



Overview of Technological Advancements in Current Healthcare Systems: A Futuristic Approach

Mitali Pareek*¹, Brahmansh Kaushik²

1. Mahatma Gandhi Dental College and Hospital, Jaipur, Rajasthan, 302022
2. Department of Mechanical Engineering, Indian Institute of Technology Jammu, J & K, 181221

Corresponding Author: Mitali Pareek, Mahatma Gandhi Dental College and Hospital, Jaipur, Rajasthan, 302022

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Abstract

Technology always influences all the spectrum of humans as well as nature. Technological changes are happening at a very high pace, and healthcare is also evolving rapidly under this influence. The development in technology provides the potential for the evolution of advanced techniques that improve, sustain, and maintain individuals' health. Integration of advanced technology such as artificial intelligence (AI), augmented reality and virtual reality (AR/VR), genome sequencing, nanotechnology, and several other techniques have significantly transformed healthcare systems. The deployment of advanced technological methods has helped clinicians, researchers, and healthcare professionals to develop efficient and innovative healthcare services. The results for the deployment are very evident in diagnosis, treatment planning, patient care, and cost optimization. The following review highlights the impact of technological advancements and their potential for transforming healthcare. In conclusion, the technology has innovative and disruptive approaches for transforming healthcare by making it more affordable and sustainable for society and the environment.

Introduction

The influence of technology changed healthcare entirely in the last few years. Incorporating information technology in healthcare has shown excellent results in improving quality care, enhancing disease monitoring, and reducing medication errors [1]. The doctors can now diagnose the disease quickly, and the treatment also becomes effective and affordable. The inclusion of artificial intelligence (AI) provides a better insight into conditions to doctors, thus ensuring a proper treatment line. The AI-enabled chatbots help humans in the treatment for the disease from home. Integration of different technological advancements like augmented reality, cloud-based databases, 3D printing technology helps make healthcare more personalized and handier. Wearable device with several sensors provides an overall view of health on smartphones these days. In the hospitals, the deployment of robot-based nursing staff is under development, which will reduce the risk of infection in nursing staff taking care of patients. Engineers and contributors to technology need to analyze the dynamics of the effective approach of technology and its need for adoption in the healthcare system [2]. These technological enhancements are making healthcare more affordable, faster, and more efficient than the classical methods. Moreover, digitalization in healthcare and the incorporation of recent technical aids will help provide an evidence-based approach that will help make better clinical decisions and enhance preventive patient care and immunization [3]. In this review, several technological advancements are discussed in the following paragraphs that have transformed healthcare in the last few years.

TOPICS OF INTEREST

Cloud Integration in Healthcare

Cloud integration and data analytics are game-changers in the healthcare segment. Healthcare data is tremendously growing in the form of electronic records, and digital images serve to be a good fit for cloud system storage [4]. The complete data of patients from the diagnosis and the line of treatment followed is stored. This data can be used to train the machine learning models and artificial intelligence models to predict and analyze the disease progression. Data from thousands of cases of a particular disease will also help develop disease-specific drugs and formulate treatment protocol. Deadly diseases like cancer are predicted early by tracking the patient's lineage, which may have traces of cancer. By this, cancer can be controlled in humans. Several start-ups are working to contribute the breast cancer treatment. In some diseases like ebolavirus, the use of supercomputers helped the doctors search for a suitable medicine that can be redesigned to treat ebola virus diseases, and the results are very promising.

Medical Imaging

Medical imaging and analysis of diseases are changing at a faster rate. Medical imaging used are x-ray, ultrasound, computed tomography (CT), magnetic resonance imaging (MRI). The conventional methods

are changing as the innovative technology is using advanced electromagnetic imaging techniques such as Terahertz tomography THz, infrared imaging, and thermography [5]. These changes are helping the patients by giving more informative imaging techniques with high resolution images and providing image-guided surgeries at a lower cost. Equipment is now becoming portable and easy to handle. By developing a handheld medical imaging device that can replace MRI and ultrasound big machines and give diagnosis more economically and efficiently. These handheld devices are also beneficial when patients cannot move and reach the imaging centres. When a dataset of images is used to train the artificial intelligence models, the results are quite efficient in predicting the diseases by comparing it with the existing image set, such as COIVD-19 [6].

Drug Development

The process of drug development by the conventional method is very costly and time taking. The process of drug development is also changing by new ways with use of artificial intelligence. This makes the process fast and cost-efficient. The molecular structure data and the drug's mechanism are combined for the simulations, which helps drug development. With the rate at which advancement is happening in technological drug development, it is sure that treatment will be made available faster for a new disease. The development of Virtual Physiological Human (VPH) is used to research heart disease and osteoporosis. The VPH is a computer model that is patient specific and are intended to develop personalized and preventive health services. [7]

Virtual Reality (VR) and Augmented Reality (AR) in healthcare

AR and VR products help doctor in training their students on the virtual models for the surgery [8]. Training on the virtual model gives the freedom to experiment without risking patients' life. The implementation of AR and VR is beneficial, but the virtual experience is very different from the real one. This point is critical. For example, in a virtual surgery experiment, the pain felt by a natural body is very different from the virtual patient. So, consideration of this difference is essential when doing actual surgery. In the recovery phase after surgery, it is essential to relax the patients for faster recovery, so VR headsets give relaxing views virtually in the hospital area only. The AR and VR also help to treat mental health issues like anxiety and fear by generating a suitable environment. However, psychological therapies could be greatly increased by exploring the ability of VR. The treatment outcomes could be modified with the help of technology's capability of altering the realities [9].

Wearable Healthcare and Medical Tricolor

Wearable health care devices are essential in humans' busy lives as they have several essential features: heart rate monitoring, sleep tracking, footstep counting, and calorie count [10]. Advance health wearables also give oxygen level saturation and ECG data monitoring features that can be related to an individual's stress level. Therefore, health wear devices are primary investment as it is tracking the lifestyle and suggesting actions to maintain good physiological health. Medical tricolor is a device capable of diagnosing and analyzing all the diseases. This device has a powerful memory to store all the information for all the recognized diseases. This device can be referred to as a Swiss Army knife for physicians [11].

Genome Sequencing and Nanotechnology

The genome sequencing methods give vital, personalized information regarding drug sensitivity, allergy, and data about family history [12]. This information is beneficial for a disease like diabetes, in which lineage plays an important role. Information on the tolerance to smoking and alcohol tells the individuals to control the intake for a safe life as smoking and alcohol may result in deadly disease. Nanotechnology is also contributing to better healthcare by developing micro-robots and smart pills that are changing the diagnostic methods. Smart pills are already in use for colon examination in a risk-free patient-friendly way [13]. Nano level drug delivery systems are beneficial in cancer treatment and several small-scale surgeries.

Robotics

The idea of accurate and efficient treatment, robots are the first choice of doctors. Machines are capable of doing work with high accuracy, and the duty cycle is also excellent compared to humans. With this thought, exoskeletons are new supporting devices that provide adequate support in spinal injury or paralysis. They are motorized mechanical, which helps the individual in movement. Physiologists could better understand human bodies with the help of exoskeleton to provide a novel experimental perturbation [14]. Personalized robots are developed to provide emotional and mental support because mental health is also critical where some people find it challenging to connect with real people [15]. Robot-assisted surgery is also increasing because the accuracy of human error is significantly less when robots are deployed. In pandemic situations where sensitizations are required at a reasonable level, robots are deployed to reduce life danger to humans to disinfect the areas. Soon the robots are also integrated with artificial intelligence to make decisions independently. Still, it is essential to look after the decision made by the robot for the prevention of danger.

3D printing

The development in the field of additive manufacturing leads to better 3D printed products. 3D printing is getting faster and more precise in recent years. 3D printing provides the personalization of medical implants for better and long-lasting performance [16]. Replication of the exact part is now possible due to the responsive mechanism of 3D printing technology. Mainstream implementation in healthcare is in orthopaedics and dentistry at a billion-dollar level. 3D printing cannot completely replace the classical treatment because of the limitation in the material aspect. There are several issues with the material in 3D printing as material must be biocompatible, so the body does not identify it as a foreign element and does not accept it. Dimensional accuracy must be high when it comes to the case of the heart and other susceptible organs. Risk calculation in the implant is very critical for proper and safe treatment.

Artificial Intelligence (AI)

Artificial Intelligence aims to bring a rapid change in the working methodology of healthcare systems. The tremendous increase in the data flow and the incorporation of AI in various health care sectors will help reduce the system's complexity by improving decision-making ability and providing better treatment quality [17]. The AI and its other components, such as machine learning enable early diagnosis and prognosis evaluation which has the potential to decrease the morbidity and mortality rates [18,19]. The deployment of massive past data into AI training systems will help in future referencing and balancing clinician workload by providing them with a better treatment plan. AI is a reformative technology that is highly data-driven and will bring a massive paradigm shift in the healthcare systems. Still, there is a long way to go in the medical field as digitalization has started in reports, but it will take time to formulate an accurate data set that can be used in model training. [20]

Conclusion

Integration of emergent technology in healthcare has great potential to create innovative methods that will further improve healthcare services' quality, safety, and cost optimization. The advanced technologies discussed in this work holds the capacity to make a healthier lifestyle and improve treatment planning. These technological advancements benefit both ends, i.e. easing the diagnostic and treatment procedures for clinicians and improving the patients' overall healthcare. All the above progressive technologies will serve as a revolutionizing force in the current healthcare system. The implementation of these advancements needs to be assessed with the current market situation to balance the cost and quality delivered to maintain the overall health economy. There are a few challenges such as data aggregation, data privacy, data security of patients, and expert knowledge is required in the implimentaion of the same. In the near future, there will be widespread implementation of these

technical aids to ultimately strive to save millions of lives and improve the healthcare facilities.

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