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Implementation of Digital Health Technology at Academic Medical Centers in Saudi Arabia

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ABSTRACT

Academic Medical Centers (AMCs) in Saudi Arabia are dedicated to providing high-quality patient care and promoting the health and wellbeing of its citizens. Additionally, they provide medical education and conduct research in a wide range of clinical disciplines. A recent global trend in academic hospitals with mandates similar to those in Saudi Arabia is that they have started utilizing digital health technology in a bid to increase efficiency and improve the quality of patient care. This paper takes the position that such digital health technologies should also be utilized in AMC settings in Saudi Arabia. Electronic health records (EHRs), smartphones, video-imaging technologies, virtual desktop infrastructures, mobile EHR access, and smart-beds can help AMCs serve patients more effectively. Rural people can be connected to consultants at AMCs using these technologies using virtual self-care tools. Validation of new digital health devices can be performed in collaboration with digital health partners and serve to enrich the knowledge of medical students in the area of digital health. This review aims to draw the attention of stakeholders to the need to implement digital health technology in AMCs in Saudi Arabia and help improve the quality of healthcare.

Digital health technologies involve the use of information and communication technologies (ICT) to address health problems faced by patients.[1] These technologies include both hardware and software solutions and services such as telemedicine, web-based analysis, email, mobile phone applications, text messages, and clinic or remote monitoring sensors.[2,3] The use of such technologies aid healthcare professionals (HCPs) and patients in managing illnesses and health risks as well as in promoting health and wellbeing.[1,3] Smart-patient-rooms are an example of such technology. These are fully integrated with patient care, electronic health records (EHRs), and the nurse call system. Such facilities help patients learn about their pathologies themselves.[4]

Many HCPs use smartphones and tablets to share patient-related clinical information, and investment in digital health research is increasing exponentially.[5,6] Several researchers have begun to discuss digital health technologies in high-quality studies related to healthcare.[7–9] In keeping with these current trends, Saudi Arabia announced a new National Model of Care in March 2017, which includes virtual self-care programs, eHealth, health innovation centers, and a platform for Saudi medical appointments, referral centers, and health education programs.[10] Virtual medicine impacts physician recruitment and plays a major role in the gig economy, which has a digital labor platform.[11] The gig economy refers to an environment which allows organizations to offer contracts to independent workers for short-term engagements.[12] Nomad Health, an online marketplace suggested bringing the gig economy to healthcare, thereby allowing doctors and nurses from various regions to team up with hospitals that require medical professionals on a short-term, freelance basis. It takes the digital health-gig economy hybrid philosophy a step further by expanding operations into the world of telemedicine and virtual doctor visits.[13]

Hospitals in the US are diversifying their digital healthcare programs using the Internet to engage

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and monitor patients.[14] In academic medical centers (AMCs), digital health technologies offer massive potential to improve the quality of patient care, reduce costs, and increase patient-centeredness in healthcare.[7] The Saudi Arabian government has also emphasized utilizing information technology (IT) in the healthcare sector. To achieve this, some hospitals have started using healthcare information systems to provide high-quality patient care.[15] Of late, digital health technologies have gained much attention among stakeholders of AMCs in Saudi Arabia.

An AMC, or university teaching hospital, is a constellation of functions and organizations committed to improving the health of patients through the integration of their roles in research, education, and patient care.[16] The objectives of the AMC in Saudi Arabia include treatment, teaching, and research.[17,18] Patient care delivered by AMCs is complex and expensive, which in turn mean they depend on the government for funds.[17] The model for hastening biomedical innovation at AMCs can be well-established and driven by expertise in basic science and technology, colocation of patients, physicians, and clinical facilities, and availability of funding for biomedical research.[19] AMCs are now recognizing the need to retool their innovation programs for the emerging world of digital health. Therefore, this review aimed to discuss the importance of implementing digital health technologies in AMCs in Saudi Arabia and discuss the impact of the gig economy on healthcare workers.

Effect of gig economy on healthcare workers

The gig economy and digital labor, by way of facilitating the provision of job offers in required areas, are considered integral to planning for economic development by many governments and policy-makers. Given the influence these new technologies have on the livelihoods of workers, the subject has been gathering increased attention worldwide.[20] The rise of digital labor has developed due to the convergence of two trends: (i) unemployment and under-employment, which are major social and economic concerns for policy-makers, for people with jobs and people looking for jobs;[21] and (ii) rapidly changing connectivity, observed in most countries. The International Labor Organization estimated that there would be 213 million new labor market entrants between 2014 and 2019.[22] About 10 years ago, < 15% of people were connected to the Internet, whereas now over 40% of the world's population is connected.[23] In the early stages of business process outsourcing (BPO), only a few locations offered adequate connectivity to maintain transnational workflows.[24] But as the number of people connected to the Internet increased in low-income countries, a different type of outsourcing developed. In digital labor platforms, clients post jobs and workers bid on them. In contrast to BPO work, digital labor platforms are characterized by a new model, which allow the outsourcing of business processes without the mediation of formal BPO organizations. Work is turned into a commodity and the workers into a 'computation service'.[25]

In 2016, the market for digital work was rapidly growing and valued at around US$ 4.4 billion.[26] An index measuring the utilization of digital labor platforms estimated that their use is growing globally at a rate of 25% per year.[27] This is true regarding the healthcare market as well, where digital labor is badly needed to reduce the cost of healthcare services.

In recent days, labor markets have started facing a radical change in their nature of work due to the transformation of digital platforms. This development has had a positive impact, chiefly, by matching workers with jobs more efficiently and transparently. On the other hand, there is a loss of the traditional employer-employee relationship, which has long served as the primary channel through which worker benefits and protections are provided.[28]

The interest of the Saudi population in digital health technology

In Saudi Arabia, consumers have begun to consider digital health technology as an integral part of effective health management. About 84% of consumers found the importance of technology in managing their health. They use websites (44%), applications (40%), social media (41%), and wearable technology (14%) to manage their health. Some consumers also use remote consultation (24%) and remote monitoring (12%) for health management. Further, health applications related to fitness (46%) and diet/nutrition (54%) are the most popular among users. About 81% of consumers acknowledged better care when their doctors access and use EHRs. In contrast, 65% of consumers prefer in-person visits over virtual visits (35%). Such customers also believe that virtual

visits could provide benefits such as lower costs (50%), scheduling convenience (37%), and quality care (48%). Moreover, Saudi consumers are eager to track their health using digital tools and share the data with HCPs. The percentage of consumers ready to share wearable or application data with a doctor and nurse were reported as 76% and 67%, respectively.[29] Thus, digital health technologies are assisting patients on how to understand, monitor, and gain control of their health.[29] The National Model of Care announced in 2017 by the Minister of Health emphasizes the role of digital health technology as an important component of health services, and the Saudi population is responding favorably to the use of such technology in obtaining quality healthcare.[21]

Digital health technology in AMCs

Developing a digital hospital network at AMCs

Digital hospitals are complex ecosystems with various clinical and business processes comprising numerous sub-processes. Through proper integration using ICT, these processes unite patients, HCPs, assets, and information throughout the hospital, and thereby deliver the right information and resources at the right time to the point of care. In Spain's Catalonia, digital health technologies are utilized in the hospital network to aid HCPs in sharing patient data, improving patient experience, and delivering time-sensitive care. Similarly, New Parkland hospital of the Parkland Health and Hospital System in Dallas was pronounced a 'Digital Hospital', and a more automated and integrated ICT environment was created to help solve patient care problems and bring about improvements.[4,30] Patient waiting time for consulting specialists has been significantly reduced through digital health technologies that connect primary care physicians with hospital professionals.[31] These advances can help patients facing a variety of health problems. For instance, in Saudi Arabia, of all the deaths that occurred in 2014, about 5% were due to diabetes and 46% to cardiovascular diseases.[32] Digital health devices should be designed and utilized in hospitals to assist patients in the management of such non-communicable diseases (NCDs); AMCs can use such devices to support cardiac patients remotely.

However, AMCs face significant barriers to the development and adoption of digital health technologies and should be positioned to overcome them.[33] Barriers to the adoption of eHealth technologies by physicians were identified as design and technical concerns, privacy and security, cost and liability issues, productivity, patient and physician interaction, lack of time, workload, and threatened clinical autonomy.[34] AMCs and the authorities involved in their governance need to create the necessary infrastructure and processes to meet these challenges.

Sharing information between AMCs

Using integrated healthcare information systems has allowed Saudi hospitals to provide the best possible treatment for clinical problems and maintain medical and administrative records. In addition, some hospitals have integrated networks to share clinical information and patients' medical histories. Through these integrated networks, it is possible to diagnose and treat patients online. One can choose doctors and instruments for their treatment through information networks.[35] Further, using integrated networks, feedback on patients' status and their management can be obtained from various HCPs of partnering AMCs inside and outside Saudi Arabia.

Developing research in academic and clinical areas

AMCs should focus on research activities in academic and clinical areas by exploring and testing the use of various advanced devices in digital health. The University of California at San Francisco (UCSF), an AMC, recently initiated a Health e-Heart study, which combines biometric monitoring and social media tools to predict the risk of cardiac diseases.[7] UCSF has also developed a new research methodology and is validating new research tools.[36] In Oman, Al-Abri et al,[37] intended to validate the iOS device-based uHear application as a screening tool for hearing loss in a clinical setting. By validating this app, healthcare workers in primary care could detect hearing loss and reduce unnecessary referrals.

Ortiz and Clancy[38] explained the development of an Integrated Delivery System Research Network (IDSRN), which could capitalize on the research capacity of large integrated delivery systems in the US. This network includes various partners who are well-matched for conducting relevant research. The advantages of IDSRNs are that they generate results at a faster rate and study the different ways

that ICT can improve the quality of health care in diverse settings. Some network partners studied how automated electronic reminders affect compliance with recommended guidelines for the management of patients with diabetes. Along these lines, AMCs in Saudi Arabia can develop research networks through partnerships between AMCs within and outside the country using digital health technology in the screening, detection, and management of NCDs. Further, these networks will also provide a channel to faculty and medical students to perform a wide range of research using digital health technology along with physicians outside Saudi Arabia.

Apart from patient care, teaching and research are also considered key functions of AMCs. It is observed that the utilization of ICT in teaching, learning, and research to support the outcome in the educational system is inadequate. Therefore, Saudi universities should invest sufficiently in ICT, technical infrastructure, and skilled human resources to generate and improve the quality of learning and teaching. Further, it is essential to create collaborations between international academicians and Saudi universities; this can improve the quality of research and will facilitate international benchmarking. In addition, university-industry collaboration is essential to increase industry-based financial support for research, which focuses to a greater degree on practical health outcomes that would be of ultimate benefit to the nation.[39]

Developing AMCs as a platform for digital health innovation

Recently, UCSF developed a center for digital health innovation to assist researchers, patients, and physicians in developing new technologies and validating the developed tools through collaborations with partners such as Samsung.[40] AMCs such as UCSF and Partners Healthcare have also worked to integrate digital health tools into medical education and training programs. A new course available at UCSF allows medical students to gain credit for editing health-related Wikipedia articles.[7] In addition, opportunities for both internal and external internship in digital health are offered at AMCs.[7] Such centers for digital health innovation can be developed at AMCs in Saudi Arabia through digital health partners so that new digital health devices can be created and validated. New courses on digital health can also be introduced to Saudi medical students in collaboration with digital health partners, thereby achieving integration of digital health innovation and medical education.

Use of mobile devices in digital health

Mobile devices can empower patients and their caretakers in controlling health problems and reducing their dependency on physicians for health information. These devices can use digital technology to present research information online, share experiences, and identify treatment options. They provide access to health information and education, which are important drivers of patient engagement. Fitness, medical reference, and wellness applications are widely available health applications that provide information related to health. In 2014, the number of health applications on iOS and Android had doubled to over 100 000 in 2.5 years, and top pharmaceutical companies had 63% more unique applications.[41] Therefore, AMCs in Saudi Arabia can expect to have or create customized applications on fitness and health, so that health information can be shared between health centers, patients, and carers. Since NCDs accounted for 78% of total deaths of the Saudi population,[32] clinical information about NCDs can be made available through unique health applications. This may assist in creating awareness among Saudi citizens about NCDs and other communicable diseases.

The use of mobile devices and medical applications for HCPs also include information and time management, health record maintenance and access, clinical decision-making, patient monitoring, and medical education and training.[42] Several studies have also shown that mobile devices allow HCPs to be more efficient in their work practices.[43,44] Deloitte (2013) stated that effective implementation of health information technologies such as EHRs, e-prescribing, health information exchange, analytics/decision support, patient support tools, and mobile health technologies can improve the efficiency of clinical practice.[45]

Telehealth/telemedicine

In recent years, there has been significant growth in the use of telehealth. Many hospitals in the US connect patients and consultants using video and other technology.[46] The Medical University of South Carolina, an AMC, has utilized telehealth to improve the health of the state including most rural

regions.[47] Nationally, according to the Washington Post, over 15 million Americans have received some form of remote care.[11] In 2016, about 72% of hospitals and 52% of physicians offered telemedicine services.[11] Since various factors such as coverage, payment, and other policy issues limit the complete use of telehealth, there is a need for the expansion of America's government-supported Medicare coverage and payment; hence, and a more flexible approach to add new telehealth services to Medicare has been advocated.[46]

Altuwaijri[15] stated that a robot could be used by surgeons while conducting surgery in another city. This service can greatly be utilized in Saudi Arabia due to its vast geographical spread and the existence of many villages. Hence, AMCs in Saudi Arabia can also implement telehealth/telemedicine to connect patients with consultants of various medical centers abroad. This way, international standards of medical treatment, health education, and public health services can be provided to citizens. Also, patients from outside Saudi Arabia can be linked with consultants of AMCs in Saudi Arabia through telehealth/telemedicine. In addition, it is essential to connect primary care centers in rural areas of Saudi Arabia with AMCs inside and outside the country using digital health technologies, so that better treatment and health education can reach rural populations. As stated earlier, the National Model of Care declared that the nation's healthcare system should benefit from technology to the maximum, implying the use of virtual self-care, telemedicine, national-wide EHR, and health education programs.

Creating collaboration with industry and technology accelerators

A recent study stated that UCSF and Partners Healthcare made academic-industrial partnerships with industries which range from start-ups in their early stages to large incumbent technology companies.[7] Even though many AMCs have existing relationships with large IT vendors, new partnerships with technology accelerators like Rock Health and StarX play a significant role in introducing AMCs to early-stage start-ups.[48] Such involvement of technology accelerators assists AMCs to create areas of continual development and innovation, improve health incomes, reduce costs, and enhance the patient experience. For example, UCSF and Rock Health have conducted annual events where clinical issues identified at UCSF are presented to digital health technology inventors and sponsors from the large US digital health community.[7] Likewise, AMCs in Saudi Arabia can also demonstrate to technology developers various clinical problems found in the Saudi population by conducting annual conferences. This, in turn, would expose AMCs to new inventions of the digital health community and induce digital health partners to further work on innovative technologies to help address clinical problems among the Saudi population.

Developing new business models through AMCs

AMCs are also initiated to explore new business models to monetize their efforts in digital health. AMCs like UCSF and Partners Healthcare have created programs where the costs of clinical research studies can be balanced through sharing agreements with industry partners. For example, the UCSF-Samsung Digital Health Innovation Lab was created by UCSF after forging a partnership with Samsung to validate mobile health sensor technologies. New licensing and contracting capabilities tailored for ICT solutions are developed by UCSF and Partners Healthcare to allow new undertakings within their commercialization offices.[7] In Saudi Arabia, AMCs can share agreements with digital health partners to create new programs to reduce the cost of their clinical trials and validate the health sensor technologies. New inventions from research can also be claimed for patency and commercialized through various digital health partners.

CONCLUSION

Hospitals incorporating the latest digital health technology into the services they provide have seen better prospects in boosting their efficiency and quality through greater integration of all sources of care at their disposal. Such technologies also aid in providing online information, disease management, remote monitoring, and telemedicine services. AMCs should be updated with digital health technologies in the form of EHR, health applications in smartphones, telehealth, and digital health innovation to meet the demands of the growing Saudi population and the challenges posed by the increased occurrence of NCDs and other communicable diseases. Through this, AMCs can

expand capacity, bring about high process efficiencies and broad advances in healthcare access, and improve the quality of patient care and safety. Barriers should also be identified and resolved while implementing digital health technologies in AMCs.

Disclosure
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