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Digital Health Transformation in Saudi Arabia: Evaluating Healthcare Information Systems and the HIMSS Digital Health Indicators in Alignment with Vision 2030

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Background

ABSTRACT: The healthcare industry is rapidly embracing and progressing swiftly with health management and informatics due to its ability to leverage big data and extract valuable insights that support health management clinical choices and enable value-based treatment. Healthcare executives need to understand the state of health management. Health informatics is having a growing impact on almost every aspect of healthcare, from health management in real-world settings to clinical decision support at the point of care. However, there are several obstacles and costs associated with the development and application of informatics technology. For health companies to successfully integrate health management with informatics, several challenges must be overcome.

Aim of this systematically review: To provide the current applications of Health management and informatics Applications in the healthcare management sector and their influence on informatics transformation, and to identify the opportunities presented by expanding informatics Applications adoption to improve healthcare management services in alignment with Vision 2030 in Saudi Arabia2024.

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Method: The study employs a systematic review approach to synthesize the literature on Health management and informatics Applications in healthcare, drawing insights from a wide range of sources including research articles, reports, and news articles.

Results: The usability and outcome of health management and informatics Applications on the Digital Transformation of Healthcare Delivery in Saudi Arabia Opportunities and Challenges in Alignment with Vision 2030. 7 articles were selected that compliant with the theme of this present systematic review (Table 1). Among the 7 reviewed articles, articles have explained the health management and informatics Applications on the Digital Transformation of Healthcare Delivery in Saudi Arabia.

Conclusion: Health management and informatics Applications hold immense potential to revolutionize healthcare delivery and public health initiatives, offering opportunities for enhanced efficiency, accuracy, and accessibility of healthcare services. Healthcare providers, technologists, and other stakeholders are essential to harness the full benefits of informatics Applications while addressing its challenges.

BACKGROUND:

The Kingdom of Saudi Arabia (KSA) has witnessed rapid digital transformation across sectors in recent years. This has been driven by the national Vision 2030 plan which aims to reduce dependence on oil revenues and transition towards a knowledge-based economy (1). The healthcare sector specifically has seen major reforms and adoption of advanced technologies like informatics Applications to improve services as part of the Vision 2030 human capital development goals (2). The Saudi government views informatics Applications and digital health as essential to increasing access, efficiency, and quality of healthcare under Vision 2030 (3)

Informatics Applications is having a growing impact on almost every aspect of health management, from research in real-world settings to clinical decision support at the point of care. However, there are several obstacles and costs associated with the development and application of Informatics Applications.(4) For health companies to successfully integrate Informatics Applications several challenges must be overcome. The challenges encompass the following: (1) inadequate comprehension of the potential benefits and constraints of particular Informatics Applications technologies; (2) unclear approaches for integrating diverse Informatics Applications into current health management to tackle the most pressing problems encountered by healthcare institutions; (3) a shortage of skilled personnel for Informatics Applications deployment; (4) incompatibility of Informatics Applications technologies with antiquated infrastructure; and (5) restricted availability of high-quality and varied medical data required for training health management Informatics Applications (5) Informatics Applications plays an important role in health-care systems, as it guides investments in Health management and informatics Applications and respects resource constraints (6). The public health sector in KSA is led and represented by the Ministry of Health. The Ministry of Health has concentrated on the National Vision 2030 to focus on a number of objectives to enhance the quality of medical care. These objectives concentrate on informatics Applications based health care and management of public health (7). Hence, Ministry of Health needs to set priorities to meet national and international Health management and informatics Applications, as well as funding research domains that match the priority informatics Applications. Who solve health problems in Health management therefore, it is very important for Ministry of Health to identify and declare their priorities. (8)

The Saudi government has promoted public-private partnerships to accelerate informatics applications in health management integration and the Health Ministry has worked closely with technology firms to incorporate informatics applications into health management care delivery (9). Informatics Applications have already been implemented for health management, administrative functions, diagnosis, and data analytics in major hospitals and clinics (10). These informatics applications in health management have increased efficiency and productivity in healthcare system in health management and leading to higher quality of care.(11) However, lack of informatics Applications skills among many healthcare professionals has inhibited wider adoption. Concerns about privacy and medical ethics with informatics Applications also persist (12). As Saudi Arabia embarks on this ambitious transformation, it prompts a crucial inquiry into the extent and impact of these health management reforms.(13) This question gains further importance when considered within the global context of health management evolution, where nations strive to balance between health management and informatics applications innovation with

accessibility and quality care.(14) The relevance of examining Saudi Arabia's health management and informatics applications journey extends beyond its borders, offering insights and lessons for countries pursuing similar health management and informatics applications transformations (13).

METHODOLOGY

Aim of the study:

To provide the current applications of Health management and informatics Applications in the healthcare management sector and their influence on informatics transformation, and to identify the opportunities presented by expanding informatics Applications adoption to improve healthcare management services in alignment with Vision 2030 in Saudi Arabia 2024.

Study design:

Systematic reviews using Online searching engines were using databases to identify relevant articles through the included electronic databases: Google Scholar, PubMed, and Saudi Digital Library (SDL), data extracted from published articles were systematically analyzed for determining the health management and informatics Applications on the Digital Transformation of Healthcare Delivery in Saudi Arabia Opportunities and Challenges in Alignment with Vision 2030 in Saudi Arabia 2024 .

Search strategy:

This systematic review follows the online searching engines were used to identify relevant articles through the included electronic databases: Google Scholar, PubMed, and Saudi Digital Library (SDL). The search terms used were health management , OR informatics Applications , OR Digital Transformation, OR Healthcare Delivery and Opportunities and Challenges , and Saudi Vision, OR Vision 2030. All searches were limited to the English language and to the year 2020 and after. The result of this search would be used to offer a thorough overview of the Strategies of Challenges and Advantages of Impact of the health management and informatics Applications in Saudi Arabia . The number of articles extracted for the research is evaluated based on Preferred Reporting Items for Systematic Reviews.

Searches and Data Sources

A comprehensive search was performed to obtain studies on the Challenges and Advantages of Implementation for health management and informatics Applications in Saudi Arabia. The databases used in the search included Pro Quest and Scopus, and the keywords used were 'Impact ', 'health management', 'Saudi Arabia' , 'Opportunities ' , 'Challenges' 'informatics Applications' . These keywords were used to find articles with matching terms in their abstracts or titles. To discover the most recent studies and literature on our review topic, the search was limited to articles published between 2020 and 2024.

Inclusion criteria

Studies were included if they met the following: Saudi articles, focusing on Impact of the Health management and informatics Applications on the Digital Transformation in Saudi Arabia, focusing on issues, Challenges and Advantages of Implementation in Saudi Arabia, informative and original research articles, published in the last recent 4 years, published in 2020 or after, and in English language.

Exclusion Criteria

Exclusion criteria were studies that not review of the abstract met the inclusion criteria, but on reading the full text were not in which the outcomes of health management and informatics Applications on the Digital Transformation but not opportunities and Challenges.

Data Extraction

As this review relies heavily on a prior systematic review that included online articles, the findings could be affected by selection bias. However, efforts were made to collect the necessary information for the appropriate review, explanation, and interpretation of the available literature. Studies were excluded if they investigated health management and informatics Applications on the Digital Transformation outside Saudi Arabia, review studies, studies were not directly related to health management and informatics Applications, and studies were excluded if they were published before 2020.

The process of selecting the articles, which are contained in this review .

Presents method used for selecting eligible studies for this review. In the first stage, Pro Quest and Scopus returned 240 articles. After duplicate articles and those published before 2020 were removed, 57 remained. Non-peer-reviewed articles (45) and articles not mainly about health management and informatics Applications Saudi Arabia, (32) were then excluded. After excluding studies with sample sizes under 80 and response rates under 60%, 7 articles were included in this review.

Table1: Summary of Impact of the Health management and informatics Applications on the Digital Transformation of Healthcare Delivery in Saudi Arabia Opportunities and Challenges in Alignment with Vision 2030 .

Author, Date, Country	Region	Study design	Study aim	Results
Moafa et al (2024) (15)	Saudi Arabia, Riyadh	systematic review	To provide a comprehensive overview of the role of artificial intelligence (AI) and machine learning (ML) in various domains, particularly healthcare, and its implications for international development and public health.	In the future, real-time data from the integration of AI with other technologies, such wearable's and the Internet of Things (IoT), could improve the predictability and accuracy of forecasts. By clarifying the underlying mechanics of predictions, explainable AI (XAI) solutions are also being developed to improve the accountability and transparency of AI-based illness forecasting systems. Another area with room to grow is personalized disease forecasting, which uses algorithms to examine data from electronic health records and other sources to anticipate a patient's likelihood of developing a particular disease and to inform treatment choices. Additionally, by combining geographic data with Geographic Information System (GIS) technology, disease forecasting can benefit from focused interventions that improve local-level predictions. **Conclusions** The integration of AI technologies into healthcare systems holds tremendous promise for revolutionizing patient care, improving efficiency, and reducing costs. Real-world applications such as IBM Watson's diagnostic capabilities and the use of AI assistants like Cortana and Alexa in hospitals demonstrate the tangible benefits of AI in augmenting medical staff and enhancing patient experiences. From predictive analytics for operational efficiency to virtual nursing assistants for patient support, AI-driven solutions are transforming every aspect of healthcare delivery.
Наливайко et al (2024) (16)	Ukraine	Adopts a theoretical review methodology	To analyze existing theoretical frameworks and practical experiences to develop strategies for effective digital tool integration in medical management education.	The integration of digital tools into the training of medical managers is not merely an adjunct to traditional educational methods but a fundamental shift necessitated by the evolving landscape of healthcare. The recommendations outlined in this study address critical areas that collectively enhance the preparedness

				of medical managers to lead in a digitally transformed healthcare environment. The inclusion of digital health content in curricula aligns educational programs with the realities of modern healthcare systems. By embedding courses on telemedicine, health informatics, and data analytics, educational institutions equip future medical managers with the knowledge to harness technology effectively. This alignment is crucial, as studies indicate a significant correlation between digital competency and organizational performance in healthcare settings. **Conclusions** Faculty development programs play a pivotal role in this process, equipping educators with the necessary skills to deliver high-quality digital education. Inter professional education fosters collaboration and communication skills essential for managing multidisciplinary teams in digital health projects. Blended learning models offer flexibility and cater to diverse learning preferences, making education more accessible to a broader range of students. Change management training prepares medical managers to navigate the complexities of organizational transformation, a frequent consequence of digital technology implementation.
Uraif, et al (2024) (17)	Saudi Arabia	Descriptive study	To explore the challenges and opportunities associated with developing healthcare infrastructure in Saudi Arabia through the implementation of smart technologies	In recent years, the concept of smart cities has gained global traction, driven by the increasing interest in employing technology to address urban challenges. Within this landscape, the healthcare domain stands out as a critical area where smart technologies can revolutionize patient care, accessibility, and overall efficiency. In this synthesis, we explore the challenges faced by healthcare systems worldwide and the transformative potential of smart technologies. Challenges in Healthcare Infrastructure Development, Limited Accessibility and Resource Constraints, Aging Healthcare Infrastructure, Health Data Volume and Security Concern Potential Solutions, Smart City Technologies, Resource Optimization and Efficiency, Patient-Centered Approaches. **Conclusions** By exploring the transformative impact of digital solutions, research studies and case reports highlight evidence-based practices. These practices demonstrate how smart technologies improve patient outcomes, operational efficiency, and resource

				utilization. Furthermore, understanding how Saudi Arabia aligns its national policies (such as Vision 2030) with healthcare technology adoption contributes to global discussions on policy formulation. Comparative analysis with the approach taken by other countries further enriches our understanding.
Alharbi, et al (2024) (18)	Saudi Arabia Qassim	systematic review	To investigate the efficacy and efficiency of e-health solutions in Saudi hospitals to enhance the resolution of interoperability issues;	Saudi Arabia's healthcare system is undergoing fast change, and the incorporation of e-health solutions is essential to this development. In line with the Vision 2030 endeavor, the Saudi government is proactively advocating for the integration of cutting-edge technologies to augment the caliber and availability of healthcare services. The integration of various E-health tools, such as telemedicine, electronic health records, and advanced health information systems, is part of this paradigm shift . The adoption of E-health solutions in Saudi healthcare is driven by a variety of factors, including the need to improve service quality, boost efficiency, and increase accessibility. With the help of these technical developments, isolated and underprivileged communities may now have access to healthcare services, removing geographical constraints, for example, computerized health records make it easier for healthcare practitioners to share data seamlessly, which encourages coordination and more individualized patient treatment **Conclusions** There are obstacles associated with integrating E-health technologies into Saudi hospitals; yet there is also a significant chance for improved healthcare quality. A roadmap for overcoming these obstacles and seizing opportunities is provided by the research. Saudi hospitals can maximize E-health integration for better healthcare outcomes by addressing the theoretical and practical aspects and putting the suggested techniques into practice. The sample size was limited so results could be generalized therefore; future researchers are required to conduct similar studies with larger sample sizes including more regions to build a powerful theory for knowledge and practice.
Alfahad, et al. (2024)(19)	Saudi Arabia	comprehensive review	The review examines the core objectives of Vision 2030 in healthcare, including infrastructure expansion, workforce development,	Vision 2030 has led to substantial improvements in Saudi Arabia's public health outcomes by advancing healthcare infrastructure, expanding workforce capacity, promoting preventive health, and

			digital health integration, and research advancements.	integrating digital technologies. These changes are contributing to better quality of care, increased healthcare access, improved health literacy, and a stronger focus on preventive measures. Below are some key impacts on public health outcomes. Vision 2030 has prioritized quality improvement across healthcare services, including training healthcare professionals, expanding specialized medical centers, and enhancing facility infrastructure. These efforts have raised the standard of care available in Saudi Arabia, with patient satisfaction levels improving as a result. National surveys show that healthcare users report greater satisfaction due to shorter wait times, access to specialized services, and more comfortable hospital environments. Additionally, the adoption of international healthcare quality standards has ensured that care quality meets global benchmarks, further enhancing patient trust in the healthcare system. **Conclusions** Saudi Vision 2030 represents a transformative effort to modernize Saudi Arabia's healthcare system, improve public health outcomes, and position the Kingdom as a leader in healthcare innovation. This comprehensive review has examined the vision's impact on healthcare infrastructure, workforce development, digital transformation, and preventive care, all of which contribute to enhanced quality of care, increased accessibility, and better public health outcomes. Vision 2030 initiatives have led to notable achievements, including increased hospital capacity, advancements in healthcare workforce training, widespread adoption of digital health technologies, and a focus on preventive health that has improved chronic disease management and public health awareness.

Limna, et al. (2023) (20)	Thailand	Systematic review to analyze the data.	To assess the existing literature regarding the digital transformation of healthcare in the digital economy.	The digital economy has created new opportunities for innovation and growth in the healthcare industry, and the adoption of digital technologies has become increasingly important for healthcare providers and administrators to remain competitive and provide high-quality care. In addition, the digital transformation of healthcare in the digital economy refers to the use of digital technologies to improve the quality, accessibility and efficiency of healthcare services. This includes the use of telemedicine, electronic health records, wearable devices, mobile health applications, and other digital tools that enable healthcare providers to deliver care remotely and in real-time. The decreasing costs of manufacturing microscopic sensors and the availability of cloud computing have made it possible for Internet of Things (IoT) technologies to revolutionize healthcare. **Conclusions** The digital transformation of healthcare in the digital economy is a crucial area of research and development that can improve the quality of healthcare services and enhance patient outcomes. The existing literature on this topic
				Demonstrates the potential benefits of digital technologies in healthcare, including telemedicine, catboats, and mobile applications. Furthermore, healthcare in the digital economy is expected to undergo significant changes in the future. While total eradication of illness and disease is unlikely, a digital-first approach will make it easier for healthcare providers to prioritize preventive care, coordinate care across diverse teams and regions, and deliver services in a way that is convenient and personalized for each patient.
Dionisio, et al (2023) (21)	Covers many different countries	A Systematic review	To understand how digital transformation is translated into practice,	Considering the quick evolution of these technologies and its massive adoption, the current literature is still incipient on how innovations are translated into practice, with limited empirical evidence of its effectiveness, problems, and applications in digital healthcare. In fact, despite a considerably growing body of research literature on the use of new technologies in healthcare there is no systematic analysis on the practice of DT in healthcare

				systems. We believe that a literature review to fill this gap is important and pertinent, especially through the lens of applications, benefits, opportunities, and threats to analyze the status of these implementations and its impact in healthcare systems. We chose to perform a systematic literature review because it is a methodology that reviews previous literature and bring the field together, with rigor, concision, and minimal room for subjectivity, offering transparency in data collection and results with a higher level of objectivity and reproducibility **Conclusions** To identify how studies on the impact of digital transformation in the healthcare industry have evolved and what are the main applications, benefits, opportunities, and threats identified in this context. The bibliometric analysis showed the growth of articles on this subject, demonstrating the newness of this subject and its growing importance in theory and practice. We were also able to observe that the literature is very broad and covers many different countries.

RESULTS AND DISCUSSION

The usability and outcome of health management and informatics Applications on the Digital Transformation of Healthcare Delivery in Saudi Arabia Opportunities and Challenges in Alignment with Vision 2030 . 7 articles were selected that compliant with the theme of this present systematic review (Table 1). Among the 7 reviewed articles, articles have explained the health management and informatics Applications on the Digital Transformation of Healthcare Delivery in Saudi Arabia; articles assess the prospective role of in achieving Vision 2030 goals in the healthcare system. Different health insurances system was explained in different articles, articles highlight the strengths and weaknesses of health management and informatics Applications on the Digital Transformation of Healthcare Delivery. Finally, articles have provided recommendations for Saudi health management and informatics Applications on the Digital Transformation of Healthcare Delivery.

Vision 2030 has catalyzed a transformative leap in the healthcare sector of Saudi Arabia through targeted investments and forward-looking strategies (22). This initiative has not only led to the expansion of healthcare infrastructure but also introduced Health management and informatics Applications on the Digital Transformation of Healthcare Delivery. In order to close this Challenges gap, medical personnel and patients must effectively communicate while reassuring people of the advantages of health management and informatics Applications on the digital Transformation in improving care delivery and results. In the age of Digital Transformation, cyber security issues are also quite important, especially when it comes to data security and privacy (23). Because health management and informatics systems rely on large datasets, data collecting and sharing privacy concerns are brought up. To reduce barriers to research, confidentiality laws and regulations must be followed (24) To protect individual rights and social values, Digital Transformation of Healthcare Delivery technology decision-making procedures also need to take ethical, legal, and moral factors into account.(19)

Traditional ideas of managerial control and healthcare delivery methods are also under threat from the introduction of health management and informatics Applications in the field (25). The healthcare industry is moving toward more integrated, patient-centric care models as a result of Digital Transformation time and place (26). In order to enhance patient outcomes, this transformation requires a shift away from traditional bureaucratic governance structures and toward dynamic, networked care delivery systems that make use of Digital Transformation technologies and interdisciplinary skills. Additional important factors to consider are worries about Digital Transformation replacing jobs and the necessity of worker education and training (27). Digital Transformation may make some employment obsolete, but it also opens up new career prospects for competent workers

in support, development, and implementation roles (28). Professionals need to be equipped with the skills necessary to navigate the Digital Transformation healthcare landscape. Companies like Amazon and educational institutions like medical schools have launched effective workforce training programs that do just that (29). Additionally, the potential for Digital Transformation to strengthen patient-provider relationships highlights the significance of integrating Digital Transformation technology and teaching into medical school curricula (30)

Cooperation projects, like data sharing programs and federated learning, are viable ways to protect patient privacy while optimizing the advantages of health management and informatics Applications insights (22). The healthcare sector may leverage artificial intelligence Digital Transformation to enhance patient outcomes and promote public health by following regulatory frameworks, encouraging interdisciplinary collaboration, and advocating for ethical health management and informatics Applications.

The emergence of cutting-edge facilities underscores a strategic pivot from quantity to quality, aiming to establish a healthcare model that is sustainable and adaptable to the evolving needs of the population (31) This strategic shift highlights a commitment to not merely expanding the healthcare network but significantly enhancing the quality of care, patient satisfaction, and system efficiency through Health management and informatics Applications on the Digital Transformation of healthcare Delivery in Alignment with Vision 2030.(2)

Central to this transformative is the emphasis on leveraging technology and innovation to increase healthcare capacity (7) Smart hospitals equipped with the latest medical technologies and digital systems are being established to improve healthcare delivery and patient outcomes (24). These futuristic facilities are designed to facilitate seamless patient experiences, from in Alignment with Vision 2030 to remote monitoring, ensuring that healthcare services are more accessible and efficient (15).

CONCLUSION

The existing literature on this topic demonstrates the potential benefits of digital technologies in healthcare, including health management and informatics Applications, telemedicine, and mobile applications. Furthermore, healthcare in the digital economy is expected to undergo significant changes in the future. While total eradication of illness and disease is unlikely, a digital-first approach will make it easier for healthcare providers to prioritize preventive care, coordinate care across diverse teams and regions, and deliver services in a way that is convenient and personalized for each patient. Thus, there is a constant need for a commitment to the advancement of technology that improves patients' lives and delivers care in ways that align with their needs and preferences, making it a critical priority for healthcare systems. However, it is critical to note that there are also challenges that must be addressed.

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