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Digital Health: An Overview

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ABSTRACT

Digital health is an emerging area at the intersection of healthcare and digital technologies. It covers technologies (such as mobile health, telemedicine, big data, genomics, artificial intelligence, blockchain, and wearable devices) that are used to improve access to healthcare, reduce the cost of care, and improve the quality of patient care. A digital-based healthcare system is desperately needed. Deploying digital health services that fit into existing healthcare systems is crucial to improve their performance, accessibility, comfort, and efficiency. All citizens have a right to digital healthcare because it is better, more sustainable, and empowering. For this reason, the digital healthcare is a booming industry. The future of digital health continues to look bright, as long as policy makers, privacy experts, and the private sector can work together to address key issues that limit its potential impact. This paper provides an overview of digital health and its uses.

KEYWORDS: *technologies, digital health, digital healthcare, digital healing, digital transformation, eHealth, digital revolution, mHealth*

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INTRODUCTION

Healthcare is a huge industry and is increasingly reliant on technology. It is changing rapidly around the world due to breakthroughs in digital technologies that are being adopted to meet various challenges. Technological breakthroughs bring patients and doctors closer, regardless of their physical distance. They lead to better, personalized healthcare services and make them more affordable and accessible. Modern healthcare is technological healthcare. Technology is everywhere. The adoption of new technologies will transform every part of the healthcare industry. Technology surrounds every aspect of 21st century life. It is in the cell phones we use, the cars we drive, and even the food we eat [1]. Figure 1 shows a typical example of how healthcare and technology go hand-in-hand [2].

The main uses of technology in the health sector include [3]:

- Mobile health
- Electronic health records
- Precision/personalized medicine
- Predictive analytics
- Telehealth and telemedicine
- Wearable technologies
- Smart technologies
- Connected devices
- Monitoring services
- AI-enabled check-ups
- Biotechnology/bioinformatics
- Medical Robotics
- Chatbots & drones
- Nanomedicine
- Social media
- 3D-printing (advanced prosthetics)

Since the dawn of healthcare, doctors have tried to make informed decisions with a very limited set of tools. They easily burn out under the burden of bearing with all the responsibility concerning medical decisions and consequences. They have the huge responsibility of involving patients as partners in designing care and decision making; and guiding them in using various digital health technologies. They have started sharing responsibility with patients. Empowered patients see themselves as equal, engaged, and they want to take active part in making

decisions about their care even it involves use of disruptive technologies [4].

With longer life expectancies, the increasing number of people living with chronic diseases, the rising costs of treatment, and doctor shortages are imminent worldwide, there is an ever-growing pressure on healthcare systems around the world. Increases in life expectancy have led to a disproportional increase in demands on the health sector.

WHAT IS DIGITAL HEALTH?

By the 2010s, the digitalization of healthcare became inevitable. Today, everything is affected by the digital revolution, improving the health and well-being of individuals, communities, and populations in an unprecedented manner. Digital health has made a range of technologies such as artificial intelligence, robotics, genomics, telemedicine, virtual and augmented reality, and wearable technologies. It is a multi-disciplinary area involving patients, stakeholders, healthcare practitioners, researchers, and scientists with expertise in medicine, engineering, social sciences, public health, and data management.

A digital-based healthcare system is undergoing digitalization of healthcare. It goes further than just achieving a stage where citizens have full access to their health data and better access to more effective and comfortable care. Digital healthcare strengths lie not in technology but rather in the fact that digital technology will be present in processes, professionals, and patients in ways such that everyone can be a healthcare creator. Online shopping, teleeducation, telework, telehealth will be used more extensively. Security of data, privacy, and interoperability are the basis of trust necessary for the new social contract [5].

Tight budgets, aging populations, and the rapidly growing prevalence of chronic illness are exerting pressure on healthcare systems that are already struggling to cope with demands for services. Digital health technologies are widely advocated by policy makers as a solution to the complex challenges facing healthcare systems. Digital health is focusing on tracking and managing the personal health. Its aim is to improve health management for both patients and care providers. Digital transformation is the fundamental change all branches of medical industry. Digital healthcare requires a new way of thinking, as well as new technologies. Digital health innovations aim to reduce health-care professionals' administrative burden and other repetitive aspects of their jobs. Benefits of digital health systems are seen a lot when it comes to respiratory illnesses. Telehealth makes the monitoring of these diseases way easier and streamlined [6]. The major factors fueling the digital transformation of healthcare include lower cost, accessibility, and value-based care models. Figure 2 shows the components of digital health [7].

The major objectives of digital healthcare include the following [7]:

- Enabling affordable – universal – access to the best possible for all;
- Making healthcare systems, sustainable and affordable.
- Educating and empowering people in a measurable way to prevent diseases and provide care when needed.
- Enabling a faster diagnosis and insights/decisions.
- Putting people first, while technology is at their service, not the other way around.
- Bringing the various stakeholders in any healthcare system together to find collaborative and innovative ways.
- Enhancing the quality of healthcare delivery.
- Improving patient-centricity in the full and true sense of the term, with a better patient satisfaction.
- Enhancing staff satisfaction.
- Developing innovative healthcare ecosystems with a place for new players and entities.
- A digital transformation of healthcare that respects the key stakeholders, as well as their privacy and integrity.

Digital health means different things to different people. Here are the main subcategories [8]:

1. Remote sensing and wearables
2. Telemedicine and health information
3. Data analytics and intelligence, predictive modeling
4. Health and wellness behavior modification tools
5. Bioinformatics tools
6. Medical social media
7. Digitized health record platforms
8. Patient-physician portals
9. DIY diagnostics, compliance, and treatments
10. Decision support systems
11. Imaging

APPLICATIONS OF DIGITAL HEALTH

Digital health is a discipline that uses information and communication technologies (ICTs) to treat patients, conduct research, promote learning and training, monitor diseases, and improve the wellness for individuals. It is an umbrella term that includes mobile health (mHealth) apps, electronic health records (EHRs), electronic medical records (EMRs), wearable devices, telehealth, health information technology, and telemedicine as well as personalized medicine. Most

efforts in digital health consist of unifying information about patients, such as medications, consultations, and exams, integrating software and devices through the technology currently available.

There are many key areas where digital health companies can make the biggest impact. The main application areas in digital health include the following [9,10].

- **Remote Monitoring:** Remote management is possible for many patients that are hospital outpatient. This is a digital health application where the data collected from sensors and cameras feed into EMRs/EHRs. In-hospital monitoring, nurses can monitor a larger number of patients at once and give alerts for ones requiring urgent attention. Smart inhalers are monitoring asthma patients' use of medication.
- **Telemedicine:** Digital health and telemedicine complement. Telemedicine is one of the broadest areas of digital health. It is the delivery of healthcare services by healthcare professionals, where distance is a critical factor. Specialty clinics and other healthcare organizations are now embracing telemedicine's potential to provide quality services and generate revenue regardless of geography. For many, telemedicine is an additional component to enhance healthcare delivery, quality of care, patient-centric healthcare through the usage of digital health technologies enabling to lower waiting times and lower costs. Digital and remote clinics are commonly used to provide quick, nonurgent consultations that save both the patients and doctors time. Telemedicine also covers online health records, where both patients and doctors have access to the relevant information at all times. This paves the path for a more personalized healthcare system. Telemedicine has proved to limit unnecessary hospital visits. Figure 3 depicts US adults who used telemedicine in 2019 to 2023 [11].
- **Personalized Care:** Digital health is a revolution that puts patients at the center, empowers them to manage their health, and enables several actors to use digital tools to personalize treatments and medicines. Digital health has the potential to prevent disease and lower healthcare costs, while helping patients monitor and manage chronic conditions. It can also tailor medicine for individual patients. Healthcare provision is being increasingly driven outside clinical settings to community and home. Digital technologies like smartphones and social media offer new ways for patients to monitor their health and have increased access to information. The result is increased efficiency and improved medical outcomes. Better outcomes hinge on patients' ability to navigate the healthcare ecosystem with confidence and proactively manage their health.
- **Health Records:** This replaces paper with electronic health records (EHR). An EHR is a digital version of a patient's health records. EHRs help eliminate the problems associated with physical records such as loss and lack of accessibility. Electronic health records or digital health records are the information backbone of digital health. With EHRs, doctors are able to view their patient's complete medical history even if they are treating the patient for the first time. This would help reduce duplication of tests and facilitate the secure exchange of information.
- **Wearable Technology:** A wearable device is any device that is worn comfortably on the body and enables user interaction. It is typically integrated into the clothing or attached to the body of a person to enhance human performance. It often includes smart devices that can be worn on the body or attached to clothes. Perhaps the most crucial bit of wearable tech accessible today is Google Glass. Wearable devices or systems are usually lightweight, miniature electronic or digital devices that are worn by a user. Wearable technology comes in many forms, including smartwatches and on-body sensors [12].
- **Internet of Medical Things***:* This refers to the combination of medical devices and applications connecting to health IT systems that use networking technologies. Internet of things (IoT) is the global interconnection of several heterogeneous devices. In healthcare system, the motivation of using modern technologies such as IoT is to offer promising solutions for efficiently delivering all kinds of medical healthcare services to patients at affordable cost. Internet of medical things (IoMT), a healthcare application of the IoT technology, has emerged as a combination of advanced medical sensing system, computer communication technologies. The sensing systems include RFID, GPS, and wireless sensor networks. IoMT enables machine-to-machine interaction and real time intervention solutions which are helping the healthcare industry increase its delivery, affordability, reliability, and productivity [13].

There is more to come. Many telcos entering the digital health market have chosen to focus in terms of applications.

BENEFITS

Digital health provides several benefits to healthcare practitioners, patients, and society. It should be an integral part of health priorities and benefit people in a way that is ethical, safe, secure, reliable, equitable, and sustainable. The World Health Organizations (WHO) strongly advised member states to invest in digital health technologies because digital health technologies offer enormous potential. But they also carry the risk of dehumanizing care.

Using digital health is a teamwork and has ended the era of lonely doctor heroes. To enjoy the full potential benefits of digital health tools, internet connectivity and digital health literacy are crucial preconditions. How is the region doing in terms of connectivity and digital health literacy? Connectivity is related to various socioeconomic factors, such as living in urban or rural areas, income level, and age. Income level affects connectivity because of affordability. Much of the growth in digital health industry is being driven by the urgent need to innovate in chronic diseases such as cancer, diabetes, mental illness, heart disease, and respiratory disease. Use of digital health tools by providers promotes consistent and successful adherence to evidence-based service delivery protocols. The eventual rewards of technology the healthcare should include lower-cost equipment, patients having access to their health data, and the capacity to provide telehealth. Figure 4 shows some of the impacts of digital health [14].

Other main benefits include [15]:

- **Better Healthcare:** Digital health provides the realization of a better healthcare through digital transformation. The use of digital technologies offers new opportunities to improve people's health. If digital technologies are to be integrated into healthcare systems, they must demonstrate long-term improvements over the traditional approaches. Digital transformation is geared towards better care for all. Digital natives naturally turn to digital solutions when facing medical issues
- **Less is Better:** Uses of digital tools in healthcare have focused on restoring health, and too few on prevention, or eradication of certain risk factors. The hallmark of a digital healthcare system is not better care, but less need for care. Less is the new better.
- **Personalized Service:** Digital technologies make medicine more personalized for patients. Personalized care offerings would both support high-quality health care and reduce costs in the long term. Using wellness apps enable, patients can set up a personal profile, which will then track key measures like weight, calorie count, and blood sugar levels. With personalized healthcare, people can have more control over their health.
- **Preventive Care:** This models in the age of digital transformation – collaboratively working towards a sustainable and inclusive prevention, care and post-care approach with people and outcomes first.
- **Societal Trust:** Europe needs a health data coalition to build public understanding of the value of health data, and enhance confidence in how data is collected and used. Key stakeholders are responsible for the use of health data and would contribute to a change in attitudes to data-sharing. Healthcare systems should address several challenges in order to create a frictionless health data flow built on trust.
- **Empowering Patients:** Patients need to own their data. Digital health is a catalyst that will accelerate the changes necessary to creating an efficient, patient-centered health system. Digital health ecosystems empower consumers by leveraging the digital infrastructure and technology to support and enable consumers to self-manage their health. Patient empowerment goes hand in hand with increased digital literacy.

CHALLENGES

As innovation and progress push health towards an interconnected digital future, the provision of universal access and the necessity of alleviating the digital divide, become increasingly important. To turn this vision into a reality, caregivers need to overcome several barriers. No single digital health product can address every social, environmental, or behavioral factor impacting someone's health. The unregulated technological solution for health problem is likely to increase. Patients will have higher expectations when it comes to the quality, safety, and effectiveness of digital health solutions. Without key changes in policy, privacy, and access to care, the adoption and expansion of digital health services may be limited.

Other challenges include [16,17]:

- **Funding:** This is the major challenge to the implementation of most of the digital innovation solutions.
- **Health Literacy:** This dictates the development of health status. Those with lower health literacy levels are generally in a worse state of health, visit the doctor more often, use fewer prevention techniques, and are more costly for the healthcare system. Each nation must improve its people's digital health literacy. When digital health tools are readily available, people who are "digital

health tools literate" would enjoy the tools' full potential.

- **Inequalities:** Lack of connectivity and digital health literacy threaten to exacerbate existing health inequalities. Inequality in health is an important issue for many Latin American countries. In the region, there are efforts to reduce health inequalities through digitalization. Two key conditions to achieve this are connectivity and digital health literacy. Age is another factor related to connectivity in the region. These results indicate that people of older age, from rural areas, with lower levels of income, would have lesser chances of having access to care.
- **Pace of Innovations:** Although digitalization provides a key opportunity, policy makers worldwide face the challenge of keeping up with the fast pace of innovations which are hard to integrate into the over-regulated healthcare systems.
- **Ethics:** Digital health leads to some ethical considerations and challenges policy makers in an unprecedented way. There are many of dubious health apps that are finding identity in a crowded healthcare market. Patients must approach newer products with caution.
- **Lack of International Standardization:** The widespread of digital health has been curtailed by the lack of an internationally agreed upon set of standards. Digital health standards remain fragmented on an international basis.
- **Cybersecurity:** When looking at the nexus of health and the digital field, cybersecurity is a key concern. Health data is considered protected and highly sensitive, regardless of jurisdiction. Encryption is crucial to the safety of health data.
- **Interoperability:** The majority of digital tools and platforms available online to consumers are not interoperable with information infrastructure in formalized healthcare systems. This makes it nearly impossible for consumers to reach out and connect to health teams. Coordination between organizations and information systems becomes increasingly challenging.

Other challenges include privacy, security, trust, traceability, and accountability.

CONCLUSION

Digital technologies have transformed our society. They have delivered efficiency, transparency, and convenience. Digital health refers to the use of digital technologies to enable universal healthcare access. It is a broad multidisciplinary concept that encompasses a variety of terms technologies such as e-health, m-health, and telehealth. It has emerged as a pivotal pillar in the delivery of healthcare. It captures everything from electronic patient records, remote monitoring, connected devices, digital therapeutics, etc. It is rooted in eHealth, which is the use of information and communications technology in support of health-related fields. Figure 5 illustrates the future implementation of digital health [12].

Digital health is not only a technological but a cultural transformation. The recent efforts of most nations have been focused on building digital literacy as a whole through including basic digital skills in school programs. Modern medical education should include teaching students skills that facilitate their job and prepare medical practitioner for working with technologies. More information about digital literacy can be found in the books in [18-28] and the following related journals:

- Digital Health
- Cardiovascular Digital Health Journal
- European Heart Journal – Digital Health
- Frontiers in Digital Health
- Lancet Digital Health
- PLOS Digital Health
- Digital Medicine,
- npj Digital Medicine
- International Journal of Digital Health
- International Journal of Digital Healthcare

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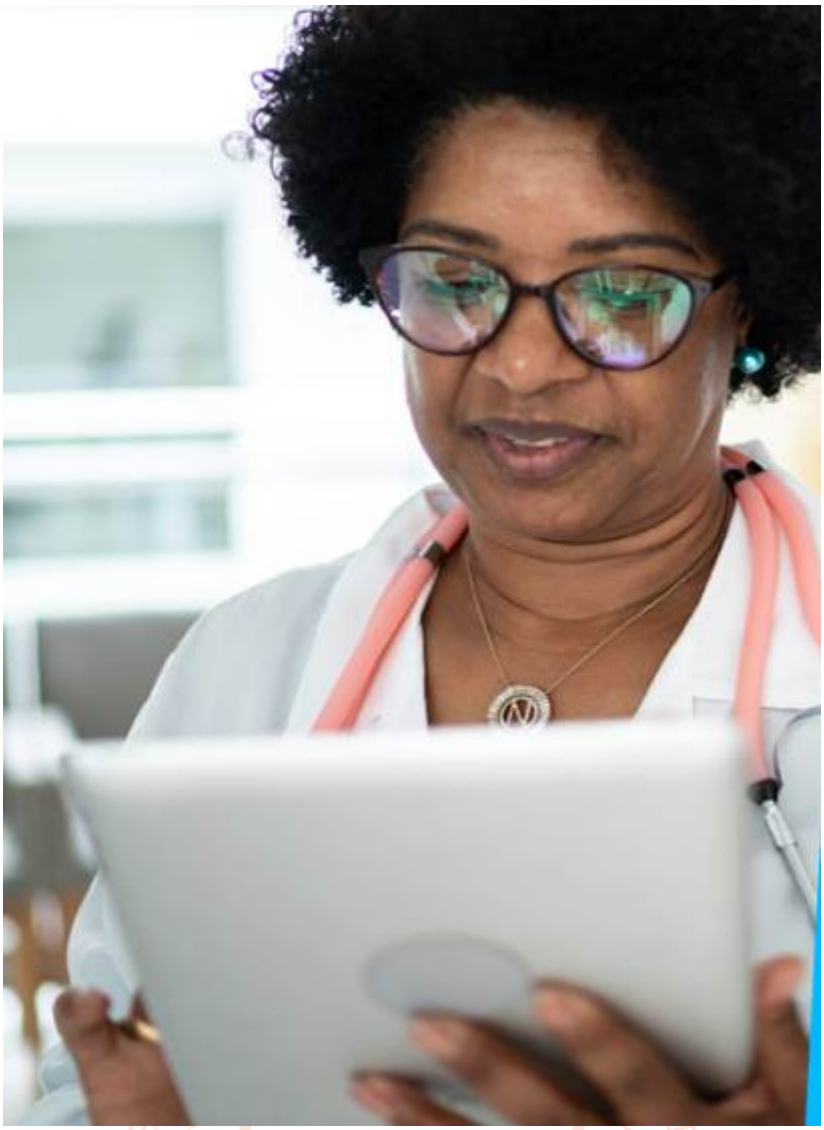

Figure 1 Healthcare and technology go hand-in-hand [2].

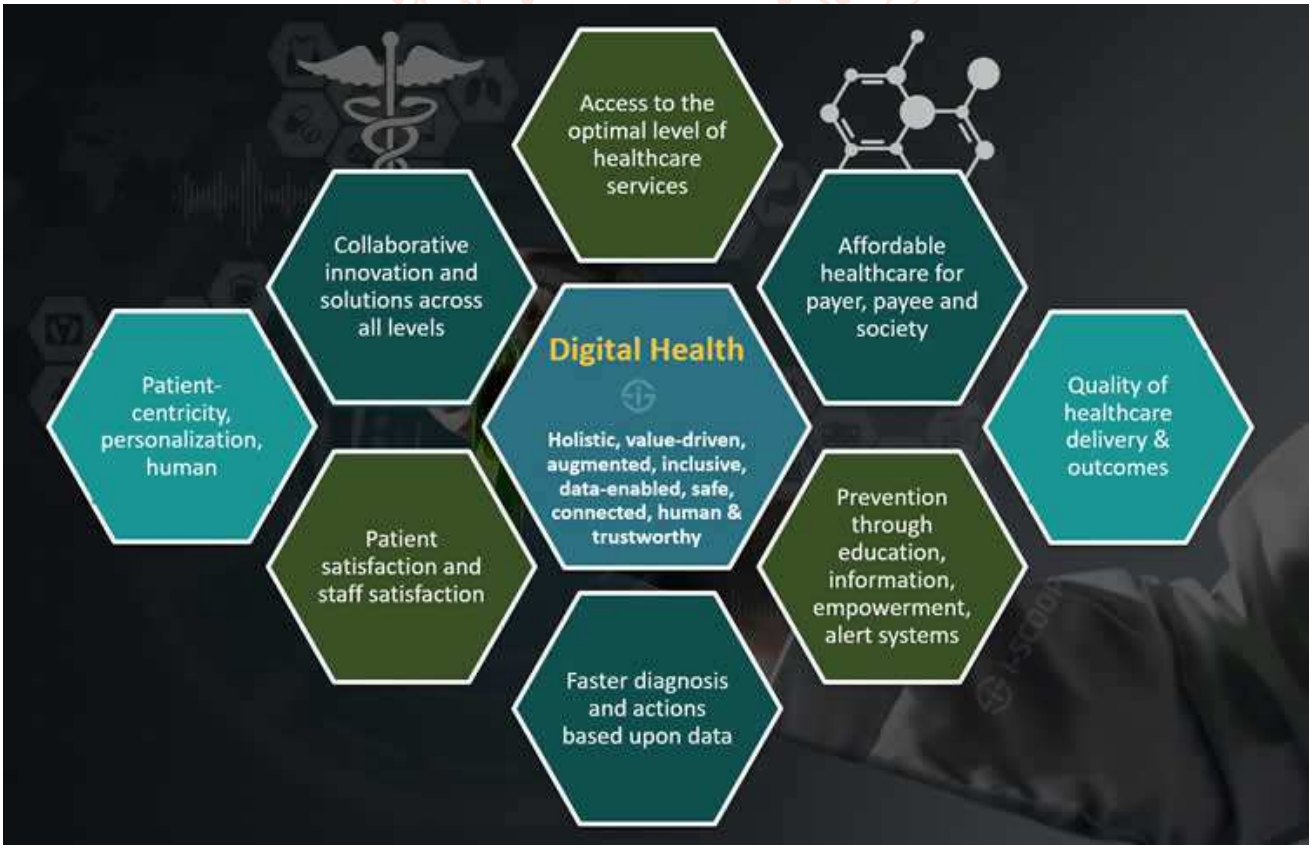

Figure 2 Some components of digital health [7].

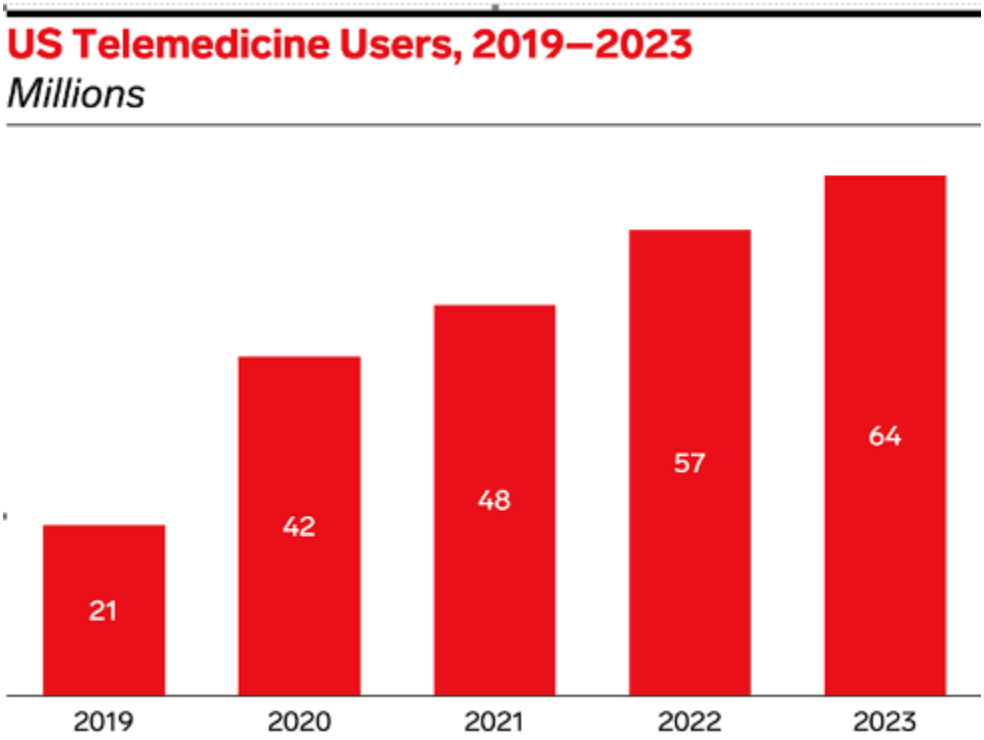

Figure 3 US adults who use telemedicine in 2019-2023 [11].

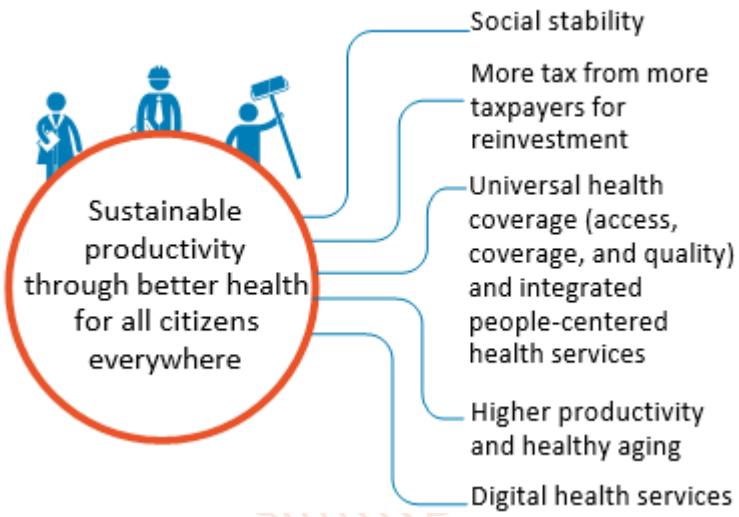

Figure 4 Impact of digital health [14].

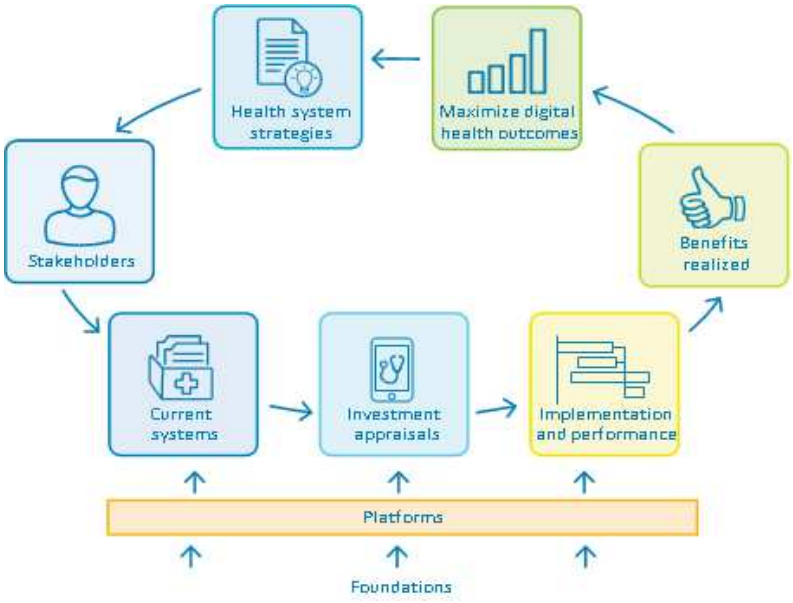

Figure 4 Future implementation of digital health [14].