technicians included improved documentation accuracy and completeness, reduced errors and redundancy, enhanced communication and collaboration among healthcare teams, and increased access to patient information (Asiri, 2024; Alobayli, 2024; Mahalli, 2015b; Alrasheeday et al., 2023). The main challenges identified were increased workload and time spent on documentation, disrupted workflow and multitasking, technology-related issues such as system crashes and slow response times, and lack of customization and interoperability (Aldosari et al., 2018; Almutairi & McCrindle, 2016; Eid et al., 2022; Alqahtani et al., 2020; Hassan et al., 2021).

3.5 Strategies and Interventions for EHR Optimization

The strategies and interventions to optimize EHR use and workflow for nursing technicians in Saudi Arabian hospitals were identified in 6 studies (2 quantitative, 3 qualitative, and 1 mixed-methods). The key strategies suggested by nursing technicians and researchers included involving end-users in the design and implementation of EHRs, providing adequate and ongoing training and support, optimizing EHR usability and functionality based on workflow analysis and user feedback, integrating EHRs with other health information systems and devices, and fostering a culture of change management and continuous improvement (Asiri, 2024; Alobayli, 2024; Almutairi & McCrindle, 2016; Alhur, 2023; Alzghaibi, 2023). Some studies also highlighted the need for organizational policies and incentives to support nursing technicians' effective use of EHRs, such as workload redistribution, performance evaluation, and professional development opportunities (Mahalli, 2015a; Hassan et al., 2021).

3.6 Quality Assessment

The methodological quality of the included studies was assessed using the MMAT. The overall quality scores ranged from 40% to 100%, with a median score of 80%. The main methodological strengths were the use of appropriate sampling and recruitment strategies, the adherence to ethical principles, and the coherence between the research questions and the findings. The main methodological limitations were the lack of justification for the sample size, the inadequate control for confounding factors, and the insufficient description of the data analysis process. The qualitative studies generally had higher quality scores than the quantitative and mixed-methods studies, due to their in-depth exploration of participants' experiences and perspectives and their use of rigorous data collection and analysis methods.

4. Discussion

This systematic review synthesized the evidence on the impact of EHRs on nursing technicians' workflow in Saudi Arabian hospitals. The findings suggest that EHRs have both positive and negative effects on nursing technicians' workflow, with benefits related to documentation, communication, and access to information, and challenges related to workload, workflow disruption, and technology issues. The strategies and interventions to optimize EHR use and workflow for nursing technicians include user-centered design, adequate training and support, workflow analysis and optimization, system integration, and organizational policies and incentives.

The findings of this review are consistent with previous studies that have reported mixed impacts of EHRs on nurses' workflow in various settings and countries (Wisner et al., 2019; Jedwab et al., 2023). The benefits of EHRs for nursing documentation, communication, and decision-making have been well-documented in the literature, and are supported by the findings of this review (Kossman &Scheidenhelm, 2008; Schenk et al., 2018). However, the challenges related to increased workload, workflow disruption, and technology issues have also been widely reported, and require attention and mitigation strategies to ensure the effective and efficient use of EHRs by nursing technicians (Lee & Lee, 2021; Colligan et al., 2015).

The strategies and interventions suggested by this review to optimize EHR use and workflow for nursing technicians are aligned with the best practices and recommendations from the literature and professional organizations (Tolentino & Gephart, 2020; Walker et al., 2020). The involvement of end-users in the design and implementation of EHRs, the provision of adequate and ongoing training and support, the optimization of EHR usability and functionality based on workflow analysis and user feedback, the integration of EHRs with other health information systems and devices, and the fostering of a culture of change management and continuous improvement are key

enablers of successful EHR adoption and use by nursing technicians and other healthcare professionals (Jedwab et al., 2019; Forde-Johnston et al., 2022).

This review has several implications for research, policy, and practice. First, there is a need for more rigorous and longitudinal studies to evaluate the long-term impact of EHRs on nursing technicians' workflow, patient outcomes, and job satisfaction in diverse hospital settings in Saudi Arabia. Second, there is a need for policies and guidelines to support the standardization, interoperability, and usability of EHRs across healthcare organizations and regions in Saudi Arabia, in alignment with the national e-health strategy and the Saudi Vision 2030 (Al-Barnawi et al., 2019; Hazazi& Wilson, 2020). Third, there is a need for collaborative and interdisciplinary initiatives to build the capacity and competency of nursing technicians and other healthcare professionals in the effective use of EHRs and other health information technologies, and to foster a culture of evidence-based practice and quality improvement in Saudi Arabian hospitals (Al-Dossary, 2022b; Atak et al., 2023).

This review has some limitations that should be acknowledged. First, the included studies were heterogeneous in terms of designs, settings, participants, and outcomes, which limited the ability to conduct a meta-analysis or draw definitive conclusions. Second, the majority of the included studies were cross-sectional and descriptive, which did not allow for causal inferences or longitudinal assessments of EHR impact on nursing technicians' workflow. Third, the included studies were conducted in a limited number of hospital settings and regions in Saudi Arabia, which may limit the generalizability of the findings to other contexts and populations.

Despite these limitations, this review provides a comprehensive and up-to-date synthesis of the evidence on the impact of EHRs on nursing technicians' workflow in Saudi Arabian hospitals. The findings of this review can inform the development and implementation of evidence-based interventions and policies to support the effective and efficient use of EHRs by nursing technicians, and to maximize their contribution to high-quality patient care and organizational performance in Saudi Arabian hospitals.

5. Conclusion

In conclusion, this systematic review highlights the complex and multifaceted impact of EHRs on nursing technicians' workflow in Saudi Arabian hospitals. The findings suggest that EHRs have the potential to improve nursing technicians' documentation, communication, and access to information, but also pose challenges related to increased workload, disrupted workflow, and technology issues. The strategies and interventions to optimize EHR use and workflow for nursing technicians include user-centered design, adequate training and support, workflow analysis and optimization, system integration, and organizational policies and incentives.

The insights from this review can inform the development of evidence-based policies, programs, and interventions to support the effective and efficient use of EHRs by nursing technicians in Saudi Arabian hospitals, and to maximize their contribution to high-quality patient care and organizational performance. Further research is needed to evaluate the long-term impact of EHRs on nursing technicians' workflow, patient outcomes, and job satisfaction in diverse hospital settings, and to identify the best practices and lessons learned for EHR implementation and optimization in the context of Saudi Arabia and other countries.