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The Transformative Impact of Artificial Intelligence (AI) on Enhancing Healthcare Systems in the Middle East

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ABSTRACT: This review explores the transformative potential of integrating Artificial Intelligence (AI) technologies in healthcare across the Middle East. The study underscores the substantial benefits AI brings to patient care, exemplified by the deployment of Chabot's for disseminating critical COVID-19 information during the pandemic, enhancing patient experiences through streamlined access to medical records and online appointments, and the proliferation of health-related mobile applications, thus significantly advancing patient-centered care. However, the review acknowledges the challenges associated with integrating AI in healthcare. Factors such as data privacy, regulatory compliance, and the need for robust infrastructure are identified as critical considerations for successful implementation. Moreover, the Middle East's unique socio-economic and cultural dynamics necessitate thoughtful adaptation strategies to ensure the widespread acceptance of AI solutions among healthcare professionals and patients. In conclusion, the evidence presented in this review unequivocally demonstrates that AI is affecting a discernible and positive change in healthcare practices throughout the Middle East. The region stands at the forefront of AI adoption, leveraging its potential to surmount healthcare hurdles and enhance patient well-being. As AI technology evolves, the Middle East's healthcare landscape is poised for even greater strides in innovation and improved patient care.

Keywords: Artificial Intelligence; Middle-East; AI Challenges; Healthcare System; Patient Education

1. INTRODUCTION

Artificial Intelligence (AI) is revolutionizing healthcare by enhancing drug discovery, improving disease diagnosis accuracy, assisting in surgeries, and optimizing resource utilization [1]. AI, a branch of computer science that aims to create intelligent machines capable of emulating human cognition and decision-making, is promising to revolutionize various domains of human endeavor. From automating routine tasks to delivering personalized experiences and contributing to groundbreaking medical discoveries [2], the potential of AI to revolutionize human society is boundless. However, such transformative power also raises profound ethical and societal considerations, necessitating a careful and responsible approach to its integration. The field of AI is vast and multifaceted, encompassing a range of techniques and methodologies [3]. Machine Learning (ML) forms the bedrock of AI, where algorithms learn from data and improve their performance over time without explicit programming. Deep Learning, a subset of ML, leverages neural networks to simulate human-like learning patterns and has achieved remarkable breakthroughs in areas like image and speech recognition [4]. Reinforcement Learning enables AI agents to learn through interaction with an environment akin to trial and error, leading to the development of sophisticated gaming algorithms and autonomous systems. One of the most prominent advantages of AI lies in automation. AI-driven automation streamlines labor-intensive and repetitive tasks across various industries, increasing efficiency and productivity [1]. For instance, in manufacturing, AI-powered robots can perform intricate assembly line tasks with precision and speed, reducing production time and costs. Similarly, in

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customer service, AI Chabot's can provide instant support, answer queries and resolve issues, enhancing customer experiences and reducing the workload on human agents. Furthermore, AI's ability to process vast amounts of data quickly and accurately offers a distinct advantage in decision-making [1]. By analyzing big data sets, AI algorithms can extract valuable insights, identify patterns, and make data-driven decisions more accurately than human judgment alone. In the healthcare sector, AI-powered systems can analyze patient data to assist in diagnosis, treatment planning, and drug development, potentially leading to improved patient outcomes and more effective medical interventions [5]. The personalization of services and experiences is another notable advantage of AI. By leveraging AI-powered recommendation systems, companies can offer tailored content, products, and services to individual users. For instance, streaming platforms use AI algorithms to recommend movies and shows based on users' preferences, increasing user engagement and satisfaction.

Predictive analytics, enabled by AI, empowers organizations to forecast future trends and behaviors based on historical data [3]. This capability has significant implications in areas like marketing, finance, and supply chain management, allowing businesses to make data-driven decisions and stay ahead of the competition.

While the potential benefits of AI are vast, ethical considerations loom large as AI becomes more pervasive in our lives [6]. Integrating AI into critical domains, such as healthcare and autonomous vehicles, demands robust ethical guidelines and accountability to ensure AI systems act responsibly, fairly, and transparently. Addressing bias, privacy, and security issues is paramount to fostering public trust and realizing the full potential of AI [7]. With broad-reaching impacts across different areas, artificial intelligence (AI) has progressively integrated itself within the realm of medical and healthcare practices [8]. The attempt of AI into medicine traces back to the mid-20th century when medical practitioners embarked on their initial endeavors to enhance diagnostic accuracy through the employment of computer-assisted applications [9]. Since then, AI has evolved into an essential resource, facilitating the creation of complicated algorithms tailored to support healthcare providers in the complex tasks of patient diagnosis, treatment strategy formulation, and prognosis projection across diverse medical domains. The combination of AI and medicine shows how medical technology keeps advancing to improve patient care [8]. The transition of artificial intelligence (AI) from a phase of experimentation to active implementation is occurring rapidly and significantly [10]. This shift has led to transformative changes in the healthcare landscape within both clinical and community contexts. AI is proving to be effective in many areas of healthcare, and its theories and methods are changing how patients are treated. AI has already shown impressive achievements in various parts of healthcare, including keeping health records, educating patients, using location data for health purposes, studying social media trends, tracking diseases, making predictions with support, mobile health projects, and examining medical images like X-rays and eye scans [11]. AI's potential in the identification of disorders such as Alzheimer's [12], cancer [13], diabetes [14], and cardiac conditions, even during their asymptomatic phases, has been well established. Industries in the healthcare sector have embraced AI for diverse applications, with managing medical records and patient histories a prominent application. This transformation emphasizes AI's pivotal role in enhancing healthcare delivery and outcomes [15]. Moreover, AI enhances cognitive functions in precision medicine by enabling data-driven insights, exploring drug compounds, optimizing surgical procedures, and improving imaging techniques through advanced machine learning and deep learning applications [16], as showed in Figure 1. In the realms of pharmaceutical and healthcare sectors, AI-driven models have substantiated their value by amplifying the efficiency of drug production processes, facilitating immediate health tracking, and improving predictions about future health issues. The potential of AI in the pharmaceutical sphere is demonstrated through its role in streamlining drug discovery endeavors, spanning from initial design phases to subsequent screening stages [17, 18]. There are comparable instances where AI predicts heart failure by analyzing electrocardiogram (ECG) information [19]. The integration of AI within robotic surgeries, particularly spinal surgical interventions, attracts attention within the healthcare sector. AI-infused robotic systems harness insights from previous surgical interventions to advance novel operative techniques. These robots perform surgeries very accurately, reducing unintended motions [20]. Beyond spinal surgery, AI's footprint extends to minimally invasive procedures, surgeries augmented by robotic assistance, and postoperative care tasks like prognosticating recovery durations [21]. Notably, in the context of the COVID-19 pandemic, natural language processing (NLP) methodologies have found practical utility in converting clinical annotations into computationally digestible formats, thereby highlighting patient status, medical history, subjective evaluation findings, and medical recommendations [22]. Additionally, advanced machine learning (ML) algorithms can standardize datasets, thus enhancing the accuracy of clinical diagnostics and facilitating predictions about drug encapsulation's efficacy and the cytotoxic impact associated with nanoparticle formulations. Consequently, AI interventions alleviate the strain on healthcare infrastructure by preventing incorrect medical assessments and needless hospital admissions, therefore

generating cost and time savings for patients by avoiding unnecessary medical consultations. The integration of AI-empowered methodologies augments the horizon of surgical practices and medical domains, promising a blossoming future [23].

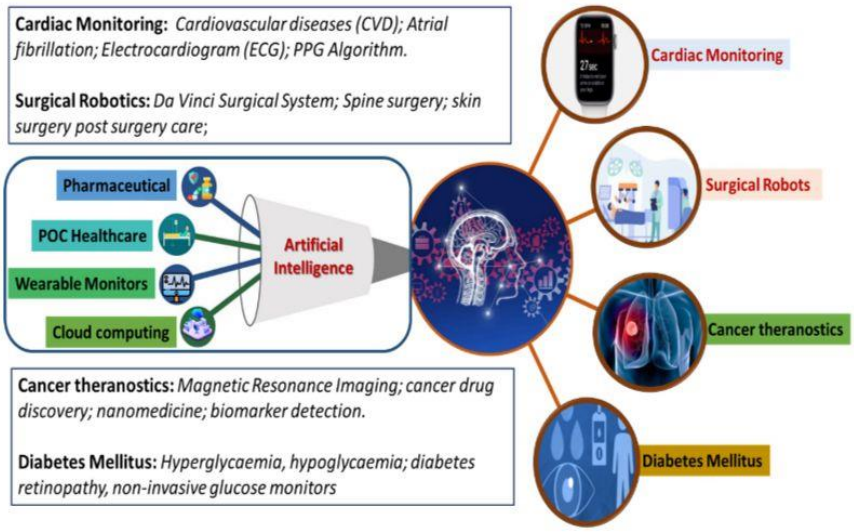

FIGURE 1. The role of AI methods in diverse areas of health system [23]

The reset of the document is structured in the following manner: Section 2 delves into the Research Literature relevant to this study, while Section 3 outlines the Methodology employed. Section 4 addresses the Challenges of AI in Health Systems, followed by a Discussion in Section 5. The final section contains Recommendations and the Conclusion.

2. LITERATURE REVIEW

2.1 Middle East region's initiatives for utilizing AI in healthcare

This paper discusses incorporating artificial intelligence (AI) in healthcare, particularly focusing on its potential in patient engagement and health information systems among some Middle East nations. A brief comparison of using various health technologies in the five Eastern Mediterranean countries (Table 1). We highlight initiatives such as the Patient Smart Portal in the UAE, which optimizes patient experience through health record access and online appointment scheduling. Furthermore, the use of AI Chabot's in Bahrain for disseminating COVID-19 information is examined along with the application of AI in Saudi Arabia for healthcare improvement and its response to the COVID-19 pandemic. Theoretical frameworks and models related to AI's impact on healthcare are discussed including challenges and benefits of AI adoption among medical staff and the need for awareness raising sessions. In addition, a study in Egypt emphasized the essential for collaboration between medical professionals and AI developers. This sheds light on addressing the limited use of AI techniques in resource-limited regions like Syria which underscoring the important role of training and collaboration to aid medical professionals. Table 2 shows the relevant studies that explain the role of artificial intelligence in the in the different aspects of medical field.

Table 1. The Utilization of health technologies across five states.

	UAE	Bahrain	Saudi Arabia	Egypt	Syria
Software	AI	AI			
Platform	AI				
Services	AI	AI	AI		
Application		AI	AI		

2.2 AI-Driven Transformation in UAE Healthcare

In the sphere of healthcare, the incorporation of artificial intelligence (AI) within health information systems (HIS) presents considerable potential, spanning various sectors and dimensions across nations globally. While numerous healthcare establishments emphasize patient engagement and encourage the utilization of AI tools, such as the Patient Smart Portal (PSP). A pivotal initiative undertaken by the Ministry of Health and Prevention (MOHAP) in the UAE is the implementation of the Patient Smart Portal Project within the HIS. This endeavor involves a service aimed at optimizing patient experience by granting access to health records and facilitating online appointment scheduling. Notably, a research study revealed that 58% of patients utilized the Patient Smart Portal to review their health records and test outcomes [24]. Before the patient smart portal was introduced, the UAE faced a significant issue of about 37% of healthcare appointments being missed by patients [25]. Hence, interviews were conducted with healthcare authorities to evaluate the utilization of the Patient Smart Portal (PSP), assess regional vulnerabilities, and detect the role of artificial intelligence (AI) in mitigating risks within the UAE [24]. Accessible from various devices, the PSP system aims to revolutionize the healthcare landscape of the UAE by enhancing the accessibility of medical consultations. [26] During medical appointments, patients obtain advice and treatment for their prevailing conditions. Through this platform, patients can promptly schedule appointments and receive reminders via text messages and emails [27]. The system further permits patients to easily reschedule or cancel appointments. Furthermore, patients have the option to approach alternative healthcare professionals to seek secondary opinions and clarifications regarding their concerns [28]. Patients also can review their medical analysis results, which can subsequently be downloaded or printed. The Patient Portal allocates space for users to add personal notes, organize contact lists, and compile a directory of links to valuable resources, encompassing treatment options, support networks, research materials, and clinical trials. As documented in the Appendix, findings drawn from interviews with a pair of medical professionals and one IT specialist align to underscore the crucial function of the PSP in delivering secure, accurate, and user-friendly information accessibility. Moreover, unanimous emphasis was placed on the PSP's AI-powered capacity to deliver analysis, predictions, and recommendations to users, thereby simplifying the tasks of healthcare professionals and furnishing instant access to information and knowledge sought by patients. Additionally, the consensus highlighted the potential of AI to simplify the process of arranging appointments, sending notifications, examining patient information, and potentially even taking on nursing responsibilities in future situations [24]. An additional instance of applying artificial intelligence is evident in the management of healthcare business administration, exemplified by its implementation within the Ministry of Health and Prevention (MOHAP) in the UAE. MOHAP has introduced novel AI technology to diminish patient waiting durations within emergency rooms. This initiative is oriented towards augmenting operational efficiency and service efficacy while sustaining safety and maintaining quality standards [29].

2.3 Bahrain’s Effective Use of AI Chatbot’s during the COVID-19 Pandemic

Within the healthcare setting, a variety of chatbots are available to support operational activities. Intelligent communication, characterized by the incorporation of chatbots, encompasses natural language comprehension, linguistic processing, and machine learning from observable patterns [30]. In Bahrain, an AI-infused chatbot was developed utilizing an accessible, open-source, high-level programming framework known as Rasa. This chatbot possesses the capability to furnish users with fundamental COVID-19 guidelines; for instance, if a user is unwell and displaying symptoms such as cough, fever, and/or shortness of breath, the chatbot engages in a query-response interaction wherein the patient selects the relevant options from a multiple-choice questionnaire. Moreover, users can inquire about the COVID-19 vaccine registration location, to which the chatbot responds by furnishing the official registration link. This service facilitates the determination of the user's health concerns and reinforces human-computer interactions. Conversely, amid the COVID-19 pandemic, medical professionals encountered challenges in disseminating accurate information to the public. The chatbot effectively played a role in disseminating knowledge regarding COVID-19 protocols (e.g., mask usage, hand hygiene, social distancing, and staying home). Additionally, it aided users in combating pandemic-induced depression and anxiety while addressing up to seventy percent of customer inquiries. To summarize, the chatbot's distinction was rooted in its capacity to effectively convey precise pandemic-related details, enhance awareness, offer personalized support, track symptoms, and serve as a virtual companion to users. This excellence is attributed to the chatbot's versatility and advanced capabilities [31].

2.4 Saudi Arabia's Healthcare Transformation through AI Integration

Saudi Arabia has undertaken various initiatives to integrate AI into healthcare, encompassing numerous health-focused mobile applications, telemedicine platforms, and electronic medical records [32]. These endeavors have led to enhancements in healthcare provision, bolstered interactions between patients and healthcare personnel, and led to cost reductions [33]. The COVID-19 pandemic posed a global challenge to healthcare systems, with predominantly adverse consequences. Nevertheless, the pandemic prompted Saudi Arabia to swiftly engage in the application of artificial intelligence (AI), spanning from nationwide digitalization to the development of mobile health applications [32]. These initiatives have yielded benefits by enhancing the accessibility of healthcare services, particularly for patient demographics like the elderly, who face greater challenges in accessing healthcare providers [33]. Saudi Arabia recently introduced the Center for the Fourth Industrial Revolution in collaboration with the World Economic Forum (WEF) [34]. This establishment has conceived frameworks aimed at advancing collaborative engagement among diverse stakeholders, focusing on agile governance structures and the domains of AI, IoT, and blockchain technologies [35]. Theoretical frameworks, methodologies, and models stemming from artificial intelligence (AI) are instigating transformations within the healthcare milieu, impacting both clinical and community settings. These advancements have already demonstrated promising outcomes across several healthcare domains, encompassing integrated health information systems, patient education, geocoding health data, analytics of social media dynamics, epidemic and syndromic monitoring, predictive modelling, decision support, mobile health, and medical imaging applications such as examinations of radiology images and analyses of retinal images [36]. Following this, a study undertaken in Saudi Arabia involving 714 participants from diverse educational heritages revealed findings that a significant majority (71.3%) agreed with the idea that AI plays a noteworthy role in enhancing the acquisition of images with high quality [37].

2.5 Perspectives from Egypt's Medical Professionals and Patients Regarding the Promotion of AI Integration in Healthcare

Although medical AI offers advantages to healthcare systems, challenges persist in encouraging medical personnel to adopt AI [38]. Certain medical staff fined AI involvement necessitates elevated capacities to manage additional and unpredictable work responsibilities [39]. Consequently, it becomes pivotal for organizations within the healthcare sector to comprehend methods for augmenting the adoption of artificial intelligence among medical personnel [40]. A research investigation was conducted to assess the perspectives of both managers and patients regarding the implementation of artificial intelligence (AI) within the healthcare sector in Egypt. The study comprised two distinct participant groups: managerial staff (comprising nurses and medical personnel) and patients from three designated hospitals. The data collection process incorporated the administration of three distinct questionnaires, both before and after awareness-raising sessions. These questionnaires pertained to managers' comprehension of AI, managers' perceptions of AI, and patients' viewpoints on AI's incorporation within healthcare. The findings demonstrated that within all three studied hospitals, individuals across both managerial and patient groups lacked comprehensive awareness of the complete scope of AI, its applications within nursing and medicine, its advantages, categorizations, and segments, as well as the associated prospects and hazards in the healthcare context. Following the awareness sessions, a notable majority exhibited heightened awareness concerning these aspects. Statistical analysis indicated a highly significant ($p < .001$) disparity in managers' knowledge about AI before and after these sessions. The majority of nurse and medical managers expressed a positive perception regarding AI's utilization within nursing and medicine. Similarly, patients conveyed a favorable perspective on AI's integration within healthcare [41]. Therefore, both AI developers and medical institution administrators must collaborate in facilitating the integration of medical staff with their "AI counterparts" [40]. To ease the burden on healthcare professionals through medical AI imaging and AI-based triage [42].

2.6 Evaluating AI Knowledge among Medical and Dental Students in Syria

Furthermore, over the past six decades, notable advancements have been achieved in the field of artificial intelligence (AI). Nevertheless, the utilization of machine learning techniques in regions with limited resources has been comparatively modest. Therefore, a questionnaire-based cross-sectional study was conducted online through the Google Forms platform. This survey included demographic information and the understanding and perception of AI among medical and dental participants at various educational levels (undergraduate, graduate, and postgraduate) in Syria. Among the 1,494 participants, approximately 1,055 (70%) indicated prior familiarity with AI. However, only 357 (23.7%) participants knew of its applications in the medical domain. The obligatory training of medical professionals in Syria for

integrating artificial intelligence into their practices should be a priority. Such training could be delivered either online or through in-person sessions. Collaborative efforts between the Syrian government and international organizations are pivotal in aiding the country's medical professionals [43].

Table 2. Summary of key articles: Study design, Methodology, and Findings.

Article Title	Study design	Aim of the study	Results	Discussion	Conclusion	Year of publication
The effect of AI on project and risk management in health care industry projects in the United Arab Emirates (UAE)	Literature review	To discuss the project risk management specifically for Patient Smart Portal (PSP) systems and how Artificial Intelligence (AI) can mitigate those risks and add valuable functionalities to the system	The results focus on the impact and growth of artificial intelligence (AI) usage in the healthcare industry between the years 2012 and 2016, which was a substantial increase in the adoption of AI in the healthcare sector. This adoption resulted in a significant jump in revenue, growing from $30 million to $892 million during that period. Hypothesis with a case study	The research identified benefits and challenges associated with implementing AI in healthcare and the factors contributing to project success and failure, supported by a case study	It emphasized the recommendation to consider success factors in future AI project executions, with an emphasis on controlling potential risks	2021 [24]
Patient Portal Use and Experience Among Older Adults: Systematic Review	Systematic reviews	To evaluate the research landscape on older adults' use of patient portals and electronic personal health records (ePHRs), focusing on understanding the advantages and obstacles associated with their adoption	In summary, the study identified two primary barriers to the use of patient portals and electronic Personal Health Records (ePHRs): concerns related to privacy and security, and challenges associated with access to and proficiency in technology and the Internet. Additionally, the research highlighted two facilitating factors: the availability of technical assistance and guidance from family and healthcare providers	The review designed recommendations for patient portals and ePHRs among older adults. However, evidence strength was limited due to small sample sizes and study diversity. It also emphasized the need for longitudinal and standardized research on widely used systems to inform design recommendations	Further research is essential to comprehensively grasp the patient portal experience among older adults, encompassing the journey from initial use to adoption	2017 [25]

Article Title	Study design	Aim of the study	Results	Discussion	Conclusion	Year of publication
			The study found that key factors influencing the	Key factors included performance expectancy, effort expectancy, habit,	The study enhanced understanding of preferred	

Electronic Health Record Patient Portal Adoption by Health Care Consumers: An Acceptance Model and Survey	Cross-sectional (questionnaire)	To understand the factors that drive individuals to adopt electronic health record portals	intention to use EHR portals are performance expectancy, effort expectancy, habit, and self-perception. The predictors of actual use behavior include habit and behavioral intention. The overall model accounted for 49.7% of the variance in behavioral intention and 26.8% in use behavior	and self-perception. Age positively affected technology use, suggesting older individuals use EHR portals more. However, the study didn't find evidence supporting the idea that patients with chronic illness or disability are more likely to use EHR portals, possibly due to a lower proportion of participants with chronic conditions and a younger sample	EHR portal features, using an IT acceptance model to identify patient-valued factors including health care consumer-related constructs significantly improves comprehensio n of EHR portal adoption	2016 [27]
Access to Radiology Reports via an Online Patient Portal: Experiences of Referring Physicians and Patients	Cross-sectional (survey) Data were analyzed using descriptive statistics and qualitative methods	To describe the patterns of manual release of radiology reports by referring physicians and the experiences of both patients and referring physicians during the initial year of offering the option to release radiology reports	Most patients (74%) found accessing medical reports easy and considered it important. Referring physicians (88%) found releasing reports to patients useful. While 58% preferred auto-release of x-ray reports with a 1-week delay, there was reluctance for CT and MRI reports. Follow-up activities for referring physicians remained unchanged or decreased for 86%	The survey highlighted potential unfounded concerns, as less than 10% of physicians worried about confusion or anxiety for patients. Yet, some areas for improvement were identified, including the need for clearer language in reports and improved communication from referring physicians. Physician preferences for auto-release also underscore the need for more information	Releasing radiology reported through the online portal by referring physicians is valued by patients, deemed useful by referring physicians, and does not impact their workloads	2015 [28]

Article Title	**Study design**	**Aim of the study**	**Results**	**Discussion**	**Conclusion**	**Year of publication**
Implementing Artificial Intelligence-Based COVID-19 Chatbot in the		The research focused on using a chatbot in helpline situations to help individuals determine if their	Some characteristics of the chatbots were analyzed including accuracy and reliability of the information, tailored assistance, ability to spread awareness, symptoms monitoring, mental health support,	The proposed chatbot is a comprehensive solution developed to address key challenges during the COVID-19 pandemic. It excels in providing accurate information, raising awareness, offering personalized	The chatbot served as a 24/7 virtual assistant and friend, particularly during the COVID-19 which provided comprehensiv e information, protocols, and	2022 [31]

Kingdom of Bahrain		symptoms indicate COVID-19 or the flu through proposed a state-of-the-art chatbot model based on machine learning	pressure on customer care executives, and some other key features, these features have made the proposed chatbot better than several other chatbots that exist in the market	assistance, and monitoring symptoms. The chatbot's adaptability and sophistication aim to overcome weaknesses in similar healthcare sector chatbots	mental health support. Performance analysis confirms its flexibility, adaptability, and relevance for future healthcare needs	
Artificial Intelligence in Health care and its application in Saudi Arabia	Review article	To explore the potential of AI in healthcare, its drawbacks, and the role of AI in the national health transformation mission in Saudi Arabia.	The COVID-19 pandemic has significantly increased the role of AI, accelerating the need for prompt action. AI has played a crucial role in various stages of the pandemic, including identifying new virus strains, implementing containment measures, and promoting public adherence to safety protocols	In Saudi Arabia, Vision 2030 emphasizes digital transformation, with the Saudi Data and Artificial Intelligence Authority (SDAIA) established to drive AI initiatives and position the country as a global leader. The integration of technology is crucial for achieving Vision 2030 goals, including economic and social development	Saudi Arabia rapidly embraced AI in healthcare during the challenges of COVID-19, resulting in significant digital transformation and exponential growth	2022 [32]

Article Title	**Study design**	**Aim of the study**	**Results**	**Discussion**	**Conclusion**	**Year of publication**
Electronic-health in Saudi Arabia: A review	Review article	To examine the recent state of e-health in Saudi Arabia, with a particular focus on studies regarding trends and the technologies utilized in the field of electronic health	The integration of e-health contributed to evidence-based policies, generating big data for healthcare advancements. Saudi Arabia's government is successfully achieving health objectives and improving healthcare quality through the strategic implementation of e-health and health informatics	Current literature on e-health in Saudi Arabia lacks coverage of prescription aspects and health information exchange. Future research should address these gaps for a comprehensive understanding of e-health's impact on the healthcare system	Saudi Arabia faced challenges in slow e-health implementation due to poor planning, workforce shortages, and low citizen awareness	2021 [33]
Health Care Employees'		To explore health care employee perceptions and attitudes toward the implementat	The study found that 3.11 out of 4 respondents expressed concerns about artificial intelligence replacing employees and	Saudi healthcare employees show moderate AI acceptance but worry about job replacement. Differences from a previous study	The healthcare sector in Saudi Arabia offered significant	

Perceptions of the Use of Artificial Intelligence Applications: Survey Study	Cross-sectional (questionnaire)	ion of artificial intelligence technologies in health care institutions in Saudi Arabia	displayed a general lack of knowledge about AI. Many respondents were unaware of the benefits and common challenges associated with AI applications in the health sector, highlighting a need for training	may be due to lower knowledge levels. Respondents recognize AI's speed advantage but doubt its real-time data capabilities. Job type significantly influences responses, with technicians more exposed to AI advances	market potential and is appealing for researchers and developers of artificial intelligence solutions	2020 [36]

Article Title	**Study design**	**Aim of the study**	**Results**	**Discussion**	**Conclusion**	**Year of publication**
Radiology Community Attitude in Saudi Arabia about the Applications of Artificial Intelligence in Radiology	Cross-sectional (questionnaire)	To assess the radiology community's attitude in Saudi Arabia toward the applications of AI	The study reported that 61.2% of participants are aware of AI in radiology, with radiologists showing more interest. A majority (82%) believes AI should be part of medical education, and 86% see it as essential for the future. Despite recognizing the importance of human-machine interaction, 89% don't think AI will replace radiologists	The study in Saudi Arabia revealed healthcare providers' awareness of AI in radiology, emphasizing its potential to improve healthcare, particularly in managing radiological big data. About 60% believe AI enhances treatment, with concerns about validation, bias, and patient consent. The study underscored the need for developing skills in man-machine interaction for the future	Participants in this study demonstrated an acceptable understanding of AI, and the study emphasized incorporating AI into medical education. Future work will explore AI's impact on routine radiology procedures and address implementation challenges in Saudi Arabia	2021[37]
Artificial Intelligence in Medicine: Today and Tomorrow		To discuss recent scientific literature and provide a perspective on the benefits, future opportunities and risks of established artificial intelligence applications in clinical practice on physicians, healthcare institutions, medical		AI in medicine faces validation challenges with unreliable studies. Solutions include open science and focusing on clinician-algorithm interaction. Patient data ownership is crucial and the universities introduced curricula for "augmented doctors" with digital expertise. Additionally, technology supports, not replaces, physicians and future studies should compare AI-	AI in clinical practice is promising but requires attention to ethical and financial issues as it evolves alongside precision medicine and teleconsultation	2020 [38]

		education, and bioethics		assisted and non-AI physicians		

Article Title	Study design	Aim of the study	Results	Discussion	Conclusion	Year of publication
Does AI explainability affect physicians' intention to use AI?	Cross-sectional (questionnaire)	To validate an innovative conceptual model aimed at exploring physicians' intention to use AI with AI explainability (XAI) as an antecedent variable of technology trust (TT) and perceived value (PV).	In this study with 295 collected questionnaires from physicians, the findings indicated a strong intention among physicians to use artificial intelligence (AI). Explainable AI (XAI) is highlighted as crucial, significantly influencing both AI technology trust (TT) and perceived value (PV). Additionally, TT in AI is shown to have a significant impact on PV. The study reveals that physicians' PV and TT in AI significantly affect their behavioral intention to use AI (BI). However, there is no conclusive evidence supporting the impact of XAI on BI.		The study highlighted XAI's impact on physicians' intention to use medical AI, offering valuable insights for AI-human interaction in healthcare	2022 [39]
Increasing acceptance of medical AI: The role of medical staff participation in AI development	Cross-sectional (questionnaire)	The study aimed to understand how medical staff participation influences their acceptance of AI and explores the moderating effect of speciesism in this mechanism	The study found that medical staff participation significantly influenced acceptance of medical AI in both the identification and adoption stages. Additionally, AI self-efficacy and AI anxiety were identified as significant mediating factors, while speciesism demonstrated significant moderating effects in the theoretical model	The study emphasized the positive impact of medical staff participation in AI development on AI acceptance, noting the moderating role of speciesism in the relationship with AI anxiety. Practical implications include encouraging participation, providing feedback, and addressing cognitive and affective aspects. It suggested future research should expand to include various professions and cultures in exploring the impact of employee participation on AI acceptance	Future collaboration between medical staff and AI is expected. The study emphasized the positive impact of staff involvement in AI development on acceptance, suggesting active participation for better results.	2023 [40]

Article Title	Study design	Aim of the study	Results	Discussion	Conclusion	Year of publication
Artificial intelligence as an innovative approach for investment in the future of healthcare in Egypt	Quasi-experimental	To investigate perception of managers and patients about AI application in the healthcare domain in Egypt	The study found managers' lack of AI knowledge before awareness sessions, with significant improvement post-sessions. Nurse managers generally agreed with AI application in healthcare, with some variation across hospitals. Medical managers held a positive perception of AI in medicine, and patients generally agreed with AI application in healthcare, with no significant differences between hospitals	The study highlighted AI's extensive role in healthcare, but most participants lacked awareness of its definition and benefits. This contrasts with existing literature emphasizing AI's role in supplementing and enhancing human judgment in healthcare. The transformative impact of AI on health and healthcare is acknowledged, emphasizing its potential in diagnostics, care management, and medication management	Managers showed a significant improvement in AI knowledge after awareness sessions. Both nurse and medical managers had a positive perception of AI application in their respective fields, and patients also viewed AI in healthcare positively	2020 [41]

Article Title	Study design	Aim of the study	Results	Discussion	Conclusion	Year of publication
Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Syria: A cross-sectional online survey	Cross-sectional (survey)	To determine AI's knowledge, attitude, and practice among doctors and medical students in Syria	The study included 1,507 participants, mainly medical students (83.1%), aged 21-30 years (97.2%), and mostly male (52%). Knowledge about AI is limited, with 70% having a basic concept. Qualification level significantly influences knowledge scores. Attitudes toward AI vary, with 45.7% strongly agreeing on its necessity in healthcare. Demographic factors like gender and age influence attitude scores. Regarding AI practices, 89.3% have never applied AI, while 78.6% are willing to use it in the future	The study in Syria revealed limited knowledge of artificial intelligence (AI) applications and subtypes among medical participants, despite 70% having basic AI knowledge. However, 87.4% recommend AI use in medicine, and 68.1% recognize its importance during the COVID-19 pandemic. The study suggests the need for AI education in medical school curricula and proposes training programs to enhance healthcare workers' understanding of AI	Urgent action is needed to enhance AI knowledge and attitudes in Syria's medical professionals and students. Despite current limited AI usage, there's a positive attitude toward its benefits. Proposed measures include mandatory online/offline training, requiring collaboration between the Syrian government and international organizations	2022 [43]

3. METHODOLOGY

The study is based on several steps, beginning with a review and investigation of relevant works to determine the research gap. In the subsequent steps, the literature is deeply analyzed to identify the main AI applications within the healthcare sector and their benefits. This paper aims to demonstrate the impact of artificial intelligence (AI) in the Middle East region on the healthcare system. We reviewed the studies including cross-sectional, systematic review and Quasi-experimental and conducted searches on the Web of Science, Google Scholar, PubMed, and Scopus databases using these keywords (electronic health records, mobile health and artificial intelligence) from 2015 to 2023.

4. CHALENGES OF AI IN HEALTH SYSTEMS

AI, characterized by its ability to execute intelligent tasks, offers a multifaceted approach to problem-solving. This is exemplified through the classification of AI into two fundamental methodologies: the symbolic approach, which employs rule-based systems with mechanisms of reward and penalty, and the connectionist approach, which utilizes highly interconnected paradigms for learning and classification [24]. The application of AI in the HIS of the healthcare sector has the potential to revolutionize various missions and tasks. From enhancing healthcare providers' planning and logistics, forecasting and preventing disease spread, to economizing efforts, time, and resources, refining medical diagnoses, and ultimately saving lives through improved treatments, AI's influence is far-reaching [44,49]. However, this remarkable potential is accompanied by various challenges and risks when incorporating AI into HIS are shown in Figure 2. These challenges encompass both technical and human-centric aspects. One of the central hurdles revolves around providing adequate training sessions for healthcare providers to navigate AI technologies adeptly. Moreover, the absence of uniform ethical standards across the healthcare industry raises concerns about AI's responsible and ethical deployment [45,50]. The potential misuse of clinical data, the lack of patient education regarding the benefits and drawbacks of AI, and the complex issue of integrating AI without compromising the emotional element of patient care further underscore the multifaceted nature of these challenges. As AI continues to permeate the healthcare landscape, addressing these obstacles becomes imperative to harness its potential effectively.

Challenges: However, the seamless integration of AI into HIS presents an array of challenges:

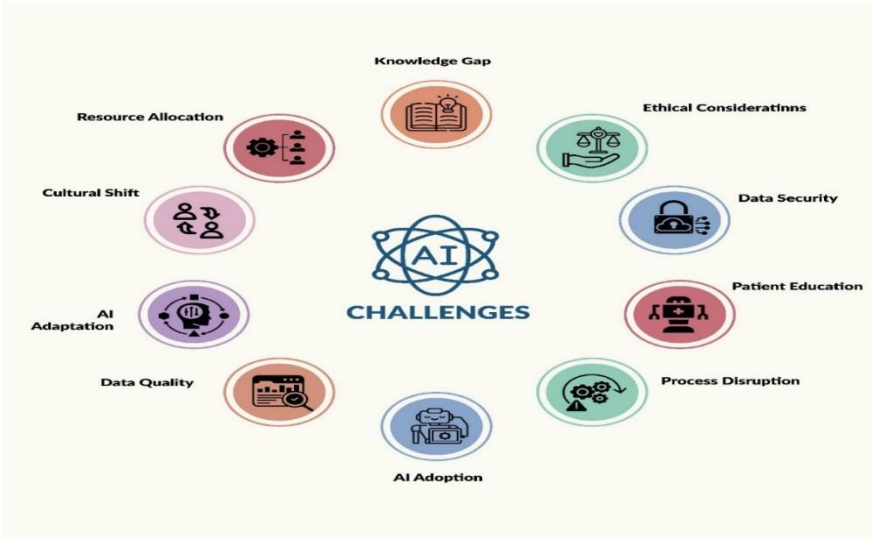

FIGURE 2. The common challenges of AI adoption in healthcare systems

Challenge 1: Bridging the Knowledge Gap despite the potential benefits of AI in healthcare information systems (HIS), one of the major challenges is the need to bridge the knowledge gap between healthcare providers and AI technologies. Many healthcare professionals may not be adequately trained or educated about AI, which can hinder the successful integration and utilization of AI-powered tools and systems within the HIS. Addressing this challenge requires comprehensive training sessions and educational programs to empower healthcare providers with the knowledge and skills to leverage AI effectively for improved patient care and decision-making [46].

Challenge 2: Ethical Dilemmas and Standards Adopting AI in the HIS raises ethical concerns and the need for clear standards within the healthcare industry. As AI algorithms increasingly influence medical diagnoses, treatment recommendations, and patient interactions, ethical considerations such as data privacy, transparency, bias mitigation, and accountability become paramount. Developing and enforcing ethical guidelines and standards for AI usage in healthcare is essential to ensure patient trust, uphold professional integrity, and safeguard against unintended consequences [35,50].

Challenge 3: Ensuring Data Privacy and Security Integrating AI into HIS introduces the challenge of ensuring robust data privacy and security. Healthcare data is sensitive and subject to stringent privacy regulations. AI-powered systems must be designed and implemented with robust security measures to prevent unauthorized access, data breaches, and potential misuse of patient information. Balancing the benefits of AI with the imperative to protect patient privacy requires a comprehensive approach to cybersecurity [35].

Challenge 4: Patient Education and Informed Consent a significant challenge lies in educating patients about the role of AI in healthcare and obtaining informed consent for AI-driven interventions. Patients should be informed about the advantages, limitations, and potential risks associated with AI-powered tools and systems in the HIS. Ensuring patients clearly understand how AI is used and its potential impact on their care empowers them to make informed decisions about their treatment plans [32].

Challenge 5: Integration with Existing Workflows Integrating AI into the HIS while seamlessly fitting into existing healthcare workflows is a complex challenge. AI implementation should enhance efficiency and effectiveness rather than disrupt established processes. Ensuring a smooth integration requires careful planning, customization of AI solutions to match specific healthcare contexts, and collaboration between IT professionals and healthcare providers [47-50].

Challenge 6: Overcoming Resistance to Change Adopting AI in the HIS may face resistance from both healthcare professionals and patients who may be hesitant to embrace new technologies. Overcoming this challenge involves effective change management strategies, transparent communication, and showcasing tangible benefits of AI, such as improved diagnosis, treatment outcomes, and overall patient experience [47].

Challenge 7: Data Quality and Interoperability AI applications heavily rely on high-quality, standardized, and interoperable healthcare data. However, healthcare data often exists in diverse formats and across various systems. Ensuring data quality, consistency, and interoperability is crucial to enabling AI algorithms to provide accurate insights and predictions. Addressing this challenge requires robust data governance frameworks and interoperability standards [43].

Challenge 8: Adapting to Technological Advancements the field of AI is rapidly evolving, leading to continuous advancements and updates in algorithms and technologies. Healthcare organizations adopting AI within the HIS must remain agile and capable of adapting to these changes to ensure that their systems remain up-to-date, effective, and aligned with the latest developments in AI [48-51].

Challenge 9: Resource Allocation and Sustainability Implementing and maintaining AI-powered systems within the HIS requires significant financial and human resources. Healthcare organizations need to allocate budgets for AI integration, ongoing training, system updates, and infrastructure enhancements. Striking a balance between investing in AI technologies and ensuring the sustainability of healthcare operations is a critical challenge [31].

Challenge 10: Cultural and Organizational Shifts the successful adoption of AI in the HIS necessitates a cultural and organizational shift towards embracing technology-driven healthcare solutions. This shift involves technological changes and changes in attitudes, mindsets, and organizational structures. Encouraging collaboration between healthcare providers, IT teams, administrators, and patients is crucial to fostering a culture that promotes the effective utilization of AI for improved healthcare outcomes [37].

5. DISCUSSION

The study presented in this review underscores the transformative impact of Artificial Intelligence on patient care, with specific examples highlighting its significant benefits. It also has discussed the AI challenges in the healthcare sector. Notably, AI-driven chatbots have played a crucial role in disseminating vital COVID-19 information during the pandemic. They have not only provided a valuable source of information but have also demonstrated the potential of AI in enhancing healthcare communication. Therefore, AI has proven instrumental in improving the patient experience. Streamlined access to medical records and online appointments has streamlined healthcare processes, making them more efficient and patient-centric. The proliferation of health-related mobile applications has empowered patients to take a more active role in managing their health, contributing to the advancement of patient-centered care. However, these advancements are promising, the study doesn't shy away from acknowledging the challenges associated with integrating AI into healthcare. Data privacy, regulatory compliance, and the need for robust infrastructure are identified as critical considerations for the successful implementation of AI solutions in healthcare. These challenges are pivotal in ensuring the ethical and secure use of AI in healthcare settings. Moreover, the review recognizes the unique socio-economic and cultural dynamics of the Middle East, emphasizing the need for thoughtful adaptation strategies. Tailoring AI solutions to these dynamics is essential to ensure widespread acceptance among healthcare professionals and patients, ultimately leading to successful integration and adoption. The primary challenge of this research study was the scarcity of prior studies focusing on the role of artificial intelligence in Eastern Mediterranean countries' healthcare systems. This limitation has constrained the available resources and led to a restricted scope, involving a limited number of countries to assess the impact of AI in the health sector. To address the lack of existing literature, our study pioneers innovative strategies. We have adopted an interdisciplinary approach by exploring related fields, thereby broadening the geographical scope to encompass more countries in the region. Furthermore, we've identified analogous topics that have significantly contributed to our research.

6. RECOMMENDATION AND CONCLUSION

Integrating Al technologies can bring significant benefits to patient care in the Middle East. For instance, chatbots provide essential COVID-19 information during the pandemic, improving patient experiences with access to medical records and online appointments, and various health-related mobile apps that make healthcare services more accessible. However, there are challenges to implementing Al in healthcare. Additionally, the Middle East's unique socio-economic and cultural factors need consideration to make sure Al is accepted by both healthcare professionals and patients. This review also emphasizes the importance of specific regional examples and success stories. These cases prove how Al can transform healthcare in the Middle East, tackling challenges and inspiring more innovation. In conclusion, Al is making a noticeable difference in healthcare across the Middle East. However, a comprehensive approach is necessary to create a future in which AI significantly enhances healthcare, benefiting patients and healthcare systems involves developing regulations, investing in infrastructure and education, enhancing data management, fostering collaboration, and prioritizing ethical AI.

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