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Key Messages

The rapid spread of the COVID-19 pandemic has currently infected more than three million person globally and has surged the need and demand for healthcare services beyond the capacity of some healthcare systems. Digital health, that includes big data, e-health and technologies such as artificial intelligence, has emerged as a fundamental tool for governments, healthcare providers and healthcare institutions to effectively respond to this public health crisis.

Technologies leveraged upon in the COVID-19 Response

► Online platforms were leveraged to perform various functions including, raising awareness, educating personnel, sorting and monitoring patients, enabling virtual care, and informing decision-makers and the public.

► Machine learning and artificial intelligence played an important role in contact tracing, effective design of diagnostic technologies, identification of drugs that can be re-purposed for COVID-19 treatment, and enhancement of epidemiological forecasts.

► Blockchain technology was used to allow immediate payments for hospitals and connect healthcare providers to new vendors.

► Robots and drones were utilized for preventing disease transmission, screening, diagnosis, and minimizing human-to-human contact.

Advancing the Agenda of Digital Health in the Eastern Mediterranean Region

► Leverage on digital health to respond to public health emergencies such as the COVID-19

► Promote the utilization of big data to advance and support digital health technologies in informing and supporting the response to COVID-19 and beyond

► Invest in robust national health information systems (HIS)

► Harness the utilization of virtual technology to respond to the continuous increase in demand for health services that is not limited to public health emergencies but also extends to everyday practice.

► Enable public engagement and enrollment in digital health interventions
Preamble

On March 11, 2020 the World Health Organization (WHO) declared the novel coronavirus as a pandemic. Since then the number of confirmed COVID-19 cases reached over three million overwhelming healthcare systems around the globe and challenging economies. In addition to strict measures that escalated from social distancing to complete lockdowns, governments that have succeeded so far in containing the virus, heavily invested in digital health that includes technologies and big data.

Digital health encompass the utilization of electronic health, advancing computing science such as big data and leveraging on artificial intelligence (AI). Digital health draws on various technologies including phones, applications, telemedicine, wearable devices, robotics, drones, virtual reality and AI to support tasks and inform decision making. Digital technologies provide opportunities to address health system challenges, and enhance the coverage and quality of health practices and services, particularly in outbreaks (WHO, 2019; WHO, 2020).

Governments and international organizations mobilized digital technology during the Ebola crisis for numerous functions including awareness, education, outreach, coordination, surveillance, and planning. For instance, mobile technologies were leveraged to raise public awareness on disease prevention, educate healthcare workers on best practice, and provide infected individuals and those living in hard-to-reach regions with essential needs and financial support (Dahiya et al., 2016; Oza et al., 2017; Tambo et al., 2016). Mobile-based applications in addition to dashboards also helped front-line healthcare workers and management carry out various tasks such as information coordination, surveillance and reporting, real-time notifications on new cases, prompt results sharing and strategic planning (Tambo et al., 2017).

As the COVID-19 pandemic spreads to nearly every country around the world including the most developed, the role and scope of digital health stretched beyond that observed in the Ebola epidemic.
Selection Process

A search of the literature was undertaken to identify articles -systematic reviews and single studies- addressing the use of technology in COVID-19 response. A combination of free word and controlled vocabulary to combine the following concepts: “Pandemic” AND “Technology”; “COVID-19” AND “Technology”; “Epidemic” AND “Technology”; “Digital” AND “Health” AND “COVID-19”; “Digital” AND “Health” AND “Technology” were used to search the following databases: Medline/Pubmed, Health Systems Evidence, and Cochrane Library. Google Scholar and grey literature were also reviewed. Last search was done on the 4th of May, 2020.

While this document does not evaluate the impact of the components of digital health, it provides insights based on evidence and experience during the COVID-19 on how digital health can harness and enable health systems to respond to the COVID-19 pandemic and other public health emergencies in the Eastern Mediterranean Region.
E-health

E-health which is “the use of information and communications technology in support of health and health-related fields” (WHO, 2019), covers a broad range of tools including health information systems (HIS), Electronic Health Records (EHR) and telemedicine (Kierkegaard, 2013). Robust HIS are particularly important E-health tools as they are pre-requisites for the provision of information essential for evidence-informed decision making, proper management and planning, and health system monitoring and evaluation (Alwan et al., 2016).

It is essential to assess the state of E-health in the EMR to determine the region’s preparedness to leverage advanced technological applications. The socioeconomic and cultural variations among countries in the EMR reflect a wide array of challenges related to e-health preparedness especially in low-to-middle income countries (Al Shorbaji, 2008). Countries in this region vary in terms of wealth which results in a huge disparity in the level of networked readiness (Al Shorbaji, 2008). For instance, whereby countries such as UAE, Qatar and Bahrain are the top three leading countries in the EMR in terms of the networked readiness index, Yemen and Algeria have scored much less (Portulans Institute, 2019).

Other challenges include lack of standardized policies for health data management, lack of sustainable funding, poor E-health public-private partnerships, lack of skilled human resources, lack of political commitment, underdeveloped health information systems (HIS), poor policy and legal frameworks and cultural and multilingual challenges (Al Shorbaji, 2008, Alwan et al., 2016).

E-health preparedness depends on four key pillars including (1) network readiness, (2) standardization policies, protocols, and procedures, (3) user access and accessibility, and (4) government regulations and roles (Wickramasinghe et al., 2005).
Big Data

Big data describes a large, complex and fast data that is difficult to be analyzed using traditional methods. Big data can be used for information extraction, machine learning and artificial intelligence, predictive modeling, and advanced analytics (Rouse, 2020). The opportunities revealed from big data include quality improvement, population and health management, early detection of disease, data quality, structure, and accessibility, improved decision making, and cost reduction (Kruse et al., 2016; Mehta et al., 2018).

Evidence showed that big data approaches that include analyzing social media data, such as posts, likes and comments, can be used to detect outbreaks. (Xie, et al., 2013). A Canadian artificial intelligence start-up called “Bluedot” was able to alert the world of the novel coronavirus outbreak 9 days before WHO released information. The start-up used big data and artificial intelligence to process information from different sources including statements from public health organizations, digital media, airline ticketing, livestock health reports and population demographics to detect and forecast the size of the outbreak (CNBC, 2020).

Lessons learned from previous epidemics showed that active case finding and prompt treatments are crucial in the reduction of disease incidence (Yuen et al., 2015). The Taiwanese government leveraged big data to actively find and test high-risk individuals. This was done by integrating the travel and customs database with the national health insurance database and patients’ travel histories and incorporating this information into the individuals’ medical records. This allowed clinicians to receive real-time alerts to investigate COVID-19 infection for those who report with flu-like symptoms and have recently visited endemic regions (Wang et al., 2020a).

Nonetheless, the use of big data should consider the data structure, security, data standardization, storage and transfers, and data governance to mitigate the negative impact of big data and enhance its benefits (Kruse et al., 2016).
Digital Health Technologies Utilized for COVID-19 Response

01 Online Platforms

RAISING PUBLIC AWARENESS

Authorities are leveraging on social media to efficiently reach the public with accurate and comprehensive information. For instance, the Singaporean authorities established chatbots and a national WhatsApp channel to raise awareness on COVID-19 (UNDP, 2020). Nevertheless, social media has also been the platform for the fast and overwhelming spread of information, which created an infodemic, making it harder for people to distinguish credible from fake information (Wong et al., 2020). To mitigate the spread of misinformation, WHO collaborated with search companies and social media giants to track fake-news and ensure that the information published by WHO appears on the top of the search results when people search for information on COVID-19 (Bullock et al., 2020).

EDUCATING AND TRAINING HEALTHCARE WORKERS

WHO launched a list of online courses to educate healthcare workers on how to protect themselves and take better care of COVID-19 patients (WHO, 2020). China also trained healthcare workers through government-supported online courses and live teleconferencing sessions presented on mobile platforms (Li et al., 2020).

Virtual healthcare emerged as a key strategy to manage demand on hospital care as well as reduce the exposure and potential spread of the virus among healthcare professionals, patients and their communities (Greenhalgh et al., 2020). Several governments, such as the Chinese and the British governments, resorted to virtual consultations to provide initial patient screening and “forward triage” (Dorsey and Topel, 2020; Greenhalgh et al., 2020; Hollander and Carr, 2020). Additionally, virtual consultations and COVID-19 specific mobile applications were used to support and monitor suspected cases and patients with mild symptoms, therefore, decreasing the demand on healthcare (Ohannessian et al., 2020). Several countries such as the United States and Australia have also shifted non-COVID-19 related consultations online to ensure the continuous provision of routine care without the risk of exposure in busy and contaminated hospitals (Smith et al., 2020; Leite et al., 2020).

National, regional and international live dashboards were established to provide decision-makers and the public with up-to-date information. For instance, John Hopkins developed an interactive dashboard that allows people to track cases around the globe in real-time (Dong et al., 2020).

On the national level, numerous countries including Lebanon and the United Kingdom established country-specific dashboards. Some dashboards expanded to include key information that can help coordinate efforts, assess the impact of interventions and direct the flow of resources (Digital Health, 2020).
Several countries resorted to technology to automate the contact-tracing process whilst encountering the fast spread of the COVID-19 disease (Ferretti et al., 2020). For instance, the Chinese public health authority developed an application that collects real-time data on people’s geolocation and latest COVID-19 diagnosis to generate a green or a red QR code that is scanned at the entrance of public spaces, transportation systems, malls and hotels. A red code would deny entry to its holder and would indicate that the individual either tested positive for COVID-19 or came into proximity to another person who has recently tested positive (Ferretti et al., 2020). Singapore, traced the digital signature of people who tested positive with COVID-19 to identify the people they came in contact with, to test and isolate them accordingly (UNDP, 2020).

Evidence suggests that machine learning can be potentially used for COVID-19 diagnosis as machines can be trained to identify particular radiological signatures associated with COVID-19 on CT-Scans (Ai et al., 2020; Wang et al. 2020b) or identify an abnormally rapid breathing pattern associated with COVID-19 through footage from kinetic depth cameras (Cascella et al., 2020; Wang et al., 2020c). Other approaches include using mobile phones to diagnose COVID-19 through embedded sensors or through a questionnaire that can filter high-risk patients based on their responses (Maghdid et al., 2020; Rao & Vazquez, 2020).
Machine learning and artificial intelligence played an important role in contact tracing, effective design of diagnostic technologies, identification of drugs that can be re-purposed for COVID-19 treatment, and enhancement of epidemiological forecasts.

**TREATMENT**

Artificial intelligence can be used to identify the structure of the proteins associated with viruses, identify drugs that can be re-purposed for the treatment of this infection, and propose new drugs that provide the potential for treatment (Zhavoronkov, 2018). For instance, Richardson et al. (2020) used an artificial intelligence technique to identify Baricitinib, a drug which is commonly used to treat arthritis, as a potential drug that can be used for the treatment of COVID-19. Beck et al. (2020) used a machine learning approach to identify Atazanavir as a potentially effective drug for the treatment of COVID-19.

**EPIDEMIOLOGICAL RESEARCH**

Explaining the spread of the virus, and its effect on different demographics and geographic locations is crucial to inform policy decisions. Given the rapid progression of COVID-19, researchers leveraged models with machine learning capabilities to provide real-time forecasts (Bullock et al., 2020). For instance, Hu et al. (2020) used data compiled by WHO to develop a dataset of cases in China. This dataset was then used to train a modified auto-encoder to provide real-time forecasting of new cases.
03 Blockchain

STREAMLINING INSURANCE OPERATIONS

Blockchain technology can be used to securely store patients' medical records (Chen et al., 2019). Using this technology, an insurance company in China was able to get data directly from hospitals, track history of patient treatment, the tests they received, and the physicians that treated them in a secure manner ensuring no data tampering. The company also used smart contracts to automate insurance payments to issue immediate payments upon discharge (Field, 2020).

ADDRESSING SUPPLY CHAIN ISSUES

The rapid spread of COVID-19 resulted in a drastic increase in demand for medical supplies (i.e. PPE). Many non-traditional suppliers, such as apparel companies, shifted their activity to address this shortage, yet connecting these suppliers to health authorities and health providers was still a time-consuming task. In the United States, IBM launched a blockchain based network to connect health authorities and healthcare providers with non-traditional suppliers which allowed them to quickly identify and verify new vendors (Landi, 2020).
Blockchain technology was used to allow immediate payments for hospitals and connect healthcare providers to new vendors.
Robots and Drones

PREVENTING DISEASE TRANSMISSION

Autonomous disinfection using UV Robots can be more efficient and effective compared to manual disinfection which requires workforce mobilization and increases the exposure risk of cleaning workers (Yang et al., 2020). Similarly, China and Spain adapted drones that were originally designed to spray pesticides for agricultural applications to spray disinfecting chemicals in public spaces. Drone spray can be fifty times more efficient than hand spray and can help reduce the transmission mechanisms of the novel coronavirus (Pan, 2020; Yang & Reuter, 2020).

SCREENING

Mobile robots that incorporate thermal sensors and vision algorithms technology can increase the efficiency and coverage of screening in public areas and ports of entry (assisting with border controls). China deployed mobile robots to thermally scan large crowds and detect suspected coronavirus carriers; these robots live-stream temperature readings to control centers and send alerts when necessary (Ng, 2020; Yang et al., 2020).
Robots can come in handy in performing nasopharyngeal and oropharyngeal swabbing to test for COVID-19, thus speeding up the diagnostic testing process, reducing the risk of infection and freeing up staff for other tasks (Yang et al., 2020; Caixiong, 2020).

Robots have been used for the delivery of medications and meals for people in hospitals and quarantine zones in China to minimize human-to-human interaction and prevent the spread of COVID-19 (Okyere et al., 2020). Also, China has been utilizing drones to deliver medical testing samples which significantly reduced unnecessary human contact throughout the transport cycle and speeded the feedback for critical tests by cutting delivery time by more than half (Yang & Reuter, 2020). Drones are being used in China and Spain to patrol public spaces and track non-compliance to quarantine directives (Onyango, 2020; Pan 2020).
Ethical Considerations

Privacy, cybersecurity and data misuse

Various technology applications described throughout require the collection and analysis of a large amount of citizens’ data. For instance, some contact tracing solutions require that the geolocation of every citizen at any point in time be stored in a central server. This raises significant concerns around privacy, cybersecurity and data misuse, especially when the utilization of the collected data shifts from its original purpose (Cho & Yu, 2020). Failing to address these concerns in public health emergencies may undermine public trust and result in public resistance to follow government recommendations (Ienca & Vayena, 2020).

Social inequity

The use of technology in the provision of healthcare raises a concern of social inequity. Barriers such as poor digital literacy, financial constraints, and poor infrastructure may result in inequitable access to digital healthcare (O’Connor et al., 2016). For instance, the younger generations are expected to have good digital literacy, older adults still struggle with the use of technology (Levine et al., 2016). Additionally, the cost of acquiring technology and poor internet access may prohibit certain groups from accessing digital healthcare especially those living in low-to-middle income countries (O’Connor et al., 2016; Yamin et al., 2011).
Advancing the Agenda of Digital Health in the Eastern Mediterranean Region

The COVID-19 pandemic provides an opportunity for countries in the EMR to advance digital health to proactively develop and implement evidence-informed decisions for effective and efficient response to the pandemic and beyond.

Insights derived from the global response to the COVID-19 pandemic highlight the importance of advancing the digital health agenda for better response. Key strategies were developed based on international best practices and specific examples from the response to COVID-19.

01 LEVERAGE ON DIGITAL HEALTH TO RESPOND TO PUBLIC HEALTH EMERGENCIES SUCH AS THE COVID-19 (MAHMOOD, 2020; SCOTT, 2013; WHO, 2019)

→ Assess the current state of digital health in the country and identify the national needs to integrate the utilization of digital health modalities within the system
→ Develop a national partnership across multiple sectors to align investments, resources and efforts; therefore ensuring sustainability of digital health efforts and enabling growth
→ Ensure data interoperability by complying with health data standards. This can allow the seamless flow of data among different stakeholders
→ Develop and implement a national and context-specific E-health vision and strategy based on local needs
→ Ensure the availability of adequate and sustainable financial resources
→ Develop a digital infrastructure that can support digital transformation
→ Build health workforce capacity including skills related to leadership and governance as well as technology-related skills
→ Develop laws and policies to ensure compliance with ethical standards
02 PROMOTE THE UTILIZATION OF BIG DATA TO ADVANCE AND SUPPORT DIGITAL HEALTH TECHNOLOGIES IN INFORMING AND SUPPORTING THE RESPONSE TO COVID-19 AND BEYOND (VAYENA ET AL., 2018; GUPTA ET AL., 2018; KRUSE ET AL., 2016; SAMUEL & DERRICK, 2020).

→ Identify big data sources that can be used to support digital health technologies and information mining
→ Promote interoperability of data sources
→ Develop an intricate governing framework to address concerns related to (1) data minimization, (2) privacy and security, (3) transparency, and (4) consent
→ Ensure that big data is leveraged for the public good

- Updating HIS policies laws and regulations
- Improving national coordination, planning and accountability and integrating both public and private providers.
- Ensuring availability of adequate human, financial and technical resources
- Optimizing data generation, quality assurance, monitoring and flow
- Building capacity of users on the utilization of the health information systems
- Strengthening data and information dissemination, such as translating data into information through dashboards and issuing alerts based on outbreak identification using the HIS
- Conducting a periodic assessment of additional health information needs

04 HARNESS THE UTILIZATION OF VIRTUAL TECHNOLOGY TO RESPOND TO THE CONTINUOUS INCREASE IN DEMAND FOR HEALTH SERVICES THAT IS NOT LIMITED TO PUBLIC HEALTH EMERGENCIES BUT ALSO EXTENDS TO EVERYDAY PRACTICE (SMITH ET AL., 2020).

- Ensure sustainable financing and appropriate remuneration for service provision
- Train healthcare workforce on new methods required for virtual health consultations
- Redesign the existing model of care by adopting a whole-system approach and embedding virtual health within the health system
- Develop policies and procedures for virtual health
- Ensure adequate infrastructure to support virtual technology (that can be scaled-up during emergencies)
ENABLE PUBLIC ENGAGEMENT AND ENROLLMENT IN DIGITAL HEALTH INTERVENTIONS (O’CONNOR ET AL., 2016)

→ Raise public awareness on the role of different digital health interventions, their benefits, and potential risks.
→ Consider incorporating two-way communication platforms where users can interact with healthcare providers or peers with similar health issues.
→ Obtaining endorsement from respected healthcare providers or instructions on the digital health technologies utilized to promote additional user sign up and engagement
→ Market the digital health interventions by targeting not just the patient but also his wider support network, such as his peers and his healthcare providers
→ Develop user-friendly and easy access and sign up digital interventions
→ Invest in upgrading network capacity and technical infrastructure
→ Invest in digital upskilling which would allow users to gain the skills needed to utilize the digital solutions
→ Provide funding models that can ensure equity
→ Inform the public of potential security threats and develop regulations to address security and user privacy and ensure the anonymity of information gathered
Further Insights

As the COVID-19 pandemic unfolds, technological applications are emerging as fundamental tools for governments, healthcare providers and healthcare institutions to effectively respond to public health crisis and to improve access to healthcare. There is no one-size-fits-all when it comes to digital health yet this advancement will require extensive assessments, localizing validated solutions and commitment to enable it.

While COVID-19 is a public health crisis, it is also an opportunity for the EMR governments, healthcare providers and healthcare institutions to harness, invest and capitalize on digital health technologies to strengthen evidence-informed decision-making during outbreaks and to address global and national health challenges.
REFERENCES


REFERENCES


