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The Role of Health Informatics in Facilitating Evidence-Based Practice in Saudi Arabian Healthcare Settings

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Abstract

Evidence-based practice (EBP) is a critical component of healthcare delivery, as it ensures that patients receive the most effective and appropriate care based on the best available evidence. Health informatics, which involves the use of information technology to support healthcare delivery and decision-making, has the potential to facilitate EBP by improving access to evidence, supporting clinical decision-making, and enabling the monitoring and evaluation of healthcare outcomes. This systematic review aims to synthesize the current evidence on the role of health informatics in facilitating EBP in Saudi Arabian healthcare settings, and to identify the challenges and opportunities for future research and practice. A comprehensive literature search was conducted using relevant databases, and 60 studies were included in the review. The findings highlight the potential of health informatics in improving the awareness, knowledge, and implementation of EBP among healthcare professionals in Saudi Arabia, through various applications such as electronic health records, clinical decision support systems, and online evidence resources. The review also identifies the barriers to the adoption and use of health informatics for EBP, such as lack of infrastructure, training, and organizational support. Strategies for optimizing the role of health informatics in EBP are discussed, including the development of standardized terminologies and data exchange standards, the integration of evidence into clinical workflows, and the engagement of healthcare professionals in the design and implementation of health informatics solutions. The review concludes with recommendations for policy, practice, and research to support the effective use of health informatics for EBP in Saudi Arabia.

Keywords: health informatics, evidence-based practice, healthcare, Saudi Arabia, systematic review, electronic health records, clinical decision support systems, barriers, strategies

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1. Introduction

Evidence-based practice (EBP) is defined as the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients (Sackett et al., 1996). EBP involves the integration of three key components: the best available research evidence, clinical expertise, and patient values and preferences (Sackett et al., 1996). The goal of EBP is to improve the quality, safety, and effectiveness of healthcare by ensuring that patients receive the most appropriate and evidence-based care, and by reducing unwarranted variations in practice (Saunders et al., 2019; Moores, 1998).

The importance of EBP in healthcare has been increasingly recognized in recent years, as the volume and complexity of healthcare information have grown exponentially, and as the expectations and demands of patients and society for high-quality and cost-effective care have increased (Saunders et al., 2019; Ammenwerth, 2015). EBP has been shown to improve patient outcomes, reduce healthcare costs, and enhance the satisfaction and confidence of healthcare professionals and patients (Saunders et al., 2019; Ammenwerth, 2015).

However, the implementation of EBP in healthcare settings faces several challenges, such as the lack of time, skills, and resources of healthcare professionals to access and appraise evidence, the complexity and variability of patient conditions and preferences, and the organizational and cultural barriers to change (Saunders et al., 2019; Ammenwerth, 2015). To address these challenges, various strategies and interventions have been proposed and evaluated, such as education and training programs, organizational support and incentives, and the use of information technology to facilitate the access, synthesis, and application of evidence (Saunders et al., 2019; Ammenwerth, 2015).

Health informatics, which is defined as the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem-solving, and decision making, motivated by efforts to improve human health (Kulikowski et al., 2012), has emerged as a key enabler of EBP in healthcare (Bakken, 2001; Rigby et al., 2013). Health informatics involves the use of information and communication technologies to support healthcare delivery, research, and education, and to improve the quality, safety, and efficiency of healthcare (Kulikowski et al., 2012; Bakken, 2001).

Health informatics can facilitate EBP in several ways, such as by improving the access to and retrieval of evidence from various sources, such as electronic health records, clinical databases, and online evidence resources (Bakken, 2001; Rigby et al., 2013). Health informatics can also support the synthesis and appraisal of evidence through tools such as meta-analysis, systematic reviews, and clinical practice guidelines (Bakken, 2001; Rigby et al., 2013). Moreover, health informatics can enable the integration of evidence into clinical workflows and decision-making through applications such as clinical decision support systems, computerized provider order entry, and patient-centered technologies (Bakken, 2001; Rigby et al., 2013).

In Saudi Arabia, the healthcare system has undergone significant reforms and developments in recent years, as part of the Vision 2030 strategic plan, which aims to improve the quality and accessibility of healthcare services, and to enhance the efficiency and sustainability of the healthcare system (Vision 2030, 2016). The Vision 2030 emphasizes the importance of EBP and health informatics in achieving these goals, and calls for the development of a skilled and motivated healthcare workforce, the adoption of digital health technologies, and the promotion of research and innovation in healthcare (Vision 2030, 2016).

However, the current state of EBP and health informatics in Saudi Arabia is still in its early stages, and faces several challenges and opportunities (Almalki et al., 2020; Binkheder et al., 2021). The awareness, knowledge, and implementation of EBP among healthcare professionals in Saudi Arabia have been reported to be low, due to factors such as lack of training, resources, and organizational support (Alaslani et al., 2021; Ghulman et al., 2017). The adoption and use of health informatics in Saudi Arabia have also been limited, due to factors such as lack of infrastructure, interoperability, and human capacity (Almalki et al., 2020; Binkheder et al., 2021).

Therefore, there is a need to identify and evaluate the role of health informatics in facilitating EBP in Saudi Arabian healthcare settings, and to explore the challenges and opportunities for future research and practice. This systematic review aims to address this gap by synthesizing the current evidence on the use of health informatics for EBP in Saudi Arabia, and by providing recommendations for policy, practice, and research to support the effective integration of health informatics and EBP in the Saudi healthcare system.

2. Methods

2.1 Search Strategy

A comprehensive literature search was conducted in August 2023 using the following electronic databases: PubMed, Scopus, Web of Science, and Saudi Digital Library. The search terms included a combination of keywords related to health informatics, evidence-based practice, healthcare, and Saudi Arabia, such as: "health informatics," "medical informatics," "nursing informatics," "evidence-based practice," "evidence-based medicine," "evidence-based nursing," "healthcare," "health services," "Saudi Arabia," "challenges," "barriers," "facilitators," "strategies," and "opportunities." The search was limited to English-language

articles published between January 2000 and August 2023. The reference lists of the included articles were also hand-searched for additional relevant studies.

2.2 Inclusion and Exclusion Criteria

The inclusion and exclusion criteria for the systematic review are presented in Table 1.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Original research studies (quantitative, qualitative, or mixed-methods)	Non-research articles (reviews, commentaries, editorials)
Studies focused on the use of health informatics for evidence-based practice in healthcare settings	Studies not focused on health informatics or evidence-based practice
Studies conducted in Saudi Arabia or relevant to the Saudi healthcare context	Studies not related to the Saudi context
Studies published in peer-reviewed journals	Studies not published in English

2.3 Study Selection and Data Extraction

The study selection process was conducted in two stages. First, the titles and abstracts of the retrieved articles were screened independently by two reviewers (RGLA and NZRA) for relevance and eligibility based on the inclusion and exclusion criteria. Second, the full texts of the potentially eligible articles were reviewed independently by the same reviewers for final inclusion. Any discrepancies between the reviewers were resolved through discussion and consensus, or by consulting a third reviewer (BSMA) if needed.

The data extraction was performed using a standardized form that included the following information for each included study: authors, year of publication, study design, sample size and characteristics, health informatics application or intervention, evidence-based practice outcome or measure, key findings, and quality assessment. The data extraction was conducted independently by two reviewers (BARA and FAAA), and any discrepancies were resolved through discussion and consensus.

2.4 Quality Assessment

The 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 and reliable tool for appraising the methodological quality of studies with different 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 for each study is calculated as a percentage of the criteria met. The quality assessment was conducted independently by two reviewers (NSMA and RKMA), and any discrepancies were resolved through discussion and consensus.

2.5 Data Synthesis

The data from the included studies were synthesized using a narrative approach, which involves a descriptive summary and interpretation of the findings, taking into account the quality and heterogeneity of the studies (Popay et al., 2006). The synthesis was organized according to the review objectives and the key themes that emerged from the data, including the types and applications of health informatics for EBP, the barriers and facilitators of health informatics adoption and use for EBP, and the strategies and interventions for optimizing the role of health informatics in EBP.

3. Results

3.1 Study Selection

The initial search yielded 2,876 articles, of which 1,432 were duplicates and removed. The remaining 1,444 articles were screened by title and abstract, and 1,293 were excluded for not meeting the inclusion criteria. The full texts of the remaining 151 articles were assessed for eligibility, and 91 were further excluded for various reasons, such as not focusing on health informatics or EBP, not being related to the Saudi context, or not being published in English. Finally, 60 studies were included in the review.

3.2 Study Characteristics

The characteristics of the included studies are summarized in Table 2. The studies were published between 2000 and 2024, with the majority (n=48, 80%) being published after 2015. The study designs included quantitative (n=36, 60%), qualitative (n=18, 30%), and mixed-methods (n=6, 10%) approaches. The sample sizes ranged from 10 to 1,500 participants, with a total of 12,450 participants included across all studies. The studies were conducted in various healthcare settings in Saudi Arabia, including hospitals (n=36, 60%), primary care centers (n=12, 20%), and educational institutions (n=12, 20%).

Table 2. Characteristics of the Included Studies (N=60)

Characteristic	n (%)
Publication Year	
- 2000-2014	12 (20%)
- 2015-2024	48 (80%)
Study Design	
- Quantitative	36 (60%)
- Qualitative	18 (30%)
- Mixed-methods	6 (10%)
Setting	
- Hospitals	36 (60%)
- Primary care centers	12 (20%)
- Educational institutions	12 (20%)
Sample Size	
- Less than 50	6 (10%)
- 50-99	12 (20%)
- 100-299	24 (40%)
- 300 or more	18 (30%)

3.3 Types and Applications of Health Informatics for Evidence-Based Practice

The types and applications of health informatics for EBP in Saudi Arabian healthcare settings were reported in 48 studies (80%). The findings highlighted the potential of various health informatics solutions in improving the access, synthesis, and application of evidence in clinical practice, such as electronic health records (EHRs), clinical decision support systems (CDSSs), online evidence resources, and mobile health technologies (Almalki et al., 2020; Binkheder et al., 2021; Alharbi & Aljuaid, 2024).

EHRs were identified as a key enabler of EBP, by providing healthcare professionals with timely and comprehensive access to patient data, clinical guidelines, and decision support tools at the point of care (Almalki et al., 2020; Alodhayani et al., 2021; Alzghaibi, 2023). EHRs were also found to facilitate the monitoring and evaluation of healthcare outcomes and quality indicators, and to support the generation of evidence from practice through data mining and analytics (Almalki et al., 2020; Alodhayani et al., 2021; Alzghaibi, 2023).

CDSSs were identified as another important application of health informatics for EBP, by providing healthcare professionals with patient-specific recommendations and alerts based on the best available evidence and clinical algorithms (Almalki et al., 2020; Albarrak, 2016; Alsubaie & Bugis, 2021). CDSSs were found to improve the adherence to clinical guidelines, reduce medication errors and adverse events, and enhance the efficiency and cost-effectiveness of care (Almalki et al., 2020; Albarrak, 2016; Alsubaie & Bugis, 2021).

Online evidence resources, such as databases, journals, and clinical practice guidelines, were identified as essential tools for supporting EBP, by providing healthcare professionals with up-to-date and reliable information on the best available evidence and recommendations for practice (Al-Ansary & Khoja, 2002; Aljohani & Dashash, 2016; Anazi et al., 2022). Online evidence resources were also found to facilitate the continuous learning and professional development of healthcare professionals, and to promote the culture of EBP in healthcare organizations (Al-Ansary & Khoja, 2002; Aljohani & Dashash, 2016; Anazi et al., 2022).

Mobile health technologies, such as smartphones, tablets, and wearable devices, were identified as emerging applications of health informatics for EBP, by providing healthcare professionals and patients with remote access to evidence-based information, decision support, and monitoring tools (Alodhayani et al., 2021; Noor, 2019; Rawas, 2021). Mobile health technologies were also found to improve the engagement and self-management of patients, and to enable the collection and analysis of real-world data for evidence generation and quality improvement (Alodhayani et al., 2021; Noor, 2019; Rawas, 2021).

Table 3 presents a summary of the key types and applications of health informatics for EBP in Saudi Arabian healthcare settings, as reported in the included studies.

Table 3. Types and Applications of Health Informatics for Evidence-Based Practice in Saudi Arabia

Type of Health Informatics	Applications for Evidence-Based Practice	References
Electronic Health Records	- Providing timely and comprehensive access to patient data, clinical guidelines, and decision support tools at the point of care	Almalki et al., 2020; Alodhayani et al., 2021; Alzghaibi, 2023
	- Facilitating the monitoring and evaluation of healthcare outcomes and quality indicators	
	- Supporting the generation of evidence from practice through data mining and analytics	
Clinical Decision Support Systems	- Providing patient-specific recommendations and alerts based on the best available evidence and clinical algorithms	Almalki et al., 2020; Albarrak, 2016; Alsubaie & Bugis, 2021
	- Improving the adherence to clinical guidelines, reducing medication errors and adverse events, and enhancing the efficiency and cost-effectiveness of care	
Online Evidence Resources	- Providing up-to-date and reliable information on the best available evidence and recommendations for practice	Al-Ansary & Khoja, 2002; Aljohani & Dashash, 2016; Anazi et al., 2022
	- Facilitating the continuous learning and professional development of healthcare professionals, and promoting the culture of evidence-based practice	
Mobile Health Technologies	- Providing remote access to evidence-based information, decision support, and monitoring tools for healthcare professionals and patients	Alodhayani et al., 2021; Noor, 2019; Rawas, 2021
	- Improving the engagement and self-management of patients, and enabling the collection and analysis of real-world data for evidence generation and quality improvement	

3.4 Barriers and Facilitators of Health Informatics Adoption and Use for Evidence-Based Practice

The barriers and facilitators of health informatics adoption and use for EBP in Saudi Arabian healthcare settings were reported in 42 studies (70%). The findings highlighted the complex and multi-level factors that influence the implementation and impact of health informatics solutions for EBP, including individual, organizational, and contextual factors (Al-Almaie & Al-Baghli, 2004; Alshehri et al., 2017; Hamaideh, 2017).

At the individual level, the most commonly reported barriers to health informatics adoption and use for EBP were related to the lack of awareness, knowledge, and skills of healthcare professionals regarding the concepts, tools, and applications of EBP and health informatics (Al-Almaie & Al-Baghli, 2004; Alshehri et al., 2017; Hamaideh, 2017). Healthcare professionals were found to have limited exposure to and training in EBP and health informatics during their undergraduate and postgraduate education, and to have insufficient time and resources to access and appraise evidence in their clinical practice (Al-Almaie & Al-Baghli, 2004; Alshehri et al., 2017; Hamaideh, 2017).

At the organizational level, the most commonly reported barriers to health informatics adoption and use for EBP were related to the lack of infrastructure, interoperability, and human capacity for implementing and supporting health informatics solutions (Almalki et al., 2020; Asiri, 2014; Alyoubi, 2022). Healthcare organizations were found to have limited financial, technical, and human resources for investing in and maintaining health informatics systems, and to have fragmented and incompatible information systems that hinder the exchange and use of data for EBP (Almalki et al., 2020; Asiri, 2014; Alyoubi, 2022).

At the contextual level, the most commonly reported barriers to health informatics adoption and use for EBP were related to the cultural, social, and regulatory factors that shape the healthcare system and the practice of EBP in Saudi Arabia (Alaslani et al., 2021; Al-Jazairi & Alharbi, 2017; Alqahtani et al., 2019). The hierarchical and physician-centric culture of the Saudi healthcare system, the limited public awareness and demand for EBP, and the lack of national policies and standards for health informatics and EBP were found to impede the adoption and use of health informatics for EBP (Alaslani et al., 2021; Al-Jazairi & Alharbi, 2017; Alqahtani et al., 2019).

On the other hand, the most commonly reported facilitators of health informatics adoption and use for EBP were related to the leadership support, organizational culture, and stakeholder engagement in the implementation and evaluation of health informatics solutions (Almalki et al., 2020; Binkheder et al., 2021; Wahabi & Zakaria, 2020). The commitment and involvement of senior leaders, the alignment of health informatics initiatives with the strategic goals and values of healthcare organizations, and the participation of healthcare professionals and patients in the design and implementation of health informatics solutions were found to enhance the acceptability, feasibility, and effectiveness of health informatics for EBP (Almalki et al., 2020; Binkheder et al., 2021; Wahabi & Zakaria, 2020).

Table 4 presents a summary of the key barriers and facilitators of health informatics adoption and use for EBP in Saudi Arabian healthcare settings, as reported in the included studies.

Table 4. Barriers and Facilitators of Health Informatics Adoption and Use for Evidence-Based Practice in Saudi Arabia

Level	Barriers	Facilitators
Individual	- Lack of awareness, knowledge, and skills of healthcare professionals regarding evidence-based practice and health informatics	- Education and training programs for healthcare professionals on evidence-based practice and health informatics
	- Limited exposure to and training in evidence-based practice and health informatics during undergraduate and postgraduate education	- Provision of time and resources for healthcare professionals to access and appraise evidence in their clinical practice

	- Insufficient time and resources to access and appraise evidence in clinical practice	
Organizational	- Lack of infrastructure, interoperability, and human capacity for implementing and supporting health informatics solutions	- Leadership support and commitment for health informatics initiatives
	- Limited financial, technical, and human resources for investing in and maintaining health informatics systems	- Alignment of health informatics initiatives with the strategic goals and values of healthcare organizations
	- Fragmented and incompatible information systems that hinder the exchange and use of data for evidence-based practice	- Participation of healthcare professionals and patients in the design and implementation of health informatics solutions
Contextual	- Hierarchical and physician-centric culture of the Saudi healthcare system	- National policies and standards for health informatics and evidence-based practice
	- Limited public awareness and demand for evidence-based practice	- Collaboration and partnerships among healthcare organizations, educational institutions, and professional associations for promoting health informatics and evidence-based practice
	- Lack of national policies and standards for health informatics and evidence-based practice	- Cultural and social awareness campaigns for educating the public about the importance and benefits of evidence-based practice

3.5 Strategies and Interventions for Optimizing the Role of Health Informatics in Evidence-Based Practice

The strategies and interventions for optimizing the role of health informatics in EBP in Saudi Arabian healthcare settings were reported in 30 studies (50%). The findings highlighted the need for a multi-faceted and collaborative approach to address the barriers and leverage the facilitators of health informatics adoption and use for EBP, involving the efforts of policymakers, healthcare organizations, educational institutions, and professional associations (Altuwaijri, 2010; Alshammari et al., 2019; Bahkali et al., 2014).

At the policy level, the most commonly reported strategies for optimizing the role of health informatics in EBP were related to the development and implementation of national policies, standards, and guidelines for health informatics and EBP (Altuwaijri, 2010; Alshammari et al., 2019; Bahkali et al., 2014). These policies and standards should provide a common framework and direction for the adoption and use of health informatics solutions across the healthcare system, and should ensure the quality, safety, and interoperability of health informatics systems and data (Altuwaijri, 2010; Alshammari et al., 2019; Bahkali et al., 2014).

At the organizational level, the most commonly reported interventions for optimizing the role of health informatics in EBP were related to the integration of health informatics solutions into the clinical workflows and decision-making processes of healthcare professionals (Almalki et al., 2020; Alzghaibi, 2023; Bin kheder et al., 2021). These interventions should involve the design and implementation of user-friendly and evidence-based health informatics applications, such as EHRs, CDSSs, and mobile health technologies, that support the access, synthesis, and application of evidence at the point of care (Almalki et al., 2020; Alzghaibi, 2023; Binkheder et al., 2021). They should also involve the provision of education and training programs for healthcare professionals on the use and benefits of health informatics for EBP, and the

establishment of incentives and rewards for the adoption and use of health informatics solutions (Almalki et al., 2020; Alzghaibi, 2023; Binkheder et al., 2021).

At the individual level, the most commonly reported strategies for optimizing the role of health informatics in EBP were related to the engagement and empowerment of healthcare professionals and patients in the design, implementation, and evaluation of health informatics solutions (Alodhayani et al., 2021; Alshammari et al., 2022; Altwaijiri & Aldosari, 2008). These strategies should involve the active participation of healthcare professionals and patients in the development and testing of health informatics applications, and the incorporation of their feedback and preferences into the design and functionality of these applications (Alodhayani et al., 2021; Alshammari et al., 2022; Altwaijiri & Aldosari, 2008). They should also involve the provision of education and support for healthcare professionals and patients on the use and benefits of health informatics for EBP, and the promotion of a culture of continuous learning and improvement in the use of health informatics solutions (Alodhayani et al., 2021; Alshammari et al., 2022; Altwaijiri & Aldosari, 2008).

Table 5 presents a summary of the key strategies and interventions for optimizing the role of health informatics in EBP in Saudi Arabian healthcare settings, as reported in the included studies.

Table 5. Strategies and Interventions for Optimizing the Role of Health Informatics in Evidence-Based Practice in Saudi Arabia

Level	Strategies and Interventions
Policy	- Development and implementation of national policies, standards, and guidelines for health informatics and evidence-based practice
	- Ensuring the quality, safety, and interoperability of health informatics systems and data
Organizational	- Integration of health informatics solutions into the clinical workflows and decision-making processes of healthcare professionals
	- Design and implementation of user-friendly and evidence-based health informatics applications, such as electronic health records, clinical decision support systems, and mobile health technologies
	- Provision of education and training programs for healthcare professionals on the use and benefits of health informatics for evidence-based practice
	- Establishment of incentives and rewards for the adoption and use of health informatics solutions
Individual	- Engagement and empowerment of healthcare professionals and patients in the design, implementation, and evaluation of health informatics solutions
	- Active participation of healthcare professionals and patients in the development and testing of health informatics applications
	- Incorporation of feedback and preferences of healthcare professionals and patients into the design and functionality of health informatics applications
	- Provision of education and support for healthcare professionals and patients on the use and benefits of health informatics for evidence-based practice
	- Promotion of a culture of continuous learning and improvement in the use of health informatics solutions

4. Discussion

This systematic review provides a comprehensive synthesis of the current evidence on the role of health informatics in facilitating EBP in Saudi Arabian healthcare settings, and the challenges and opportunities for future research and practice. The findings highlight the potential of health informatics in improving the awareness, knowledge, and implementation of EBP among healthcare professionals in Saudi Arabia, through various applications such as EHRs, CDSSs, online evidence resources, and mobile health

technologies (Almalki et al., 2020; Binkheder et al., 2021; Alharbi & Aljuaid, 2024). These applications have been shown to enhance the access, synthesis, and application of evidence in clinical practice, and to support the monitoring and evaluation of healthcare outcomes and quality indicators (Almalki et al., 2020; Alodhayani et al., 2021; Alzghaibi, 2023).

However, the review also identifies the barriers to the adoption and use of health informatics for EBP in Saudi Arabia, which include individual, organizational, and contextual factors (Al-Almaie & Al-Baghli, 2004; Alshehri et al., 2017; Hamaideh, 2017). At the individual level, the lack of awareness, knowledge, and skills of healthcare professionals regarding EBP and health informatics, and the limited exposure to and training in these areas during their education and practice, have been reported as major barriers (Al-Almaie & Al-Baghli, 2004; Alshehri et al., 2017; Hamaideh, 2017). At the organizational level, the lack of infrastructure, interoperability, and human capacity for implementing and supporting health informatics solutions, and the limited financial, technical, and human resources for investing in and maintaining these solutions, have been identified as key challenges (Almalki et al., 2020; Asiri, 2014; Alyoubi, 2022). At the contextual level, the hierarchical and physician-centric culture of the Saudi healthcare system, the limited public awareness and demand for EBP, and the lack of national policies and standards for health informatics and EBP, have been reported as significant barriers (Alaslani et al., 2021; Al-Jazairi & Alharbi, 2017; Alqahtani et al., 2019).

To address these challenges and optimize the role of health informatics in EBP, the review suggests a multi-faceted and collaborative approach that involves the efforts of policymakers, healthcare organizations, educational institutions, and professional associations (Altuwaijri, 2010; Alshammari et al., 2019; Bahkali et al., 2014). At the policy level, the development and implementation of national policies, standards, and guidelines for health informatics and EBP, and the ensuring of the quality, safety, and interoperability of health informatics systems and data, have been recommended as key strategies (Altuwaijri, 2010; Alshammari et al., 2019; Bahkali et al., 2014). At the organizational level, the integration of health informatics solutions into the clinical workflows and decision-making processes of healthcare professionals, the design and implementation of user-friendly and evidence-based health informatics applications, and the provision of education and training programs for healthcare professionals on the use and benefits of health informatics for EBP, have been suggested as important interventions (Almalki et al., 2020; Alzghaibi, 2023; Binkheder et al., 2021). At the individual level, the engagement and empowerment of healthcare professionals and patients in the design, implementation, and evaluation of health informatics solutions, the active participation of healthcare professionals and patients in the development and testing of health informatics applications, and the promotion of a culture of continuous learning and improvement in the use of health informatics solutions, have been proposed as essential strategies (Alodhayani et al., 2021; Alshammari et al., 2022; Altwaijiri & Aldosari, 2008).

The findings of this review have several implications for policy, practice, and research. First, there is a need for more comprehensive and evidence-based policies and guidelines to support the adoption and use of health informatics for EBP in Saudi Arabia, and to align them with the Vision 2030 goals and priorities (Altuwaijri, 2010; Alshammari et al., 2019; Bahkali et al., 2014). These policies and guidelines should provide clear and consistent definitions and expectations of the role and value of health informatics in EBP, as well as the necessary resources, incentives, and support systems for their effective implementation and evaluation (Altuwaijri, 2010; Alshammari et al., 2019; Bahkali et al., 2014). They should also address the cultural, social, and regulatory barriers to the adoption and use of health informatics for EBP, such as the hierarchical and physician-centric culture, the limited public awareness and demand for EBP, and the lack of national standards and interoperability frameworks for health informatics (Altuwaijri, 2010; Alshammari et al., 2019; Bahkali et al., 2014).

Second, there is a need for more innovative and evidence-based strategies and interventions to enhance the capacity and competence of healthcare professionals and organizations in using health informatics for EBP in Saudi Arabia, based on their individual and contextual needs and preferences (Almalki et al., 2020; Alzghaibi, 2023; Binkheder et al., 2021). These strategies and interventions should leverage the existing strengths and resources of the Saudi healthcare system, such as the national e-health initiatives, the digital health infrastructure, and the health informatics education and training programs (Almalki et al., 2020;

Alzghaibi, 2023; Binkheder et al., 2021). They should also engage the key stakeholders, such as the healthcare professionals, patients, policymakers, and technology vendors, in the design, implementation, and evaluation of health informatics solutions for EBP, and incorporate their feedback and preferences into the functionality and usability of these solutions (Almalki et al., 2020; Alzghaibi, 2023; Binkheder et al., 2021).

Third, there is a need for more rigorous and longitudinal studies to evaluate the long-term effectiveness and impact of health informatics interventions on EBP outcomes and quality indicators in Saudi Arabia, as well as their transferability and scalability to different healthcare settings and populations (Almalki et al., 2020; Binkheder et al., 2021; Alharbi & Aljuaid, 2024). These studies should use mixed-methods approaches to capture the complex and multi-level factors that influence the adoption and use of health informatics for EBP, such as the individual, organizational, and contextual barriers and facilitators, and the process and outcome measures of EBP (Almalki et al., 2020; Binkheder et al., 2021; Alharbi & Aljuaid, 2024). They should also explore the perceptions and experiences of healthcare professionals and patients in using health informatics for EBP, and identify the strategies and interventions that are most acceptable, feasible, and effective in promoting the culture and practice of EBP in the Saudi healthcare system (Almalki et al., 2020; Binkheder et al., 2021; Alharbi & Aljuaid, 2024).

Moreover, the review highlights the importance of adopting a systems approach to health informatics and EBP, which recognizes the interdependence and interactions among the different components and levels of the healthcare system, and the need for a shared vision, values, and goals for healthcare transformation (Bakken, 2001; Rigby et al., 2013; Al-Shehri, 2014). This approach requires the integration of health informatics and EBP into the broader strategies and processes of healthcare delivery, research, and education, such as the quality improvement, patient safety, interprofessional collaboration, and health system strengthening initiatives (Bakken, 2001; Rigby et al., 2013; Al-Shehri, 2014). It also requires the engagement and empowerment of all healthcare stakeholders, including healthcare professionals, patients, policymakers, and technology vendors, as active partners and change agents in the design, implementation, and evaluation of health informatics solutions for EBP (Bakken, 2001; Rigby et al., 2013; Al-Shehri, 2014).

Finally, the review underscores the need for a paradigm shift in the education and training of healthcare professionals in Saudi Arabia, from a traditional and discipline-specific model to a transformative and interprofessional model of health informatics and EBP (Altuwaijri, 2010; Majid, 2007; Alanazi, 2023). This shift requires the integration of health informatics and EBP competencies and values into the curricula and programs of healthcare education and training, as well as the continuing professional development of healthcare professionals (Altuwaijri, 2010; Majid, 2007; Alanazi, 2023). It also requires the development of the necessary attitudes, behaviors, and skills of healthcare professionals towards health informatics and EBP, such as the critical thinking, problem-solving, communication, collaboration, and lifelong learning competencies (Altuwaijri, 2010; Majid, 2007; Alanazi, 2023).

5. Conclusion

In conclusion, this systematic review provides a timely and relevant synthesis of the current evidence on the role of health informatics in facilitating EBP in Saudi Arabian healthcare settings, and the challenges and opportunities for future research and practice. The findings highlight the potential of health informatics in improving the awareness, knowledge, and implementation of EBP among healthcare professionals in Saudi Arabia, through various applications such as EHRs, CDSSs, online evidence resources, and mobile health technologies. The review also identifies the barriers to the adoption and use of health informatics for EBP, such as the lack of infrastructure, training, and organizational support, and suggests strategies and interventions for optimizing the role of health informatics in EBP, such as the development of standardized terminologies and data exchange standards, the integration of evidence into clinical workflows, and the engagement of healthcare professionals in the design and implementation of health informatics solutions.

To support the effective use of health informatics for EBP in Saudi Arabia, the review recommends the establishment of comprehensive and evidence-based policies and guidelines, the design of innovative and stakeholder-engaged strategies and interventions, and the conduct of rigorous and longitudinal studies to

evaluate their outcomes and transferability. The review also emphasizes the importance of adopting a systems approach to health informatics and EBP, which integrates them into the broader strategies and processes of healthcare transformation, and engages all healthcare stakeholders as active partners and change agents.

By leveraging the unique strengths and opportunities of the Saudi healthcare system, and by aligning the health informatics and EBP initiatives with the Vision 2030 goals and priorities, Saudi Arabia can make significant progress towards improving the quality, safety, and effectiveness of healthcare services, and achieving better health outcomes and experiences for its population.

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