Review Article

Challenges and opportunities of digital health in a post-COVID19 world

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Digital health as a rapidly growing medical field relies comprehensively on human health data. Conventionally, the collection of health data is mediated by officially diagnostic instruments, operated by health professionals in clinical environments and under strict regulatory conditions. Mobile health, telemedicine, and other smart devices with Internet connections are becoming the future choices for collecting patient information. Progress of technologies has facilitated smartphones, wearable devices, and miniaturized health-care devices. These devices allow the gathering of an individual's health-care information at the patient's home. The data from these devices will be huge, and by integrating such enormous data using Artificial Intelligence, more detailed phenotyping of disease and more personalized medicine will be realistic. The future of medicine will be progressively more digital, and recognizing the importance of digital technology in this field and pandemic preparedness planning has become urgent.

Key words: COVID19, digital health, mobile health, telemedicine

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INTRODUCTION

Digital revolution has changed the product and service development in almost all aspects of human life, including human health.[1] Digital health is a rapidly expanding medical field with a significant impact on improving the quality of health care, its effectiveness, lowering the cost of the health-care system and patients, and clinical research.[2] The quick propagation of digital innovations for data gathering and communication technologies has transformed the way that physicians collect, share, and analyze health information for better clinical decision-making and health-care delivery. Digital health technology has produced a flow of data from patients vital signs,[3] lifestyles, and past medical histories[4] to health-care professionals that could support the development of a personalized medicine model.[5]

The availability of real-world health data instead of the momentary snapshots seen in hospitals and clinics will reform disease management, in both developed and underdeveloped countries.

Despite the rapid growth of digital technologies, the involvement of the various stakeholders, including patients, clinicians, the insurance industry, and regulators in medicine, remains relatively low.[6] This article aims to provide an overview of the current status of digital health, describe the future perspectives in this field, and point out some of the challenges that need to be addressed.

THE HISTORY OF DIGITAL HEALTH

Digital health is a multidisciplinary domain that aims to enhance the efficiency of monitoring of the patients, diagnosis, management, prevention, rehabilitation, and long-term care delivery.[7] Digital health is not an instant overnight phenomenon. The history of digital health returned to the 1970s when health telematics came into existence.[8] Telecommunications give the

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health-care systems a great opportunity to improve health, health education, and follow-ups using health telematics. Health telematics at that time aims to focus on diseases and improvement in diagnosing and treatment of diseases.[9] Health telematics, which is now known as telemedicine, is one of the most famous domains of digital health nowadays.[10]

With the beginning of the 21st century and extensive use of desktop personal computers and the Internet, the health-care systems found that the Internet is a great infrastructure for health promotion. At this time, eHealth came into existence. In contrast with health telematics, eHealth focuses on health instead of diseases.[9]

In the 2010s, another shift in technology and emerging mobile phones makes an opportunity that a new domain emerges, mobile health (mHealth). One of the main differences between eHealth and mHealth is adherence. Having a device that always is with people gives the community an ability to use health care services every time and everywhere.[11]

Finally, in 2015 with the widespread use of smartphones, tablets, and improvement in other technologies like robotics, a broader term than eHealth and mHealth was emerged. A term that we called it digital health.[9,12]

DIGITAL HEALTH DOMAINS

Digital health broad scope encompasses telemedicine, mHealth, wearable devices and biosensors, electronic health records (EHRs) and big data, artificial intelligence (AI), and machine learning. Augmented reality (AR) and virtual reality (VR) are other domains of digital health.[13]

Health telematics or telemedicine is the oldest domain of digital health that is put into more consideration more than other domains. Telemedicine makes it possible that health-care personnel visits the patient remotely. Telemedicine is now used for screening, diagnosing, and treating patients. Moreover, follow-up visits and consultations are also available by using telemedicine.[14]

One of the most knowns screening in telemedicine refers to ophthalmology.[15] Glaucoma, diabetic retinopathies, and retinopathy of prematurity are the diseases that have a successful screening by telemedicine.[16-18] In this approach also, a teleconsultation disk photograph is sent to ophthalmologists for screening retinopathies and glaucoma. Using telemedicine for diagnosing the diseases is much more common than screening. From psychiatry disorders like autism[19] to emergencies like Myocardial infarctions are handled by telemedicine.[20] Telemedicine is a good choice for follow-ups because it can reduce the cost of accommodation of patients in hospitals, and they can have access to the doctor even in rural areas. Joint arthroplasty and traumas are two the examples of using telemedicine.[21,22]

mHealth has been defined as medical and public health practice supported by mobile devices.[23] Using applications and web applications is now very common among people. There is a great penetration of using smartphones worldwide, even in the lifestyle of people with low socioeconomic status. Hence, health-related mobile applications might deliver the chance to overcome inequity to health-care access. Each person has tens of applications installed on their smartphones. Like telemedicine, this domain also has a variety of uses. The mHealth apps could be categorized based on their use into patient education apps,[24] clinical decision support apps;[25] therapeutics, and treatment support apps.[26,27]

Wearable devices, gadgets, and biosensors facilitate real-time ambulatory monitoring of human vital signs throughout daily life with the least discomfort and interference with normal human activities.[28] Currently, various wearable systems including microsensors integrated into textiles and clothes, computerized watches, belt-worn sensors, glasses, gloves, and everything that are worn contacting some parts of the body are designed for relevant health data gathering.[29]

Besides, many innovative wearable biosensors have been developed to detect a wide range of multianalyte/metabolites (such as lactate or glucose), electrolytes (for example, sodium, potassium, or calcium), and other biomarkers in fluids such as sweat, saliva, or tears and skin interstitial fluid.[30,31]

New wearable sensors like wearable glucose monitors are one of the new wearable devices that the US Food and Drug Administration approved. These sensors continuously monitor the blood glucose so the patient can control the blood glucose much more strict and prevent the complications of low or high blood glucose.[32]

Wearable biosensors must have the ability to work in uncontrolled environments, so calibration for variations in temperature, pH, and humidity is necessary for them.[31]

VR, AR, and mixed reality (MR) are being increasingly used in medical applications such as medical education, procedure simulation, rehabilitation, and psychotherapy.[33]

VR is a pure virtual digital picture, while AR is the result of the integration of information or graphical elements to the user's environment in real time.[34] Thus, AR is usually preferred to VR since the AR is focused on the real world rather than a totally artificial environment.[35]

It has been shown that VR, AR, and MR can improve the effectiveness of medical education, led to better performance of the physician.[36]

One of the main uses of AR and VR is in rehabilitation.[37] Poststroke and posttraumatic stress disorder rehabilitations are the most use of AR and VR. Creating new worlds only in small places with specific pieces of training aims to improve the disabilities is one the main reasons that VRs and ARs are used in this field.[38,39]

Computers can act as a human because they have the ability of processing and memorizing data, so computers can tackle complex learning tasks. AI – coined by John McCarthy in 1956 – is a broad term that describes any computational programs that simulate and mimic human intelligence, such as problem solving and learning. In machine learning, the machine learns from the data and performs tasks based on the learned model.[40] An applied AI and machine learning have been usually used interchangeably.

AI has been revolutionized medicine. The popularization of big data production and computing machine power has changed the fundamentals of health-care practice and research. Traditional statistics remain effective only in simple data sets, and many areas in clinical practice and research have been transformed by robust prediction and exploration of big data using AI.

Using this strategy in digital health leads to the invention of decision support systems. These systems help the doctor and the patient to personalize the decisions according to patient characteristics. Moreover, signal and image processing leads to improvements in diagnosing diseases in the field of pathology and radiology.[41,42]

Not only screening, diagnosing, and treating the diseases improved by new technologies but also the ability to collect and storing data digitally can lead to health promotion. EHRs make it possible that all the data related to a patient are stored in one place so anybody in the health-care system can have access to it and use the data for better decisions.[43] Moreover, EHRs lead to creating big data that can have an invaluable price for research and management of the health-care system.[44] Although some governments create EHR systems, private sectors also try to create an infrastructure for big data.[45]

COVID-19 AND DIGITAL HEALTH

Coronavirus caused by SARS-CoV2 is our newest guest. The epidemic started in China and spread all over the world, affecting millions of people. This epidemic affects people's lifestyles in all ways, from the first quarantines in countries to wearing a mask, social distancing, etc.[46] People's health care is also affected by this new virus. Most of the health-care system inevitably has to serve only COVID-19 patients and in many countries, because of the lack of enough medical resources the patients faced many problems. These problems lead the medical system to put "Digital Health" into more consideration.[47]

Digital health helps the healthcare system to fight against COVID-19 in different ways: 1 – prevention and primary care, 2 – screening, 3 – monitoring, and 4 – surveillance.

Using digital health for the screening of COVID-19 can lead to a decreased number of visits in emergency departments and help the health-care systems to stay more organized.[48] Using mhealth and ehealth and developing different mobile applications and websites for screening the patients is one of the most common uses of digital health.[49]

During the pandemics, the sudden increase of patients in peaks of the disease can lead to the inability of hospitals to admit all the patients so monitoring of the patients remotely using digital health can be beneficial. Using mhealth for developing applications that the patients can use for patient education or answering certain questions for ensuring the condition of patients is one of the main uses.[50] Moreover, telemedicine for distance consultation and using health gadgets like pulse oximetry is another use of digital health in the COVID-19 pandemic.[51,52]

Surveillance and using contact-tracing applications is another way that digital health comes to help to fight against the pandemic. Founding the pattern of the pandemic by using contact-tracing applications and isolating the suspected people is a beneficial way of controlling the spread of disease.[53,54]

KEY CHALLENGES OF DIGITAL HEALTH

Digital health adoption has been quickly accelerated since the onset of the COVID-19 pandemic as a "no-touch" emergency state. The need for physical distancing has turned the attention of both health-care providers and patients to digital health and reduced resistance to the use of telemedicine provided an opportunity for recognizing the advantages of digital health. The COVID-19 pandemic has revealed not only the need for data sharing but also the need for serious evaluation and ethical aspects to be developed beside the emerging field of digital healthcare. Taking informed patient consent will be a key challenge to provide transparencies regarding what data are collected and which third parties can access patient data. On the other hand, the application of health tracking reward programs by insurance companies encourages using wearable health technology.

Disturbed health-care systems and the need for physical distancing seem to necessitate an extensive experience of digital health solutions, many of them might have the potential to be extended after the pandemic passes, although the long-term use of digital health solutions largely depends on handling some of the challenges.

Key challenges affecting the development of digital health consist of a lack of evidence-based digital health standards and privacy, data governance, and ethical challenges.

Digital health and using EHRs create big data that can use for creating pieces of evidence, but all these data are acquired by convenience sampling.[55] Hence, this problem affects the quality of evidence from researches on these technologies. To resolve this issue, background variables such as age, sex, socioeconomic status, and the geographical distribution must be reported and compared between the groups.[56]

Another problem that emerged from health digitalization is privacy. All domains of digital health finally create data that need protection. Although anonymization technologies improve in recent years, finally re-identification is necessary because the new data should be merged properly with the previous data of the same person. Due to this re-identification hacking, digital health platform is a big deal.[56]

Data governance is another challenge that governments have. Although the improvement of technologies lowers its cost and because of it most of the governments take a step into digitalization, only half of them have privacy policies to protect the data. Hence, it is important that governments set up policies and standards for data governance.[57]

Ethical challenges are also important in health digitalization. User consent is one of these ethical challenges. Users should know about the collection of data. Although most applications ask users for this permission, it is often neglected by users, and almost all users only push the "I agree" button at first without reading the terms of use of the applications.[58]

There is a "no evidence, no implementation–no implementation, no evidence" paradox in digital health field.[59] Evaluation of the impact of digital health interventions entails a multidimensional analysis approach employing mixed methods to study the effects of the program on health-care workers, patients/healthy people, and the health system. The main knowledge gap about the use of digital health strategies is the lack of evidence on how such strategies may influence health outcomes, health system efficiencies, and cost-effectiveness of service delivery.[7]

Cost-effectiveness and sustainability of digital care should be mentioned by policymakers. It is necessary to build public trust and confirm a commitment to take care of their privacy.

CONCLUSION

Digital health will support the future needs of medicine by analyzing the massive amounts of recorded patient's data that generate by high-tech devices from multiple sources. Digital care can transform disease-centered services toward patient-centered services. Many of the digital health solutions are still in their infancy and need to be improved. Furthermore, they need extensive and successful validation in human testing and improved clinical reliability. Medical professionals also need to be familiarized and adapt themselves with these advances for better health-care delivery to the patients. Along with digital care growth, researchers, scientists, clinicians, payers, and regulators must accompany technology developers to reach the ultimate goal, which is to help patients live longer and feel better.

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Conflicts of interest
There are no conflicts of interest.

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