

"Advancement of Telehealth Services in Saudi Arabia: A Comprehensive Review"

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Abstract

Telehealth has now become a critical component in healthcare delivery globally, most especially in Saudi Arabia in alignment with the Vision 2030 initiative. Incorporation of telehealth services into the Saudi healthcare delivery system will improve access to healthcare, reduce in-person visits, and enhance patient care, especially in remote and underserved areas. Although telehealth services in Saudi Arabia were successful during the COVID-19 pandemic, there are various barriers to its widespread adoption, which include technical barriers, lack of face-to-face interaction, and cultural perceptions. The main purpose of this review is to analyze the current status of telehealth in Saudi Arabia, key challenges, and future potential in the context of emerging technologies that can facilitate telehealth services in the country. Methodologically, the review synthesized recent literature from 2019-2024 on telehealth adoption, technological advancement, and cultural perception. The outcome shows that good digital infrastructure, enhanced training programs, and proper regulatory frameworks need to be built for the successful implementation and use of telehealth services by the general population. Moreover, Saudi Arabia is majorly investing in its infrastructure, AI, and newer technologies, including RPM, VR, and blockchain, for achieving the goals of Vision 2030, which would further advance the telehealth services of the country.

Keywords: Telemedicine, Artificial Intelligence, Healthcare quality, healthcare reforms, Electronic Medical Records, Blockchain, Delivery of Healthcare, Remote Patient Monitoring.

Introduction

Telehealth is defined as the use of digital information and communication technologies to access health care services when the patient and provider are not in the same physical location (Al Baalharith et al., 2022). In Saudi Arabia, telehealth has reshaped the national healthcare landscape, aligning with the strategic goals of Vision 2030. This ambitious framework seeks to modernize the healthcare sector, improve societal well-being, and reduce economic reliance on oil and other "high carbon" products (Almutairi et al., 2023). A significant milestone in this transformation is the integration of telehealth technologies, exemplified by projects such as the Seha Virtual Hospital. This state-of-the-art platform facilitates remote consultations and treatments, thereby enhancing access to healthcare services, primarily in rural and underserved areas, and promoting equity in service delivery (Alghamdi et al., 2022).

The development of telehealth in Saudi Arabia is an evolutionary journey that has been influenced by both global trends in healthcare and local needs. Telehealth has evolved as an important response to healthcare disparities in access, particularly within a country characterized by extensive geographical spread and rural underserved populations (Almutairi et al., 2023). The COVID-19 pandemic has greatly catalyzed the introduction of these telemedicine applications, namely the SEHA application and the 937 telehealth service, for remote care to be adopted as part of the core of the healthcare system (Al-Rayes et al., 2021; Al Baalharith et al., 2022). The Saudi Vision 2030 framework also supported integrating telehealth into the health system of the

nation, calling for digital transformation and more patient-centered care. The initiatives under this framework aim to enhance healthcare accessibility, reduce costs, and improve the quality of services provided (Alghamdi et al., 2022).

The COVID-19 pandemic further broadened the reach of telehealth, transforming it from an optional service to a critical component of healthcare delivery. The crisis highlighted the importance of adaptable healthcare systems capable of functioning in emergency modes. Consequently, both public and private sectors have made considerable investments in telemedicine infrastructure, supporting the worldwide transition towards future digital-first healthcare solutions (Mani & Goniewicz, 2024). Despite these advancements, telehealth implementation in Saudi Arabia continues to face challenges. Infrastructure gaps, digital literacy issues, and varying levels of public trust across regions remain significant barriers to widespread adoption (Alanazi et al., 2023). Addressing these challenges is crucial for telehealth to fulfill its potential as a tool for bridging service gaps and improving patient outcomes.

The rapid development of telehealth in Saudi Arabia, backed by the Vision 2030 initiative, presents immense opportunities for improving access, efficiency, and quality in healthcare (Alghamdi et al., 2020). Despite efforts from the government to improve digital infrastructure and integrate advanced technologies, uneven connectivity, technological literacy gaps among healthcare providers and patients, regulatory barriers, and integration difficulties with existing healthcare systems persist (Uraif, 2024). Cultural attitudes toward remote healthcare, and also the need for continuous education, have become another form of hindrance to the broad adoption of telehealth services (Abozenadah, 2024; Bendary & Rajadurai, 2024; Masmali, 2023).

This review has identified some of these main barriers in the context of emergent trends and innovations including AI, RPM, smart cities, VR/AR, blockchain, and genomic medicine that are driving the future of telehealth in Saudi Arabia. The research gap here lies in a comprehensive understanding of how these technologies can effectively answer the challenges and facilitate smooth integration into the healthcare system. This review aims to analyze the current status of telehealth in Saudi Arabia, outline challenges, and examine the possible roles of new emerging technologies in changing the health sector to eventually support national digital transformation objectives.

The significance of this review stems from it presents a comprehensive view of the state of telehealth in Saudi Arabia analyzing the challenges, opportunities, and future trends set in the context of the country's Vision 2030. It has identified issues concerning gaps in infrastructure, technological literacy, the regulatory framework, and the cultural perception that inhibit the adoption of telehealth services. It also discusses the possibility of overcoming these challenges with emerging technologies such as AI, RPM, VR, and blockchain. The findings from this review contribute to strategies that can drive the integration of telehealth into the Saudi healthcare system in a sustainable manner, accessible, and aligned with the broader goals of digital transformation and healthcare innovation.

Methodology

Search Strategy

In this review, the authors utilized previous 6-year articles that were published in peer-reviewed journals. Data was searched on widely used databases such as PubMed, Scopus, and Google Scholar. Time frame filters were then applied to improve the review. To conduct this review on telehealth development in Saudi Arabia, its relationship with Vision 2030, challenges encountered, and future innovations, data was collected with a specific focus on publications released between 2019 and 2024. The search also included official government websites, for instance, the Ministry of Health, and the international organization's reports from the World Health Organization (WHO). This approach offered a solid platform to better understand the developments, barriers, and anticipatory direction of telehealth in Saudi Arabia. As indicated in Table 1 below, the authors chose particular search approaches to obtain the data.

Table 1: Search Keywords

S. No.	Search Keywords
1.	("Telehealth in Saudi Arabia") AND ("Telehealth and Vision 2030") AND ("challenges of telemedicine in Saudi Arabia") AND ("government initiatives in digital health") AND ("Saudi Arabia's future trends in telehealth")
2.	("digital transformation in healthcare in Saudi Arabia") AND ("Regulatory barriers in telehealth") OR ("Legal frameworks for telemedicine") AND ("Cultural attitudes toward telehealth") OR ("Family involvement in healthcare decisions") AND ("Privacy sensitivities in telehealth consultations") AND ("Telehealth integration with EMR systems")
3.	("Telehealth training programs") AND ("Telehealth training for healthcare workers") OR ("Technical skills for healthcare workers") OR ("Lack of patient technical knowledge") OR ("Technological literacy in telehealth users") AND ("Artificial intelligence in telehealth") AND ("Virtual reality (VR) in telemedicine") OR ("augmented reality (AR) in telemedicine") AND ("Blockchain in telehealth")

	AND (“Personalized medicine in telehealth”) AND (“Smart cities and telemedicine”)
4.	(“Privacy concerns in telemedicine”) AND (“Data protection in telemedicine”) AND (“SEHA application effectiveness”) AND (“Sehhaty application user satisfaction”) AND (“Future trends in telehealth in Saudi Arabia”) AND (“AI-powered telehealth tools”) AND (“Telehealth-enabled smart homes”) AND (“Genomic integration in telemedicine”)

Selection Criteria

Table 2 represents the inclusion and exclusion criteria of the studies that were utilized to review, focusing on the Advancement of Telehealth Services in Saudi Arabia.

Table 2: Inclusion and Exclusion Criteria (Source: Author)

Inclusion Criteria	Exclusion Criteria
Studies that were published in journals with peer-reviewing policies provided by the publishers were included.	Studies that were published in journals with peer-reviewing policies not provided by the publishers were excluded.
The studies included in the review were selected based on the keywords telehealth development in Saudi Arabia, challenges of telemedicine in Saudi Arabia, and Saudi Arabia's future trends in telehealth.	The studies did not have a specific keyword telehealth development in Saudi Arabia, challenges of telemedicine in Saudi Arabia, and Saudi Arabia's future trends in telehealth were excluded from the review.
The studies published in the last 6 years from 2019 to 2024 were included in this review.	The studies performed or papers published before 2019 were excluded.
Only studies that were accessible in full-text format for the public view were included.	Studies not accessible in open access format in any authorized database were excluded.

Data Analysis

12 studies were selected based on their titles, publishers, and main objective of the review aligned with the current study's rationale. The analysis of the obtained data from the 12 articles was conducted using thematic analysis as presented in the discussion. The data was obtained by utilizing recurrent keywords in the paper such as telehealth development in Saudi Arabia, challenges of telemedicine in Saudi Arabia, and Saudi Arabia's future trends in telehealth.

Discussion

Evolution of Telehealth in Saudi Arabia: Early Challenges to Strategic Advancement

The history of telehealth in Saudi Arabia illustrates the country's foresight and use of technology to evolve its healthcare system. The first attempts to implement telehealth were based on the idea of long distances between centers with urban health services and people living remotely. The large geographic spread of the country created major access problems that would give rise to the early use of technology to help solve these issues (Nelson, 2017).

Initially, the use of telehealth was limited and confined to a few fundamental areas. It included teleconsultations and basic telemedicine services in some specific government hospitals and health centers (Alanazi et al., 2023). During the period of establishment, incremental advances were made with the support of the Saudi Ministry of Health (MOH) which sought to bring basic care to rural areas. Yet, this was limited by technology and unstable internet access (Almojaibel, 2024). This changed with the launch of Vision 2030, a national vision for transformational and modernization progress through digitalization across various sectors including healthcare. This policy facilitated the transition to a stronger, more organized telehealth system.

The launch of initiatives such as the Seha Virtual Hospital signifies a new paradigm in telehealth, bridging high-tech capacity with public health demand (Sheerah et al., 2024). It was a tremendous upgrade to enable the full package of remote medical services including consultations, diagnostics, and treatment on this world-class platform. This time also highlighted the potential of telehealth, resetting what we define as a supplementary versus essential service (Aldekhyyel et al., 2024).

However, the journey towards widespread adoption of telehealth in Saudi Arabia has not been a smooth one. Digital literacy, resistance from healthcare providers and patients alike, and the lack of requisite technological infrastructure have been major obstacles. However, over these years and through trial and error while adjusting the policies regularly, such challenges have been addressed successfully making Saudi Arabia one of the frontiers in Telehealth services in the Middle East (Ahmed, 2021). From the brief historical development of telehealth in the Kingdom, it can be observed that there was a growth response from previously focused on immediate health needs to a long-term strategic direction towards leveraging technology for improved public health outcomes (Alasiri & Mohammed, 2022).

The Current State of Telehealth Services in Saudi Arabia

During recent years, Saudi Arabia has witnessed fast growth in telehealth as supported by improving digital infrastructure and a sudden growth in demand for remote healthcare services that has considerably accelerated in the COVID-19 period (Al Mutair et al., 2023). The expansion can be said to be part of the transition currently

carried out by Saudi Arabia with considerable involvement of the Saudi MOH. These different digital platforms such as "Sehhaty" and "Mawid" offer the option of accessing health services (habbash saleh Almansour & Almansour, 2024). There is the feature of virtual consultations, making appointment scheduling and prescription management easier while tracking chronic diseases. For example, people who reside in remote locations could access these healthcare facilities from the comfort of their homes since healthcare facilities might be distant from them physically (Sheerah et al., 2024). Telehealth improved accessibility for patients and also reduced pressure on hospitals and clinics since it allowed remote handling of non-urgent consultations and checkups. The development of telehealth services in Saudi Arabia has been highly expedited by the COVID-19 pandemic and the government's Vision 2030 initiative. These include telehealth services provided through platforms such as Sehhaty, Mawid, and Seha, besides 937 telephone health services. Public use of these services increased as the pandemic progressed, but its utilization is reflected more evidently in the 937 services (Alotaibi et al., 2023). Generally, providers expressed moderate to high levels of preparedness for telehealth, however, they found it challenging in many regards with limitations placed on financial support and their time (Moussa et al., 2023). Patients have responded quite positively to telehealth service delivery, and several described it as an excellent way to fulfill non-acute healthcare needs (Alotaibi et al., 2023). However, challenges such as connectivity problems and an enduring preference for in-person consultations stand as a barrier to the more universal use of telehealth. These factors have made it imperative that more work be done on improving the infrastructure, training, and educating patients on the true benefits of telehealth (Brown, 2024).

Technological Infrastructure and Digital Integration

With the push for strong tech infrastructure and digital ecosystems, Saudi Arabia has made this a key aspect of Vision 2030 to transform the Kingdom from an oil economy to more of a knowledge-based economy. The Information and Communications Technology (ICT) sector of Saudi Arabia has progressed rapidly with investments in innovative networking technology especially the nationwide deployment of 5G which provides very high-speed connectivity for sophisticated applications such as the Internet of Things (IoT), Artificial Intelligence (AI), and smart city projects. Infrastructure investments, for example, find an idealistic epitome in the planned city of NEOM - a digital-first smart city developed to ensure that "the city's core environment is fused with technology" (Alharbi et al., 2021).

Across the sectors, especially healthcare which is being powered with telehealth and telemedicine services owing to the digital feel integrated in the country. Platforms such as Seha and the 937-Call Center have enabled remote consultations, and provision of comprehensive patient engagement in Saudi Arabia's healthcare system. During the COVID-19 pandemic, these services were a critical component of minimizing disruption to healthcare as individuals practiced social distancing. At the heart of successful telehealth are interoperable data systems that enable secure and efficient access by medical professionals to patient records which, in turn, facilitate quicker diagnostics and treatment (Al-Wathinani et al., 2024).

In addition, Saudi data centers and cloud infrastructure play an important role in their digital landscape. The facilities are well-equipped to process and analyze copious amounts of data as well as support large applications. Cloud computing has allowed businesses and public services to scale their operations much more flexibly whilst ensuring that their data remains accessible as the digital economy turns global. Its collaborations with tech behemoths are here to make its architecture stronger and withstand the test of time (Almutairi et al., 2023).

At the same time, cyber security has also been a strategic priority to ensure that this critical umbrella of infrastructure maintains its credibility and integrity. With rapid digitization comes the inevitable fears around the security and privacy of data. While the Kingdom is rapidly expanding its digital ecosystem, strong cybersecurity frameworks have been established to help secure trust and safety in the provision of digital services (Garcia-Perez et al., 2023). Such a combination of actions has enabled Saudi Arabia to take the front seat in the digital transformation in the Middle East and establish an ecosystem wherein the habilitation of newer technologies is possible in the public as well as private sectors.

This comprehensive strategy highlights the determination of Saudi Arabia to not only modernize its physical infrastructure but also embrace state-of-the-art digital technologies that are in line with a sustainable and diversified future economy.

Government Initiatives and Vision 2030

Consistent with Vision 2030, Saudi Arabia has initiated various governmental programs and projects to improve telehealth and digital health services. A key aspect of Vision 2030, the overarching plan meant to shake up how the country runs itself both economically and socially, is modernizing healthcare. The need for strong digital transformation across sectors is highlighted in the plan to ensure effective service delivery, low-cost efficiency, and accessibility (Almutairi et al., 2023).

Telemedicine and remote healthcare availability is a key part of Vision 2030 Agenda where access to healthcare services is improved upon. The government has launched national platforms, such as the nationwide Seha app and 937-Call Center to provide remote consultations and facilitate patient care. This came during the COVID-19

pandemic, where services such as these played a vital part in enabling medical consultations to be held with minimal physical contact between parties. This adaptation proved not only the large scalability of telehealth but also supported its potential permanency in Saudi Arabia's health landscape (Sheerah et al., 2024). The Saudi Ministry of Health has collaborated with local and foreign technology companies to develop digital infrastructure and incorporate telehealth services into the public health system. As a part of their strategy, the government has invested in cloud computing by providing high-speed internet and data management systems that ensure secure telemedicine practices. Under the NTP, which is viewed as a sub-component of Vision 2030 and aims to build/improve health information systems, there are specific initiatives directed at integrating healthcare providers using unified electronic medical records (Almutairi et al., 2023).

The government has also imposed rigid laws to safeguard data and monitor patient privacy in telemedicine. This emphasis on cybersecurity is important to gain patient and provider confidence so telehealth can be more widely utilized in medical practice. A structure for this transition into a digital format has been set with the introduction of dedicated guidelines on telehealth from the Saudi Health Council and efficient implementation into best practices worldwide (Crisera et al., 2024). The growth of telehealth under Vision 2030 is not only about convenience but also tied to larger public health outcomes as related to less-than-optimal healthcare costs. Telehealth services within mainstream healthcare, the Saudi government made sure that even distant rural communities are covered in terms of keeping quality medical procedures within their reach. Such a sustainable and resilient healthcare approach has been reflected in the vision.

Challenges Encountered in Telehealth Expansion

With all these developments, several challenges have been encountered which telehealth needs to overcome for its sustained prosperity. The first is the issue of the digital divide since not all regions in the country, especially in the rural and underserved regions, have consistent access to high-speed internet or have enough digital devices to make use of telehealth. According to recent research, although the cities are highly connected, there are still areas in the countryside where connectivity is not at a good level, thus telemedicine may not be available to them (Haleem et al., 2021). The quality of care in telehealth also is a problem since some conditions require a physical examination or an evaluation that can only be done in person. Providers are also worried that a misdiagnosis or incomplete care may happen in a virtual setting (Almutairi et al., 2023).

Additionally, the aspect of data privacy and security is a huge concern as telehealth solutions handle the collection and exchange of confidential patient information. The Saudi government has implemented laws such as the Personal Data Protection Law that address patient data security, but efforts need to be made to catch up with the pace at which technological innovation is taking place in the health sector (Al-Muhtadi et al., 2019). To address the issues mentioned above, the Saudi government is investing through Vision 2030 into upgrading digital infrastructure, expanding internet services into rural areas, and developing advanced technologies such as AI and remote monitoring devices for telehealth systems. These efforts look forward to improving the quality, efficiency, and accessibility of telehealth services to position them as an integral component of the Saudi healthcare system in the future (Alghamdi et al., 2022).

Challenges in Connectivity and Infrastructure

Saudi Arabia certainly spent its share on broadband internet and digital devices but access to the latter was hardly uniform across the entire country, especially in remote or isolated areas. The next step is ensuring reliable and fast internet, which is indispensable for providing seamless telehealth services, from high-speed video consultations to real-time data transfer. While urban 5G networks are being developed, deployment to outlying areas is lagging behind, creating a speed gap that fosters digital inequities that limit telehealth utilization and continuity of care (Alharbi, 2023).

Telehealth services in Saudi Arabia face major connectivity and infrastructural challenges, mostly concerning rural and remote areas. Large geographical size often presents this country with limited broadband access, especially within non-populated areas. Consequently, this limits telehealth services (Alghamdi et al., 2022). Moreover, the limited integration of technology in health care services, for example, the linkage between telehealth platforms and existing EMR systems, is a weakness in operational efficiency (Alaboudi et al., 2016). Furthermore, the literacy of technology on both the provider's and recipients' sides remains a factor that constrains the adaptation and effective integration of telehealth services leading to quickening these problems. These two, in correlation with the cultural resistance in addition to the complexities inherent in incorporating telehealth technologies, create a pressing mandate for full-scale solutions into addressing deficiencies in infrastructure and connectivity deficits in delivering telehealth services widely across the country.

Training in Technical Literacy

Albarrak et al. (2019) carried out a study that reported that although healthcare providers are aware of the benefits of telemedicine, 77% of them felt a need for continuous training to enhance the use of these technologies. The major barriers reported included issues of privacy, high costs of equipment, and lack of IT training (Albarrak et al., 2021). Experts have encouraged the inclusion of telehealth in the nursing curricula in Saudi Arabia, considering the need to increase the technical skills of health professionals. According to Al Baalharith et al. (2022), it is necessary to incorporate telehealth training and reskilling into educational

programs to be responsive to the changing health industry needs (Al Baalharith et al., 2022). Different challenges mentioned by Jeddah-based primary care physicians are mainly the minimal patient technical literacy and minimal access to technological facilities to implement telehealth services adequately (Al Baalharith et al., 2022).

Among the physical therapists, 62.1% reported lacking prior training in telehealth, although they expressed a willingness to adopt these technologies in future practice (Almutairi, 2023). Similarly, patients face challenges due to limited technical knowledge, which acts as a barrier to their use of telehealth platforms. A study conducted regarding the Sehhaty application reported high consumer satisfaction but required easy usability interfaces and patient education that would promote engagement (Dawood & Alkadi, 2022).

Regulatory and Legal Barriers

Regulatory and legal barriers continue to impede the expansion of telehealth services as creating regulations that explicitly define telehealth practices, data privacy, and patient consent is a continuous ongoing progress. Although Saudi Arabia has registered some significant developments in this regard, for instance, its telehealth guidelines on how to improve cyber security and protect patient data, it is still the speedily changing digital arena that forms a major issue. This fast-paced environment will not be easy for the health care providers because it necessitates them to always adapt to the changed requirements concerning the technological and legal front (Alghamdi et al., 2020).

Perhaps, the most significant factor acting as a hindrance to telehealth services spreading widely is the fact that standardized legal regulations do not exist. Findings based on studies show the challenge related to the aspect of patients' confidentiality and security of data and also related to liability in law and worsened by specific legislation on telemedicine issues that are not present. Research suggests that there needs to be an all-around legal structure that can deal with all the different aspects related to telehealth and value the cultural, religious as well as legal complexities related to Saudi Arabia (Alhabter et al., 2023). There are two other critical issues, which are data privacy and cybersecurity. Telehealth services must comply with strict standards so that any patient information shared remains confidential. However, legal scope uncertainties often lead to hesitation on the part of healthcare providers to fully embrace telehealth technologies (Wenhua et al., 2024). Furthermore, the training and licensing requirements for healthcare providers in telehealth practices are a major challenge.

The regulatory environment is unclear about whether telehealth requires specific or additional credentials for practitioners, leading to confusion about compliance obligations. Studies indicate that inadequate training is another reason for the reduced application of telehealth, and various healthcare professionals reported a requirement for more explicit regulatory support (Almutairi, 2023). Lastly, Saudi regulation has failed to properly cover reimbursement policies and financial incentives for telehealth services. Policymakers often identify the lack of sustainable funding models as one of the major obstacles to implementing telehealth. These funding models must be in harmony with the overall objectives and economic constraints of the healthcare system (Wenhua et al., 2024).

Working with Current Healthcare Systems

Another challenge lies in the integration of telehealth into traditional brick-and-mortar healthcare facilities. Telemedicine is not merely an additional service but requires a fundamental shift in the workflow as many healthcare institutions are designed to accommodate face-to-face care. Significant resources and funds must be allocated to restructuring these systems to accommodate telehealth. This process is further complicated by the compatibility issues between new telehealth platforms and the electronic medical record (EMR) systems already in use. For telehealth to function effectively, it cannot operate in isolation, it must interact with other healthcare services and databases to enable comprehensive patient data exchange across the care spectrum (Almutairi et al., 2023).

The SEHA application, developed by the MOH, has been critical in the COVID-19 pandemic by making access easier and reducing physical contact. However, technical issues and lack of direct doctor-patient contact have been cited as major drawbacks (Alomari & Jenkins, 2021). There was a high satisfaction level for patients with telehealth services, according to the survey conducted in Saudi Arabia, where 82.7% of patients were contented with telemedicine consultations, highlighting ease of access and time savings as the main advantages. However, there is still a factor impacting the overall experience of patients in terms of lack of personal contact and persistent technological challenges (Alotaibi et al., 2023). Several areas need further attention for the successful integration of telehealth into Saudi Arabia's healthcare system.

For telehealth to be properly integrated into the healthcare system of Saudi Arabia, some aspects require more attention. Firstly, there is a need for comprehensive training programs both for healthcare providers and patients so that knowledge gaps can be addressed and telehealth services be better adopted (Alghamdi et al., 2020). Secondly, proper digital infrastructure development, particularly in rural areas, will help to make telehealth accessible equitably (Alshammari, 2019). Finally, integration of telehealth platforms with existing electronic medical record (EMR) systems should be established in a way that optimizes the workflow process and improves service delivery.

Cultural and Social Factors

The speed of telehealth adoption also partly reflects cultural attitudes toward remote healthcare. Others in the industry believe that some patients and providers still prefer to see each other in person as it is considered more effective or more trustworthy. These perceptions need to be addressed through ongoing public education so that potential telehealth clients can have the same confidence in the quality and reliability of their telehealth services (Alharbi et al., 2021).

The cultural landscape of Saudi Arabia, surrounded by Islamic traditions and extended family, is deeply influencing the practice of telehealth. According to research, patients are inclined to seek face-to-face encounters with their healthcare providers. It can be ascribed to a culture that holds a strong belief in trusting people and relationships. Many people are uncertain about telehealth as there is no face-to-face communication between them and their doctors (Alshammari, 2019). In Saudi society, healthcare decisions often involve the participation of the family. Most patients depend on relatives when it comes to health matters that might either promote or constrain telehealth adoption, contingent on their views and technology savviness. Numerous studies related to telehealth in home care settings reported problems with communication and trust that resulted from indirect interactions, with a suggestion that models must include roles of family (Alodhayani et al., 2021).

There are concerns over privacy and data security, and cultural issues that arise from the use of cameras during consultations have emerged as a common problem. There is a view among patients and their caregivers that telehealth is intrusive or compromising to privacy, reflective of broader apprehensions in society about digital communication (Alodhayani et al., 2021).

Future Trends and Innovations in Telehealth

Rapid developments and adoption of high technologies targeted towards improving outcomes for patients and healthcare delivery will define the prospects of telehealth in Saudi Arabia. The telemedicine landscape is anticipated to be shaped by a number of trends and innovations as the nation continues to align its strategies with Vision 2030.

By automating procedures, enhancing diagnostics, and customizing patient care, the combination of AI and machine learning is expected to significantly transform telehealth services. With more efficient analysis of patient data, machine learning algorithms are likely to support predictive analytics, allowing for the detection of diseases earlier in life and the formulation of better treatment strategies. AI-powered tools that assist physicians in making better decisions during virtual consultations are being investigated by the Saudi Ministry of Health and other organizations (Alhur et al., 2023).

Remote Patient Monitoring (RPM) expansion

Adoption of RPM devices is expected to increase, particularly for chronic conditions like diabetes and cardiovascular diseases, which require tracking real-time health metrics. These technologies enable the monitoring of patient's health outside the limitations of conventional clinical settings in line with Saudi Arabia's objectives of minimizing hospital stays and maximizing healthcare resources. The incorporation of wearable technology, and smartphone apps for monitoring vital signs, will further improve the procedures of RPM. This is a more effective method of patient care (Al Muallem et al., 2015).

Smart Cities and Telehealth

It is anticipated that the growth of smart cities like NEOM will produce an ecosystem in which telehealth services are smoothly incorporated into urban life. Telehealth-enabled smart homes will make it easier to share health data, conduct remote monitoring, and have in-home medical consultations. In line with Saudi Arabia's goal of developing a sustainable, digitally driven urban environment, this integration will facilitate a more integrated and effective healthcare system (Mufleh et al., 2024).

Virtual reality (VR) and augmented reality (AR)

Advanced technologies such as VR and AR are set to make telehealth experiences more immersive with medical consultations and simulation-based training for healthcare professionals. AR, for example, can help surgeons perform remote procedures by superimposing important information in their field of vision. Additionally, these technologies can be utilized to educate patients by offering interactive instructions on medical procedures and treatments (Dinh et al., 2023).

Blockchain for Interoperability and Data Security

Some of the issues telehealth faces with data privacy and interoperability may be resolved with the use of blockchain technology. By offering transparent health records that are impervious to unwanted access, blockchain's decentralized architecture promotes trust and guarantees safe patient data management. As a result, telehealth will be easier to incorporate into larger healthcare networks (Almutairi et al., 2023).

Genomic Integration and Personalized Medicine

In Saudi Arabia, telehealth is also heading toward personalized medicine, in which each patient receives a customized course of treatment based on their genetic information and other unique data. By integrating telehealth into genetic research and individualized treatment plans, medical professionals can provide more efficient, tailored medical advice via online platforms (Aldekhyyel et al., 2024; Almutairi et al., 2023).

Conclusions

Telehealth is to significantly and in concert with Vision 2030 reshape the face of healthcare in Saudi Arabia, despite challenges still facing issues like connectivity, low levels of literacy with respect to technology use, and regulatory barriers. The country is investing in infrastructure, AI, and newer technologies, including RPM, VR, and blockchain, which would further advance its potential. These technological breakthroughs bring an inclusive, efficient, and patient-centered healthcare future for a health system that puts Saudi Arabia well for an economically and technologically sustainable healthcare future.

Limitations and Future Implications

Although the review provides insights into telehealth in Saudi Arabia, it is limited to several aspects such as lack of focus on specific challenges within the rural areas, the influence of socioeconomic factors on adoption, and lack of in-depth analysis on regulatory and ethical issues of widespread telehealth use. The future of telehealth in Saudi Arabia is promising, driven by advancements in AI, machine learning, RPM, and emerging technologies such as VR and blockchain. These innovations enhance diagnostics and disease management. Thus optimizing healthcare delivery, especially in smart cities such as NEOM. Nonetheless, it also faces some challenges such as rural connectivity, technological literacy, and regulatory barriers. Telehealth will be a significant tool in the achievement of healthcare goals under Vision 2030, with continued investment and integration into the healthcare system.

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