

Middle East and North African Health Informatics Association (MENAHA): Inclusive Digital Health in MENA Region

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Summary

The region of the Middle East and North Africa (MENA) is diverse and retains a superior growth potential. It benefits from a privileged geographical location with big markets, a young and growing educated population, and competitive advantages in several industries. Regardless of their differences, countries face shared concerns, most notably in health. In response to the COVID-19 pandemic, MENA countries enact reforms to create a more robust and inclusive digital health systems to increase growth, development, and integrity. Throughout the coordinated containment and mitigation efforts, most of the countries have integrated digital technologies into the health systems. These procedures include digital government initiatives, the introduction of digital health

training courses, live video surgeries and virtual patient monitoring, rural and remote telemedicine programs, and the development of a national electronic health records (EHR) system. Each country took necessary actions to address equity, literacy, and development of resilient health systems. The nine featured countries in this report illustrate the diversity among the MENA region and account for major opportunities and achievements as well as promises and challenges that “digital health” presents for its populations.

Keywords

Digital health, telemedicine, MENAHIA, IMIA, sustainable development goals, COVID-19, Egypt, Iran, Jordan, Kuwait, Morocco, Palestine, Qatar, Saudi Arabia, United Arab Emirates

Introduction

Technology can eliminate health disparities by providing people with access to digital health services that will better manage, track, and improve their health. Adopting a digital mentality is critical for achieving the market change that prioritizes sustainability since practically all 17 Sustainable Development Goals (SDGs) have a digital component [1]. SDGs’ challenge is implementing technology to include social, cultural, and organizational factors, as identified by the World Health Organization (WHO) [2].

Digital health has been promoted as a strategy for delivering healthcare in societies more efficiently and effectively. Its implementation has the potential to contribute to SDG3 accomplishment, which aims to “ensure healthy lives and promote well-being for all at all ages” [3]. Besides SDG three and its 13 targets covering all major health issues, practically every SDG is directly or indirectly related to health. SDGs global agenda creates, therefore, new chances for countries in the Middle East and North Africa (MENA) region to develop healthcare, well-being, and universal health coverage (UHC). However, increased reliance on digital technologies might exacerbate inequities in health between those with access and expertise to a digital ecosystem and those who do not. Equity in health, healthcare, and health outcomes is a significant key for including diverse populations. In developing technical solutions, digital inclusion entails proper infrastructure, governance, access, digital skills, and usability and navigability concerns. All this should promote inclusiveness while respecting the autonomy of individuals and populations who choose not to use or cannot use digital services.

Overview of Digital Health Inclusion in MENA Region

WHO forecasts a global health care workforce shortage of roughly 12.9 million health care workers by 2035 [4]. To address these issues, the WHO emphasized the critical role of digital technology in facilitating universal access to affordable person- and community-centered care and services in its numerous drafts and reports. The WHO’s Thirteenth General Program of Work 2019-2023 [5] targets one billion more people benefiting from UHC, better protection from health emergencies, and better health and well-being to serve the most vulnerable using digital technologies. Whilst the WHO Global strategy on digital health 2020-2025 [6] aims to create a worldwide plan for digital health that strengthens national digital health strategies and collaborates on the appropriate use of digital technology to achieve national health and well-being goals and enable UHC.

Digital inclusion is a term referring to the efforts required to ensure that all individuals and populations, particularly the most underprivileged, have accessibility to the usage of Information and Communication Technologies (ICTs). It consists principally of five components [7]:

1. Access to an inexpensive and reliable broadband internet service;
2. Functional and convenient internet-enabled devices;
3. Opportunities for digital literacy training;
4. First-rate technical support;
5. Applications and online content that promote independence, participation, and collaboration.

The social determinants of health are the circumstances in which individuals are born, develop, live, work, and age. They encompass socioeconomic position, education, neighborhood, physical environment, job, social support networks, and health care accessibility [8]. Health equity is only achieved when everyone can attain their health and well-being potential. There are too many determinants for health equity, including geography, location, ethnicity, political, legal, and economic factors, education, digital literacy, age, gender, disability, etc. Inequities in health care are not only due to limited access to services, but they may also be due to poor quality or inappropriate services. Digital health has emerged in the past decade and flourished in the form of telehealth and telemedicine during the COVID-19 pandemic as an accessible, affordable, and practical solution to health care for all.

The MENA region is one of the world’s most diversified socioeconomic regions as it can be divided into sub-regions, each having its socioeconomic ecosystem (Figure 1) [9]. However, healthcare digital technologies are relatively advancing at a breakneck pace in a dynamic and competitive environment in many of the MENA countries. The MENA region performed relatively well overall in the 2021 digital riser report, with eleven out of fourteen analyzed nations improving their relative digital competitiveness [10]. Egypt’s out-performance, for example, can be attributed primarily to its “ICT 2030 Strategy” ligh-

thouse program, contributing to its 2030 vision by establishing Digital Egypt [11].

Digital health is expanding across several domains including telemedicine, health information systems, and mobile health. Hence, healthcare professionals are increasingly taking control of digital tools and services, and citizen-patients seek to regain control of their health. The COVID-19 crisis has surely expedited the digitization of health, education, and other sectors, emphasizing the importance of digital inclusion in achieving equal health care.

Our present report covers significant facts on the use of digital health in MENA societies, ensuring that no one is left behind as stated by SDGs. It necessitates not only reaching the most vulnerable populations (e.g., in rural and remote areas, medical “deserts” that can be present even in small cities and villages, refugees escaping conflicts, immigrants, vulnerable groups, areas with no electricity, or poor connectivity, etc.), but also the population groups who are digitally illiterate, aged individuals, non-schooled, poor, and precarious, persons with disability, minorities of different kinds, etc. By allowing people to access high-quality information and relevant digital tools for prevention and treatment at the right time and in the right and valuable format, ICTs offer the potential to minimize health inequities in the region. This paper features nine countries (out of 24 countries) representing the region in its diversity. It will spotlight the digital revolution in the MENA region to make health more inclusive and establish a system with equality in healthcare.

Egypt

Egypt, as many Low- and Middle-Income Countries (LMICs), is striving to compensate for the deficits in healthcare services with affordable solutions. Digital healthcare is one of the potentially efficient solutions, putting into consideration it is not meant to replace traditional healthcare services but rather augment them. Many efforts have been made by Ain Shams University Virtual Hospital (AVH), a pioneering institute in digital health services and innovations, located in

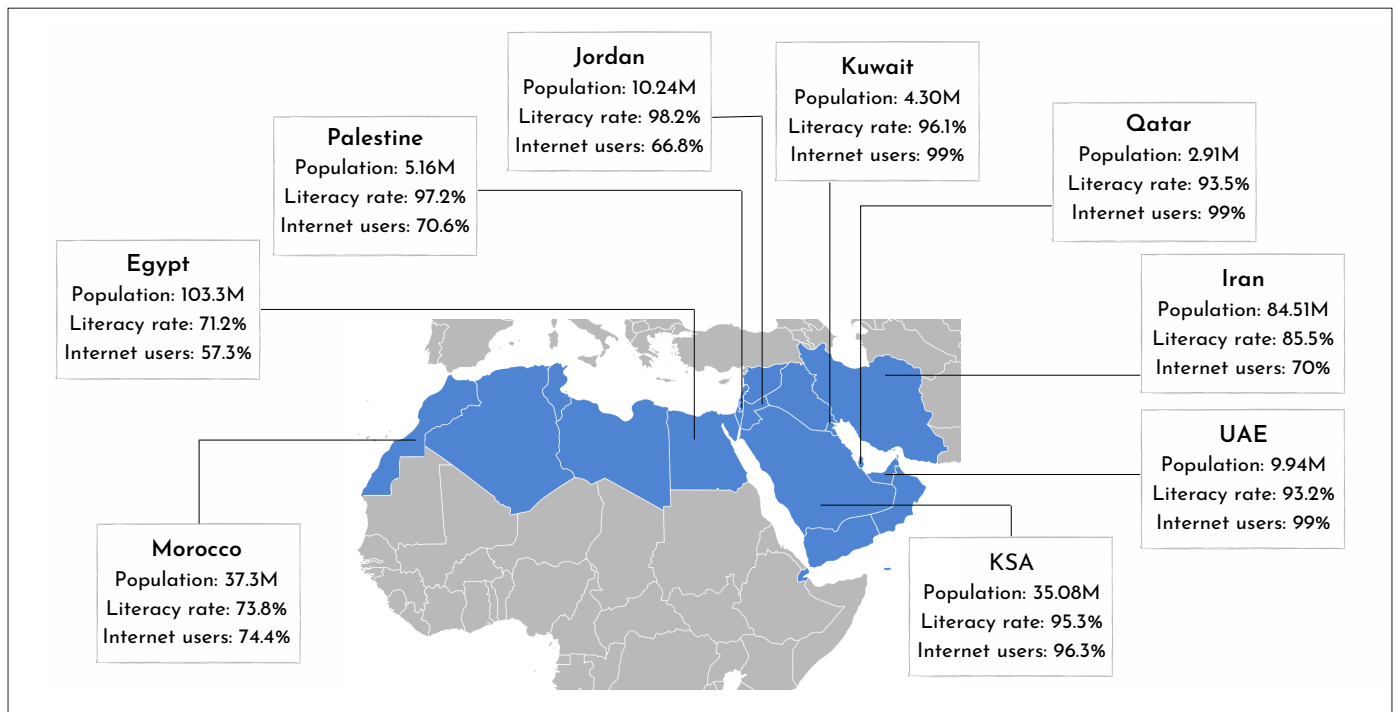


Fig. 1 Social indicators of featured MENA countries in this report.

Cairo in the heart of Ain Shams University Hospitals. Its telemedicine service started prior to the COVID-19 pandemic, has evolved considerably providing services to around 30,000 persons during the last couple of years with positive feedback from both patients and providers. To maximize the usage of telemedicine for best efficiency and eliminate risks, many actions were performed targeting different stakeholders; patients, providers, and policymakers directed to improve awareness, acceptance, and technology literacy. AVH performed many awareness campaigns, tutorials, and test sessions tailored to the recipients' needs and level of literacy. The development of the telemedicine platform is a continual process governed by daily monitoring and evaluation. Customer support services for both patients and providers with step-by-step guidance, video tutorials, and reminders have almost doubled the success rate.

In an attempt to increase access, a new telemedicine service is to be launched by the end of 2021 which provides asynchronous telemedicine empowered by FDA-approved

telemedicine devices and run by an operator who also helps patients with the application to overcome the barrier of technology illiteracy. "Healthpods" will be located in pharmacies to provide assistance to individuals. Parallel to the technical development, the team has earned international accreditation through the Washington-based.

The Utilization Review Accreditation Commission (URAC) (<https://www.urac.org/>) and the approval of the Egyptian Supreme Council of University Hospitals and intends to accredit all new telemedicine services introduced. The capacity-building activities targeting physicians in digital health have extended to undergraduate medical students offered through a one credit hour introductory course that includes topics as coding, robotics, virtual reality (VR), telemedicine, and value-based care. Moreover, research in many domains of digital health has been published and under investigation in acceptance, adoption, efficiency, feasibility, and efficacy [12, 13]. Many efforts have been targeted to funding opportunities and international partnerships allowing more

smooth and solid kick starts and sustainable solutions. Some of the major measures being adopted and serve to support informed decision-making are the digitization of the healthcare system, the use of artificial intelligence (AI), and geographic information system mapping (GIS).

Iran

The history of eHealth in Iran dates back to more than 20 years [14]. Iranian Ministry of Health and Medical Education (MOHME) has been the main organization to develop and deploy eHealth strategies. MOHME has successfully implemented the activities in the area of electrolyzing data collection, storage, and retrieval in the primary care sector called "Sib", Hospital Information System (HIS) across the country, and running "SEPAS", a system aimed to collect some parts of inpatient data through HISs to improve hospital administration. Social Security Administration has stepped into eHealth too in parallel through

implementation of ePrescription services. Despite these achievements, MOHME is aiming at a comprehensive electronic health record (EHR) deployment across the country [15]. This upcoming attainment is a big step toward eHealth inclusiveness as it includes an electronic version of patients' medical history, created, and maintained over time by the health care providers. It contains all the key administrative and clinical data leading to more optimized decision making, less medical error, cost reduction, and better communication between care providers and patients, even after discharge and during home self-care [16]. This extended e-service, which is on the agenda, will cover all Iranian population, who receive health services from public and private sectors. It has the potential of providing telemedicine services too which is the cornerstone for improving the health system resilience.

Although Iranian people are at a high level of e-services acceptance [17], there is a need to improve their eHealth literacy, on one hand, and define eHealth standards ensuring safety and data security, on the other hand. That is, there are some eHealth start-ups mainly focused on e-visiting and e-consultant ongoing by the private sector for users in a high level of socioeconomic segment; the tariff for eHealth services has not been defined officially and there is no regulation for eHealth service coverage by insurance companies. The eHealth services, which are a public demand and in progress without precise supervision, need to be defined and monitored by authorities and insurance companies. The increasingly emerging start-ups of eHealth services need to be observed based on regulation, tariff, clinical and technical improvement through understanding their weak points [18].

The implementation of a comprehensive EHR and taking advantage of start-ups are gigantic steps toward eHealth inclusiveness and equity improvement. To meet this aim, readiness and pre-implementation analysis [19, 20], rules and regulations set by Iranian legislators are required [14]. More attention to intra-sectoral and inter-sectoral cooperation, standards for data interoperability [21, 22], avoiding parallel work, using methods with the highest level of cost-benefit, taking

advantage of the available immature systems such as SEPAS [23], improving the technical facility, training human resources, and public education are highly essential.

Jordan

The emphasis in this annual report will be on the private medical sector in Jordan as along with the public sector, it is supposed to provide services to all people of Jordan, one way or the other. The non-governmental sector (private) is the main employer of health care workers in Jordan (especially medical doctors, dentists, laboratory technicians, and pharmacists). This is not the place to elaborate on the role of private actors in the provision of health care services in Jordan — whether as direct providers of services or as the providers or manufacturers of materials and technologies used in health care provision (hospitals, clinics, pharmacies, medical laboratories, manufacturers, research institutions). The disparity in the quality of health services between the health sector institutions and between different geographic regions was identified by the National Strategy for Health Sector in Jordan 2015-2019 in addition to the weakness in access to data and information of the private sector [24]. The governance of health in Jordan has a number of weaknesses, among them is the lack of coordination between the public and private sector which resulted in absence of reporting to a central health data system in the country. Access to, and availability of health data from the private sector (hospitals, pharmacies, laboratories) are among the challenges faced in the country. In order to be truly inclusive, health data from all people should be collected, analyzed and used for the good of the whole country. Different health care institutions in the private sector (unlike the public sector as it uses Hakeem [25]) use different data management systems which results in utilization of different standards (if they exist), absence of interoperability and duplication of effort, inability to perform a nation-wide analysis of health issues, cybersecurity challenges, and other financial consequences. Private healthcare institutions in Jordan focus on reactive care

rather than preventive care that is left to the public sector to perform. Raheja, Dubey, and Chawda [26] suggested three ways, health care data analysis is making healthcare better simultaneously, reducing care costs:

1. Health care data stresses on preventive care as compared to reactive care;
2. Health care data analysis enables evidence-based treatment to patients;
3. Analysis of health care data helps in the improvement of personalized care.

When talking about health data and UHC in the country, it becomes clear that data from the private sector is lacking especially since there are multiple sources of such data that need full cooperation to manage. These include public, private, or both sectors. There is disparity in data provision as the two sectors do provide data and both contribute to the UHC, one way or the other, being described as “all people receiving the services they need without incurring financial ruin”. UHC does not mean healthcare is free (definitely not by the private sector), but that personal out-of-pocket payments do not deter people from using health services, and that people are protected from “catastrophic health expenditure”.

Data sources may include:

- a) Public:
 - Vital statistics registries;
 - Public records;
- b) Private:
 - Claims data from payers and financial transactions;
 - Purchase records from pharmacies, laboratories, etc;
 - Social media;
- c) Both:
 - Hospital information systems;
 - Hospital admission statistics;
 - EHRs;
 - Health information exchanges;
 - Patient registries;
 - Patient portals;
 - Research studies;
 - Genetic datasets;
 - Web searches;
 - Mobile phones, data capturing devices, sensors, and other wearables;
 - Geographic information systems (GIS and GPS).

Kuwait

The onset of the COVID-19 pandemic has undoubtedly accelerated the healthcare sector in its digital transformation journey to improve healthcare services and delivery in the State of Kuwait. The COVID-19 pandemic provided the opportunity to showcase how digital health solutions can be a catalyst for improving the resiliency and inclusivity of healthcare. With the adoption of several digital health solutions such as Telehealth and Geographic Information Systems (GIS) to support public health applications [27], ensuring the accessibility of these solutions to everyone was key. For example, Sihaty [28], a Kuwaiti-based startup telehealth provider, has been involved in providing care to populations that have been experiencing challenges with access to healthcare due to, for example, lockdowns in Kuwait or war in Syria. The Kuwait Health Informatics Association (KHIA) continued its role in sponsoring telehealth webinars to ensure providers and consumers of healthcare services had equal opportunity to understand how to use these solutions. With the use of publicly available data, and using a mathematical modeling approach, a group of scientists studies the effects of non-pharmaceutical interventions on the transmission of the COVID-19 causing the virus, SARS-CoV-2, in different socioeconomic populations in Kuwait [29].

Morocco

Morocco strives continuously to provide inexpensive, accessible, and outstanding healthcare. By 2019, more than 74% of the population already had access to the internet [30], and electrification covers all Moroccan territory [31]. Accordingly, Moroccans are rapidly adopting digital technologies due to growing access to infrastructure and a significant reduction in the costs of devices and services, particularly mobile phones. Therefore, the Kingdom evolved into a culture of expanded connection, with individuals increasingly accessible and constantly able to access services remotely. The Digital Development Agency (ADD) prioritizes education and health in its 2020-2025 roadmap [32], including the use of innovative technologies to expand access to education

and training to achieve Sustainable Development Goals (SDG4 in particular-*Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*) [3], as well as the improvement of patient care, including the establishment of an electronic medical record (EMR) to facilitate information sharing and patient follow-up, as well as telemedicine deployment for remote rural areas. The Ministry of Health (MoH)'s Digital Development axis within the 2025 Strategy [33] focuses on the application of assisted living technology that enables continuous monitoring of people with chronic diseases in their homes, thereby improving their quality of life and providing them with necessary healthcare to achieve the health-related (SDG 3), mainly Target 3.8 on Universal Health Coverage [34].

In the wake of COVID-19, telemedicine has taken a springboard trajectory [34]. Morocco is taking significant steps to establish itself as a vital stakeholder in achieving the SDGs by 2030. As part of the health management strategy implementation, the MoH developed a free medical "tele-advice" digital platform "tbib24" [35] in which doctors from all medical disciplines participated during the general lockdown to benefit citizens. The portal, also available as a mobile app, has brought together over 100 doctors. Patients can schedule appointments with specialists based on their needs, and they can select between a physical consultation in the hospital/doctor's office and a teleconference via the digital platform.

Thus, several telemedicine initiatives took place in Morocco, targeting mainly rural and remote areas [36]. For instance, a "Mobile Ultrasound Patrol" telemedicine project aimed to enhance women's care in underdeveloped regions by identifying and treating maternal mortality's fundamental causes early on and revealing the possibility of high-risk pregnancies [37]. Further, the Moroccan Society for Telemedicine, the University Mohammed VI of Health Sciences in Casablanca, and the MoH launched a vast telemedicine program that aims to cover 160 rural communes and a population of nearly 2 million people living in significant health isolation [38]. As a pilot, teleconsultation activities are already being launched in twelve health centers [39], allowing patients

to benefit from medical services provided remotely and in real-time by doctors at the Khalifa International University Hospital, Casablanca in different medical disciplines, including obstetrics, dermatology, pneumology, nephrology, and internal medicine. Another telemedicine platform has been deployed in the region of Marrakech-Safi since 2018. The program targets more than 4 million people from 8 provinces, with 60% of them living in rural areas. The initiative involved equipping 28 sites spread all over the region with telemedicine technology to connect them to the Marrakech University Hospital. Teleconsultations in many medical fields have been operated. Two connectivity strategies are set up for the remote areas to overcome exclusion in the most underserved areas: satellite connectivity and the progressing deployment of 5G. Legally, the law of telemedicine is continuously accommodating and evolving, which allows a more extensive deployment and more substantial data protection [34]. Another example illustrating the consideration of the digital divide in Moroccan society concerns the deployment of a centralized national appointment platform by the MoH. Digitally illiterate patients are encouraged to use the service offered through "public phone shops" located around major hospitals whose managers were sensitized and trained. Similarly, to reach every Moroccan citizen, the vaccination campaign is being broadcast on social media, and through text messages in addition to mass media.

Palestine

Development in health informatics solutions and more widely digital health has been taking an increasing role in the healthcare sector in Palestine. Although developing eHealth solutions and applications to monitor and control the COVID-19 pandemic have taken priority over the last two years, other developments have also been developing on the side to create a more inclusive digital health infrastructure, both in primary and secondary care, as well as the education sector. For the education sector, several education programs, both undergraduate and postgraduate, have been developed and

running over the last few years. Two notable programs are, an undergraduate pathway in health informatics at Bir Zeit, developed by the HiCure project [40, 41], and a master's degree in health informatics at the Arab American University [42]. These have been instrumental in building capacity and developing the skills in health informatics, to support and drive the eHealth development in Palestine, which their positive effect is anticipated to have on the ground direct influence towards more health informatics driven solutions in the coming few years. On the solutions aspect, two particular ones include the development of applications to support Palestine's maternity and child health, and another for family health. For the first, an electronic medical registry and electronic health data management applications have been developed to support natal needs in primary care clinics. One application, named Mother & Child Health (MCH), has been developed on the top of DHIS2 [43], to support maternal and child health in Palestine and monitor and support both mothers and their children throughout, during pregnancy, through birth, and thereafter [44]. The solution, inclusive of a suitable web-based application and an underlying infrastructure, has been installed in more than 400 primary care clinics, out of 743 (583 in the West Bank and 160 in Gaza [45]), across the West Bank and Gaza. This initiative has been led by, the WHO-funded, Palestine National Institute of Public Health (PNIPH) [46, 47]. For the second, although development is still in progress, has been focusing on developing an infrastructure to support family health, in general, opposed to just maternity. It is also aimed to develop applications to support family health, or general practice needs to provide improved health follow-up and management.

In secondary care, the Ministry of Health has been leading the deployment of a national EHR system in hospitals [48]. The EHR system, based on Avicenna from Datasel, has been deployed in 14 governmental hospitals, primarily in the West Bank. However, the plan is to expand to other governmental hospitals. Some of the private hospitals have also adopted the use of Avicenna [49], others have developed their EHR systems in-house, and many others have not yet

adopted well-developed EHR systems. The secondary care sector, in Palestine, overall requires substantial development to reach an interconnected interoperable infrastructure, to cover all government, public and private hospitals (81 hospitals: 53 in the West Bank and East Jerusalem and 30 in Gaza).

Qatar

Qatar announced its first national health strategy in 2011, where the provision of universal healthcare services for both citizens and expatriates was a cornerstone of the strategy [50]. Since then, Qatar has launched a number of national strategies and initiatives to create a more resilient healthcare system that addresses key priority areas focused on the most vulnerable segments of the population. The national initiatives and strategies which are driven by Qatar's Human Development Pillar of the 2030 National Vision include [51]: Qatar's National Dementia Plan [52], National Autism Plan [53], National Mental Health and Wellbeing Strategic Framework [54], Occupational Safety for Migrant Workers [55], and an eAccessibility Policy [56].

Although the national strategies and initiatives, with the exception of the eAccessibility policy, do not specify a clear direction for digital health inclusion and accessibility, many of the projects stemming from state Ministries, Universities, and Non-Profit Organizations are using technological innovations to help achieve the goals of the national and strategic plans, which as a result and by proxy, are creating a more digitally inclusive society.

To illustrate with a few examples, Qatar's National Research Fund (QNRF) Development and Innovation priority areas have funded projects relating to accessible remote healthcare and mental health [57]. The Ministry of Public Health (MOPH) recently launched a platform for Autism Spectrum Disorder (ASD), which is the first stage of an online platform for persons with disabilities in Qatar to offer parents and caregivers a digital source of scientific information covering educational, social, and health-related topics [58]. Hamad Medical Corporation (HMC), the primary healthcare provider for all citizens and residents wit-

hin the State of Qatar, developed different technology applications for the elderly during the COVID-19 pandemic [59]. For example, HMC launched an online platform for the elderly that includes information and advice on healthy aging and also established an Elderly Telephone Reassurance Service where a medical professional will reach out to an elderly within the community over the phone to check on their mental and physical wellbeing. During the COVID-19 pandemic, all of Qatar's ministries, academic institutions, and organizations were working diligently on ensuring healthcare access representing all the different languages and cultures had access to information and healthcare services through phones, smartphones, and computers.

Overall, Qatar has made it a national priority to provide universal access to healthcare through physical and/or digital means for all citizens and residents living in the country. Although challenges such as health system navigation, digital health literacy, personalized digital health interventions, and others do exist, the ethos of human development in the country through free or highly subsidized universal healthcare is a priority for the country that makes Qatar's experience unique to the region.

Saudi Arabia

In 2021, the Saudi General Authority for Statistics released the report of households and individuals ICT access and use. The report shows that around 97.7% of Saudi individuals (15 years old and above) use mobile phones, and 92.5% use the internet [60]. The access to computers among households reached 62.5% [60]. In 2016 around 35% of all IT investments were in Cloud services compared to a global average of 20% [61]. Approximately 78% of Saudi companies plan Big Data & Analytics roll-outs compared to 62% worldwide [61]. All these numbers show the level of transformation and engagement to the digital world in Saudi Arabia, and the healthcare sector is no exception. Saudi Arabia ranked at the top digital riser within the Group of Twenty (G20) report in the year 2020 and second in the year 2021 [62, 63].

The Saudi Ministry of Health has a vision to improve the quality and standards of healthcare outcomes, equability, and availability of services. In 2018, the Saudi Ministry of Health announced the Digital Health Strategy to deliver the national plan of Vision 2030 for the healthcare sector, working with national and international advisors [64]. The Digital Health Strategy focused on many levels where two components focused on digital health: the need for digital reinvention and rapid digital change. The digital health strategy in Saudi Arabia is planned on three primary levels with six stages [65]:

A. Digital Health Foundations:

1. Digitally Enabled Care : Electronic Medical Record, Decision Support;
2. Smart Care : Precision Medicine, Artificial Intelligence, Robotics, and Medical Printing;

B. Digital Transformation:

3. Care Anywhere : Virtual Care, Connected Care Teams, and Connected Homes;

C. Digital Reinvention:

4. Empowered Care : Models of Care, Patient Experience, and Personal Health Data;
5. Intelligent Health Enterprises : Seamless Financing, Data-Driven, Value-Based, Accountable Care, and e2e.

The investment in digital health enables the Saudi MoH to launch more than ten applications and telemedicine services before, during, and after the COVID-19 pandemic. In 2020, the Saudi MoH [66] expanded its telemedicine regulations by launching an e-health “Seha” App. The “Seha” App provides medical consultation with healthcare providers by connecting the patients for virtual face-to-face consultations across the country. During the COVID-19 pandemic, the implemented digital health solutions in Saudi Arabia provided opportunities to improve healthcare delivery and help relocate resources.

One of the Saudi MoH’s applications is called “Tetamman,” designed to provide healthcare services for citizens and residents [66]. “Tetamman” launched many clinics to serve over four million beneficiaries. Another application called “Mawid” is designed to enable patients and beneficiaries to book, cancel, or reschedule medical appointments

at primary care centers [66]. Beneficiaries booked over 100 million appointments through the “Mawid” application with over 26 million registered patients [67]. Another Application called “Tawakkalna” has exceeded 23 million users connected to over 20 governmental and non-governmental partners inside Saudi Arabia. “Tawakkalna” app was developed to facilitate electronic permits during the curfew period for citizens and residences [66,68]. Also, it offers COVID-19 health status, show if the user is vaccinated, and a function as a health passport during traveling [68]. “Tawakkalna” application offers more than 100 services and is available to use in over 75 countries in the world. These are only a few examples of how the Digital Health Strategy can benefit patients and increase the efficiency of healthcare services. The effect and impact of digitalization and the Digital Health Strategy have changed the expectations of the culture, market, and healthcare industry in Saudi Arabia.

United Arab Emirates

Like other countries across the globe, the United Arab Emirates (UAE) was harshly affected by the COVID-19 pandemic. However, the foresight of the healthcare ecosystem, the existing technical infrastructure spurred the development of trilateral collaboration that involved government, academia, and the private sector. Despite the fact that UAE has three different healthcare regulatory systems, they managed during the pandemic to work collaboratively and break silos through agile fusion teams and integrative technology solutions such as Al-Hosn mobile app, which is being effectively used for digital contact tracing and vaccination recording. The prevalence of the COVID-19 pandemic has also unlocked the power of virtual care across the UAE, as it was the only option to resume prioritized care delivery for patients especially during the lock-down periods. Regulators relaxed the regulations and policies governing virtual care during the pandemic to encourage providers to establish their telehealth services in a timely fashion and with minimum burdens.

Notwithstanding that UAE regulators focused their efforts in the last 18 months in combating the pandemic, several strategic digital transformation projects were successfully rolled out. Both Nabidh (Pulse) and Riayati (My Care), the Health Information Exchange projects (HIE) of Dubai Health Authority and Ministry of Health and Prevention, respectively. These two strategic projects, which joined the Malaffi (My File) project which was launched in 2019, aimed at unifying patient records across the ecosystem to achieve a 360-degree view of every patient to improve quality of care and to minimize the waste within the healthcare system. The two HIE projects jointly achieved unifying 7.1 million medical records, connecting 207 healthcare facilities and including more than 26,000 clinicians within their clinical portals as of November 2021 [69-71].

Discussion

While most countries in the MENA region engaged in the digital health adventure, however, they vary in terms of importance and conviction (Table 1). The nine contributing countries to the present report show the impact of the COVID-19 crisis in accelerating the adoption of digital health in the fight against the pandemic and beyond. The fact is that, like most developing countries, MENA countries face numerous challenges in implementing digital health due to a lack of robust ICT infrastructure or stable power supply, digital divide, logistical and cultural issues, and a general lack of efficient data collection tools and resources in healthcare facilities as well as human resources. Fortunately, it is notable all MENA countries aim to integrate ICTs and combat digital literacy to ensure efficient digital health and telemedicine adoption and increased access to healthcare services. If the pandemic has put a strain on all MENA’s health systems, especially in fragile and conflict-affected country members, however, the situation is different for the wealthier Gulf states and emerging economies in North Africa. With varying degrees of success, most countries contribute to initiatives to bridge the digital divide and the repercussions on UHC, despite the disparities.

In addition, mobile technology presents an opportunity for inclusion and equity in health as it can reduce financial, geographic, and workforce barriers. Indeed, in the aftermath of the COVID-19 crisis advent, every single country made a mobile application in the form of “contact tracing” or else. Mobile technology continues to be a significant tool for digital inclusion in MENA, as smartphones account for 60% of internet connectivity, particularly in non-Gulf Cooperation Council (GCC) areas where access to alternative types of internet connectivity, such as fixed broadband, is limited. The number of smartphone users almost doubled from 86 million in 2014 to an estimated 174 million in 2019. The Smartphone penetration rate is the highest in the GCC sub-region, with countries like the United Arab Emirates reaching 99%, or Egypt with 92.7% [72]. In Saudi Arabia, for example, the penetration rate of mobile internet in Saudi households is approximately 91%, compared to 26.2% of Saudi families having a fixed broadband connection [73].

According to projections, by 2025, 6% of MENA mobile internet users will be using 5G technology. However, adaptation will not be uniform across the region. The sub-economic region’s development and political situation will play a major role in technology adaptation. According to projections, 10% of mobile internet users in the GCC sub-region will utilize 5G technology by 2025. While only 5% of North African users will have made the move at the same time, no consumers in the Arab world’s periphery will have adopted 5G technology until then.

Digital inclusion involves actions such as services, projects, or programs that help everyone utilize digital devices and the internet more conveniently and confidently by enhancing motivation, access, skills, or trust. The MENA countries have made impressive achievements by developing teleconsultation and tracking applications during the pandemic. The efforts are still ongoing to realize a digital inclusion and prevent other COVID-19 outbursts or further calamities. Several countries have adopted extensive use of EHR and have introduced digital health courses and skills to colleges and universities.

No doubt, technologies have proven to have the potential to improve health outcomes by improving medical diagnosis, data-based treatment decisions, digital therapeutics, and better pandemic management. However, the majority of MENA countries do not seem to have a substantial Digital Health strategy for the better usage of digital tools and techniques to achieve inclusion and equity in health care and services. Luckily, the pandemic has accelerated the rise of digital health solutions such as telemedicine and other forms of remote care worldwide and in the MENA region. As an immediate consequence, a significant number of healthcare organizations in the MENA region are focused on digital inclusion as a critical goal in building a resilient society and helping meet the SDGs by 2030.

In recent years, substantial growth in digital technology solutions for health and their implementation in the MENA region has been achieved. “MENA HIA” has been established to support, strengthen collaborative works among country members and stakeholders, and disseminate knowledge in this area. Opportunities to help scale up digital health in the region remain. The continued growth in digital health solutions will happen through a combination of government, NGOs, and private-sector initiatives and partnerships. There must be increased awareness and clarity regarding the impact and more precise evidence of how digital technologies can benefit society while minimizing negative externalities. Actually, there is a digital health inequity among MENA countries, which is specific to this region, given the countries belong to different economic levels.

The digital health inequity among MENA countries is visible, considering that these countries belong to different economic groups. This would constitute the main challenge to achieve a more inclusive digital health development in all MENA region. Collaborative and integrative work with our international partners, such as the World Health Organization Eastern Mediterranean Regional Office (EMRO), the International Telecommunications Union (ITU) Regional Bureau, the International Medical Informatics Association (IMIA),

the International Society for Telemedicine and eHealth (ISfTeH), or the Health Information Management Systems Society (HIMSS), will be instrumental.

Conclusion

The MENA region is affected by two major challenges: political stability as six countries live in war and conflict and the growing social and economic divisions between the countries. In addition, MENA region is not a homogeneous one as each country’s economic, political, social, cultural, and natural and human resources are distinct and must be evaluated separately. These specific conditions are also the source of various requirements and, as a result, disparate priorities for attaining sustainable development in health using digital health strategies and solutions. Thus, the implementation of the SDGs varies across the MENA region. While some sub-regions, such as the Gulf, have made more progress, others have made little growth. Furthermore, priorities fluctuate considerably across MENA due to each country’s unique requirements and circumstances. Generally speaking, there is an enthusiastic willingness to include digitalization in the health systems in all MENA countries, yet with various intensity and speed, thus promising a better future for people of the region. With digital networks rapidly expanding, the MENA region can undoubtedly solve the problem of fair access to healthcare, resulting in longer, more productive lives for people in the region that shelters 6% of the world’s population. Digital technology has immense potential to close gaps in healthcare delivery by directing limited health resources to where they are most needed. To that aim, national and local players should focus on linked solutions to promote equal access to health innovation throughout MENA.

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Table 1 Summary of inclusive digital health initiatives per country in the MENA region.

Country	COVID-19 Apps	Inclusive Digital Health initiatives
Egypt	<ul style="list-style-type: none"> - Eksheff.asuvh.com and CDOC - EGYHealth passport - Seha-Masr 	<ul style="list-style-type: none"> - Ain Shams University Virtual Hospital (AVH) major initiatives in digital health services and innovations - Telemedicine service available in pharmacies - Digital health courses for physicians and medical students - ICT 2030 Strategy lighthouse program
Iran	<ul style="list-style-type: none"> - ACT19 - CSASR - Mask - SEPAS 	<ul style="list-style-type: none"> - Electrolyzing data collection, storage, and retrieval - E-prescribing - Ongoing Electronic Health Record and HIS deployment - Iran's Health Electronic Record project
Jordan	<ul style="list-style-type: none"> - AMAN - Electronic Services Platform "e-Med" - KAUH Patient Connect 	<ul style="list-style-type: none"> - Hakeem program by Electronic Health Solutions to automate the public healthcare sector in Jordan and implement Electronic Health Record solution - Telemedicine program allowing citizens of Lebanon to have access to Jordanian doctors - Online medication refill request and telemedicine program by the Ministry of health, Royal Medical Services and the Hakeem/eMed platform - Pilot studies of virtual reality rehabilitation
Kuwait	<ul style="list-style-type: none"> - Sihaty - TrackCOVIDKW.com - CoronaCareKW 	<ul style="list-style-type: none"> - The Kuwait Surgical Telehealth Network (KSTN) implementing live video surgeries and virtual patient monitoring
Morocco	<ul style="list-style-type: none"> - Wiqaytna - Tbib24 - Jawaz-asseha 	<ul style="list-style-type: none"> - Digital Health component in the Digital Development Agency 2020-2025 roadmap - Digital Health component in The MoH Strategy 2025 - Nationwide Telemedicine projects targeting rural and remote areas - Telemedicine regulation - Telemedicine platforms - Nationwide "rendez-vous online" platform for medical appointments
Palestine	<ul style="list-style-type: none"> - UNRWA "Toll-free telemedicine hotlines" - Sehati - Weqaya - DHIS-2 	<ul style="list-style-type: none"> - Undergraduate program in health informatics at Birzeit, developed by the HiCure project, and a master's degree in health informatics at the Arab American University - Development of applications to support Palestine's maternity and child health, and family health - Deployment of a national HER system in hospitals by the MOH - Development of a Family Health e-System during the pandemic
Qatar	<ul style="list-style-type: none"> - EHTERAZ - WEQAYA - ESRA (Emotion Sensing Recognition App). - ECHO-360 	<ul style="list-style-type: none"> - National initiatives and strategies driven by Qatar's Human Development Pillar of the 2030 National Vision (Qatar's National Dementia Plan, National Autism Plan, National Mental Health and Wellbeing Strategic Framework, Occupational Safety for Migrant Workers, and an eAccessibility Policy) - Online platform for the elderly by Hamad Medical Corporation (HMC)
Saudi Arabia	<ul style="list-style-type: none"> - Sehhaty - Tawakkalna - Tabaud - Mawid - Seha - Tataman 	<ul style="list-style-type: none"> - The Digital Health Strategy - Companies planning Big Data & Analytics roll-outs - National plan of Vision 2030 for the healthcare sector - Launch of ten applications and telemedicine services
United Arab Emirates	<ul style="list-style-type: none"> - Al-Hosn - COVID-19 EHS - COVID19 - DXB Smart App 	<ul style="list-style-type: none"> - NABIDH and Riayati, the Health Information Exchange projects of Dubai Health Authority - Malaffi project unifying patient records across the ecosystem - "Doctor for Every Citizen" - "Abu Dhabi's Telemedicine Center" initiatives

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