

Research Paper



## Future well-being with digital health technologies

Athmaja Shetty<sup>1\*</sup>, Surinder Kaur<sup>2</sup>, Yuktha HJ<sup>3</sup>

<sup>1,2,3</sup>Department of Pharmaceutics, The Oxford College of Pharmacy, Bangalore, India.

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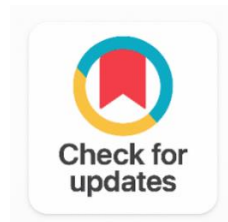
Artificial Narrow Intelligence

Based Algorithms

Portable Diagnostic Devices

Virtual

Augmented Reality



### ABSTRACT

**Background:** Digital health is a paradigm shift in the healthcare industry since the early 2000s, moving from the patient-physician relationship to a partnership. The COVID-19 pandemic has paved the way for the rapid adoption of digital tools in clinical practice all around the world.

**Objectives:** To explore possible future scenarios of digital health and how these relate to potential challenges of mainstreaming it into healthcare delivery.

**Methods:** Prospective analysis and a narrative review of digital health technologies such as machine learning algorithms, mobile health applications, wearable sensors, portable diagnostic devices, and telemedicine platforms, in the context of traditional clinical care.

**Results:** Digital health technologies have significant promise to complement the traditional clinical history-taking, physical examination, differential diagnosis and therapeutic intervention paradigm. Turning the patient into the first point of care: artificial narrow intelligence-based algorithms and portable diagnostics enable diagnosis and treatment delivery that is not based on clinical settings. A major shift toward a conceptualization of "well-being" is taking place, with patients coming into the medical system in advance of the onset of symptoms. This requires preventive strategies based on broad patient-level information and study results from a population analysis.

**Conclusion:** In the next few years, digital health will be key healthcare advancements that will transform care and patient engagement. But there are significant concerns about the privacy of patient data, patient autonomy and freedom of choice and patient clinical safety when widely used. The ethical implications of technological advancements and their impact on healthcare systems and practitioners are still a pressing concern.

#### Corresponding Author:

Athmaja Shetty

Department of Pharmaceutics, The Oxford College of Pharmacy, Bangalore, India.

Email: [athmi99@gmail.com](mailto:athmi99@gmail.com)

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## 1. INTRODUCTION

The COVID-19 pandemic has advanced the healthcare industry's digital revolution, which will change many of the core tenets of medical treatment. We are aware that there may be numerous detours on this route to advancement. The terms "health" and "well-being" have always had a close relationship since they both have an effect on one another. In 1948, the World Health Organization defined health as "not merely the absence of disease or infirmity but a state of complete physical, mental, and social well-being [1].

### 1.1 Changes to Health and Well-Being in the 21st Century

The fundamentals of healthcare and the practice of medicine have undergone a cultural revolution in the 21st century as a result of the democratization of knowledge, the migration of empowered patients, and the advent of digital health technology [2].

The doctor-patient relationship used to be hierarchical, but this is beginning to change into a collaboration on an equal footing. Patients now have access to previously unavailable research, information, and technology as the medical ivory tower begins to crumble. Health sensors, genetic information, artificial narrow intelligence, and other cutting-edge technology are now widely used. There are grounds to think that what well-being implies will fundamentally shift as we look to the future of this century [3].

Early in the 21st century, people who have access to care focus on delaying receiving treatment as long as they can. Finding the appropriate therapies and receiving an accurate diagnosis might be difficult for persons who do not have enough access to modern healthcare. Healthcare is fundamentally ill care, where the majority of resources must be used to treat those who have a medical problem. People who want to lead a healthy lifestyle fall behind and are labeled as simply caring about their well-being [4].

According to how digital health technologies have begun to influence healthcare, it appears that most people will seek medical attention long before any symptoms or diseases manifest [5]. To maintain a healthy lifestyle under specific conditions like the level of healthcare where they live, their economic situation, or their own personal habits and behavior, they will require data, knowledge, and expertise.

### 1.2 A Day in the Life of a Human in the Future

Customized smartwatch with a chatbot powered by artificial intelligence that works all day long. All of individual data, activities, and digital channels are accessible to it [6]. It will use a smart alarm to wake up from light sleep in the morning at the ideal moment so that a person feels energized for the day. Based on the results of microbiome and genome sequencing, a vast database is used to match the mood with the ideal meal that will provide energy. The gadget keeps the user motivated throughout the day, whether working or spending time with family, and it displays graphs that illustrate how mood changes when going for a run at a particular time of day. The chatbot alerts the user if any important health parameters or vital signs change, and it compares the findings to millions of medical studies and the cloud-based knowledge of medical experts [7]. Users are provided with detailed instructions if they need to perform any tasks.

The usage of chatbots might include voice pattern analysis to pick up on emotional undertones. With major financial investment raised to develop this technology, businesses (like Babylon) have heavily invested in the use of chatbots to diagnose patients in primary care.

Speech recognition technology has been around for a while, but with advances in processing power and machine learning, it may now be used in clinical settings during consultations for purposes more than merely transcribing letters. When a clinician examines a patient's eardrums and says aloud, "Red, inflamed eardrum," the system suggests the diagnosis of otitis media and then provides a list of antibiotics from the formulary based on the patient's age and allergy status. Ambient voice recognition is causing a lot of enthusiasm and has obvious uses for increasing productivity and documenting therapeutic encounters. Microsoft recently acquired Nuance, one of the industry heavyweights, for approximately \$20 billion.



Figure 1. Digital Health and Medical Technologies

### 1.3 Digital Health's Potential

With healthcare's current advancements, we may anticipate being able to treat most diseases within a few decades and beginning to concentrate on preventing illness rather than treating it when individuals become ill, with the use of artificial intelligence (A.I.) based assistants. The question is not whether digital health can help move the focus from treating illness to enhancing wellbeing, but rather how we will need to change our notion of well-being in a time where cutting-edge technology continually looks out for us to stop health problems from occurring.

Sleep alarms allow us to get up when it is most convenient and help us get better sleep over time. Gamified fitness trackers help us stay active and healthy for a long time [8]. Data from the sequencing of the genome and the microbiome can help prevent illnesses, bad therapies, or negative effects. Mobile diagnostic tools and digital tattoos can quickly identify problems. The waiting lines for transplants are eliminated via three-dimensional bio printing. Better decisions and health advantages are infused into our lives by artificial intelligence.

Patients may become the center of care thanks to digital health technology. Doctors might help their patients navigate the minefield of digital tools, health information, and choices. The provision of healthcare will become more universal in a world where physical and geographical barriers do not limit available treatments and diagnostics [9]. Patients who are aware of their options will want specialized therapies that are based on their unique demands and molecular/genetic composition. All of these will require a new level of data analysis that is beyond the capacity of a person [10]. As a result, our lifestyles and the provision of healthcare will be overrun by artificially limited intelligence-based algorithms.



Figure 2. Digital Health

Digital tools are available to help with remote assessment. These technologies range from software that can diagnose COVID-19 by listening to your cough, to an app on your phone that can evaluate your gait stability. With the categorization of skin lesions using image analysis to quickly increase diagnosis accuracy, dermatology is at the forefront of this movement. In order to determine whether a mole may be malignant, Google already has software that employs machine learning from its enormous picture library.

The true problem is figuring out how to take advantage of this new state of wellbeing without sacrificing the emotional connection, human touch, and freedom of choice.

#### 1.4 Technologies that Will Shape Healthcare's Future Mobile

In western nations, mobile phone ownership is widespread, with up to 65% of those over 65 and over 90% of those under 65 using smartphones. These provide a huge possibility for healthcare as a continually carried personal communication device that may either actively or passively collect data on a patient's health. The phone's sensors have been used to create specialized health applications. This has created a significant opportunity to evaluate progress, detect illness onset sooner, and perhaps provide remote, affordable patient-centered treatments. With over 100,000 apps accessible on the Apple and Google app stores combined, there has been an explosion of programmes (apps) as a result of the obvious potential benefits. Numerous ailments have been handled, ranging from the tracking of Parkinson's disease with gait analysis and tap testing to cardiovascular care with heart rate, heart rhythm, and blood pressure monitoring, and to apps that support mental health [11].

A personal profile can be created on many health and wellness applications, and this profile will track important statistics like weight, calorie intake, and blood sugar levels. People can regulate their health more thanks to the accessibility of tailored healthcare. Additionally, consumers and their professionals can exchange health information. During the COVID-19 outbreak, a revolutionary idea called the contact tracing app was quickly prototyped and implemented. This made advantage of a phone's Bluetooth functionality to determine people's proximity to one another and to anonymously alert anyone who had come into touch with a virus-infected person. Only 28% of people downloaded the app, yet between September 2020 and December 2020, it prevented almost 600,000 illnesses [12].

#### 1.5 IoT and Medicine

The Internet of Things (IoT) is a developing network of real-world items that can link to other internet-connected devices and systems and share data with them by using software, sensors, and other technologies. Wearable technology, monitoring, and integrated apps are used in the rapidly expanding sector of medical IoT to meet healthcare demands. The smart inhaler, a gadget that syncs patient usage with a smartphone app, is one example of how medical IoT might deliver improved versions of conventional medical products. IoT for healthcare has several advantages: improved convenience, remote monitoring, and lower costs for patients and hospitals.

#### 1.6 Wearable Technology

Consumer wearable technology is becoming more and more common. Typically, these have been rings, wristwatches, gloves, inner soles, or headgear. Through embedded sensors, they collect physiological data. Then, either on the device itself or connected to a smartphone app, data are translated. As a result, professionals now have access to more data than ever before. An example of this is guided-exercise programmes, which have already showed potential in supporting mental health-related difficulties. These could prevent unneeded medical visits, but they might also mislead patients, so they should be carefully considered.

#### 1.7 Telehealth

The delivery and facilitation of health and health-related services (such as medical treatment, provider and patient education, health information services, and self-care) using telecommunications and digital communication technology is known as telehealth. Telehealth is the practice of delivering healthcare services via the use of digital communication tools including computers, mobile phones, and tablets.



improve medical judgments, provide specific recommendations for a healthier lifestyle, and generally give people the possibility to live longer and in better health. Networks, businesses, and AI algorithms will all exchange this data. One may argue that it should be fine as long as the patient ultimately decides how much of their privacy they are ready to give up in return for a longer life, but given those health advantages, the loss of privacy seems nearly unavoidable. Access to these technologies is unequal. The richest 1% of Americans and in the UK today live 10 years longer than the poorest 1%. That distinction might be attributed to the availability of care. People may have biological disparities due to financial inequality when access to bio printing human tissues or A.I.-based medical decision assistance becomes a possibility.

Appropriate data storage and security compliance with all applicable data protection remains of utmost significance, but they should not affect the ease of data sharing. Tools and records will eventually be optimised for national healthcare systems.

## 2. CONCLUSION

Telemedicine, Internet of Things (IoT), and healthcare applications are all supported by technology that has existed for some time before the pandemic. However, it required the pandemic to advance healthcare and encourage medical organisations, professionals, pharmacists and patients to use emerging digital health trends and technologies. Now that rapid research and development techniques, remote services, and IoT devices are fully operational, both patients and providers are aware of the importance of digital health services. Activity in funding and investing demonstrates that other people appreciate digital health trends as well. The opportunity for improvement is still enormous. However, the healthcare sector is actively embracing innovation and putting a strong emphasis on building a brighter future and enhancing health equity for everyone.

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### Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Athmaja Shetty	✓	✓	✓	✓		✓		✓	✓	✓	✓			✓
Surinder Kaur	✓	✓	✓			✓	✓	✓		✓	✓	✓		✓
Yuktha HJ	✓	✓	✓		✓	✓	✓		✓			✓	✓	

C : Conceptualization

M : Methodology

So : Software

Va : Validation

Fo : Formal analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project administration

Fu : Funding acquisition

### Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

### Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

### Ethical Approval

Not Applicable.

### Data Availability


The data that support the findings of this study are available from the corresponding author upon reasonable request.


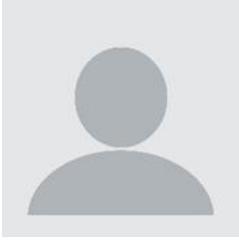
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### BIOGRAPHIES OF AUTHORS

	<p><b>Athmaja Shetty</b>, is affiliated with the Department of Pharmaceutics at The Oxford College of Pharmacy. Her academic and research interests focus on pharmaceutical formulation development, drug delivery systems, and advances in pharmaceutics. As a researcher, she contributes to studies aimed at improving the effectiveness, safety, and quality of pharmaceutical products. Through her work in pharmacy education and research, she supports the development of innovative healthcare solutions and the advancement of pharmaceutical sciences. Email: <a href="mailto:athmi99@gmail.com">athmi99@gmail.com</a></p>
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	<p><b>Surinder Kaur</b>, is associated with the Department of Pharmaceutics at The Oxford College of Pharmacy. Her academic interests include pharmaceutical formulation development, novel drug delivery systems, and quality assurance of pharmaceutical products. She is actively involved in research and educational activities that contribute to advancements in pharmaceutical sciences. Through her work, she aims to enhance drug efficacy, patient compliance, and healthcare outcomes while promoting innovation in the field of pharmaceutics.</p>
	<p><b>Yuktha HJ</b>, is a researcher from the Department of Pharmaceutics at The Oxford College of Pharmacy. Her areas of interest include formulation science, drug delivery technologies, and pharmaceutical research. She participates in academic and scientific projects focused on improving the development and performance of pharmaceutical products. Her contributions support the advancement of modern pharmaceutics and the delivery of safe, effective, and patient-friendly therapeutic solutions.</p>