

CHAPTER 15

Health and Technology

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Introduction

Technology is all of the tools developed by people to control and change their environment and the information about these tools. Health technology has been defined by the World Health Organization as the systematic application of knowledge, skills and tools developed to improve living standards by solving a health problem.

Health care is a service that is provided continuously and the need for this service changes over time. Thanks to technological developments, advances in health care have brought about an improvement in the mortality and morbidity of diseases. With the increase in discoveries in basic sciences, breakthroughs in artificial intelligence, biotechnology, nanotechnology, digital technology, engineering, robotic methods have improved medical science. Thanks to these developments, early diagnosis, prevention of diseases, better explanation of disease models, ensuring continuity in patient care and improving health service delivery are also possible (Dzau & Balatbat, 2018).

In addition to the positive effects of biomedical technological developments, it also includes some possible risks such as ethical problems, lack of confidentiality of data, and cyber security vulnerabilities. While evaluating the contributions of technological developments in health, inferences should be made by considering the risks that come with these developments. The possibility of increasing health care costs due to new technologies is a concern. The cost increase in health services is known as a global problem today. In a study stating that health costs will be 18.28 trillion dollars in 2040, it was reported that these costs were 7.83 trillion dollars in 2013 data (Dieleman et al., 2016). Meeting the costs and ensuring that individuals have equal access to services are the challenges that come with technological developments. With the advancement of technology, it is important that the developments in health care can be delivered to all individuals rather than benefiting certain individuals in the society. The fact that the technologies needed in health care become more complex and expensive complicates the access to medical aid and paves the way for socio-economic problems. Technological R&D studies that cause high costs and the use of developed technology may have positive effects on health costs in the long run. Long-term cost analyzes of health technologies are needed.

Development of Health Technology

Fundamental changes in medical science that developed efficient health systems occurred in the late 20th and early 21st centuries. Major breakthroughs in basic sciences in the 20th century opened the door to progress in medical science (Paltsev, 2008; Bircher, 2007). In this way, tools have been developed for the prevention and treatment of diseases that were once considered quite deadly, such as diabetes, hypertension, bleeding diathesis. One of the greatest developments of the 20th century is the more effective use of hygiene and sterilization, which ensures the prevention of infectious diseases (Troy et al., 2002).

The discovery of X-rays and its use in health have provided a very important convenience in the diagnosis of diseases. A better understanding of microorganisms and learning the vital properties of cells have become possible with the development of microscopic tools. The fact that intensive care healthcare services have become more effective has enabled long-lasting major surgeries to be performed. Minimally invasive procedures such as angioplasty in the treatment of atherosclerotic heart diseases, unstable angina and heart attacks have created radical changes in cardiology in the last 15 years. Thanks to these and similar developments in health technology, a significant decrease in infant mortality rates was observed in the last century. In addition, the average life expectancy has increased by 30 years compared to the beginning of the 20th century.

Table 1

Significant Developments in Health Until the End of the 20th Century with the Help of Technology

Year	Development
1900 - 1915	Diphtheria serotherapy
	Identification of Plasmodium as a malaria agent
	Understanding the importance of the immune system
1915 - 1940	X-ray discovery
	Understanding the importance of preventive medicine
	Improvement of hygiene and sterilization
	Development of penicillin
	Discovery of blood groups and Rh factor
1940 - 1970	Medical use of ultrasonography
	Application of endoscopic interventions
	First kidney transplant
	Lithium use in psychiatric disorders
	Production of antipolymyelitis vaccine
	Lung and liver transplantation
	Aorto-coronary shunt surgery
	heart transplantation

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1970 - 1999	Medical use of computed tomography Analyzing the human genome

Technological Tools and Applications in Health

Biomedical Technologies

Cell technologies such as tissue engineering products, genetic therapy, nanotechnology and biotechnological drugs are promising biomedical technologies.

a. Cell Technologies

Tissue engineering technologies, which can create many tissues from cells, such as cartilage, bone or nervous system elements, may lead to great transformations in health in the future. In this way, the functions of the organs affected by the diseases can be restored (Zeihner, 2007).

b. Gene Technologies

Especially gene technologies, which support important discoveries in contemporary pharmacotherapy, lead to more effective measures against infectious diseases. The number of vaccines produced against hundreds of known pathogens in the last century was found to be quite insufficient in studies (Logunov, 2008). Molecular and genetic technologies enable genetically modified vaccines. Serious public health problems can be prevented thanks to these vaccines, whose availability is expected to increase in the next decade.

c. Nanotechnology

Working with particles in a millionth of a millimeter, nanotechnology is another promising area in health technologies. With this technology, whose therapeutic effects are investigated at the molecular level in cells, it is possible to give isolated interactions between proteins, target interactions with DNA, and medical treatments to small structures such as cell organelles. Biological nanostructures used in branches such as dermatology, neurosurgery and orthopedics that use medical implants are another important benefit of nanotechnology.

d. Biotechnical Drugs

The fastest growing sector of biomedical technologies is the biotechnical pharmaceutical sector. With these studies, biological activity is realized, not pharmacological effects. Microorganisms or cells of animal origin are used more frequently in biotechnical drugs produced using active substances of biological origin. The difference of these drugs from genetically modified microorganisms is the use of the natural biological activities of the substrates. This use is achieved by isolating the substrate DNA intended for biosynthesis.

Information Communication Technologies

Information and communication technologies have an important role in improving health care, increasing the quality of service and ensuring the continuity of health care. With the development of information and communication technologies, progress has been made in health services, which include planning, administration, prevention, diagnosis, treatment and follow-up applications. In addition, with information and communication technologies, it is possible to continuously renew themselves and to work effectively on updated medical scientific knowledge. In addition to the convenience provided by these technologies, communication between colleagues is also carried out effectively. On the other hand, there are some who report that electronic health records cause burnout of doctors and disrupt the doctor-patient relationship.

a. Telemedicine

It is the use of telecommunications to deliver health care to distant places. In this way, doctors can make consultations with relevant specialists and make more effective decisions in a short time when faced with complex problems (Karsenti, 2008).

b. E-Health

Health service management, policies and the provision of health services were formed by getting support from the internet. Thanks to e-health, data analysis, warning mechanisms and precautionary applications have been developed. In addition, with this system, patients are provided with information about their own condition.

c. Web-based seminar (Webinar)

It is a live broadcast where conferences and meetings are held simultaneously on the internet. In this way, participants from different places can take part in the same conference.

d. Webcast

Media contents in the form of live broadcast or recording can be presented to more than one person on the internet via webcasts. The contents on the server can be accessed by users.

e. Online Learning Platforms

Adaptable online learning platforms that create opportunities in the field of social media and education can be given as examples within information and communication technologies in health.

Health Technology and Transformation

Technological developments cause some jobs to disappear, some jobs to be transformed, and some new business areas to be created, as it has done so far. This situation shows the significant effects of technological developments on the workforce. For example, with the production of robots with artificial intelligence, certain professions may decrease gradually. It is predicted that developments in artificial intelligence will change the way, place and duration of service delivery in health. By using artificial intelligence, radiological examinations, laboratory results and electrophysiological tests will be interpreted. Trained personnel are needed in order to operate the technological systems that are in use and to maintain the services. This has led to the emergence of new business lines. Transformations and new formations in the existing workforce increase the importance of education and training policies in these areas.

It is necessary to increase the knowledge, skills and education quality in order to effectively use the human-machine cooperation that occurs with technological developments. With the technological developments, the way of providing health services at the homes of the patients has been cleared by moving away from the hospitals. In addition, the increase in the effectiveness of prevention will also reduce the patient burden in clinics. Health technologies have increased the knowledge of patients about their own condition and have enabled them to make more free choices about the treatment they will receive.

Health Technology and Ethics

Ethical problems arise because of people's decisions and behaviors. For this reason, holding technology itself responsible for ethical problems may prevent the production of rational solutions. It is very important to understand the importance that should be given to ethical issues while educating physicians.

Thanks to medical technologies, whose development has accelerated in recent years, easier diagnosis and more effective treatment of health-related problems has emerged. The average lifespan of people has increased and individuals have become healthier than in previous decades. Thus, technological developments have been rapidly adopted by societies. Efforts to adapt to technological developments at an unconscious speed carry the risk of inappropriate use, and this situation brings ethical problems. These ethical issues are grouped under three main headings as problems related to patient safety, difficulties in equitable use of tools, and effects on social norms. For example, failure to meet technical education and training requirements can result in fatal misuse. Due to the pressures on the use of new technologies by doctors as soon as possible, there is a lack of technical knowledge and skills. There is a learning curve for the smooth implementation of dexterous developments. For example, in the first applications of laparoscopic methods, more complications were encountered than open surgery.

Giving privileges to wealthy and powerful groups in the society in health technologies prevents fair presentation. It can have transformative effects on personal or social norms, as it can be used for purposes such as looking beautiful, gaining a strong memory, becoming stronger without any disease. The social pressure on those who ensure that health technology is delivered to the community stakeholders is another important feature of this issue. These pressures on health professionals may prevent the effective use of resources allocated for health costs by causing excessive and unnecessary

use of technology. Unnecessary tomography scans, off-label use of 3rd generation cephalosporins, off-label cesarean section are some examples of these.

Developments in science and technology have caused some social and ethical concerns to come to the fore in all areas of concern to society. The services provided must be delivered to individuals in a fair and equitable manner. In addition, developing technologies can affect the cultural structures and belief orientations of some societies. Technological developments can affect family structure, attitudes towards disability, and religious behavior patterns. For example, if people with disabilities do not accept the genetic treatments developed, it is necessary to ensure that they continue their lives without being excluded. There may also be an increase in social inequalities as genetic improvement methods become more successful. If the advantages brought by technological opportunities are monopolized by certain groups, it may become open to abuse. For this reason, it is of great importance to make equitable legal arrangements in accordance with the dynamics of each country, taking into account the views of all stakeholders. The increase in information records also raises concerns about the security of this information. Healthcare is one of the sectors most frequently targeted by cyberattacks. Equipping technological health systems with protection systems against cyber attacks is another important requirement.

Conclusion

Health technology aims to detect diseases early, develop minimally invasive procedures, reduce the need for hospitals, reduce healthcare costs and improve quality of life. Whatever the reason may be, it is impossible to prevent scientific and technological developments. The inevitable developments in 21st century health technology have brought about many changes. These changes have brought great benefits to public health by making life comfortable in many issues. In addition, it has brought many new problems such as artificial intelligence overshadowing human intelligence, smart devices destroying the respect for hand skills, and the medical profession has become more passive. In addition, the questions of what will be the limits of the use of technological developments in the human body, what kind of hospitals should be established in the future, and how safe new technologies are, come to mind with increasing frequency. In this respect, it is necessary to make an effort to foresee the situations that will be encountered in the future. Continuing to gain momentum in science and technology in the next decade will bring transformative changes in health. Thus, there will be tools and approaches that make it possible for health services to become better for society and individuals. It is necessary to work to be aware of social, economic and ethical risks and to take necessary precautions against them. Along with the technological developments in medicine, physicians who have to constantly improve their medical knowledge also need to have information about technological tools. Due to the need for technological tools in health care, doctors spend more time in front of technological tools such as computers. It is necessary to know that it will be a disadvantage for the patients to move away from the doctors.

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