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Assessing the Newer Technological Trends in Digital Health

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ABSTRACT

The COVID-19 pandemic has caused hardship on the world's healthcare system. The epidemic has forced the healthcare system to be redesigned, reorganized, and transformed. A swift strategic change is required due to the emergence of novel COVID-19 virus strains in many nations and the infection of a greater number of communities. Various digital solutions have been presented by healthcare institutions, non-profits, and governments. These digital solutions' adaptability, functionality, effectiveness, and dependability are all unclear. Many nations are searching for support and the adoption of digital technology to tackle COVID-19 as the disease spreads more widely. This article will discuss digital health tools for COVID-19 pandemic management, surveillance, contact tracing, diagnosis, treatment, and prevention in order to ensure that healthcare is delivered effectively. Healthcare workers (HCWs) are increasingly being supported with a variety of interventions, including remote consultations, disinfection, case base surveillance, and information dissemination, using artificial intelligence (AI), big data, telemedicine, robotics, the Internet of Things (IoT), digital platforms for communication (DC), computer vision, computer audition (CA), digital data management solutions (blockchain), and digital imaging.

KEYWORDS:healthcare, telemedicine, digital healthcare, artificial intelligence, blockchain, robotic surgery.

INTRODUCTION

The emergence of digital health technologies has become an inevitable part of the healthcare evolution. Post Covid, especially public awareness about the benefits of digital healthcare service has been well documented. Like any other new disruptive technology, digital health, too, is fraught with numerous challenges in its uniform adoption. The COVID-19 pandemic that just broke out has significantly impacted socioeconomic, sustainable, and worldwide healthcare systems. The illness is extremely contagious and can cause a variety of symptoms [1], such as fever, sore throat, conjunctivitis, headache, diarrhea, and dry cough. As of May 20, 2021, there have been about 171 million morbidities and approximately 3,565,021 fatalities worldwide attributed to digital data repositories [2]. In wealthier nations, the number of critically ill patients is increasing more quickly than the capability for critical care.[3,4]. The paucity of medical resources in low- and middle-income countries (LMICs) makes them more prone to the disease's outbreak.In poor and emerging nations, the provision of intensive critical care (ICU) for critically sick patients is a significant determinant of death rates. Before it surpasses their ability to provide healthcare, emerging nations should take preventive measures and protections. The emphasis is on the necessity of appropriate preventive steps to lessen the pandemic's effects. Conventional preventive measures, such as lockdowns, safety gear, quarantines, and social separation, are being implemented. Lockdowns and quarantines, however, have caused both the economic downturn and psychological suffering in people [5] Digital health technologies can offer practical solutions to address the persistent problem, which is the main reason the information technology (IT) sector is garnering attention[6]. LMICs, or low- and middle-income nations, are especially vulnerable since they lack the resources for healthcare. 5 to Cloud data solutions, robotic technologies, real-time tracking and monitoring systems, 5G-powered telemedicine, artificial intelligence (AI), and cloud data solutions can all provide innovative approaches to reducing the risks involved in managing infectious diseases, including quicker detection and front-line protection. the outbreak of the illness.The World Health Organization (WHO) has produced a useful manual that country authorities should utilize to create and revise their COVID-19 answers [7].In accordance with these directives, several national health ministries have supported a series of healthcare interventions while promoting the promotion and prevention of disease transmission[8]. This review covers the relevant healthcare models that are currently used in developing nations as well as innovations that may be used in LMICs. Significant exposure to the most recent developments in digital health technologies may stimulate new technological endeavors and the adoption of the most recent healthcare paradigms.The review uses a siloed system approach to repeat the procedure within specific countries while synthesizing global trends in digital healthcare.

THE NECESSITY OF DIGITAL HEALTHCARE

The absence of innovative technologies found in rich nations is causing problems for the healthcare systems in low- and middle-income countries. Modern medical facilities are provided by commercial healthcare service providers on an equal footing with those of the public sector[9]. The lengthy wait times for these consultations and sophisticated treatments in public healthcare institutions make room for private healthcare organizations to offer

speedier, frequently superior services at greater prices. The underprivileged population, particularly in rural areas, struggles to pay for prompt medical attention and high-quality healthcare services. Nonetheless, Figure 1 presents a clear discussion of several variables that control the health sector's overall success in a nation. LMICs are under grave danger, even as the present epidemic is causing healthcare management to become less commonplace worldwide. The push for LMICs to adopt and adapt digital health care models comes from improvements in top-notch instruction, the deployment of qualified professionals, foreign direct investment, the widening of the minds of inland gullible users, the national demands for high moral standards, the capacity to own digital devices, the readiness to embrace change, better educational facilities, and strengthened international fraternity against invisible enemy.

DIGITAL HEALTHCARE MODELS

Using open-source web tools to monitor a suspected subset of people.

Research revealed that a single infectious person can determine the number of new infectious cases[10], and that person may or may not exhibit symptoms[11]. Therefore, it is essential to identify the afflicted patient and track down their contact to stop the transmission. A social graph of people and their interactions is being created with the use of a centralized tracking system called the Pan-European Privacy-Preserving Proximity Tracing (PEPP-PT)[12]. With the use of this centralized method, sensitive information about geological locations, whereabouts, and close contacts is tracked down and stored in central repositories for easy access and monitoring by the relevant authorities. Nonetheless, human rights authorities oppose this centralized method[13], citing the possibility of information access for future surveillance by government agencies and law enforcement. Decentralized privacy-preserving proximity tracing (DP-3T), or decentralized data tracing, is thus being emphasized. Nonetheless, a lot of European countries are keen to use this idea in conjunction with short-range tracking technology like Bluetooth (Bluetooth tracking). Privacy-conscious methods typically do not work with contact tracers that hold sensitive data, such credit card transactions, location monitoring, or CCTV footage. As a result, Bluetooth tracking seems to become more appealing. To determine the duration of a contact and close contacts, Bluetooth "Handshaking" is sufficient. In the meantime, decentralized contact tracing systems will receive technological backing from Google and Apple, according to their announcements[14].

District health information software (DHIS2+) digital toolkit

A digital data management and analytics program that is involved in a range of applications globally, mostly with countries in Africa and Asia, has been released by District Health Information Software 2 (DHIS2). The complex charts, geographic information system (GIS), pivots, and dashboards of this data aggregation and management tool make it simple for the program to visualize data dynamically.It makes a variety of applications possible[15]. Health information systems, COVID-19 monitoring, the COVID-19 vaccination, education management systems, and tracking are among them.

To support active monitoring, case scenario reporting, expedited case detection, and the COVID-19 reaction, it captures person IDs as well as additional sociodemographic information. This model makes it possible to identify the suspected subsets using tracking techniques.

DYNAMIC DASHBOARD MODELS

The dashboard platforms are web-dependent models that undergo extensive real-time data processing. International dashboard providers like Johns Hopkins University dashboard, Microsoft Bing COVID-19, CDC, WHO, and the Centers for Disease Control and Prevention (CDC), NXC, DXY, and BNO,use integrated information from these organizations to track COVID-19 statistics in real-time. Worldometer.info and The New York Times[16]. The public can get the raw data on GitHub [17]which guarantees researchers' access to COVID-19 statistics.Dashboards for data analysis in low- and middle-income countries (LMICs) like Sri Lanka are made possible by a variety of domains, including the Presidential Secretariat[18] and the Health Promotion Bureau [19]. These dashboards provide real-time case dynamics, disease growth rate comparisons with other countries, death rate comparisons, and district-wise case distribution. With the use of these dashboards, citizens can avoid false alerts and unnecessary anxiety while still getting private updates from law enforcement.

AI-enabled big data analysis and computer vision

Even in the medical field, technology can offer a creative answer by supporting screening, diagnosis, and customized risk assessment. Through case tracking and modeling, AI-based big data analysis can help with risk assessment or even enhance prognosis. A large amount of data is needed for training and validation to remove biases in forecasting AI tools and algorithmsthat are successful. Consequently, AI has not yet had a significant enough influence to offer reliable solutions for predicting outbreaks on its own[20]. Due to a lack of raw data, noisy social media data, outliers, and big data hubris, many forecasting algorithms used established epidemiological models, known as the SIR model (Susceptible, Infectious, and/or recovered), for illness forecasting. AI may also be useful in the hunt for the right vaccinations[21]. Not many vaccinations have been developed recently, and the WHO has licensed quite a few of them for use in emergencies. The World Health Organization has authorized the use of the COVID-19 vaccines from Pfizer/BioNTech, AstraZeneca-SK Bio, Janssen, Sinopharm, Serum Institute of India, and Moderna in emergency situations[22]. But large immunization and booster programs have begun, and the clinical trials for these vaccines are now complete. Healthcare workers (HCWs) and authorities are implementing AI-powered devices to identify the target group in addition to standard diagnostic tests. These devices include computed tomography (CT) scanners and temperature scanners. Reverse transcriptase-polymerase chain reaction, or RT-PCR, takes days to detect the infection and fails to identify 39–61% of asymptomatic cases[23]. According to Li et al., PCR's (71%) accuracy may not be as high as CT imaging's (98%)[24]. Thus, Shanghai, China, pioneered artificial intelligence-based CT scanning. A Beijing-based startup named "Infer Vision" developed software that uses artificial

intelligence in CT images. Ping Smart Healthcare has invented a smart image reading technology that analyzes CT scans in 10 seconds with a more than 90% confidential rate, whereas human CT diagnostics can take up to 15 minutes[25].However, neither RTPCR nor AI-enabled CT scanning significantly affects the capacity to identify infected individuals. Rather, it helps medical staff diagnose patients and keep them apart from the public without causing major spread.

Wearable data analytics and IoT

Micro or nano sensors or implantable microchips are used by wearable and implantable medical devices (IWMDs) to provide continuous health monitoring and treatments. These rapidly developing wearable devices have a great deal of promise to save lives and money. On the other hand, wearable sensors on the outside are flexible and simple to operate. If any sensor identifies anomalies in physiological measurements, the gadget notifies the patient automatically via Bluetooth or Wi-Fi to the mobile app and concurrently uses data fusion to connect with the cloud. It allows caregivers and medical professionals to watch patients from a distance and provide real-time care. The app-based solution DETECT, developed by the Scripps Research Translational Institute in collaboration with Care Evaluation, analyzes wearable data supplied by users to determine the spread of viral infection. To transfer physiological parameters utilizing electronic health records (EHR) and avoid overcrowding test facilities, these systems are preferable for in-home quarantines. Examples of apps that offer the necessary functionality are "Alexa Daily Check," "Give Me Guidance," and "Apple Health Check-up Siri."

Telehealth during the pandemic

Using two-way media exchanges, telehealth connects patients and medical providers who are frequently geographically separated. The chief medical officer of Carbon Health, a telehealth company, Dr. Ceasor Dhavaherian, explains that telemedicine is the extension of healthcare services into virtual interactions aided by devices, such as the use of remote stethoscopes like "EKO Health" or some other at-home pressure cuffs and connected scales.As a result, telehealth solutions offer medical treatments from a safer distance than traditional healthcare systems. The ability of a physician or doctor to triage patients based solely on physical symptoms during the pandemic is, in a sense, the best result of telemedicine, as it avoids the need for hospitalization of patients. Telehealth solutions therefore developed during the pandemic. But there are several additional factors that come with implementing telehealth services.

Robotics in healthcare

Cutting-edge telepresence technology is being used by autonomous robots to help stop the COVID-19 virus fromspreading. Robots have been employed in the delivery of food and medications, cleaning of rooms, examination and treatment of suspected patients, and protection of staff members from viral exposure.

Delivery

Since everyone has been forced to stay inside their homes without access to supplies, the need for delivery robots is mostly driven by the necessity for hospitals and food delivery services. So, there is currently a surge in the need for delivery robots. Zhen Robotics, a Beijing-based company, delivers food while keeping an eye out for those not wearing masks in the shopping centers. A robot chef has been integrated into the kitchen of Ezhou Hospital to prepare and serve food. "REV-1" in food delivery was created by University of Michigan start-up Refraction AI as a test deployment for about 500 consumers in corona use-cases. In a different instance, the hospital quarantine zone's secure distribution of medications or supplemental medications was handled by the self-sufficient mobile robot "Phollower 100" from the company Photoneo.

Screening and treatment

Seattle, USA hosted the first COVID-19 patient to receive treatment from a robot outfitted with a stethoscope and virtual screen. The robot collected the man's vital signs while he was segregated and conversed with the physician via the console. China deployed robotic hand sanitizer dispensers that were replenished with antiseptics in its urban areas. In Shenyang, China, a patrol robot checks people's body temperatures and sanitizes areas. The robot is controlled by the people who ride the movable scooters. The police in Tunisia used a robot that was fitted with thermal imaging cameras, an alert system, and infrared technology.

Awareness

The Indian start-up company "Asimov Robotics" has unveiled two robots to spread facemasks and hand sanitizers and to increase awareness.

Interactive

A robot called "Zorabots" was created in Belgium to allow elderly people to stay in their homes and stay in touch with family members in a secure setting that protects the most vulnerable populations from infection[26].

Disinfecting spaces

The potentially fatal COVID-19 virus emphasizes the need for discovering ways to clean bio-contaminated air and transmission surfaces. Hospital-acquired infections (HAIs) pose a novel risk to healthcare facilities since they can spread during patient visits. Hospitals, healthcare facilities, airports, and shopping centers are implementing disinfection using robotic equipment for UV disinfection. Robotics companies like "UVD Robots," "Blue Ocean Robotics," and "Kenex" are at the forefront of deploying UV-Light-based virus-fighting robots in hospital facilities globally. These robots are refilled with sanitizers and operated via remote technologies.

Blockchain in healthcare

Information about how many ventilators, PPE, medications, and hospital/ICU beds are in the supply chain, where they are located, who can share them, and who is most in need is still not uniform between states and hospitals in various countries[27]. Government entities find it very difficult to effectively respond to the requirements during the epidemic due to the fragmented and unstructured information flow. In order to properly coordinate and handle this matter, a single, precise, and consolidated picture of the supply and demand for these essential pieces of equipment in real-time is required. The combined capabilities of digital technologies like Blockchain, Cloud, and AI may be used to build a coherent, trustworthy, and clear picture of supply and demand data that includes a wide range of stakeholders, geographical locations, and legal entities[28]. Subsequently, local governments might collaborate to promptly and effectively allocate resources in response to variances in demand among states. One kind of decentralized ledger technology that makes data transfer and storage safe is called blockchain[29].Since every transaction is stored on every network node, it is impossible to alter a record in the past without also altering blocks that come after it. Decentralizing data recording enhances financial and logistical traceability in intricate healthcare supply chains, as well as security and stability in data ownership and administration[30].

ROLE OF SOCIAL MEDIA IN PUBLICIZING GOVERNMENT SAFETY MEASURES

When responding to the pandemic epidemic, the general population prioritizes education, public involvement, and technical literacy. Regardless of the facts, the press and media releases shaped public opinion among constituents. Nonetheless, the population's resource-constrained segment was still unable to receive real-time information in a timely manner. On the other hand, in addition to illness, excessive exposure to social media and phony internet resources may cause psychological anguish in certain people.With 2.4 billion internet users, social media has emerged as one of the primary online news sources. Of them, 64.5% rely on websites like Instagram, Facebook, Twitter, WhatsApp, Snapchat, and other sites for breaking news. It is estimated that 90.4% of millennials, 77.5% of Xers, and 48.2% of baby boomers use social media frequently[31]. The information is delivered by this international factchecking network's (IFCN) WhatsApp bot through machine learning techniques[32]. WhatsApp revealed a $1 million grant for fact-checking initiatives of ICFN to report on misinformation that are disseminated through SMS and WhatsApp[33].

COVID-19 DIGITAL RESPONSES

Massive digital solutions and potential mitigation measures were unlocked by the unexpected pandemic. Digital techniques include using radio, television, cell phones, blockchain, artificial intelligence (AI), drones, unmanned aerial vehicles (UAVs), and geographic information systems (GIS) that enable satellite and internet technologies to provide quick solutions. Digital response includes important elements including self-diagnosis, teleconsultation, information sharing, case surveillance, reminders, laboratory data management, and track records. A few developing nations use tabulated solutions as one of their most important instruments for responding to the COVID-19 pandemic. All citizens now have better access to healthcare thanks to these instruments. With thorough evaluation, the solutions can be reestablished in other emerging nations.

CHALLENGES AND OPPORTUNITIES

Even if digitalization is praised as a source of advancement, there are hidden obstacles. Digitalization is crucial during the pandemic because it generates quick answers.People might, however, be averse to the shift and harbor several worries. Employees in particular may have significant setbacks when the pandemic is gone.It makes sense that if digitalization results in less human connections, people would be afraid of losing their employment, having their positions changed, finding it difficult to adjust to the new environment, and having to take on more duties. Consequently, businesses and entities ought to plan to future-proof their working solutions and workforce demands to be ready for these anticipated outcomes.

CONCLUSION

The worldwide healthcare industry faced numerous obstacles because of the COVID-19 epidemic. For current and impending epidemics, digital technology can offer a reliable and accurate answer along withsteps to assist the healthcare industry. With maximum effectiveness, technology

introduces fresh perspectives and optimism for the community's improvement. In addition to providing faster case identification, continuing monitoring, access, smart decision-making, and virtual consultations, these digital healthcare technologies also improve the quality of care. From every perspective, the pertinent authorities and decision-makers should be aware of the core characteristics, innate abilities, opportunities, and potential of these solutions. A comprehensive and honest assessment of how well these solutions integrate with the country's current infrastructure is also necessary. Additionally, the public and other organizations need to collaborate closely and promote digital health solutions.

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