

Digital Health Technologies and Well-Being in the Future

Bertalan Meskó

The Medical Futurist Institute,
Semmelweis University

Abstract—The cultural transformation called digital health has been shaping the fundamental basics of healthcare since the beginning of the 21st century. The doctor–patient hierarchy has been transforming into an equal-level partnership. Patients are becoming empowered, thus giving birth to the empowered physician movement. The role of physicians has been changing from being the key holder to the ivory tower of medicine to being a guide for patients in the jungle of health and digital information. This transformation will dominate the major changes in healthcare in the coming decades. Advanced technologies such as sensors, portable diagnostic devices, or artificial narrow intelligence based algorithms will make patients the point-of-care receiving diagnosis and treatment wherever they are.

These developments will redefine well-being as patients will enter healthcare before their first symptoms arise and will need their medical professionals to design preventive plans using a huge amount of data obtained about the patient and from studies. Such changes will inevitably come with unprecedented challenges around privacy, the freedom of choice, and patient safety. This article discusses potential scenarios about the future of digital health and aims at addressing the major challenges around that.

HEALTH AND WELL-BEING CHANGING IN THE 21st CENTURY

■ **THERE HAS ALWAYS** been a strong relationship between what health and what well-being mean

as both impact each other. 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.” In the 21st century, the democratization of information, the movement of empowered patients,

Digital Object Identifier 10.1109/MITP.2019.2963121

Date of current version 12 February 2020.

and the rise of digital health technologies have led to a cultural transformation of the basics of health-care and the practice of medicine.¹

The hierarchy in the doctor–patient relationship has started to transform into an equal level partnership. The ivory tower of medicine has started to break down, making previously inaccessible studies, information, and technologies accessible to patients. The use of health sensors, genomic data, artificial narrow intelligence, and other advanced technologies have become commonplace.² Looking ahead at what awaits us in this century, there are reasons to believe that what well-being means will fundamentally change too.

In the early 21st century, those patients having access to care focus on avoiding it for as long as possible. For those without a proper access to modern healthcare, finding the right treatments and being diagnosed properly are an everyday struggle. Healthcare is essentially sick care, where we have to dedicate the vast majority of resources to dealing with those having a medical condition. Those who would like to live a healthy lifestyle lose ground and are labeled as people only interested in wellness.

The way digital health technologies started shaping healthcare, it seems most patients will enter healthcare far before any symptom or disease would arise. They will need data, information, and expertise to keep on living a healthy lifestyle under given circumstances such as the quality of care where they live, their economic background, or personal habits and behavior.

A DAY IN THE LIFE OF A JOHN IN 2045

John has a thin smartwatch that features an artificial intelligence-based chatbot he takes everywhere with him all day long. It has access to all his data, habits, and digital channels. It wakes John up from light sleep in the morning at the very best time with a smart alarm to make sure John feels energized for the day. His breakfast is chosen from a huge database that can match his mood that day with the best kind of food that gives him energy based on his microbiome and genome sequencing results.

It helps him get to work in the most convenient way, preparing for every route and change

in time. The device keeps him motivated for the whole day whether he is at work or enjoying time with his family and persuades him to go out for a run by using his favorite Monty Python jokes and showing him graphs about how his mood changes when he goes out for a run this time of the day. In the evening, it prompts him to meditate before choosing the movie he likes.

The chatbot notifies him when any of his major health parameters or vital signs change and compare the results to millions of medical studies and the expertise of medical professionals available in the cloud. If there is anything John has to do, he receives clear instructions and gets motivated with gamification to help him stick to the solution (see Figures 1 and 2).

It might sound like an obsessive scenario where John does not have freedom of choice or has to focus on his health all day long. In reality, John will not experience much of what is happening around and about him. He is being taken care of while not even noticing it.

THE PROMISE OF DIGITAL HEALTH

With healthcare's current progress, we can expect to be able to take care of the majority of diseases within decades and, with the help of artificial intelligence (A.I.) based assistants, start focusing on keeping people healthy instead of treating them when they are sick. The challenge is not whether digital health can help shift the attention from treatments to improving well-being but how we will have to adjust the definition of well-being in an age where advanced technologies constantly take care of us to prevent health issues from happening.

Sleep alarms help improve sleep in the long-term and wake us up at the most convenient time. Fitness trackers with gamification help keep us active and healthy for decades. Genome and microbiome sequencing data help avoid diseases, incorrect treatments, or side effects. Digital tattoos and portable diagnostic devices catch symptoms on the go. Three-dimensional bioprinting eradicates transplantation waiting lists. Artificial intelligence infuses our lives with better decisions and health benefits.

Digital health technologies can make patients the point of care, meaning that the roles of

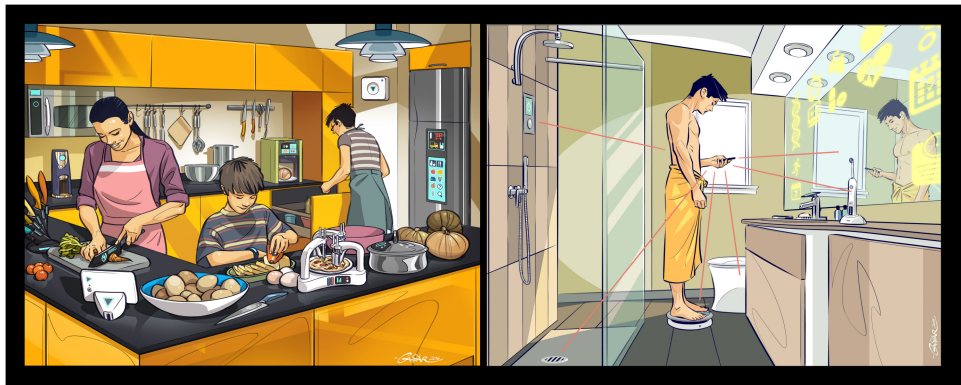


Figure 1. Concept art about the future of our homes. The kitchen features technologies such as food printer, food scanner, fitness tracker, or the smart knife (left). The bathroom demonstrated the Internet of healthy things featuring a smart mirror, microchip testing urine, smart thermostat, and a smart scale (right). Copyright by Bertalan Mesko. Published with Permission.

stakeholders will have to adjust to that. Physicians, instead of being the keyholders to the ivory tower of medicine, could become guides for their patients in the jungle of digital methods, health information, and decisions.³ Healthcare is going to get global where treatments and diagnostic options are not hampered by physical and geographical boundaries. Patients, knowing they have a choice, will ask for precise and

targeted treatments tailored to their needs and molecular/genetic makeup. All these will require a new level of data analysis no human being can deal with. Therefore, artificial narrow intelligence-based algorithms will flood healthcare and our lifestyles.⁴

When these technologies become commonplace, the question is not whether we can improve life expectancy and healthy life years



Figure 2. Concept art about the future of our workplace. Fitness trackers keep workers healthy and compete against each other (left). Advanced technologies such as virtual and augmented reality have become commonplace (middle). Exoskeletons and other robotic structures help workers perform in a way that their health is protected (right). Copyright by Bertalan Mesko. Published with Permission.

for all, but whether we can remain human in the age of A.I.-based decisions. The real challenge is to learn to enjoy this new level of well-being without losing the human touch, emotional connection, and the freedom of choice.

THE DOWNSIDES OF A MEDICAL UTOPIA

We would not be able to reach such benefits without major risks and challenges. One challenge lies in the issue of privacy. Making better medical decisions, providing targeted suggestions for a healthier lifestyle, and generally giving a chance to live a longer and healthier life require a huge amount of personal data. Such data will be shared among networks, companies, and A.I. algorithms. One might argue that as long as the final decision about how much of our privacy we are willing to share in exchange for a longer life remains to be made by the patient, it should be acceptable, but the loss of privacy seems almost inevitable in light of those health benefits.

A second challenge is inequality in accessing these technologies. Today, the wealthiest 1% of U.S. and U.K. citizens live ten years longer than the bottom 1%.⁵ We can attribute that difference to access to care. When the access to bioprinting human tissues or A.I.-based medical decision support come into the picture, people might experience biological differences among each other due to financial ones.

A third challenge is even more philosophical. When there are no diseases or certain major diseases such as cancer do not mean milestones but only bumps in one's life, what if the use of digital health technologies result in a general negligence about taking care of ourselves? What

if instead of patients switching from being cared for by physicians in the ivory tower of medicine to becoming proactive partners, they prefer being cared for by machines in silicon towers?

FURTHER READING

<https://medicalfuturist.com/>

The Guide to the Future of Medicine (WebicinaKft., 2017, ISBN-13: 978-9630898027, <http://amzn.to/1w003sx>).

■ REFERENCES

1. B. Mesko, Z. Drobni, É. Bényei, B. Gergely, and Z. Gyórfy, "Digital health is a cultural transformation of traditional healthcare," *mHealth*, vol. 3, p. 38, 2017.
2. E. J. Topol, *The Patient Will See You Now: The Future of Medicine is in Your Hands*. New York, NY, USA: Basic, 2015.
3. B. Mesko and Z. Gyórfy, "The rise of the empowered physician in the digital health era: Viewpoint," *J. Med. Internet Res.*, vol. 21, no. 3, 2019, Art. no. e12490.
4. E. J. Topol, "High-performance medicine: The convergence of human and artificial intelligence," *Nature Med.*, vol. 25, pp. 44–56, 2019.
5. R. Cohen, "Richest Americans live seven to 10 years longer than poorest," *Reuters*, 2016. [Online]. Available: <https://www.reuters.com/article/us-health-lifeexpectancy-wealth-idUSKBN13U200>

Bertalan Meskó is currently The Medical Futurist and the Director of The Medical Futurist Institute, Budapest, Hungary, analyzing how science fiction technologies can become reality in medicine and healthcare. He has received the Ph.D. degree. He is also a Private Professor with Semmelweis Medical School, Budapest. Contact him at berci@medicalfuturist.com.