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The Future of Medical Education

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Abstract

In the present study, new technologies that affect medical education and innovations in the education system are discussed. The contributions of e-learning, simulation, and health information technologies to the education of assistants and medical students in the future have been tried to be explained by providing examples from various research studies. In addition, the future of medical education will be in the field of scientific research, and the importance of patient safety is discussed while adapting to new technologies in medical education.

Keywords: Education, medicine, technology

INTRODUCTION

The main aim of medical education is to train specialist doctors with full knowledge of modern medicine and who are equipped with the latest knowledge and skills. Modern medicine is currently subdivided into internal medicine, surgery, oncology, pediatrics, and gynecological diseases. Currently, there are many technological developments affecting these areas. There is a consensus worldwide that it is difficult for medical education institutions to succeed with conventional training methods in terms of these rapid technological and social changes (1). While medical education should adapt to this new system, standards should be ensured, and patient safety should not be put at risk.

Nowadays, undergraduate and postgraduate medical education is transformed into a model in which students are less associated with patients; this is known as the Halstedian model in the literature, from the volume-based model in which many patients are examined and operated on (2). The reasons for this differentiation in education include development of advanced diagnostic methods, easy access to the doctor, decreased number of complicated surgical procedures, increase in the elderly patient population, and more minimally invasive surgery as surgical treatment (3). Today, surgical simulations rise into prominence in the training of residents because more importance is given to the patient rights, and the number of complicated surgical cases has decreased in our country similar to other countries worldwide.

How future doctors are going to be transformed into competent practitioners who can work efficiently and safely in a challenging environment of the health system of the changing world is the challenge faced by everyone working in both undergraduate and graduate medical education. The aim of the present study, which tried to examine the future of medical education, was to determine the rapid evolutionary stages in the future of medicine and to investigate its effects on education. In our study, new imaging and diagnostic methods, minimally invasive surgeries and simulations, and the role of new future technologies in undergraduate and postgraduate medical education are discussed.

Technological Innovations in Medical Education

Medical simulations reduce the duration of the learning curve of challenging surgical procedures in the work environment without compromising patient safety. The importance of patient safety in our country and in the world is better understood. Therefore, utilizing the learning methods in an environment where skills can be applied and developed before learning in real life is the most ideal (4). Simulation is increasingly used in the education of both medical students and residents.

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Residents can not only apply their clinical skills in a safe environment but also develop their general skills, such as teamwork and leadership (5).

Minimally invasive surgery plays an important role in medicine. Therefore, the concept of simulation in surgical training has gained increasing interest. For example, simulation plays a more important role in robot-assisted surgery in resident training. This is because the resident standing by the patient during the robot-assisted surgery cannot fully monitor the skills of the surgeon. However, robotic surgery simulators provide a faster learning of the required skills (6).

The three types of simulators used in the medical field are the following: (1) mechanical simulators, (2) simulators that enable to evaluate resident training, and (3) virtual reality (VR). Mechanical simulators are boxes in which the organs are manipulated using surgical instruments, and the organs or objects are placed (dry laboratory training) (7, 8). In the second type, the performance of the residents is assessed by a programmed software of mixed simulators capable of providing feedback, including objects and organs. Simulators with simpler software can measure the duration of the required procedures, the collisions that occur while performing the job, whereas those with more complex software can also evaluate the heat energy and clip placement errors and capture errors. These errors, which are integrated into the simulators, were proposed by experts and were subject to many evaluations by experts before being made available to the residents. VR simulators allow residents and medical students to interact with real-time three-dimensional computer databases. Medical students manipulate computer-generated images and receive feedback on their performance. VR images are generated by the processing of computed tomography or magnetic resonance imaging data. They are not only used in resident training but also used as a preoperative rehearsal of surgery by experienced surgeons. The aim is to minimize the complications that may occur during surgery. In particular, this form of simulation plays an important role in increasing patient safety in the future (9, 10).

Training programs should also change in parallel with medical technologies. Since the first successful laparoscopic surgery that was conducted 30 years ago, there has been a revolution in minimally invasive procedures in medicine (11). Recently, robot-assisted surgery has been developed and popular in many surgical branches. The biggest difference between robotic surgery and other conventional surgical procedures is the distance between the surgical site and the surgeon. In laparoscopic or open surgical procedures, while the surgeon is in the operating area, the surgeon in robotic surgery manages the surgery from a distance by a method called tele-surgery. This difference causes surgery to achieve another dimension, and it is foreseen that medical education will change in the future via this groundbreaking change (12).

While some of the new practices in medical education are the extension of previous techniques, the majority are recent innovations that require different skills and have a long learning curve. The content of the training, the method of training, and the assessment methods for these various developments should be defined in the future medical curricula. The cost of newer technologies makes it important that educational programs use these expensive resources effectively (13).

Video games are seen as one of the alternative training methods for laparoscopic or robotic surgery (14). These games are frequently used for the development of hand, eye, and reflex coordination of residents by providing challenging stimulating environments. Adams et al. (15) investigated the effects of a 6-hour video game in a week on the laparoscopic simulator capabilities of 31 general surgery residents. As a result, it is reported that the assistants had better visual, spatial, and motor coordination. In addition, it was emphasized that the residents should have 6 h of video game experiments a week before the laparoscopic simulator training.

Wearable technologies, such as Google Glass® or augmented reality simulators, are also being tested as a new form of technology that makes medical education more realistic and potentially more effective. In the study conducted by Dickey et al. (16), penile prosthesis surgeries were followed by 10 residents wearing Google Glass® during the operation, and they were actively asked to participate in the surgery. At the end of the procedures, the contribution of augmented reality to the trainings was investigated by means of a questionnaire. As a result, both faculty members and residents stated that this new technology had a very important contribution to their education. In addition, they reported that augmented reality represented a paradigm shift in surgery, and that this technology would replace other conventional education methods in medical education.

In recent years, the latest developments have added new terms, such as artificial intelligence, machine learning, artificial neural networks, and deep learning into our education and training life. It is absolute that future physicians should know these issues. However, there are currently no medical doctor academicians in this field. For this reason, engineers should create new educational projects with software developers and programmers who are experts in these subjects in order for future generations to be familiar with these issues, and these issues should be overcome via multidisciplinary approaches and partnerships.

Scientific research is another area of graduate and postgraduate medical education. One of the most important indicators of a quality medical school or clinic is the quality of the residents' thesis and the scientific research studies they make during their education. The Ministry of Health supports high-quality medical research in order to provide new treatments and to improve patient care. In addition to this, it is necessary to create a natural environment for conducting scientific research studies, to find creative subjects, to provide contribution to the medical students on this subject, and to create resources for the necessary financial opportunities. In particular, as in other countries, in-hospital systems can be developed, and the research studies to be supported might be identified by a commission of academicians. Hospital archives should be available to residents and interns with special permissions, and auxiliary staff should be provided to solve problems that might be encountered during the scientific research.

The accumulation and storage of data for scientific research is very important. In order for data research, accurate entry, storage, and request of data are neglected in our country. Patient records should be systems that allow the automatic collection of more or less information, including treatment results. The accumulation of this information will be used as a resource for the creation of large data in the future and for the establishment of diagnostic or treatment algorithms in cloud systems, such as Azure Microsoft® or Google TensorFlow®. Therefore, the use and guidance of these systems are the subjects of future medical education.

In 2014, Peyton et al. (17) investigated the contribution of scientific research to postgraduate education. A total of 256 doctors who were postgraduate students in the United States were reached by mail. The residents were asked to evaluate the impact of scientific studies in their clinics on their education. The majority of the residents stated that attending scientific research studies had a positive effect on their education. In particular, the other important information in the present study is that the medical faculties who are preferred by medical students are the ones who conduct the scientific research studies.

COMMENTS

Medicine has come a long way in the past few years. Therefore, medical education and student assessment methods should be adapted to these changes. Training and evaluation are still based on experience gained from clinical practice. Therefore, the education of each student should be personal, and the transition from the volume-based education model (number of assisted cases) to the learning-based system (to do as many as one can learn) should gain importance.

Medical simulation and, especially, VR will play a major role in the future of medical education. Telemonitoring and wearable technologies (e.g., Google Glass®) will be in the curriculum of future education programs. The development of learning technologies, e-learning, social media, and mobile devices and applications will become more noticeable in daily practice (18). The importance of evidence-based medicine is increasing. Therefore, it is thought that the importance given to the duration of scientific research in medical education will gain more value.

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