**Telemedicine and Digital Health**

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**Abstract**

Telemedicine and digital health represent transformative advances in healthcare, leveraging technology to improve access, efficiency, and patient outcomes. Telemedicine enables remote clinical services through telecommunications, allowing healthcare providers to consult, diagnose, and treat patients across distances. It offers significant benefits, particularly in underserved or rural areas where access to healthcare professionals is limited. By reducing the need for in-person visits, telemedicine also enhances convenience, lowers healthcare costs, and minimizes disease transmission risks—especially crucial in situations like the COVID-19 pandemic. Digital health encompasses a broader spectrum, integrating various technologies, including applications for mobile health, wearables, electronic health records (EHRs), and artificial intelligence (AI), to support comprehensive patient care. These tools empower individuals to monitor and manage their health, from tracking fitness levels and vital signs to managing chronic conditions like diabetes and hypertension. Digital health solutions also enable healthcare providers to make data-driven decisions, improving diagnostic accuracy and personalization of treatment plans . Together, telemedicine and digital health address major challenges in healthcare, including the need for continuous, patient-centered care. By promoting preventive health measures and fostering proactive Digital health and the management of chronic illnesses can enhance quality of life and reduce the burden on healthcare systems. However, widespread adoption presents challenges such as ensuring data privacy, managing technological literacy, and addressing regulatory complexities. Despite these obstacles, advancements in telemedicine and digital health hold vast potential for creating a more accessible, efficient, and personalized healthcare system.

**Keywords:** telemedicine, digital health, m-Health,

**Introduction**

Getting Using computers to speak the same language, allowing data to flow across any network was the main goal when the internet was first developed in the 1980s. The internet has changed government, business, education, and communication over time. The healthcare industry has one of the most difficult and unique internet penetrations.

Traditionally, healthcare has been seen to be the process of enhancing and preserving health by using medical professionals' knowledge and skills to diagnose, treat, and prevent illnesses. Since the introduction of the use of digital technologies in healthcare has gotten more accurate and individualized, and it no longer requires a healthcare professional's direct involvement. The phrase digital health" is broad and encompasses any applications arising from the nexus of technology and healthcare. Digital health is " An all-encompassing word that includes eHealth, as well as emerging areas, 'Big data', genomics, and artificial intelligence are examples of the application of advanced computing sciences according to the World Health Organization. Digital health technology has become a key component of healthcare delivery. The industry for health technology, including wearables, telemedicine, e-pharmacies, etc., has expanded rapidly in recent years. Furthermore, a great deal of research and development has been done on the integration of technologies like blockchain, virtual reality, robotics, and artificial intelligence with the pharmaceutical and healthcare industries. In order to improve health management, the industry is gamifying non-gaming activities. The use of ambient computing approaches is also helping to bridge the gap between accurate healthcare delivery through traditional methods and technology. The adoption and expansion of digital health solutions has the potential to completely transform how people around the world receive services to safeguard and improve their health and well-being and reach higher health standards.3. In acknowledgment of this influence, In 2015, the Indian government launched the flagship Public health initiatives to encourage the use of digital technology are part of the Digital India Campaign to make healthcare services more accessible in rural areas. The Ayushman Bharat Digital Health Mission, formerly known as the Digital Health Mission in India was launched as a result of the National Health Policy's 2017 ambition for a completely digitalized healthcare system in India. India is a favorable market for healthcare innovation and offers a plethora of investment options due to the government's growing emphasis on and support for digital health. Since there isn't a distinct legislation pertaining to digital health in India, this paper aims to combine current laws and regulations into what may be referred to as an "ad-hoc" legal framework. It is intended for people who are now testing the waters as well as those who have already made manpower or capital contributions to the field of digital health. The purpose of this research paper is to set the tone for legal conversations on broader platforms by posing questions and taking positions that have not yet been explored.

**Uses for Digital Health**

"Digital health" encompasses a wide range of applications. Digital health encompasses any use of communications and information technology to promote health and well-being. Below is a discussion of a few important applications:

1. **Telemedicine**

The practice of providing healthcare using telecommunications technology is known as telemedicine. Despite not being a distinct field, telemedicine is notable for delivering traditional medical treatments through a range of technological means from a distance.

It is a wide notion that encompasses a number of different areas, including teleradiology, teleconsultation, telenursing, tele-surgery and tele-ICU. More than 75% of people in India reside in rural areas, and more than 75% of the nation's healthcare infrastructure is concentrated in urban areas, telemedicine can be an especially helpful tool to enhance treatment outcomes. More people could have access to healthcare thanks to telemedicine, which could successfully close the gap between the patient and the physician.

**B. Diagnostics at the Point of Care**

A recent development in the medical device industry, point-of-care diagnostics, or "POCD," encompasses a variety of devices that enable individuals or health care providers to perform accurate diagnostics in settings with little funding. It creates it easier to manage illnesses, keep track of them, and diagnose certain disorders in real time. Recent years have seen the development of numerous applications, such as smartphone-based POCD, portable x-rays, handheld ultrasounds, and biosensors. Conventional clinical diagnostic methods, which usually need costly and large equipment, have been reduced to software or portable POCD devices that can be utilized at the patient's location rather than in a lab or hospital. POCD devices are typically automated technologies that use machine learning and/or artificial intelligence algorithms to simplify complicated diagnostic processes and deliver test/diagnosis findings instantly. The patient might utilize these findings to consult a medical expert for a more precise diagnosis and therapy recommendations. Furthermore, implantable biosensors of this type aid in the ongoing observation of a specific medical condition. They are useful for point-of-care analysis because they can provide reliable and timely data. This allows doctors to track, monitor, and treat the sickness, which can directly assist them make medical decisions and predict a patient's prognosis because it generates massive volumes of data regarding even little changes in health. On the other hand, it is beneficial in countries such as India where rural areas lack appropriate infrastructure and high-quality medical services. Doctors might use POCD devices to provide telemedicine services after diagnosis, removing the need for patients to visit medical facilities for diagnostic testing.

1. **m-Health**

Mobile health, or m-Health, is the provision of digital health services through a mobile platform m-Health is a very profitable option because India has the second-greatest market for smartphones in the world. Since the number of smartphone and internet users is about equal, it is easy to provide access to such applications on smartphones, especially since the nation is predicted to reach about 1412 million users of mobile internet by 2024. Thanks to mobile health's portability and digital health's ease of use, many more players can now actively engage in the change.

1. **Medical Virtual Assistants**

Virtual Assistants for Medicine One new development in the m-Health space is the use of medical virtual assistants, or "MVAs. Virtual health assistants and chatbots help patients and doctors communicate more effectively and take care of their needs between in-person visits by providing services like prescribed refill reminders, information on medical conditions, scheduling an appointment, health record maintenance, and other administrative tasks. AI-based software is commonly used by MVAs to process large amounts of data, provide personalized recommendations, and complete specific tasks for every user. MVAs are also helpful for managing administrative tasks in hospitals and other healthcare organizations.

1. **Robot - Assisted Surgery**

With the aid of robots, doctors can carry out surgical procedures more efficiently. Even though procedures that are minimally invasive have been around for a while, robotics has made it possible for surgeons to perform them more precisely and with fewer incisions. In the end, this results in less blood loss, improved pain control, and a speedier recovery for the patient Micro robots, sometimes known as micro-robots, may be used in the future to diagnose and treat illnesses. One such procedure, called capsule endoscopy, has already received approval from the US Food and Drug Administration (US FDA), the country's top regulatory body for medications and medical devices. During the procedure, the patient swallows a tiny camera that allows the medical professional to take pictures of the digestive tract. Future applications could include tissue biopsies, removing plaque from arteries, delivering particular medications to the body, and focusing on malignant tumors. Microrobots are far less likely to damage tissue than more conventional medical methods like surgical incisions and catheter insertions. By focusing on specific areas of the body, microrobots could greatly reduce the side effects of drugs. Additionally, as deep learning technology develops, robots may be able to watch and mimic simple, repetitive procedures while the surgeon concentrates on more complex ones.

1. **Self-Monitoring Healthcare Devices**

Sensors and monitors are being used more and more in wearable technology to detect various physiological changes in the body. Blood pressure, glucose, weight, sleep habits, posture, diet, and activity can all be tracked by these smart devices. By recognizing various health signs and alerting the user to any issues, the collected raw data can be used for self-monitoring.

1. **Electronic Health Records (“EHR”)**

An EHR is a digital repository for a patient's medical records. EHRs help address problems with physical records, like loss and accessibility. EHRs can be centrally stored and accessed at any time, regardless of where or when the data was collected. EHRs allow doctors to access a patient's entire medical history, even if they are treating them for the first time. This will assist patients and healthcare facilities control expenses by reducing the need for duplicate testing and facilitating the safe interchange of information.

1. **Health Service Aggregation**

One of the most significant issues facing the healthcare industry is information asymmetry. Patients lack access to information that is necessary to help them choose a doctor, and occasionally a lack of visibility prevents doctors from reaching a significant number of patients. Numerous internet venues are emerging in an effort to address this issue. These platforms enable patients to look for and schedule an appointment with the best physician for their needs by listing the names of doctors along with their specialty. In order to help other patients, make an informed choice, patients can also evaluate and assess the quality of the care they received from the physician or facility.

1. **Big Data in Healthcare**

Various Digital Health services are used to get raw data. EHRs alone produce a vast amount of data that can be utilized in a variety of ways. The Internet of Things (IOT)11 is expected to connect 25 billion devices, and processing will be required to manage the data produced by these connected devices. The massive volume of data being generated calls for technology such as big data processing, which may then be used by many businesses.

1. **Blockchain in Healthcare**

The term "blockchain" has gained popularity in the data industry in recent years. It is changing how data is stored, accessed, shared, and kept private online. Because the healthcare sector depends on enormous amounts of data, blockchain-enabled technologies offer a chance to facilitate the shift from the conventional volume-based healthcare system to a value-based system. In particular, the implementation of blockchain solutions can improve the integration and smoothness of health data administration and information sharing amongst the many stakeholders. Health profiling, prescription management, and insurance administration are further possible applications.

1. **Targeted advertising**

Wearable technology and user-provided data produce data about a person's health and medical history. Businesses can use this data to focus product advertisements to consumers who are more likely to buy or utilize those things. For example, diabetic patients' medical histories might be used to advertise glucose monitoring devices. However, targeted advertising raises a number of ethical and legal issues, and in particular cases, it may be challenging to determine the best course of action.

1. **e-Pharmacies**

In recent years, the number of e-pharmacies, also called online pharmacies, in India has increased. An e-pharmacy, also referred to as an online pharmacy, is a pharmacy that operates online and fulfills orders using mail, courier, or delivery staff. Two examples of the many strategies that have been employed are physical pharmacies with an internet presence and pharmacies that operate exclusively online. Because internet pharmacies do not have the geographical limitations that physical pharmacies do, they are able to serve a wider range of patients. Even while online pharmacies' legal position is still unclear, judicial interpretation could open the door for this development to be recognized by the law.

1. **e-Learning in the healthcare sector**

In order for doctors to stay current with the newest developments and trends in the medical field, they must engage in ongoing professional development, which is required by law. With e-learning, doctors may participate in these programs more easily. In addition to saving time and money, e-learning is available from any location, giving clinicians across better access to material and facilitating consistent knowledge exchange.

**DIGITAL HEALTH**

Digital health or digital healthcare is the term used to describe the application of digital technologies in healthcare. This broad category encompasses a wide range of technological products, including wearables, telehealth and telemedicine, electronic health records (EHRs), mobile health (mHealth) apps, electronic medical records (EMRs), and customized medication. Digital health makes it possible for healthcare to undergo a digital transition by incorporating hardware, software, networking, and sensors into healthcare delivery systems. In doing so, it has revolutionized the field and created numerous benefits for both patients and caregivers.

**What is digital health as we know it today?**

Digital health is becoming increasingly important in today's healthcare system. In general, it refers to the platforms, software, devices, sensors, and information and communications technologies used in healthcare to detect illnesses, treat conditions, and eventually enhance wellness and quality of life. The operational needs of healthcare organizations and providers are also covered, including digital platforms for scheduling, invoicing, admissions and discharges, and patient communication.

The following are some instances of digital health tools and applications:

* Wearable technology.
* Mobile applications.
* Telemedicine and telehealth.
* Tools for diagnosis.
* Modelling for prediction.
* Systems for decision support.
* Portals for patients.
* Platforms for digital health records.
* Tools for bioinformatics.

Several technologies are combined in digital health products to provide more sophisticated capabilities, increase accuracy and efficiency, and lower errors. These consist of the following:

* The use of automation.
* AI, or artificial intelligence.
* The process of machine learning.
* IoT, or the internet of things.
* Massive data.
* Robotics

Stakeholders in digital health include patients, doctors, researchers, app developers, and manufacturers and distributors of medical equipment.

## Digital health technologies

## As a result of advancements in big data, robots, AI, machine learning, and other technologies, digital healthcare is changing dramatically.

### **AI**

The ability of AI to swiftly spot patterns in massive amounts of data is one of its most powerful applications in healthcare. Therefore, AI may be used to assist diagnose common chronic disorders like diabetes, high blood pressure, or obesity, speed up clinical records, identify risk factors, and provide customized treatment plans. Additionally, AI-driven technologies are assisting in quickening the development of novel treatments and vaccinations to combat illnesses and enhance health of public.

**Intelligent production**

Intelligent production, sometimes referred to as smart manufacturing, makes use of data and digital technology to increase the agility, automation, and efficiency of supply chains and manufacturing. Compared to patient care providers, the pharmaceutical industry is more immediately affected by its use. However, more efficient drug manufacturing, for instance, may eventually be advantageous to healthcare institutions.

### **Internet of medical things**

The "internet of medical things" (IoMT) refers to network-connected medical equipment that can communicate with one other and with health IT systems. These may consist of remote patient monitoring tools, robotic caregivers, and ingestion sensors . The following use examples demonstrate how IoMT can improve the safety and quality of care:

* Sensors that are connected to the internet and track medication compliance.
* Implants in the heart that safely provide activity logs to the patient's medical staff remotely.
* Intelligent ambulances that instantly transmit vital signs to the electronic medical record of the receiving hospital.

### **MHealth**

###  MHealth supports chronic disease management, patient monitoring, care delivery, and more using wearables, mobile apps, and mobile devices. The distinction between consumer-grade and medical equipment is blurred by personal health monitoring gadgets. Depending on their intended application, features for electrocardiography, cardiac rate variability, pulse oximeters, continuous blood sugar monitoring, etc., may be added.

### In order to comply with the Health Insurance Portability and Accountability Act, or HIPAA, and enhance patient safety, treatment quality, and communication, healthcare providers also commonly employ mobile health technology.

### **EMR and blockchain**

Another significant use of digital health is blockchain technology-based EMRs, which seek to replace centralized servers with a network of decentralized nodes for patient data storage. Blockchain technology, which is still in its infancy, improves the interoperability and integrity of patient data. Security, privacy, and scalability are three benefits of blockchain technology that are particularly appealing in the healthcare sector, where data is highly valuable but also susceptible to assaults.

**Augmented reality**

In the healthcare industry, augmented reality (AR) creates a virtual, immersive world with digital information overlay on mobile gadgets with cameras, including digital phones or Augmented Reality glasses. Among its many applications are simulation-based training, surgery planning, and improving the patient experience.

### **Big data**

The digitalization of health data led to the emergence of big data in healthcare. Value-based care has contributed to its growth by motivating the industry to embrace data analytics to make informed business decisions. In the healthcare sector, "big data" refers to the collection and analysis of vast quantities of patient data, both organized and unstructured, using analytics tools and techniques including artificial intelligence algorithms. Large volumes of healthcare data are impossible to understand, let alone analyze, using manual or traditional data processing methods, which is why these technologies are crucial.

**Big data in healthcare has various advantages:**

* **Enhancing the safety of patients.** Software can identify trends linked to safety hazards and medical errors by examining patient records, such as drugs that shouldn't be taken or diseases that are acquired in hospitals, and utilize those findings to send out proactive real-time alerts to medical personnel.
* **Supporting preventive care.** Big data analysis can assist in identifying disease risk factors that were previously undiscovered. Providers may use this information to proactively identify patients who are at risk and tailor preventative treatments to maintain or improve health.
* **More precise resource allocation.** Hospitals and clinics can enhance staff scheduling and anticipate bed or room availability by using predictive analysis to forecast admission rates.

**The increasing significance of digital health**

Using tools and technology to improve a limited number of healthcare outcomes is only one aspect of digital health. Instead, it impacts every facet of healthcare operations and delivery using technology such as artificial intelligence, interactive platforms, and interoperable systems to provide safer, better, more cost-effective, and more patient-focused care and services.

Innovations in digital health increase the accuracy, efficiency, and profitability of healthcare companies while also saving time and money. They achieve this by combining several medical technologies, such as blockchain, IoT, mHealth, AR, EMRs, and more, with medicine.

Other resources are available to assist individuals in receiving better, more customized treatment. Furthermore, people may utilize digital health technology to track their health and well-being, access test results and medical history, communicate with medical providers, and make better, more informed decisions about their own health advantages

"The health care industry is undergoing a revolution because of digital technologies," according to the U.S. Food and Drug Administration (FDA), "from artificial intelligence and machine learning to mobile medical apps and software that support the clinical decisions clinicians make every day." Digital health tools have great potential to enhance the delivery of personal healthcare as well as our ability to precisely identify and treat illness.

Both patients and healthcare professionals gain from developments in digital health. Digital tools greatly increase access to health and other data, providing healthcare providers with a comprehensive picture of patient health. They can utilize this knowledge to avoid illness, reduce medical expenses, and create patient-specific interventions. They can utilize this knowledge to avoid illness, reduce medical expenses, and create patient-specific interventions.

Additionally, by automating and speeding up formerly time-consuming procedures, digital health applications can enhance human decision-making. In order to save expenses, save time, and simplify procedures, many hospitals, for example, utilize digital monitoring technology to measure patient safety data in real time, such as hospital-acquired illnesses or hand hygiene compliance. AI in medical imaging reduces the number of clicks needed to finish a task and provides useful recommendations based on current data and context. Digital twins can be used to simulate humans and medical devices and show how they could work.

**Challenges of digital health**

The digital revolution in healthcare has raised awareness of several challenges that affect patients, healthcare professionals, technology developers, lawmakers, and other stakeholders. Due to the enormous amounts of data collected from different systems that store and code data differently, data interoperability is a persistent issue that makes it difficult to use data in meaningful ways.

The other issue is patients' low level of knowledge of computers, that hinders their ability to take advantage of the tools that are now available to them. These consist of wearable technology, medical social media sites, patient-physician portals, and telehealth platforms.

Next, significant concerns about data security and patient privacy are brought up by problems with data storage, access, sharing, and ownership Can an insurer or employer, for instance, obtain information from the findings of direct-to-consumer genetic testing? Given that all of their medical devices are networked, how can a healthcare institution prevent data breaches?

Technology, ethics, and insurance costs are additional concerns. For example, who is accountable for surgical mistakes made by medical robots? The doctor who used the robot, the hospital, or the manufacturer or developer of the technology? Healthcare organizations' adoption of digital health innovations is influenced by these worries. The hospital, the doctor who used the robot, or the person who created or developed the technology? The adoption of digital health innovations by healthcare organizations is impacted by these issues.

**The evolution of digital health care**

Information and communications technology has long been used to deliver digital health interventions that can save lives, prevent disease, and enhance quality of life. However, new advancements in digital health are emerging at a very rapid pace.

The requirement for new digital tools that can improve disease identification , healthcare access, delivery, and equity, as well as provide clinical support, has been exacerbated by global issues such as rapidly aging populations, high child mortality and persistent child illness, pandemics and epidemics, rising costs of healthcare delivery, Growing disparities in wealth, and systemic racism. Because of this, cutting-edge digital health platforms, healthcare systems, and associated technology have just surfaced and are becoming more significant.

Additionally, the health insurance schemes of government like the U.S. Affordable Care Act (ACA) have led to new trends in digital health. One of the goals of the Affordable Care Act is to improve access to and quality of healthcare by utilizing technologies such as computer modeling and electronic health records. The use of data and technology to improve patient health and treatment quality is known as healthcare informatics. In order to enhance patient experiences, care results, and population health, it empowers medical practitioners to evaluate innovative initiatives, pinpoint areas for development, and incorporate new technologies into medicine.

The healthcare industry's digital revolution was further spurred by the COVID-19 pandemic. Among the most important innovations that have arisen or developed as a result of the pandemic are patient-facing technologies like telehealth platforms, patient portals, online symptom checks, and remote patient monitoring tools.

Precedence Research, a research firm with offices in Canada and India, projects that the worldwide digital health market will reach $1 trillion by 2033, up from about $310 billion in 2023. This amounts to an annual compound growth rate of 12.19%. This expansion will be facilitated by the creation of remote monitoring tools and continuous developments in new technologies, including robotics, the Internet of Things, artificial intelligence, etc.

Europe leads the digital health market as of April 2024, with Asia-Pacific and North America following closely behind. Among the factors driving the growth of digital health in these nations are aging populations, growing healthcare costs, cultural acceptance of new technology, and government initiatives promoting the field.

**Conclusion**

Digital health and telemedicine are revolutionising healthcare by using technology to improve patient outcomes, accessibility, and efficiency. When combined, they provide creative options for proactive and distant health condition management while addressing important issues in healthcare delivery, especially for marginalised communities.

The goal of telemedicine is to provide clinical care via digital means, including mobile health apps, remote monitoring, and video consultations. Telemedicine lowers geographical boundaries, saves time, and lowers costs by allowing patients to consult with medical professionals without physically visiting a clinic. This is particularly important in places with limited access to specialised treatment, such as rural or neglected areas. Subspecialties such as telepsychiatry, teleradiology, and tele dermatology have increased the accessibility and range of medical care.

Conversely, digital health includes a wider range of technologically based health management resources. Digital health empowers both patients and clinicians, from sophisticated systems like electronic health records (EHRs) and artificial intelligence (AI)-powered diagnostics to mobile health (mHealth) apps that monitor fitness and wellness. For example, wearables and Internet of Things devices make it easier to continuously monitor health data, allowing for early intervention and better results. This ecosystem is further supported by big data analytics, which forecast health trends, improve treatment regimens, and handle public health issues.

Numerous advantages result from the combination of digital health and telemedicine, such as enhanced accessibility, individualised treatment, preventative health initiatives, and more efficient healthcare operations. Nevertheless, there are obstacles to the broad use of these technologies. Data security and privacy are top priorities, necessitating strong procedures to safeguard private patient data. Another obstacle is the digital divide, which might restrict the impact of these technologies due to differences in internet access and digital knowledge. Furthermore, in order to maintain compliance and foster confidence, stakeholders must work together to navigate complex regulatory frameworks.

Telemedicine and digital health are positioned to become essential components of contemporary healthcare systems as the need for patient- centered , effective healthcare continues to grow on a worldwide scale. Their significance in influencing the direction of healthcare is highlighted by their capacity to lower expenses, improve care quality, and promote fair access. In order to realise their full potential going ahead, a well-rounded strategy that tackles obstacles while encouraging creativity will be essential. To sum up, telemedicine and digital health are prime examples of how technology may revolutionise healthcare delivery by establishing a system that is more easily accessible, effective, and adaptable to the demands of a globalised society.

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