

Progress, challenges and opportunities in building a sustainable digital health system in Oman

Salim Abdullah Al Salmi¹, Muhammad Rafiq¹, Qasem Al Salmi¹, Badar Talib Said Al-Alawi^{1,2}, Sheikha Salim Al Jabri^{1,2}, Ali Al Jabri³ and Abdullah Ali Nasser Al Maniri¹

¹Ministry of Health, Muscat, Oman (Correspondence to Salim Al Salmi: salimsalmi@hotmail.com). ²Oman Medical Specialty Board. ³The Royal Hospital, Muscat, Oman.

Abstract

Background: Oman's digital health information system now supports over 85% of its healthcare institutions. However, there are challenges in digital health governance, infrastructure, workforce development, and interoperability.

Aim: To assess the progress and challenges in Oman's digital health system in the past 4 decades and explore opportunities for a sustainable system.

Methods: We interviewed 80 digital health service providers and policymakers in Oman. We reviewed and analysed secondary data from the Oman Digital Health Maturity Assessment survey and from relevant documents, including national health policies, strategic plans, regulatory frameworks, and guidelines.

Results: Over 40% of health care institutions did not have formal digital health governance structures, more than half did not fully implement cybersecurity protocols and approximately half lacked patient data encryption. There were differences in digital health readiness between the public and private health institutions. Key challenges include weak digital health governance, inadequate information technology infrastructure to support digitalisation and lack of a unified data exchange system across health institutions.

Conclusion: Strengthening interoperability, expanding public-private partnerships and establishing clear oversight frameworks will help Oman achieve a sustainable, patient-centred digital health system.

Keywords: digital health, digitalisation, health information system, health policy, cybersecurity, Oman

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Introduction

Global health care is evolving as nations intensify efforts to establish efficient, accessible and data-driven solutions (1–3). Central to this transformation is health information system, which enables countries to digitize their health records, streamline care coordination, optimize resource allocation, and derive insights that improve patient outcomes (4).

In the last 4 decades, Oman has progressed from paper-based health record-keeping to digital records (5). Al Shifa, Oman's main health platform, has catalysed progress in unifying patient records and workflows, however, challenges with interoperability, infrastructure and governance remain, as is the case in other Gulf Cooperation Council (GCC) countries (6–10). For example, although the Saudi Health Analytics (SeHA) platform (11) and United Arab Emirates' Malaffi initiative (12) have helped in advancing health information exchange, they continue to face hurdles in standardization and policy coordination. Likewise, Bahrain's National Health Information Programme (I-Seha) (13) has helped

in digitizing health records, but it faces challenges in integrating private health services.

In response to these challenges, Oman developed a National Digital Health Strategy (2024–2030) (14), which aligns with Oman's Vision 2040 and the WHO's Global Digital Health Strategy (2020–2025) (15). The WHO strategy identifies 6 pillars necessary for the successful digitalization of health systems: leadership and governance; strategy and investment; infrastructure; standards and interoperability; legislation and policy; and workforce development. It provides guidance to countries for building sustainable, interoperable digital health systems (15). Oman's strategy highlights the need for integration, governance, information technology infrastructure, and workforce development in establishing a fully digitized healthcare system that will support telehealth, artificial intelligence and data analytics.

Countries like Kenya and India have highlighted the need for interoperability and sustainable innovation through mobile health and national health record systems (16,17). Insights from these initiatives may provide valuable lessons for other Middle Eastern and

developing countries in achieving sustainable healthcare transformation. This study evaluated progress in Oman's digital health initiatives over the past 4 decades, as well as challenges and opportunities in building a sustainable digital health system.

Methodology

A convergent mixed-methods design integrated qualitative and quantitative data to holistically assess digital health challenges, guided by the WHO digital health strategy. The strategy offers a roadmap for cohesive, comparable and context-sensitive digital health planning.

Focus groups and interviews were conducted in June and August 2024, exploring the governance, infrastructure, policy, and interoperability challenges. Using purposive sampling we recruited 80 participants who had been involved in digital health initiatives, including 30 health care professionals (15 physicians, 10 nurses, 5 allied health personnel), 20 health information management experts, 15 information technology specialists, and 15 policymakers. The participants were identified through professional networks, health care institutions and government agencies. Ethics approval and informed consent were obtained.

The focus group discussions lasted 60–90 minutes and captured diverse views, which were used to design the semi-structured interview questions. The questions were guided by the WHO digital health strategy and the study objectives. They explored the presence and effectiveness of digital health governance structures, leadership roles and policy enforcement; barriers to funding and resource allocation for digital health initiatives; challenges related to information technology infrastructure, system interoperability and adoption of digital tools; the regulatory framework for digital health in Oman; and workforce development, including the availability of digital literacy training, workforce readiness to adopt new technologies, and institutional efforts to upskill health care professionals.

The individual interviews lasted 30–60 minutes each and were recorded manually or digitally. Two researchers conducted a thematic analysis of the interviews and focus group discussions. A combination of deductive coding, based on the WHO digital health strategy, and inductive coding, to capture emerging themes, was applied to ensure a comprehensive thematic analysis.

Between August and October 2024, we analysed secondary quantitative data from the Oman Digital Health Maturity Assessment (DMA), which received responses from 250 health care institutions. The survey had 85% response rate from primary to tertiary institutions and evaluated information technology infrastructure, telehealth adoption, digital investment trends, and data security. To complement the survey data, we conducted a document analysis between October and November 2024 to review relevant national policies, strategic plans, regulatory frameworks, and health information

technology guidelines. A triangulation approach was used to enhance validity by cross-referencing qualitative insights, survey data and national policy documents. Member checking was conducted to ensure accuracy.

Results

The results of the study are presented as follows:

Leadership and governance

Over 40% of the health care institutions did not implement a formal digital health governance structure, such as digital health committees, defined leadership structures, stakeholder engagement, and monitoring and assessment (Table 1). They did not have information security and acceptable use policies. Slightly more than half of the institutions that had these policies reviewed them only once or less than once every 3 years. More than 50% of the institutions did not fully implement cybersecurity protocols, and approximately 50% lacked patient data encryption, which exposes them to the risk of data breaches.

Participants said the weak digital health governance caused delays in health initiatives and underutilisation of resources. One respondent stated:

"We don't have a dedicated digital health governance committee, and as a result, decision-making is slow and uncoordinated."

The participants said incomplete implementation of cybersecurity protocols left the institutions vulnerable to outdated procedures and security risks as digital systems became more integrated. One respondent said:

"Our cybersecurity policies exist on paper, but there's no real enforcement or monitoring, which makes us vulnerable to cyberattacks."

Strategy and investment

Quantitative data revealed differences in digital health readiness between public and private institutions. For example, while 79% of private institutions had partially implemented telehealth services, only 15% of public institutions had done so or were prepared to do so. Only 11% of public institutions had formal information technology strategies, with misaligned investments and delays in upgrading their critical systems.

Participants reported that underfunded public health institutions lagged behind their private counterparts in areas such as telehealth, artificial intelligence and advanced data management systems. A participant said:

"Private hospitals have been quick to adopt artificial intelligence and telehealth, while we in the public sector are still struggling with basic information technology infrastructure."

Services and applications

The Al Shifa system, which supports most public health institutions, effectively manages clinical workflows. However, more than 50% of the institutions had not

Table 1 Digital health governance in Oman's health care institutions

Governance factor	% of institutions affected	Key challenges identified	Data source
Lack of formal governance structure	40%	Weak policy enforcement, outdated security protocols, delays in digital health initiatives, underutilization of resources	DMA survey/interviews/ focus group discussion
Infrequent policy review (≥ 3 years)	50%	Increased risk of cyber insecurity, outdated procedures	DMA survey
Institutions with established cybersecurity protocols	<50%	Vulnerability to cyberattacks due to lack of full implementation	DMA survey
Lack of patient data encryption	$\approx 50\%$	Vulnerability to data breaches, privacy violations, undermining trust in digital health solutions	DMA survey
Lack of clear regulatory frameworks	Implied – needs data	Hinders innovation, potential legal issues.	DMA survey/interviews/ focus group discussion
Lack of enforcement of existing policies	Implied – needs data	Ineffective policies, continued vulnerabilities	DMA survey/interviews/ focus group discussion

Table 2 Digitalization of key health care services

Service/application	% of institutions affected/ ready	Key challenges	Data source
Al Shifa system effectiveness	Qualitative assessment	Effective for clinical workflows but lacks system interoperability	DMA Survey/interviews/ focus Groups
Radiology data digitization	>50% not fully digitized	Hinders efficient coordination of patient management and care	DMA survey
Telehealth readiness	Public 15%, private 79%	Disparity between public and private institutions, limits access to care, particularly in rural areas	DMA survey

fully digitized their radiology data, hindering efficient coordination of patient management and care. Only 15% of public institutions were prepared for telehealth, compared to 79% in the private sector (Table 2).

Qualitative feedback revealed persistent challenges with system interoperability. A respondent said:

“The Al Shifa system works well for internal processes, but exchanging data with private providers is a major challenge.”

Underdevelopment of telehealth services, particularly in rural areas, limits access to care and forces patients to travel long distances for basic services. A participant said:

“Patients in rural areas could benefit greatly from telehealth, but we lack the resources to scale these services.”

Technology and infrastructure

Health care systems that are based on picture archiving and communication systems (PACS) and internet of things (IoT) require high bandwidth. Participants said inadequate information technology infrastructure was a major obstacle to adopting advanced technologies. Over 60% of health care facilities reported that their data transfer rates were below 500 Mbps, and over 60% reported insufficient Wi-Fi connection, thus limiting the use of digital solutions like telehealth and mobile health applications. One participant said:

“Our internet speed is so slow that even basic video consultations are impossible.”

Standards and interoperability

Only a small proportion of the institutions used internationally recognized standards (e.g. ICD-10 and DICOM) for health data exchange, resulting in fragmented medical records and inefficiencies in patient care. Although Oman's health system aligns with recommendations of the WHO digital health toolkit, the lack of standardization hinders interoperability between the public and private sectors, contributing to fragmented medical records, complicating care coordination, and increasing the risk of duplicated diagnostic tests. Study participants expressed concerns about this lack of standardized data exchange practices across healthcare institutions. One participant said:

“Without a unified patient identity, coordinating care across hospitals is a nightmare.”

Another participant said:

“Lack of standardization slows down integration between our health systems.”

Legislation and policies

About 50% of health care institutions did not encrypt their patient data, leaving sensitive health information vulnerable to security breaches (Table 3). Qualitative data indicated a significant gap in the enforcement

Table 3 Legislation and data security gaps

Security measure	% of institutions implementing	Identified risks
Patient data encryption	50%	High risk of data breaches
Lack of clear regulatory frameworks for artificial intelligence and telehealth	Implied, needs data	Legal ambiguity slowing adoption
Lack of comprehensive cybersecurity policies	Implied, needs data	Institutional vulnerabilities

of national health information governance policies. Many institutions lacked clear regulatory frameworks and comprehensive information security policies, and existing policies were often inadequately enforced. One participant said:

“We need stronger regulations to protect patient data; right now, data security is inconsistent.”

Workforce

Approximately 80% of health care institutions did not provide formal training on digital systems for new employees, and refresher courses for existing staff were not common (Table 4). Less than 20% of health care institutions assessed employee satisfaction, a key factor in workforce engagement and retention.

Participants said the lack of training for new and existing staff contributed to low digital system use and that the infrequent assessment of employee satisfaction was a concern, potentially causing disengagement and reduced effectiveness of digital health initiatives. A participant said:

“We receive new systems but no training, therefore, staff struggle to use them effectively.”

Discussion

This study identified key challenges to the development of a sustainable digital health system in Oman, particularly regarding digital health governance, infrastructure, healthcare workforce development, and interoperability, as outlined in the WHO digital health strategy. We discuss these challenges and their implications.

Governance and leadership

With 40% of institutions lacking formal digital health governance structures and 50% failing to encrypt patient data, security risks and inefficiencies persist. This numerical evidence was reiterated by qualitative accounts. Several participants said the weak leadership and governance of digital health systems hamper decision-

making. They emphasised the need for stronger policy enforcement. The inadequate digital health governance in many institutions has caused inefficiencies, delayed implementation of new technologies and inconsistent resource allocation, with resulting cybersecurity vulnerabilities (18). Ineffective digital health governance structures put patient data at risk, and inadequate oversight causes lack of coordination among institutions (19). The governance gaps are not merely a policy issue but also a structural and leadership challenge.

Strategy and investment disparities

Only 15% of the public health institutions had implemented telehealth services, compared to 79% in the private sector, reiterating the fact that limited funding of public health institutions hinders equitable health care access, especially for disadvantaged populations (20). Such disparities limit the ability of public institutions to adopt emerging technologies like artificial intelligence and data analytics. Only 11% of public institutions had a formal information technology strategy, resulting in low-level investments and delays in adopting new technologies. Health care professionals said the limited public sector funding prevents digital health innovations. Bridging the investment gap between the public and private health sectors will require stronger government support and targeted funding for digital health.

Technology and infrastructure challenges

Many of the health care facilities had inadequate information technology infrastructure, with over 60% reporting speeds below 500 Mbps and poor Wi-Fi connections, which hindered the adoption of advanced digital health technologies such as telehealth, PACS and IoT-based health care services. These quantitative findings align with other qualitative insights, in which participants described how poor connectivity severely limited the deployment of advanced digital solutions, particularly in remote areas. Poor internet connections hamper telehealth, especially in remote areas (21). The findings suggest that upgrading information technology

Table 4 Workforce training and digital literacy

Area	% of institutions affected	Key challenges	Data source
Formal training on digital systems (new hires)	≈80% lack training	Ineffective use of health information systems, increased errors, limited benefits of digital health technologies	DMA survey
Employee satisfaction measurement	<20% reported assessment	Potential workforce disengagement	DMA survey

infrastructure is a crucial prerequisite for sustainable digital health transformation in Oman.

Standards and interoperability

The lack of standardization across health institutions in Oman impedes care coordination. The limited use of international standards—such as ICD-10 and DICOM—results in a fragmented healthcare delivery system, making it challenging to coordinate care efficiently. Lack of data standardization causes inefficient patient management and impedes data sharing between public and private institutions (22). There is an urgent need for national-level standardization and a unifying framework to harmonize digital health standards and improve health data exchange in Oman.

Legislation and policy gaps

Nearly half of the health care institutions did not encrypt patient data, and regulatory frameworks for emerging technologies such as artificial intelligence and telehealth were underdeveloped. Insufficient data protection measures pose significant risks, including potential data breaches and privacy violations (23). These gaps hinder innovation and may undermine trust in digital health.

Workforce development deficiencies

Nearly 80% of health care institutions did not provide formal training for new staff, and continuous training for existing staff was insufficient. Inadequate digital literacy and workforce training limit the effective use of health information systems, increasing errors and limiting the benefits of digital health technologies (24,25). Investing in workforce training and digital literacy is critical for sustaining digital health advancements in Oman.

Addressing disparities in digital health services

Only 15% of public health care institutions had implemented telehealth services, in contrast to 79% in the private sector. Respondents emphasized the urgent need for national strategies to bridge the telehealth gap, particularly for rural and underserved communities. Differences in telehealth readiness between public and private health care institutions limit equitable access to services, especially in remote and non-urban areas.

Recommendations and lessons learned

This study sheds light on critical challenges in Oman's digital health system and offers lessons applicable to countries at various stages of digital transformation. To operate a sustainable digital health system, Oman should establish relevant centralized governance and expand public-private partnerships to enforce policies and close funding gaps. The country should invest in upgrading IT infrastructure, particularly focusing on expanding Wi-Fi coverage and increasing data bandwidth in health care facilities, especially in underserved regions. Oman should develop a national health information exchange

policy to standardize data practices and improve care coordination. It should mandate data encryption and develop artificial intelligence and telehealth regulations aligned with GDPR to enhance security and privacy, and mandate digital literacy training, create certification programmes and appoint "digital health champions" to drive innovation and promote a culture of digital adoption.

Governance, investment and workforce development are key to the sustainability of Oman's digital health. Future research should explore frameworks for enhanced national oversight, investigate innovative solutions to expand information technology infrastructure for telehealth, assess the impact of international standards (e.g. HL7, ICD and DICOM), and evaluate the long-term effects of these policies on accessibility, efficiency and patient outcomes.

Study limitations

Although this study provides a comprehensive analysis of Oman's digital health system, we acknowledge that it has several limitations. First, the findings relied on self-reported data and may reflect institutional variations in the interpretation of digital health. Second, the study focused primarily on institutional readiness and policy frameworks, without extensive input from patient perspectives. Future research should include patient perspectives and explore readiness, perception, acceptability, and usability. Third, although the study aligns with the WHO digital health strategy, variations in how different institutions interpret and implement the strategies may have influenced the results. Future studies should consider comparative analyses with other regional healthcare systems to provide broader contextual insights.

Conclusion

Oman's digital health journey, illustrated by its progress with the Al Shifa system and guided by the National Digital Health Strategy (2024–2030), highlights the essential role of strong governance, robust information technology infrastructure and well-capacitated workforce in the advancement of digital health. Key findings from the study highlight the need to strengthen interoperability, expand public-private partnerships and establish clear oversight frameworks to sustain and scale digital health initiatives. Oman's experience offers lessons for other countries in the Eastern Mediterranean Region and developing nations. By aligning with standards and cultivating partnerships, Oman can model impactful digital health strategies that will be applicable globally. By addressing existing challenges and improving on current initiatives, Oman can achieve better care coordination, improved patient outcomes and a more resilient healthcare system.

Progrès, défis et opportunités dans la mise en place d'un système de santé numérique pérenne à Oman

Résumé

Contexte : Le système d'information sanitaire numérique d'Oman prend désormais en charge plus de 85 % des établissements de santé du pays. Cependant, il existe des défis eu égard à la gouvernance, aux infrastructures, au développement du personnel et à l'interopérabilité de la santé numérique.

Objectif : Évaluer les progrès et les défis du système de santé numérique d'Oman au cours des quatre dernières décennies et explorer les opportunités en vue de mettre en place un système pérenne.

Méthodes : Nous avons interrogé 80 prestataires de services de santé numérique et décideurs politiques dans ce domaine à Oman. Nous avons examiné et analysé des données secondaires issues de l'enquête sur l'évaluation de la maturité de la santé numérique à Oman et de documents pertinents, notamment des politiques de santé, des plans stratégiques, des lignes directrices et des cadres réglementaires nationaux.

Résultats : Plus de 40 % des établissements de soins de santé ne disposaient pas de structures officielles de gouvernance de la santé numérique, plus de la moitié ne mettaient pas en oeuvre pleinement les protocoles de cybersécurité et près de la moitié d'entre eux n'appliquaient pas de chiffrement aux données des patients. Il existait des différences eu égard à la préparation en matière de santé numérique entre les établissements de santé publics et privés. Les principaux défis comprennent la faiblesse de la gouvernance de la santé numérique, l'inadéquation de l'infrastructure informatique pour soutenir la numérisation et l'absence de système unifié d'échange de données entre les établissements de santé.

Conclusion : Le renforcement de l'interopérabilité, l'élargissement des partenariats public-privé et l'établissement de cadres de surveillance clairs aideront Oman à mettre en place un système de santé numérique pérenne et centré sur le patient.

التقدم المحرز في إرساء نظام مستدام للصحة الرقمية في عُمان والتحديات والفرص المتاحة في هذا الشأن

سالم عبد الله السالمي، محمد رفيق، قاسم السالمي، بدر طالب سعيد العلوي، شيخة سالم الجابري، علي الجابري، عبد الله علي ناصر المنيري

الخلاصة

الخلفية: يدعم نظام معلومات الصحة الرقمية في عُمان حاليًا أكثر من 85 % من مؤسسات الرعاية الصحية. ولكن، هناك تحديات تتعلق بحوكمة نظام الصحة الرقمية، والبنية الأساسية، وتنمية القوى العاملة، والتشغيل البيئي.

الأهداف: هدفت هذه الدراسة الى تقييم التقدم المحرز في نظام الصحة الرقمية في عُمان والتحديات المرتبطة به خلال الأربعة عقود الماضية، واستكشاف الفرص المتاحة لإرساء نظام مستدام.

طرق البحث: أجرينا مقابلات مع 80 من مقدمي خدمات الصحة الرقمية ورأسمي السياسات في عُمان. واستعرضنا وحللنا بيانات ثانوية مستمدة من الدراسة الاستقصائية لتقييم نضج نظام الصحة الرقمية في عُمان ومن الوثائق ذات الصلة، بما يشمل السياسات الصحية الوطنية، والخطط الاستراتيجية، والأطر التنظيمية، والمبادئ التوجيهية.

النتائج: وجد أنه لا توجد هياكل رسمية لحوكمة نظم الصحة الرقمية في أكثر من 40 % من مؤسسات الرعاية الصحية، وأكثر من نصفها لا ينفذ بروتوكولات الأمن السيبراني تنفيذًا كاملاً، كما يفتقر نصفها تقريباً إلى تشفير بيانات المرضى. وهناك أوجه تباين في جاهزية نظم الصحة الرقمية بين المؤسسات الصحية العامة والخاصة. وتشمل التحديات الرئيسية ضعف حوكمة نظم الصحة الرقمية، وعدم كفاية البنية الأساسية لتكنولوجيا المعلومات لدعم الرقمنة، والافتقار إلى نظام موحد لتبادل البيانات بين المؤسسات الصحية.

الاستنتاجات: من شأن تعزيز التشغيل البيئي، وتوسيع نطاق الشراكات بين القطاعين العام والخاص، ووضع أطر واضحة للرقابة أن يساعد عُمان على إرساء نظام مستدام للصحة الرقمية يركز على المرضى.

References

1. Thacharodi A, Singh P, Meenatchi R, Tawfeeq Ahmed ZH, Kumar RRS, V N, et al. Revolutionizing healthcare and medicine: The impact of modern technologies for a healthier future—A comprehensive review. Health Care Sci. 2024;3(5):329–349. doi: 10.1002/hcs2.115.
2. Wu Y. Big data-driven human-computer system to enhance Universal Health Coverage: A decade-long modelling study. Lancet Preprints, 2024. doi:10.2139/ssrn.4986338.

3. Ramachander A, Gowri DP, Selvi. The future of digital health in transforming healthcare. In: *Digital Technology in Public Health and Rehabilitation Care*. Elsevier Inc, 2025;363–385. doi:10.1016/B978-0-443-22270-2.00021-6.
4. Okolo CA, Ijeh S, Arowoogun JO, Adeniyi AO, Omotayo O. Reviewing the impact of health information technology on healthcare management efficiency. *Inter Med Sci Res J* 2024;4(4):420–440. doi:10.51594/imsrj.v4i4.1000.
5. Said SA, Samuel S. Towards the digital transformations of Oman's health sector - A critical review of the digital transformation initiatives of various countries' health sectors. *AIP Conf. Proc.* 2024; 3161(1). doi:10.1063/5.0229800.
6. Al-Gharbi KN, Gattoufi SM, Al-Badi AH, Al-Hashmi AA. Al-Shifa healthcare information system in Oman: A debatable implementation success. *Elect J Info Sys Dev Countries* 2015;66(1):1–17. doi:10.1002/j.1681-4835.2015.tb00471.x.
7. Anuradha Ganesh AAM. Electronic medical record system: Have we bitten off more than we can chew? *Oman Med J.* 2009; 24(1):1. doi: 10.5001/omj.2009.1.
8. Al-Mujaini A. Satisfaction and perceived quality of an electronic medical record system in a tertiary hospital in Oman. *Oman Med J.* 2011;26(5):324–328. doi: 10.5001/omj.2011.81.
9. Alharbi A, Alzuwaed J, Qasem H. Evaluation of e-health (Seha) application: a cross-sectional study in Saudi Arabia. *BMC Med Inform Decis Mak.* 2021;21(1):103. doi:10.1186/s12911-021-01437-6.
10. Zolait A, Radhi N, Alhawaishi MM, Sundram VPK, Aldoseri LM. Can Bahraini patients accept e-health systems? *Int J Health Care Qual Assur.* 2019;32(4):720–730. doi:10.1108/IJHCQA-05-2018-0106.
11. AlWatban N, Othman F, Almosnid N, AlKadi K, Alajaji M, Aldeghaither D. The emergence and growth of digital health in Saudi Arabia: A success story. In: Kozlakidis, Z., Muradyan, A., Sargyan, K. (eds) *Digitalization of Medicine in Low- and Middle-Income Countries*. Sustainable Development Goals Series. Springer, Cham. https://doi.org/10.1007/978-3-031-62332-5_3.
12. Deeb A, Lakinska B, Goyal R, Al Braiki A, Al Hashemi H. Bringing health information exchange to the Middle East and North Africa: the case of Malaffi in Abu Dhabi. In: *Health Information Exchange*. Elsevier; 2023. p. 665–80. doi:10.1016/B978-0-323-90802-3.00020-4.
13. Zahra Ayoob et al. Completion of electronic medical records in general clinics at Yousif Engineer Health Centre in Bahrain – A clinical audit. *J Bahrain Med Soc.* 2019;31(2):31–38. doi:10.26715/jbms.31_05022019.
14. WHO, UNFPA, UNICEF. Mapping of digital health tools and technologies: Oman country brief. Cairo: Unicef, 2022. <https://www.unicef.org/oman/media/1451/file/Mapping%20of%20digital%20health%20tools%20and%20technologies%20Oman%20country%20brief%20.pdf>.
15. World Health Organization. Global strategy on digital health 2020-2025. Geneva: World Health Organization, 2021. <https://iris.who.int/handle/10665/344249>.
16. Savai S, Kamano J, Misoi L, Wakholi P, Hasan MK, Were MC. Leveraging mHealth usage logs to inform health worker performance in a Resource-Limited setting: Case example of mUzima use for a chronic disease program in Western Kenya. *PLOS Digital Health* 2022;1(9):e0000096. doi:10.1371/journal.pdig.0000096.
17. Sharma RS, Rohatgi A, Jain S, Singh D. The Ayushman Bharat Digital Mission (ABDM): making of India's Digital Health Story. *CSI Trans ICT* 2023;11(1):3–9. doi:10.1007/s40012-023-00375-0.
18. Kamran R, Qasim M, Latif MU, Shabeer W. Decision-making process in infrastructure projects and losses due to delayed decision-making in public sector projects of Pakistan. *J Infrastr Dev.* 2022;14(1):24–36. doi:10.1177/09749306221092533.
19. Reddy S, Allan S, Coghlan S, Cooper P. A governance model for the application of AI in health care. *J Amer Med Infor Ass.* 2020;27(3):491–7. doi: 10.1093/jamia/ocz192.
20. Naher N, Hoque R, Hassan MS, Balabanova D, Adams AM, Ahmed SM. The influence of corruption and governance in the delivery of frontline health care services in the public sector: a scoping review of current and future prospects in low and middle-income countries of south and south-east Asia. *BMC Pub Health* 2020;20(1):880. doi:10.1186/s12889-020-08975-0.
21. Mbunge E, Muchemwa B, Batani J. Are we there yet? Unbundling the potential adoption and integration of telemedicine to improve virtual healthcare services in African health systems. *Sensors Inter.* 2022;3:100152. doi:10.1016/j.sintl.2021.100152.
22. Yaqoob I, Salah K, Jayaraman R, Al-Hammadi Y. Blockchain for healthcare data management: opportunities, challenges, and future recommendations. *Neural Comput Appl.* 2022;34(14):11475–90. doi:10.1007/s00521-020-05519-w.
23. Shahid J, Ahmad R, Kiani AK, Ahmad T, Saeed S, Almuhaideb AM. Data protection and privacy of the internet of healthcare things (IoHTs). *Applied Sci.* 2022;12(4):1927. doi:10.3390/app12041927.
24. Brown J, Pope N, Bosco AM, Mason J, Morgan A. Issues affecting nurses' capability to use digital technology at work: An integrative review. *J Clin Nurs.* 2020;29(15–16):2801–2819. doi:10.1111/jocn.15321.
25. Sheikh A, Anderson M, Albala S, Casadei B, Franklin BD, Richards M, et al. Health information technology and digital innovation for national learning health and care systems. *Lancet Digit Health* 2021;3(6):e383–96. doi:10.1016/S2589-7500(21)00005-4.