RESEARCH ARTICLE

The Role of Interactive Technologies in Optimizing the Process of Patient Treatment: Prospects and Challenges for Health Care

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ABSTRACT

The introduction of medical digital technologies can provide better access and flexibility of healthcare for the population. It includes the availability of open information about health, treatment, complications, and recent progress in biomedical research. Nowadays, even in low-income countries, diagnostic and medical services are becoming more accessible. However, many issues related to digital health technologies remain unresolved, including reliability, security, testing, and ethical issues.The penetration of AI currently affects almost all areas of work of medical organizations and government and supervision bodies in the field of healthcare, as well as all major nosological groups. The leading areas of AI application are: medical diagnostics and image analysis, predictive clinical and managerial analytics, medical decision support systems, data analysis of wearable devices, telemedicine, monitoring of patients with chronic non-communicable diseases, virtual assistants, including robot-assisted surgery, decision assistance mental health problems, etc.This article explores the role of interactive technologies in optimizing the patient care process and discusses the prospects and challenges they present for healthcare. In recent years, interactive technologies such as mobile applications, virtual reality, remote medical consultations and electronic health monitoring systems have become increasingly common in medical practice. Digital platforms can help optimize patient diagnosis, counselling and treatment. However, due to the lack of official regulations and recommendations, stakeholders, including private and public organizations, face the problem of adequate verification and testing of new digital health technologies. In this regard, proper scientific research is needed before a digital product is deployed for the health sector.The authors emphasize that interactive technologies have a significant potential for optimizing the process of treating patients in healthcare. They can improve the availability and quality of medical care, as well as increase patient satisfaction.

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INTRODUCTION

In modern healthcare, interactive technologies have become an important tool for optimizing the process of treating patients. With the advent of mobile applications, virtual reality, remote consultations and electronic health monitoring systems, new prospects in the field of medical practice are opening up [1].

A large number of digital innovations are revolutionizing healthcare, and technologies in medicine are not going anywhere. Numerous innovations and new solutions are already on the market, and all of them have radically improved healthcare.

Through the use of interactive technologies, patients can be informed about their health in a timely manner, and they can also receive recommendations for the treatment and prevention of diseases. With the help of mobile applications, you can access medical literature and monitor medication intake, as well as monitor the progress in rehabilitation.

All the technologies discussed below make it possible to improve the availability of medical care, in addition, patients can remotely receive various consultations at anytime and anywhere without personal presence in a medical organization.

The purpose of the work is to consider the role of interactive technologies in optimizing the process of patient treatment: prospects and challenges for healthcare.

MATERIALS AND METHODS

In the process of writing this study, an analysis of an array of literature was carried out within the framework of the research topic, comparative and analytical research methods were also applied.

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RESULTS

At the present stage, interactive technologies play a significant role in medicine and cover various aspects of healthcare.

Mobile phones are actively used to monitor the patient's health status and notify the health care provider in charge of him about the occurrence of threatening conditions. Periodic assessment of biometric parameters of the body and detection of symptoms are important components of the prevention of diseases and their complications. And a mobile phone is an ideal device for health monitoring and immediate notification of health workers. Monitoring can be carried out through built-in or plug-in sensors, devices, as well as on the basis of reports received from the participant. A combination of methods is possible.

Mobile applications that allow patients to get acquainted with the necessary information and improve the treatment process have become widespread today. Some applications also allow patients to track their health indicators, record symptoms and keep an electronic health diary [2].

A remote assessment of the patient's physiological parameters, such as heart rate or blood pressure, will help to get even the ideal remote consultation for the further treatment process. This approach of online monitoring will provide support for the transmission of data and information about the patient's condition.

The technology of remote rehabilitation, implemented in the form of the Portal of remote neurorehabilitation of the Federal Scientific and Clinical Center, provides the principle of continuity, social and informational support for relatives caring for patients in outpatient settings.

Communication and video communication technologies allow remote consultations between doctors and patients. This is especially important for patients who live far from a clinic or other medical institution. Remote consultations allow you to receive medical care in a timely manner and reduce the waiting time for an appointment.

Another achievement of medicine is the development of wearable devices, with their help, patients are able to receive data about their health status. These data are transmitted to electronic health monitoring systems, and medical specialists can receive them in a timely manner to make a decision on choosing a treatment method [3].

In medical education, interactive systems are used to train students and medical professionals. Such systems make it possible to master anatomy, help in the study of surgical skills, diagnostic procedures and other aspects of medical practice. They allow you to conduct virtual training, simulate complex clinical cases and develop decision-making skills in a controlled environment.

VR technologies have become a promising area that improves medical training and makes therapy more accurate. For example, studies have shown that using virtual reality applications to teach laparoscopic surgery improved the quality of training in 74% of studies. Moreover, 87% of studies have shown that specialists who have been trained using virtual reality have improved the accuracy of their work.

With the use of algorithms and artificial intelligence, doctors can make timely decisions in the field of diagnostics. These systems analyze medical data, provide recommendations and help optimize the treatment plan. It is through the use of interactive technologies that modern medicine has made a big step forward. However, despite all the advantages, the introduction of interactive technologies also faces challenges, such as data security, accessibility for all categories of patients and training of medical personnel [4].

In fact, the introduction of medical digital technologies can provide better accessibility and flexibility of healthcare for the general population. They include the availability of open information about the state of health, treatment, complications and biomedical research on the Internet. On the other hand, diagnostic and medical consulting services are becoming more accessible and accessible even in low-income countries.

Let's consider the features of using interactive applications in medical practice. Mobile apps allow users to track their physical activity, diet and sleep. They provide information about calories, nutrients, and help set goals for achieving a healthy lifestyle. Such applications are useful for those who want to control their health.

The use of mobile technologies in the healthcare sector can be extremely broad. There are already technologies that allow doctors to examine patients remotely using mobile phones and sensors, access medical information and patient health indicators over a long period of time and prescribe treatment without a personal meeting with patients.

Mobile applications allow patients to receive medical care and consultations remotely. Due to such technologies, video

communication sessions with doctors are organized, during which diagnostics is carried out, while patients are in their apartment or in the house.

Mobile apps can help patients monitor their medication intake, monitor food intake, or perform medical procedures. They can remind you to take the medicine at a certain time, monitor compliance with the recommended regimen and help patients follow the doctor's instructions.

Another promising area of medical research is virtual clinical trials, which have a number of advantages over the traditional model. Unlike standard clinical trials that require frequent visits, the virtual model of clinical trials is based on home observation of the patient. This gives people from rural areas or people with disabilities the opportunity to participate in research. This becomes especially important during pandemics and cataclysms of natural or man-made origin.

Virtual reality is used in rehabilitation programs and physical therapy to improve functional mobility and recovery after injury or surgery. Patients can use VR technology to exercise, develop coordination of movements and restore muscle strength.

Virtual reality is used in medical education to train medical school students, interns and doctors. It allows you to simulate complex medical situations, conduct virtual operations and training procedures. VR technologies also allow doctors to practice new skills and develop experience in a safe environment [5].

Another promising area of application of intelligent technologies is medical education. In fact, the volume of medical knowledge and data is growing very fast. In addition, medical professionals do not have enough time for continuous education and self-improvement. Medical education is mainly based on patient care, medical knowledge, communication skills, practical training, professionalism and systematic practice. A significant part of any medical education is mainly based on memorization and requires a lot of time. In this case, some tasks can be solved and delegated to platforms based on artificial intelligence. Moreover, teaching medical education on this basis can complement and enrich the current curriculum. Thus, students will have the opportunity to learn how to use intelligent tools to understand the basic principles and solve real clinical problems.

Let's look at some examples that show how virtual reality has improved medical training.

1. Students received more real cases to study

Medical students often study corpses to learn more about the human body and practice operations on a real body. Unfortunately, this does not give a complete understanding of how the operation is performed on a living person. On the contrary, VR technologies immerse students in real medical cases and suggest optimal actions during training.

2. Interactive learning improves academic performance

Virtual reality technology immerses students directly into a simulated medical environment. The visual representation of organs is shown in 3D, creating the atmosphere of a real operation, giving the opportunity not only to study abstract theory and imagine situations in which you have never been, but also to get real experience on which you can learn more successfully.

3. The ability to explore the human body from the inside

Students can explore the human body from the inside without real intervention. A VR user can view the body at an approximate scale and 360°, as well as observe the work of organs. The technology also allows you to trace how the organs are connected throughout the body.

4. Hundreds of interactive medical cases

The treatment of patients and operations do not always follow the scenario from textbooks. Situations and circumstances are different, so it takes many years to gain expert-level experience. VR medical training software generates hundreds of real cases and creates a real environment for them. Thus, students gain many years of experience in an independent training course.

5. Professional development at a high level

Medical education begins in college, but never ends. Doctors undergo regular training to update their knowledge and prove that they are real professionals who can be trusted with human lives. VR training makes learning more comfortable and effective at any stage of your career.

Another important advantage of VR training is that during the training the user can be accompanied by a virtual instructor who provides students with up-to-date information and guides them.

Recent studies have explored the potential of using immersive technologies as a way of medical intervention and an alternative way of providing care. For example, in rehabilitation VR, AR and MR are used as rehabilitation aids for patients who have suffered stroke, cerebral palsy and severe burns. Immersive technology-based rehabilitation allows patients to gain a more intensive learning and rehabilitation experience by immersing themselves in an enriched hands-on environment specifically designed for rehabilitation purposes. In addition to rehabilitation, immersive technologies are also used in telemedicine and virtual care [6]. For example, a virtual reality-based telemedicine platform is presented, which is used to diagnose and treat patients with chronic obstructive pulmonary disease during the COVID-19 pandemic. Experts also suggest combining augmented reality, Internet of Things and cloud technologies for remote treatment of balance disorders. In addition, a telemedicine application using Microsoft HoloLens has been created. The combination of immersive technology and telemedicine enabled patients to perform their daily health care tasks without requiring a healthcare professional to stand next to them. At the same time, doctors could get useful information about patients for tracking. Thus, the use of immersive technologies as a healthcare tool can increase environmental efficiency, real-time feedback, the ability to change the interface in unforeseen circumstances and flexibility, as well as provide patients with a safer environment for practice and learning.

Another significant area of use of immersive technologies is

medical practice and education. Immersive technology-based learning can provide healthcare professionals with a rich, interactive, engaging and safe learning experience, emphasizing the ability to transfer skills to clinical settings. It supports learning in practice, bridges the gap between theory and practice, and improves skill acquisition and transfer. Currently, scientists often use VR, AR and MR technologies in medical training and education as teaching aids to support, supplement or even replace traditional teaching methods. For example, technologies are used for anatomical training of medical students. On the other hand, medical practice and health care usually involve a lot of practical skills. VR, AR and MR technologies are used to improve practical and procedural learning [7].

Currently, the effects of simulation training interventions are widely studied. Randomized control trial studies show that learning based on immersive technologies can improve the assimilation of knowledge by students. Immersive technologies are believed to provide students with a new way of learning and help students acquire the necessary knowledge and practice in the field of healthcare. In particular, with the wider use of simulation training for practitioners and students in the field of healthcare or medicine, virtual reality can be developed to create an accurate and interactive operational simulation with the ability to record and analyze the results. AR and MR can revolutionize the workflow and accuracy of clinical skills such as surgery, diagnostics, image reconstruction and intraoperative imaging [8].

Specialists also conducted a meta-analysis to evaluate the effectiveness of virtual reality simulators compared to training on boxing simulators, especially in minimally invasive surgery. The key performance indicators used in their study were the execution time of minimally invasive surgery and the evaluation of effectiveness. In the study, 20 randomized clinical trials were included in a qualitative analysis, and 14 of them were included in a meta-analysis. The results showed that VR simulators can help subjects get a higher score in minimally invasive surgery. However, there was no significant difference in the time required to complete the operation.

Another group of specialists conducted a meta-analysis to determine whether virtual reality simulation-based training could improve the surgical skills of trainees compared to traditional training methods. The scope of their application was very specific, i.e. ear, nose or throat surgery. They found nine studies containing 210 subjects. Four studies were conducted in operating rooms, and five more studies were conducted in controlled training conditions. Studies conducted in operating rooms have shown that virtual reality simulation-based training can improve the surgical skills of trainees, get higher psychomotor performance and shorten the operation time. On the other hand, among the studies conducted in controlled training environments, only one study showed that virtual reality training is significantly better than conventional training in terms of acquiring anatomical knowledge. Other studies do not show a significant difference. Due to the discrepancy, the Researchers concluded that there is limited evidence to support the use of virtual reality surgical simulation in surgical training programs. They proposed to conduct further research to determine whether virtual reality training can lead to better outcomes for patients in the real world, as well as to the acquisition of non-technical skills [9].

Augmented reality has a wide range of applications in various branches of medicine. It can be used in surgery to navigate and assist in performing complex operations. With the help of AR technologies, the surgeon can see virtual images that overlap the real anatomical structures of the patient, which makes it possible to more accurately determine the location of organs and navigate during surgery. This can reduce the risk of errors and improve the accuracy of the procedure [10].

Interactive virtual simulators are used to teach medical students and doctors' various procedures and operations. They allow you to practice skills on virtual patients without risk to real patients. For example, simulators of surgical operations allow you to train in performing complex procedures, and birth simulators help doctors and obstetricians to master the skills of obstetrics [11].

There are various mobile and web applications that provide interactive training and training in medicine. They can contain information about various diseases, symptoms and treatment methods, as well as offer tasks and tests for self-examination. Some apps may also have a virtual coaching feature, helping users improve their medical skills.

Interactive simulators are used to train the skills of performing various medical procedures, such as injections, blood sampling, resuscitation, and others. These simulators usually simulate realistic conditions and allow you to practice the necessary actions and techniques safely and effectively [12].

Thus, in a world where objects are increasingly becoming digitized, there are more opportunities for creating digital ecosystems. The emergence of new digital platforms promises a revolution no less than the creation of factories more than two centuries ago. Combining social functions, mobile devices, analytics, cloud computing and Internet of Things, the platforms will allow companies to connect with each other, forming a new future of industries. In recent decades, innovations have been increasingly used to improve and optimize management, analysis and forecasting in healthcare [13]. For example, switching to electronic hospital records (EHRs) can help in storing, sorting and speeding up the processing of patient data. These technologies can significantly improve the level and quality of medical services. Moreover, the use of big data systems in the management of medical practice can improve the quality, efficiency of service, reduce the cost of treatment and the number of medical errors.

DISCUSSION

Although interactive technologies in medicine have many advantages, they also face some challenges. These problems can negatively affect the process of providing medical services. Integrating interactive technologies into existing healthcare infrastructure can be challenging. Some medical institutions and clinics may not have the necessary infrastructure and resources to implement and support such technologies. In addition, the availability of interactive technologies for all patients, including those who do not have access to modern devices or do not have the appropriate skills, is also a problem. In this regard, attention is currently focused on the specifics of the development of these technologies by practitioners.

By definition, any intelligent system cannot give a guaranteed accurate answer. There is always a possibility of errors in the interpretation of medical data, for example, due to the fact that some special cases or rare diseases were not presented in the training dataset that was used to create such a system. Thus, in addition to the really positive effect of the use of artificial intelligence in practice, there is a possibility to give an incorrect hint to the doctor, which in turn can lead to

medical errors in diagnosis and treatment, and therefore harm to the patient's health. This situation may not only not benefit the patient, but also cause harm, and this fact should also be taken into account when applying innovative technologies in the practice of medical care.

At the same time, the non-use of artificial intelligence technologies is also a serious problem, because at the present stage, without their use, we can no longer process the entire volume of data collected in the healthcare industry. The rejection of innovative technologies can throw medical organizations far back.

CONCLUSION

Thus, the study of literary sources allows us to draw a number of interrelated conclusions. Interactive technologies have a significant potential for optimizing the process of treating patients and improving the quality of healthcare. The use of various interactive technologies in various branches of medicine offers new opportunities for diagnosis, treatment, training and monitoring of patients. Thus, one group of technologies allows you to create immersive environments that facilitate the training and training of medical personnel, as well as provide visualization of complex pathologies and procedures for more accurate diagnosis and treatment planning. The other one helps to process and analyze large volumes of medical data for more accurate diagnoses, disease prediction and personalized treatment. In addition, a highly technological approach allows you to accumulate these areas of medical development, which will make it possible to improve the accuracy of diagnosis and the level of quality of medical care.

Some authors claim that intelligent technologies will have a significant impact on medical education in the near future.

At the same time, the problems of ethical use of interactive technologies, the need for a responsible attitude to them deserve the closest attention of both the regulator and developers and experts in this field.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

All authors contributed in reviewing the final version of this paper

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