Digital Health: The Future of Healthcare

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*“Harnessing the power of digital technologies is essential for achieving universal health coverage. Ultimately, digital technologies are not ends in themselves; they are vital tools to promote health, keep the world safe, and serve the vulnerable.”* Dr Tedros Adhanom Ghebreyesus, WHO Director-General

**INTRODUCTION**

Digital technologies are now integral to daily life, and the world’s population has never been more interconnected. Innovations, particularly in the digital sphere, are happening at unprecedented scale. Even so, its application to improve the health of populations remains largely untapped, and there is immense scope for use of digital health solutions.1

Digital health, also known as **eHealth** or **health informatics** or **healthcare technology**, refers to the use of technology and digital solutions to improve healthcare delivery, patient care, and overall health outcomes. It involves the integration of electronic information and communication technologies into various aspects of healthcare, from patient records and monitoring to medical research and public health initiatives. It encompasses a wide range of technologies and applications that leverage digital data, devices, and platforms to enhance healthcare processes.

In simpler words, Digital health refers to the use of information and communications technologies in medicine and other health professions to manage illnesses and health risks and to promote wellness.2

**Digital Health has been gaining momentum because it is envisioned to:**

* Improve access to healthcare
* Reduce any inefficiencies in the healthcare system
* Improve the quality of care
* Lower the cost of healthcare
* Provide more personalized health care for patients2

**Some most common benefits of Digital Health are –**

* Expanded access to health care to historically marginalized communities
* Decreased health care costs for both patients and providers
* Improved patient health outcomes through personalized treatment plans
* Increased operation efficiency at health facilities, such as hospitals
* Improved diagnoses through technology3

**Key aspects of digital health –**

1. **Electronic Health Records (EHRs):** It is a repository of information regarding the health status of an individual in computer processable form which is collected primarily to support the provision of integrated holistic healthcare to that individual and secondarily to benefit the health of the wider community.4

**Benefits -**

1. *Comprehensive Patient Information*: EHRs encompasses a wide range of patient information in one centralized and digital location facilitating efficient and comprehensive patient care.
2. *Improved Accessibility and Interoperability*: EHRs can be accessed securely by authorized healthcare professionals across different healthcare facilities promoting better care coordination.
3. *Providing Real-time Updates*: EHRs are updated in real-time aspect, which is especially crucial in emergency situations and time-sensitive medical decisions.
4. *Enhanced Patient Safety*: EHRs reduce the risk of medical errors caused by manual paper work.
5. *Efficient Workflow:* Digitalization of health records helps in improving overall efficiency in healthcare facilities.
6. *Data Analytics and Population Health Management:* Data digitalization helps to identify population health trends, monitor disease outbreaks, and evaluate treatment effectiveness.
7. *Patient Engagement:* EHRs can provide patients with secure access to their own health information through patient portals.
8. *Data Security and Privacy:* EHRs implement stringent security measures to protect patient data from unauthorized access and breaches.
9. *Reduced Paper and Storage Costs:* Transitioning to EHRs reduces the need for physical paper records and large storage facilities, leading to cost savings and a more environmentally friendly approach.

While Electronic Health Records offer significant advantages, their successful implementation requires careful planning, adequate training for healthcare professionals, and ongoing maintenance to ensure optimal usage and data integrity.

1. **Telemedicine and Telehealth:** These are innovative approaches that leverage technology to provide healthcare services and information remotely. They enable patients and healthcare providers to interact without the need for in-person visits, bridging geographical barriers and improving access to medical care.

The WHO defines telemedicine as “the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities”

WHO distinguishes between Telehealth and Telemedicine as – Telehealth being the integration of telecommunication systems into practice of protecting and promoting health, while telemedicine being the incorporation of these systems into curative medicine. In short, we can define telemedicine as only one part of Telehealth.4

**Benefits**

1. *Remote Consultations and Monitoring*: Enables patients to have virtual consultations with healthcare professionals and with help of connected devices and wearables health data is transferred to them in real time.
2. *Health Education and Information:* provides educational resources, health-related information, and self-assessment tools to empower patients.
3. *Mental Health Support:* by providing online therapy sessions and counselling,
4. Helps in getting *Specialist Consultations* and *Post-Discharge Follow-up* virtually: can be done remotely leading to better care continuity.
5. *Emergency Telemedicine:* offers quick communication between emergency responders and remote healthcare specialists, providing valuable guidance for critical patient care.
6. *Reduced Healthcare Costs:* It eliminates the need for travel expenses and reduces hospital readmissions through better monitoring and management.
7. *Pandemic Response:* Telemedicine has played a significant role during global health crises, like the COVID-19 pandemic, by allowing healthcare services to continue while minimizing physical contact and reducing the risk of infection.

Despite these benefits, telemedicine and telehealth face challenges related to internet connectivity, data privacy, and ensuring equitable access to technology, especially for vulnerable populations.

1. **Health Monitoring Devices:** also known as wearable health technologies or medical wearables, are electronic devices designed to track and monitor various health parameters in real-time. These devices provide valuable data to both patients and healthcare professionals for proactive health management.

Few of these devices are –

Fitness Trackers: for monitoring physical activities

Heart Rate Monitors: measure a person's heart rate, providing insights into cardiovascular health.

Blood Pressure Monitors: measure blood pressure levels, which is essential for individuals with hypertension or those monitoring their cardiovascular health.

Glucose Monitors: For individuals with diabetes, helps to track blood sugar levels, facilitating better diabetes management.

Pulse Oximeters: measure the oxygen saturation levels in a person's blood, helping to assess respiratory health and detect potential issues like hypoxemia.

Body Temperature Monitors: helps monitor body temperature, which can be useful in detecting fever or monitoring general health conditions.

Sleep Trackers: analyse sleep patterns, providing information on sleep duration, quality, and disruptions.

Stress and Anxiety Monitors: analyses stress and anxiety tracking features

Electrocardiogram (ECG) Monitors: capture the electrical activity of the heart, aiding in the detection of irregular heart rhythms and potential cardiac issues.

Remote Patient Monitoring Devices: helps to track patient’s health conditions and intervene when necessary, especially for individuals with chronic illnesses.

The data collected by these devices can be synchronized with mobile applications or cloud platforms, allowing users to visualize trends, set goals, and share information with healthcare providers. This can help in early detection of potential health issues and helps in promoting healthy habits.

However, it's essential to use these devices in conjunction with professional medical advice and avoid self-diagnosis solely based on the data from these devices.

1. **Mobile Health (mHealth):** According to the WHO, mobile health (mHealth) is a general term that covers public health and medical practice through the use of smartphones, sensors, personal digital assistants, wireless monitoring devices, or other wireless devices.

Mobile apps are defined as software applications designed to run on smartphones or other mobile devices. They serve various purposes, from tracking and managing health data to providing educational resources and facilitating communication with healthcare professionals.5

Some common types of mobile health apps include -

Fitness and Wellness App, Health Information App, Medication Reminder App, Telemedicine App, Mental Health App, Women's Health App.

Health Monitoring Devices and Mobile Health Apps are two interconnected aspects of digital health that empower individuals to take an active role in monitoring and managing their health. However, it's essential to use reliable and secure apps and devices and consider privacy and data protection when dealing with personal health information.

1. **Artificial Intelligence (AI):** It can be described as a range of techniques that allow computers to perform tasks typically thought to require human reasoning and problem-solving skills.6 AI is being effectively utilized in a multitude of settings such as hospitals, and clinical laboratories as well as in research approaches.7

AI systems in health care are successful because of the advanced algorithms for learning numerous characteristics from a huge amount of health care data that helps in problem-solving and achieved at a rate and amount futile for humans.

**Benefits of AI –**

Healthcare drug creation: the drug discovery process parts will be faster, safer and more economical.

Diagnostic Aid: AI is used for the detection of diseases such as skin cancer more accurately

Disease progression: By employing biomarkers, AI helps document the progression of disease at different stages.

Treatment design: AI has the ability to precisely identify and analyze the signs and symptoms of medical images such as X-rays, CT scans, MRIs, ultrasounds, and PET scans. It helps in faster diagnosis of disease.

Health monitoring: gadgets work through AI to monitor health, analyze data and provide users their health status.

Managing medical data and records: AI helps in collecting, storing, normalizing and tracing data sources.

AI provides us with the advantages of better healthcare access, improved record keeping, advanced immunotherapy methods and overall improved quality of services but on the other hand AI has associated risk factors like it is prone to cyber-attacks, systematic bias, data mismatching error and some ethical and medicolegal concerns like informed consent, safety & transparency, data privacy and medicolegal issues.

1. **Remote Patient Monitoring:** Remote patient monitoring allows health providers to monitor disease and symptom progression remotely and then engage with patients virtually to modify care plans and to provide education on self-care, based on changes in the patient’s condition.8

It is a concept that straddles both telehealth and telemedicine, all of which comprise the wider category of e-Health. RPM refers to any telecommunications and electronic information processing technologies used to monitor a patient’s status at a distance, measure certain medical parameters remotely (e.g., blood pressure, heart rate, weight, or oxygen saturation) and facilitate remote communication (telecare) between patients and healthcare professionals.

**Benefits –**

Ensuring timely intervention: RPM establishes a more fluid exchange of information between patients and healthcare professionals, resulting in more accurate and timelier clinical and technical interventions.

Chronic Disease Management: By measuring specific health parameters and permanently monitoring health conditions, RPM solutions can play a key role in preventing the worsening of chronic conditions.

Improve adherence to treatment and self-management of health conditions: As a result of data from continuous monitoring, patients can live more autonomously and with improved life quality.

Improve access to healthcare and reducing inequalities: RPM is an effective and convenient alternative for people who face restrictions in accessing healthcare centres due to geographical distance, age, physical conditions, or time limitations.

Reduced Healthcare Costs: RPM helps by minimizing hospital readmissions, emergency room visits, and unnecessary appointments.

However, there are a few challenges RPM has like its dependency on connectivity and network availability, comfort level with wearing sensors or devices and security and privacy.

1. **Big Data and Analytics:** Big data in health refers to large routinely or automatically collected datasets, which are electronically captured and stored. It is reusable in the sense of multipurpose data and comprises the fusion and connection of existing databases for the purpose of improving health and health system performance.

Leveraging big data to find patterns and predict diseases which helps both medical researchers and health leaders to better understand the disease distribution in a country or a community, which if properly used can contribute to building sustainable healthcare systems, collaborate to improve care and outcomes and eventually increase access to healthcare.

Accompanied with big data concept is data analytics which is evolving into a promising field for providing insight from very large data sets and improving outcomes while reducing costs.

As the volume of healthcare data continues to grow, harnessing the power of Big Data and Analytics will become even more critical in improving patient outcomes, enhancing healthcare delivery, and advancing medical knowledge. However, it is essential to address challenges related to data privacy, security, and ethical considerations to ensure the responsible use of healthcare data for the benefit of patients and society as a whole.

1. **Electronic Health Information Exchange (HIE):** It is a system that enables the electronic sharing of patient health information among different healthcare organizations and providers.

**Benefits –**

Minimizes Errors- ensures the safety of the patient by reducing medical and medication errors, as the data is stored and exchanged through a digital channel.

Provides Efficiency- As it digitally stores data, chances of losing any information are less.

Acts as a Support Tool- helps healthcare providers to give better treatment and effective care.

Smarter Health Monitoring- simplifies the data exchange process in healthcare and thus improves health reporting and monitoring.

Cost Effective - Eliminates the need of unnecessary testing and improves outcomes.

To maximize the benefits of HIE, stakeholders must address challenges related to data standardization, data governance, and ensure that patient consent and data sharing policies are clear and transparent.

1. **Digital Therapeutics:** The term "digital therapeutics" was mentioned for the first time in a paper published in 2015 by Sepah et al. to define "evidence-based behavioral treatments delivered online that can increase accessibility and effectiveness of healthcare."

They are used independently or in concert with medications, devices, or other therapies to optimize patient care and health outcomes.

The DTA, one of the most active organizations in defining and disseminating DTx, defined DTx as “evidence based therapeutic interventions that are driven by high-quality software programs to treat, manage, or prevent a disease or disorder.

**Benefits -**

Accessibility and Convenience - Digital Therapeutics offer the advantage of being accessible and convenient for patients. They can be accessed through mobile apps, websites, or wearable devices, allowing users to engage with their treatment wherever and whenever is most convenient for them.

Improved and long-lasting health outcomes - by applying scientifically-developed technologies that monitor all aspects of treatment progression as well as the changes in patients' behavior.

Target specific diseases/disorders - DTx is well-resourced with clinical and scientific evidence and thus are suitable to target specific conditions including metabolic, cardiovascular, and pulmonary diseases.

Behavioral Change and Patient Engagement- Mobile applications that come under digital therapeutics can improve patients' adherence to treatment by reminding them about the dosage of medicines and the time of intake.

Despite the significant positive impact on healthcare delivery, the main obstacle is difficulty differentiating evidence-based, clinically-proven digital therapeutics applications from other low-quality, unverified wellbeing applications that are easily available in the digital health market.

1. **Geographic Information Systems (GIS) for health :** GIS is a powerful tool that has been successfully implemented in healthcare to help address a number of significant health issues ranging from disease management to improved services.

Potential benefits of integrating GIS in healthcare are –

Identifying health trends,

Tracking the spread of infectious disease,

Utilizing personal technologies,

Incorporating social media and

Improvising (health) services

1. **Blockchain in Healthcare:**  This is a type of shared distributed digital ledger, which allows every event that a piece of data undergoes - whether it is viewed, used or changed - to be recorded indelibly. As each event occurs, information on the event is added as a ‘block’ connected – in sequence - to the one recording the previous event.

As the data in the blockchain is recorded on a distributed, peer-to-peer basis, it creates an ever-growing, permanent record that cannot be altered retroactively; nor can the sequence of blocks be changed without it affecting all subsequent blocks.

**Benefits -**

Increased Data Security and Privacy: provides a highly secure and tamper-proof platform for storing and sharing patient health records and sensitive medical data.

Drug Verification: The ability to verify the authenticity of drugs at the point of dispensing is an example of cross-sectoral use of blockchains with the pharmaceutical industry.

Reimbursement: patients and healthcare providers could use and exchange data more easily to verify insurance coverage.

Control The Access - to shared Electronic Health Records enabling better population management and research.

Reliable Clinical Trials: Using blockchain could help make clinical trials reliable at each step by keeping track and time-stamping at each phase of the trial.

Despite its numerous benefits, the implementation of blockchain in healthcare requires careful consideration of regulatory compliance, data standardization, and scalability. Collaborative efforts among stakeholders are essential to harness the full potential of blockchain technology, making healthcare more secure, efficient, and patient-centered.

**CONCLUSION**

Digital health holds the potential to revolutionize healthcare by improving accessibility, efficiency, and patient engagement while reducing healthcare costs. Digital health tools have the vast potential to improve our ability to accurately diagnose and treat disease and to enhance the delivery of health care for the individual.

As technology continues to evolve, the integration of digital health solutions into mainstream healthcare practices is expected to grow, leading to a more patient-centered and data-driven healthcare system. However, it's essential to address challenges related to data privacy, security, and equitable access to ensure that digital health benefits all individuals and communities.

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