







Emerging AI impact in the healthcare sector: A review

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ABSTRACT

Artificial intelligence (AI) methods have become prevalent in the healthcare sector for patient risk assessment, medication discovery and disease diagnosis. Intelligent healthcare systems and a variety of duties related to patients can benefit from AI. For accurately diagnosing illnesses using AI techniques, an extensive variety of health data sources are required, which includes genetics, computed tomography tests, ultrasound, electromagnetic resonance imaging, mammograms etc. We discussed the role of AI in developed and developing nations and also the regulative issues and perspectives in health science. This article is based on an analysis of numerous studies and research publications providing information for early illness prediction for different kinds using AI-based methods. This article explores how AI might improve healthcare by looking at cutting-edge technologies, inventive applications, challenges and upcoming seismic shifts. AI-enabled virtual health assistants have the potential to drastically alter the way healthcare is delivered.

Keywords: healthcare, artificial intelligence, machine learning, deep learning, natural language processing

INTRODUCTION

Artificial intelligence (AI) is the driving force behind digital technologies and is quickly emerging as one of the greatest advances in technology in history. Healthcare will be greatly impacted by AI in coming years and there are already a lot of AI products available as the global AI revolution gains momentum. AI has the ability to essentially review and reorganize the way that healthcare is provided. Alan Turing first introduced the idea of simulating intelligent behavior and critical thinking with computers in 1950 [1]. In his book "Computers and intelligence", Turing described a straightforward test later called the "Turing test" to see if computers were capable of thinking like humans [2]. John McCarthy described AI as "the science and technology and scientific approach for developing intelligent devices". In the discipline of medicine, there are two different kinds of AI: virtual and physical. The virtual component includes applications such as neural network-based therapy decision support and electronic medical records. The physical part covers assisted living for the elderly, intelligent assistive devices and surgical robots [3, 4]. The aim of computer science's swiftly growing AI field is to build machines that are capable of carrying out tasks that normally call for human intelligence. AI is a class of algorithms which understands,

synthesizes, generates and forecasts new text-based content using advanced machine learning (ML) techniques and extraordinarily large data sets. ML, deep learning (DL) and natural language processing (NLP) are some of these algorithms. Ever since Christopher Strachey developed the first AI program in 1951, this field has been advanced. During that time, academic research was primarily focused on AI because it was still in its infancy. John McCarthy first used the term "artificial intelligence" in 1956 at the Dartmouth Conference. AI research concentrated on trained and rule-based systems during the 1960s and 1970s. However, this plan was limited by the need for more information and computing capacity. Research on AI switched in the 1980s and 1990s to focus on ML and neural networks, that allow computers to gain experience and become more intelligent over time. AI research yielded virtual assistants like Apple's Siri and Amazon's Alexa, which could understand natural language and respond to user's requests, with a persistent focus on computer vision and NLP [5, 6]. AI has already influenced a number of industries including healthcare, finance, transportation and its effects are only expected to increase. Due to the development of modern healthcare technologies like AI, 3D printing, robotics, nanotechnologies, etc., the healthcare industry is changing quickly. There are many chances for digital healthcare to improve clinical outcomes, decrease human error and track information over time. AI techniques from ML to DL are

essential in many domains related to well-being including the administration of patient data and records, the creation of new healthcare systems and the treatment of various illnesses [7, 8]. Furthermore, AI methods are the best at diagnosing a range of illnesses. AI may also be utilized to identify specific demographics or geographic regions that have higher-than-average rates of disease or behaviors that are risky. Researchers have effectively used DL categorizations in diagnostic approaches to calculate correlations between the built environment and obesity prevalence [5, 6]. We also talked about the role AI plays in developed and developing countries, as well as the regulatory concerns and viewpoints in the field of health science. This article, which is based on an analysis of numerous studies and research publications, provides information for early illness prediction for various kinds using AI-based methods.

AI HEALTHCARE SCENARIO IN THE DEVELOPED AND DEVELOPING NATIONS

Human intelligence is the source of everything that civilization has to offer. We can't even begin to imagine what we might accomplish when that intelligence is amplified by AI tools, but the elimination of poverty, disease and conflict would be at the top of anyone's list. The greatest thing to happen to humanity in history would be the creation of AI. Regretfully, it might also be the final one. One of the greatest minds of the 20th century, Stephen Hawking, highlighted in these remarks how AI, the leading cutting-edge technology of this generation, has the ability to boost a nation's productivity, boost innovation and increase its competitiveness [9]. Three ways that AI fosters growth are through the intelligent automation of labor, the addition of labor and physical capital and the development of new business opportunities, skill sets and services. The precision of public services will significantly increase when AI is widely applied in the fields of education, healthcare, environmental preservation, metropolitan activities, the judiciary and other areas. AI technologies have a chance to greatly improve social governance's capacity and quality, which will prove essential for successfully maintaining social stability. In addition, they might be able to precisely sense, project and deliver warnings of emergencies for social safety operations and infrastructure assets [10]. The United States, which generates nearly half of all AI research worldwide, has been at the forefront of this exponential growth in AI research.

Developing countries like India have advantages over power in the form of an extensive database that simply needs to be touched, a flourishing start-up scene and a large technology workforce, even though that they lag beneath in fundamental research and resources. More importantly, the developing countries possess an entrepreneurial drive to assist businesses in leveraging real-time data and the will to grab a chance in a global marketplace increasingly ruled by AI. Strategic planning positioning, moral considerations and friendly public-private sector collaborations will be necessary to ensure the effortless adoption and application of AI in healthcare, especially radiology [11].

AI REVOLUTIONIZING THE HEALTHCARE PRACTICES

AI is revolutionizing healthcare. It offers unmatched benefits, from expediting administrative processes and resource allocation to enabling precision medicine and enhancing diagnostics. AI in healthcare must be fully utilized, which means ethical concerns must be resolved, human oversight must be maintained, and interdisciplinary collaboration must be encouraged. By embracing AI's advantages, the healthcare industry can change how care is provided, allocate resources more effectively and enhance patient outcomes [12]. There are a ton of fascinating future applications for AI in healthcare. Personalized medicine is one of the most fascinating applications of AI in healthcare. Customizing health services to a patient's family history, lifestyle and environment is known as personalized medicine. A great deal of data will be analyzed by AI to create unique treatment programs that are suited to the particular requirements of each patient. Predicting and preventing illness is another exciting application of AI in healthcare. AI may utilize data analysis from various sources, including genetic testing, medical records and environmental data, to identify individuals who are extremely susceptible to a particular disease.

The field of drug discovery could undergo a revolutionary change thanks to AI. AI may evaluate large-scale data sets to find new drug targets and enhance treatment strategies. By accelerating clinical trials, AI holds the promise of lowering the time and expense associated with introducing new medications to consumers. Concerns have been raised regarding AI's potential to support prejudice and discrimination in the medical field. It is anticipated that in the future, sophisticated AI systems with careful hardware integration will play a bigger part in actual procedures or surgeries involving humans. Therefore, a solid foundation for the same will be provided by the international regulations developed for basic acceptance in healthcare generally. For instance, only one pathological solution has been granted permission to be marketed worldwide by the US Food and Drug Administration [13-15]. AI systems can enhance medication schedules, recommend the best interventions and develop individualized treatment plans. Precision medicine enhances therapeutic efficacy, reduces adverse effects and raises patient satisfaction. AI is transforming diagnosis by giving medical professionals computer-assisted support (**Figure 1**).

Image recognition algorithms can be used to assess medical images, such as CT scans, X-rays, as well as MRIs, in order to assist with identifying anomalies and disease diagnosis. AI algorithms have the capability to highlight areas of interest or concern and to provide quantitative measurements in this regard. Computer-aided diagnostics shorten diagnosis times, reduce incorrect interpretation and improve diagnostic accuracy [16]. AI is predicted to develop quickly, changing both how medical professionals practice their profession and how patients are treated.

AI is classifying dermatology such as skin cancers also. This will have a substantial impact on the way healthcare is delivered. The intelligent assistants are able to track variables

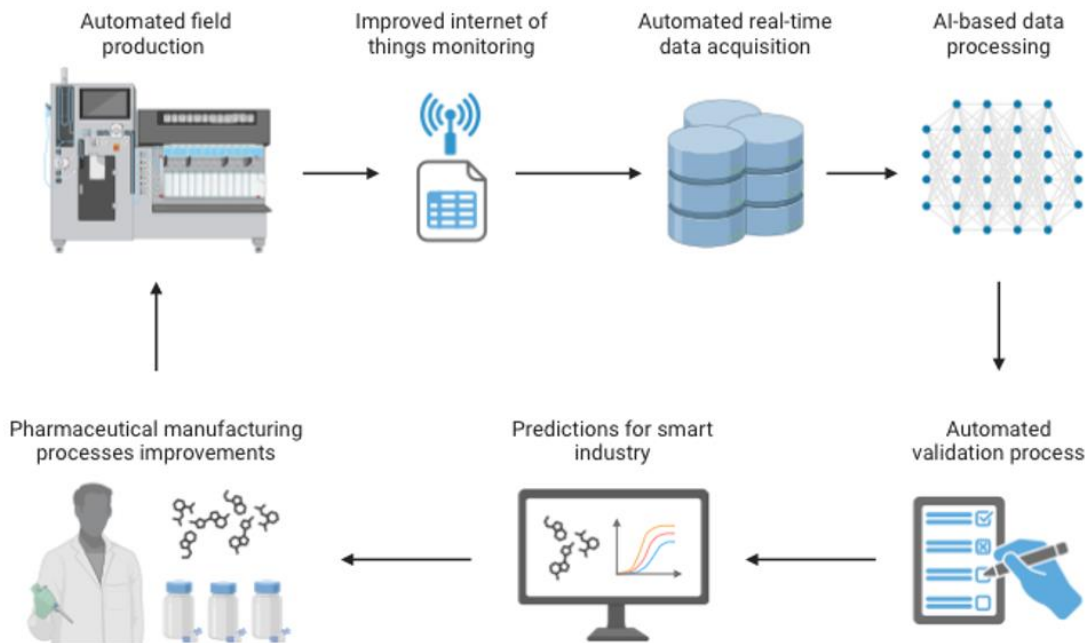


Figure 1. Benefits of AI in drug manufacturing processes (Source: Authors' own elaboration, using Biorender Software)

related to health in addition to scheduling appointments and providing patients with personalized health information and answers to commonly asked questions regarding medications. They can be contacted via voice or chat interfaces. Intelligent health assistants have the potential to reduce healthcare expenses, give patients access to resources and assistance and empower individuals to manage their own health.

AI has transformed online healthcare by enabling remote patient surveillance and diagnosis. By integrating AI algorithms, healthcare professionals can monitor patient's vital signs remotely, evaluate data in real-time and identify trends or anomalies. Utilizing this equipment improves patient outcomes in addition to reducing rates of hospital readmission and enabling prompt intervention. AI powered triage systems can also assist in identifying critical patients and prioritizing care, which can increase the efficacy and efficiency of telemedicine [17]. To protect patient privacy, maintain the relationship between physicians and their patients and reduce prejudice, ethical frameworks should inform the development, application and use of AI. Healthcare professionals and AI must play mutually beneficial roles if empathy, compassion and human connection are to be preserved in healthcare delivery. AI has a wide range of ground-breaking potential uses in healthcare, including predictive analytics, AI-assisted procedures, telemedicine and intelligent health assistants. Maintaining a human-centered viewpoint, dealing with ethical dilemmas and protecting personal information are essential to ensuring the proper and effective integration of AI. By embracing these advancements and promoting cooperation between healthcare professionals, technologists, legislators and patients, we can build a future where AI-driven healthcare delivery enhances patient outcomes, expands access to care and revolutionizes the delivery of healthcare [18]. Virtual and physical AI are two distinct types of AI in the field of medicine. Applications like electronic medical records and neural network-based therapy decision guidance have been examples of the virtual portion. The physical portion deals with elderly treatment, intelligent

devices for the disabled and robots helping with surgery. With AI at its core, medicine has a bright future that will improve lives and change healthcare delivery [19].

HAZARDS OF AI IN HEALTHCARE

When implementing AI in the medical sector, there are certain obstacles that we might run into. Integrating AI into healthcare facilities implies a wide range of people will interact with AI. We should expect some bias from AI users due to the pervasive belief of "hazardous AI" in popular culture. Moreover, the final choices about the need to incorporate a particular technology are often made by individuals who lack formal IT expertise and who have limited understanding of AI. Solving this problem and persuasive governments of the benefits of integrating the technology involves building persuasive abilities to communicate with them, eradicating prevalent misunderstandings regarding AI and increasing public awareness. Concerns regarding data security and privacy are another obstacle to AI in healthcare. As medical history data is used to train AI, care has to be taken to prevent this data from falling into unauthorized hands. Every industry needs strong protection against cyberattacks, but the healthcare industry is becoming particularly vulnerable because the industry works directly with human lives and cyberattacks have the potential to be fatal [20]. For ML and DL algorithms to accurately classify or predict a variety of tasks, large datasets are required. However, patient confidentiality concerns and health care organizations' customary reluctance to share health data present a number of data accessibility obstacles for the healthcare sector.

Moreover, data that has been processed by an algorithm is not readily available again. Notably, as long as fresh data are added to their training set, ML based systems can advance continuously. However, corporate resistance within the organization makes this situation challenging to achieve [21]. Concerns related to data security and privacy are also raised by

AI-based apps. Since health records are so important and vulnerable, they are often among the first to be weakened in breaches of data. While it involves health records, patient privacy must be protected [22]. Furthermore, the overfitting problem arises when the algorithm considers the relationships between the outcome and the patient's traits. The problem stems from the fact that the algorithm generates inaccurate forecasts due to various factors impacting the outcomes. Data leakage is another problem that concerns AI's ability to predict events beyond the smaller training dataset to be the algorithm improves prediction accuracy [23-25]. Additionally, DL algorithms have a harder time giving insightful justifications for the predictions that they make.

In the event that suggestions are erroneous, an algorithm faces a challenge in terms of legal defense. It is difficult for experts to comprehend the relationship between the data and their projections. There are considerable costs and hazards involved in transforming AI and huge amounts of data into safe and dependable medical devices, services and procedures for the healthcare industry. Protecting the business objectives of AI and data-driven healthcare technologies has therefore become more important. Prior to recently, health indicators such as blood pressure, blood sugar and heart rate could only be measured by medical professionals. However, it is now possible to continuously collect this kind of data thanks to modern mobile applications.

It is crucial to address the ethical risks that come with implementing AI, especially with regard to patient autonomy, informed consent and violations of data privacy and confidentiality [26, 27]. Strong data protection laws are essential for preserving individual privacy as big AI becomes more common in healthcare and precision medicine. Numerous nations have enacted legislation to safeguard the privacy of their citizens, including the general data protection regulation (GDPR) in Europe and the health insurance portability and accountability act (HIPAA) in the United States. The GDPR has implemented wide safeguarding law within the European Union (EU), creating a significant worldwide shift in data protection, whereas HIPAA only protects relevant health information produced by covered entities. Medical and healthcare institutions are focusing heavily on digital health as a growing trend globally. GDPR effectively mitigated the negative impact of digitalization. The EU's digital public health sectors have made costly adjustments to comply with new regulations requiring stricter patient data protection [28, 29].

THE REGULATION ISSUES AND PERSPECTIVES ON AI IN HEALTHCARE

The National Institution for Transforming India (NITI) Aayog, an organization dedicated to national strategies related to AI and other emerging technologies, was authorized by the government in recognition of AI's potential to completely transform the Indian economy. To achieve the aforementioned goals, the government has partnered with a number of top AI technology firms to carry out AI initiatives in vital fields like health and agriculture. "AI will grow to be greater than the creation of the worldwide internet or the use of electrical

power" "India has to embrace AI with all of its power". With the slogan, "AI for all" and the hashtag (#aiforall), India hopes to lead the world in AI research and applications. To achieve this, it will need to address several issues including access, affordability, lack of skilled expertise and inconsistent application. It also needs to take advantage of the opportunities that arise along the way. The AI-based radiomics project, which is being carried out by government in partnership with private center imaging biobank (ML and AI database and tumor radiomics atlas project for cancer unit), will eventually offer an unparalleled chance to enhance decision support in cancer treatment at a low cost, as well as enable the generation of imaging biomarkers for use in research studies and support the biological validation of both new and existing imaging biomarkers [30, 31].

The government has suggested a two-tiered structure to meet India's objectives for AI research and facilitate the swift growth and development of AI in the country:

1. The Center of Research Excellence aimed to advance technological frontiers by generating new knowledge and improving our understanding of the fundamental research that is already known.
2. The task of developing and carrying out application-based research falls to the International Centers of Transformational AI (ICTAI). One important component of ICTAIs is expected to be cooperation with the private sector. One of the initial projects of ICTAI will be the private sector's Imaging Biobank project.

In an effort to promote the adoption of AI across the country, the government has set up several guidelines. These suggestions could significantly contribute to the realization of "AI for all", an ambitious project that aims to address the obligations that come with AI development, including ensuring appropriate data privacy and security and striking a balance between ethical considerations and the need for innovation, in addition to promoting the technology's advancement across multiple industries [32, 33]. India rose to the third place within the "Group of Twenty International Forum" nations in 2016 with an annual compound growth rate of 86%, higher than the global average, primarily as a result of an increase in AI start-ups since 2011. Understanding the present scenario of AI within India and putting plans in place for its swift adoption in the healthcare industry are made possible by the efforts of numerous other public and private businesses. Through a bottom-up approach, NITI Aayog seeks to accomplish the sustainable development goals and strengthen cooperative federalism by involving the state governments of India in the formulation of economic policies [34, 35]. In addition, new businesses and public-private partnerships are leading the charge in creating cutting-edge AI algorithms tailored to the specific requirements of the medical field, particularly radiology.

AI'S IMPACT ON HEALTHCARE SERVICES IN THE FUTURE

Recent advances within AI methods have caused quite a stir in the healthcare sector. There is even a lot of debate about

whether AI doctors will eventually take the place of human doctors. Although AI won't ever completely replace healthcare professionals, it can help them make better clinical decisions and in some situations, even take the place for human assessment (such as in radiology). The recent successes in using AI in healthcare are a result of the big data analytics field's rapid growth as well as the accessibility of healthcare data. Large volumes of data hold clinically significant data that strong AI techniques can unlock with the help of pertinent clinical questions. Clinical decision-making may benefit from this [36-38]. Without a doubt, AI's influence on our healthcare system will only increase. AI is currently driving advancements in diagnostic procedures, pharmaceutical development, and general health care operations. However, given the state of the art, it is obvious that AI will soon play a significant role in daily health care operations, benefiting both patients and healthcare facilities. The future of healthcare delivery is going to be completely transformed by AI technologies.

CONCLUSION

AI may play a key role in the use of patient data to create personalized treatment plans and diagnose diseases. India and other nations that are developing must take advantage of this early opportunity to lead the AI revolution. Developed nations have been at the top in this competition, which truly cuts across all facets of national power, since authority within AI will lead to supremacy globally. Even though they fall behind in basic research and resources, developing nations like India have benefits over major nations in the form of a sizable data pool which is just waiting to be struck, a thriving start-up scene and a large engineering workforce. More importantly, these nations have the will to seize an opportunity in a world increasingly dominated by AI and an entrepreneurial drive to help companies capitalize on real-time data. AI holds great promise for enhancing patient outcomes and healthcare provider care. AI-powered predictive analytics can enhance the accuracy, efficacy and financial sustainability of disease diagnosis as well as testing in laboratories in clinical settings. AI integration has been shown to enhance patient care in virtual health and mental health services. Several measures need to be implemented to ensure the moral and effective use of AI in healthcare. AI can offer secure as well fair medical treatments, despite the fact that it is still a relatively new technology in the healthcare sector. Ongoing research keeps giving the technology new capabilities, which will lead to greater breakthroughs in the upcoming years in a range of industries. ML and AI have plenty to offer the healthcare sector, which is undergoing one of the quickest digital shifts at the moment.

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