Digital Health; Current Evidence and Future Perspectives

Ali Serdar Fak

Marmara University, Hypertension and Atherosclerosis Research Center, İstanbul-*Turkey*

Keywords: digital health, e-health, m-health, artificial intelligence, data mining, big data

Digital health covers the use of emerging and ever sustaining information and communication technologies (ICTs) in all aspects of health and health related activities. It is actually a broad term that includes practises and outputs of several fields such as remote medicine, telemedicine, clinical information systems, mobile health (m-health), personalised health (p-health), virtual reality, data mining, artificial intelligence and finally big data. The digital era has radically changed the production of and access to information for people all around the world and this has also had influence on patient behaviours and physician-patient relationships as well (1-3).

Certain basic ICT terms that are encompassed by digital health are given in Table 1.

The ICTs that we may be familiar with either as lay people or patients or cardiologists have dispruted and re-shaped the world in the last two decades.

However contrary to other sectors digital transformation has specific issues in healthcare:

1. Digital health is not only a technology but also a cultural transformation

Starting from the early years of internet "health related research" has been one of the most popular subjects of research on the net and this behavioral pattern has been described as "e-patient" by Ferguson in 2004 (4). These people have stated to have various motivations such as improving their own care, providing care for others, helping professionals improve the quality of their services, and participating in collaborations between patients and professionals (4). The scope of interaction and the amount of medical information easily accessible via the internet have reshaped physician-patient relationship. On the other hand in the digital era people have themselves become the sources of "data" by the use of smart phones, smart watches, sleep sensors, smart blood pressure monitors some of which have already been cleared by the FDA (5, 6). While one walks or cycles almost any app can tell him or her the amount of calories he or she has burnt instantly. There are innumerable websites, blogs etc. in any medical subject in the net some of which are run by universities and medical associations to give reliable and scientific knowledge on health and disease states to the people (7-11). Hence patients are more empowered and wish to be and finally can be a part on the discussion on their own health and disease states. As internet and disruptive smart technologies give both health professionals and patients digital and objective data, the relationship between physicians and patients will become to a shared decision-making level.

On the other hand there may be certain risks of "Googling" such as invalid and unscientific information, confusion of irrelevant information etc. However to avoid such risks physicians would better be familiar with "digital world"; should recommend their patients trustworthy websites even be involved with these sites, be donated for questions and concerns. Also the medical associations and medical societies should have comprehensive websites dedicated to patients and lay people donated with current, valid scientific information on health and related disease states and therapies and valid apps and smart gadgets etc. European Heart Society has published a position paper in 2016 (12) and a paper on big data (13).

2. Digital health might change our methods of research and practise:

People are creating and sharing data every day and everywhere in the digital era. Not only the smart phones but the wearables such as wrist bands and smart watches are at the time being the infinite sources of personal data also including biologic parameters. In January 2018 and in August 2018

Address for correspondence: Prof. Dr. Ali Serdar Fak, Marmara Üniversitesi Tıp Fakültesi, Başıbüyük Kampüsü, Hipertansiyon ve Ateroskleroz Araştırma Merkezi, HIPAM, Başıbüyük, Maltepe, İstanbul-*Türkiye*
E-mail: serdarfak@marmara.edu.tr

DOI:10.14744/AnatolJCardiol.2019.92892

Table 1. Glossary of commonly used digital health terms

eHealth	Or digital health, covers the use of emerging information and communication technologies in all aspects of health and health related activities to improve human health.
mHealth	Is the use of mobile communication technologies (smart mobile phones, wearable and attachable devices) to develop information and perform health service.
Android OS:	Is developed by Google and the Open Handset Alliance and is a Linux-based open source operating program for cellular devices.
App	Means application and it is a software program for any hardware device or platform. It usually refers to programs for mobile devices such as tablets or smart phones. Contrary to SMS and MM programs most Apps are to be downloaded either free or with charge.
Bandwith:	Refers to the data transfer speed; this is the amount of data transmitted from one point to another in a given time. This is expressed in bits per second. Modern networks have enormous speed measured in the millions of bits per second (megabits per second; Mbps) or billions of bits per second (gigabits per second; Gbps).
Bluetooth:	Is a particular wireless technology that allows computers, printers and smart phones to communicate with each other in a short-range distance.
iOs:	Is an operating system by Apple. The iPhone, iPad and iPod Touch devices use this system.
MMS	Means multimedia messaging service and it allows exchanging of pictures with sound clips on the smart phones or on the digital cameras.
SMS	Means short messaging service and it is a basic component of the mobile phones. This allows exchange of short text messages.
Wireless:	Means sending and receiving electronic signals by using radio waves without the use of any wires.
Wi-Fi:	Is a networking technology that the computers, cameras, tablets and smart phones, etc. can communicate with each other over a particular radio wave in a reasonably wide-range distance.

Fitbit revealed 6 billion-hour of sleep data and 150 billion-hour of heart-beat data, respectively (14, 15). Such amount of data is out of the scope of our clinical trials. Apple Heart Study an App-based study performed with a smart watch which included 419,297 self-enrolled people was able to detect silent atrial fibrillation episodes (16). There are surely some limitations but such great enrollments can only be achieved and performed by digital technology and hence can provide us enormous data from daily life. However necessary medical refinements and modifications for clinical accuracy are to be done in the near future. Other wearables and home devices will be used in the near future for medical data generation and medical research in similar ways.

On the other hand digitalisation of medical records and medical data has lead the opportunity of decision-making and support systems possible by machine learning, data mining and artificial intelligence (AI). For example a convolutional neural network (CNN) involving AI was trained using 129,450 clinical images, which included 2,032 different diseases. Then the performance of the CNN was shown to be comparable with the level of competency of the dermatologists in classifying skin cancer (17). Machine learning likewise, was used to estimate dipper/non-dipper blood pressure pattern in hypertensive patients without the use of ambulatory blood pressure device in a pilot study (18). Numerous examples can be given (19) although these have not yet demonstrated clinical use, AI will be recognized in the near future.

3. Digital health will enable precision medicine:

Digital era has made possible to collect, archive and processes enormous data for anyone and anywhere which is not possible in even the largest scale clinical trials. So we can get demographic, clinical, social, cultural and daily life data from sleep time to eating style, from walking distance to body temperature, from weekly shopping list to social activities and even stress level etc. Some of the cardiovascular risk scores we driven from time honored studies and we use in clinical practice today for example, rely on patients' response to doing exercise as yes, or no, or 300 minutes a week etc. However today we can count each step of our patient! We may know how much hour and minute our patient slept, yesterday, last week, or last month. Our patient can weigh himself or herself each morning on the scale with a Bluetooth communication and can send us his or her body total fat, water and salt ratios instantly.

Today we do have risk scales for coronary artery disease, for atrial fibrillation (AF), etc. However there are still many people having myocardial infarction without known classical risk factors or patients who do not develop AF even though they have

Anatol J Cardiol 2019; 22: 2-4
DOI:10.14744/AnatolJCardiol.2019.92892

fair enough risk factors. With the help of AI or big data we will most probably better estimate cardiovascular risk factors and diseases. Hence we will target our therapies on actual necessary conditions and diseases.

4. Medico legal issues need to be solved:

With the use of smart devices personal data almost automatically began to be collected and shared anytime and everywhere. Where does the patient privacy start? Is a simple pulse rate or a blood pressure measurement personal or a medical data? Will a routine "accept" button be enough for permission for these measurements to be collected by third parties? What about ECGs, skin lesion photos or even on-line pregnancy tests? All data will naturally be on the cloud. Who will be responsible in the future, in case of a conflict?

Technology goes ahead, medicine and medico legal issues still waiting to be resolved. However technology is as always so generous that all these issues will be solved in the near future.

5. Investment issues in digital health:

Digital era started much before and digitalisation has advanced in other sectors much more fairly compared to medicine. Investors are not very eager on medical R&D. Medicine and health care have unique dynamics. Firstly; human health and human life necessitate much concern and conservative approach. That's why each innovation needs to be tested in large clinical trials in terms of safety and clinical endpoints.

Secondly; patient privacy is important for all the medical community and this is an historical heritage.

Thirdly; although the end users of the medical smart devices or apps seem to be the patients or people, the medical community should be convinced about their benefits by the evidence based medicine. This is a long pathway that the industry and the stakeholders should take into account.

Last but not the least the R&D facilities should involve the health care/medical community in order to develop patient friendly devices and apps to be used with clinical benefit.

Conflict of interest: Pfizer USA (Global), (international research grant, 2018).

References

1. Dowie J, Kaltoft MK. The Future of Health Is Self-Production and Co-Creation Based on Apomediative Decision Support. Med Sci (Basel) 2018; 6: pii: E66.
2. deBronkart D. How the e-patient community helped save my life: an essay by Dave deBronkart. BMJ 2013; 346: f1990.
3. Mesko B, Győrffy Z. The Rise of the Empowered Physician in the Digital Health Era: Viewpoint. J Med Internet Res. 2019; 21: e12490.
4. BMJ, e-patient editorial
5. Cited 2019 Sep 12. https://www.accessdata.fda.gov/cdrh_docs/pdf14/K140067.pd
6. Su J. Apple Watch 4 Is Now An FDA Class 2 Medical Device: Detects Falls, Irregular Heart Rhythm. Enterprise & Cloud (cited 2019 Sep) Available from: URL: https://www.forbes.com/sites/jeanbaptiste/2018/09/14/apple-watch-4-is-now-an-fda-class-2-medical-device-detects-falls-irregular-heart-rhythm/#313920a22071
7. https://www.bhf.org.uk/
8. https://www.heart.org
9. https://www.tkd.org.tr/kardiyobil/
10. https://tkv.org.tr/saglikli-bilgiler/makaleler
11. Cited 2019 Sep 12. https://www.health.harvard.edu/healthbeat
12. Cowie MR, Bax J, Bruining N, Cleland JG, Koehler F, Malik M, et al. e-Health: a position statement of the European Society of Cardiology. Eur Heart J 2016; 37: 63–6.
13. Hemingway H, Asselbergs FW, Danesh J, Dobson R, Maniadakis N, Maggioni A, et al. Big data from electronic health records for early and late translational cardiovascular research: challenges and potential. Eur Heart J 2018; 39: 1481–1495.
14. Pogue D. Exclusive: What Fitbit's 6 billion nights of sleep data reveals about us. Yahoo Finance (cited 2019 Sep) Available from. URL: https://finance.yahoo.com/news/exclusive-fitbits-6-billion-nights-sleep-data-reveals-us-110058417.html
15. Pogue D. Exclusive: Fitbit's 150 billion hours of heart data reveal secrets about health. Yahoo Finance (cited 2019 Sep) Available from. URL: https://finance.yahoo.com/news/exclusive-fitbits-150-billion-hours-heart-data-reveals-secrets-human-health-133124215.html
16. Cited 2019 Sep 12. https://www.acc.org/~/media/Clinical/PDF-Files/Approved-PDFs/2019/03/15/ACC19_Slides/Mar16_Sat/10amET_Apple-Heart-Study-acc-2019.pdf
17. Esteva A, Kuprel B, Novoa RA, Ko J, Swetter SM, Blau HM, et al. Dermatologist-level classification of skin cancer with deep neural networks. Nature 2017; 542: 115–118.
18. Altikardes ZA, Kayikli A, Korkmaz H, Erdal H, Baba AF, Fak AS. A novel method for dipper/non-dipper pattern classification in hypertensive and non-diabetic patients. Technol Health Care 2019; 27: 47–57.
19. Konno M, Ishii H. AI for medical use. Oncotarget 2019; 10: 86–87.