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REVIEW ARTICLE

Deciphering the Role of Artificial Intelligence in Medical Sciences: An Update

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Abstract

Background: The utilization of Artificial intelligence (AI) computer systems is widespread globally, and the growing body of data in diverse scientific fields highlights the significance and requirement of computer-aided, advanced AI systems in contemporary educational systems. AI is becoming more and more of a versatile actor in the medical sciences, spanning all specializations and including diagnostics. Pharmaceutical companies, payers, and healthcare providers are already using various forms of AI. It's related techniques (machine to deep learning) are frequently employed in disease diagnosis, treatment procedure, and in the evaluation of its side effect. AI techniques utilizes various types of medical diagnostics test data in order to disease diagnosis such as MRI, CT scan, MRI and biochemistry lab reports etc. Better patient-physician communication, remote patient treatment, transcribing prescriptions and other medical documents, and ethical dilemmas are all aided by AI. While humans are still faster at some jobs than computers, the accuracy of modern computer algorithms has lately surpassed that of human experts in the medical sciences. There exist speculations suggesting that medical science roles will eventually be supplanted by people. The current article focused on how AI is transforming medical science along with allied health sector and helping to distinguish between hype and truth, as well as how it might be used to resolve ethical dilemmas and intellectual property rights issues.

Keywords: Machine learning, Health care, IPR, Ethical issues, dental care, medical diagnostics

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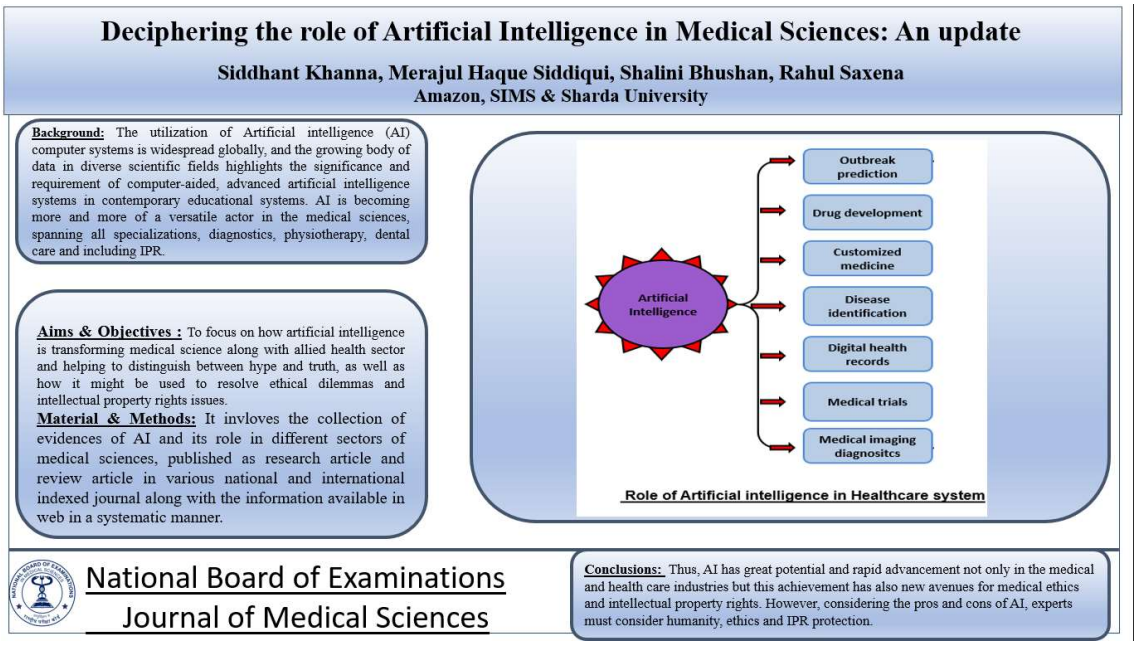
Graphical Abstract



Introduction

Various functions of humans which are done by computer based novel machines on the basis of data available in digital form is known as Artificial Intelligence (AI). When American computer scientist John McCarthy and colleagues hosted the Dartmouth Conference in 1956, the phrase AI was initially used. Prior to that time, chess program created by Dietrich Prinz and intelligence of machine measured by Alan Turing's test were some of the advancements in the field of AI [1,2]. Automated interfaces for speech recognition, vision, decision-making, and language translation are just a few of the well-known applications of AI. It has transformed many sectors of the economy and aspects of daily life, offering both exciting new prospects and challenging circumstances. Previously, AI appears as a science fiction but now a days, AI has applicable globally and involved in most of the branch of science. AI can perform similar function as that of human intelligence and covers a broad range of cognitive abilities, from simple to complicated cases in an automated decision-making mode. Interestingly, AI is universal and various sorts of industries such as banking, entertainment, health and education industry etc. utilizes this technology in an effective manner. Apart from its role in enhancing productivity and efficiency, AI has encouraged the culture of innovation in various streams such as information evaluation, predictive modelling, and tailored services. It has been observed that AI has achieved an amazing success and enhanced pace by virtue of neural network, advanced information analytics and computer-based system research. This success rate has been attributed to the availability of smart processing ability in corporation with availability of huge electronic data. These days, AI is an interdisciplinary science that has spread throughout many scientific fields, including medicine [3].

The digital age's use of AI, 3D printing, robotics, nanotechnology, and other technologies in the medical science has drawn much attention lately. The following general trend is observed in artificially intelligent systems in the medical sciences and healthcare sector. A significant amount of data is the starting point for an AI system. Machine learning methods are then used to extract knowledge from this data, which is subsequently utilized to produce an output that is helpful in resolving a specific problem in the medical system. AI has many advantages, such as lowering human mistake rates, enhancing clinical results, tracking data over time, etc. AI is being used in the medical sciences to connect patients with the right doctor based on their symptoms, diagnose and prognostic patients, find new drugs, and create bot assistants that can translate across languages, transcribe notes, and organize data and photographs.

Furthermore, from machine learning to deep learning, AI utilizes healthcare related several domains which includes novel biochemical assay system, the administration of patient data and records, and the treatment of various ailments [4]. Additionally, AI approaches are the most effective in diagnosing various disorders. However, there are several IPR, legal, and ethical difficulties in this scientific realm. The present review article focuses on various important aspect of AI in the diverse field of medical sciences including healthcare system, medical diagnostics, physiotherapy, dental care and issues related to ethics and intellectual property rights involved in health care sector.

Role in Healthcare system

Today, from creating new health assessment methods to handling patient information and finances, AI, including its subcategories of machine learning and deep learning, is moving towards becoming a fundamental part of the healthcare system. Managing and carrying out organizational duties is a major challenge for physician practices today. By automating them, healthcare companies may help solve the issue and free up physicians' time to do what they do best so that they can spend more time with patients [5,6]. Various healthcare applications in which AI has a role, are listed below, as seen in Figure 1 [7].

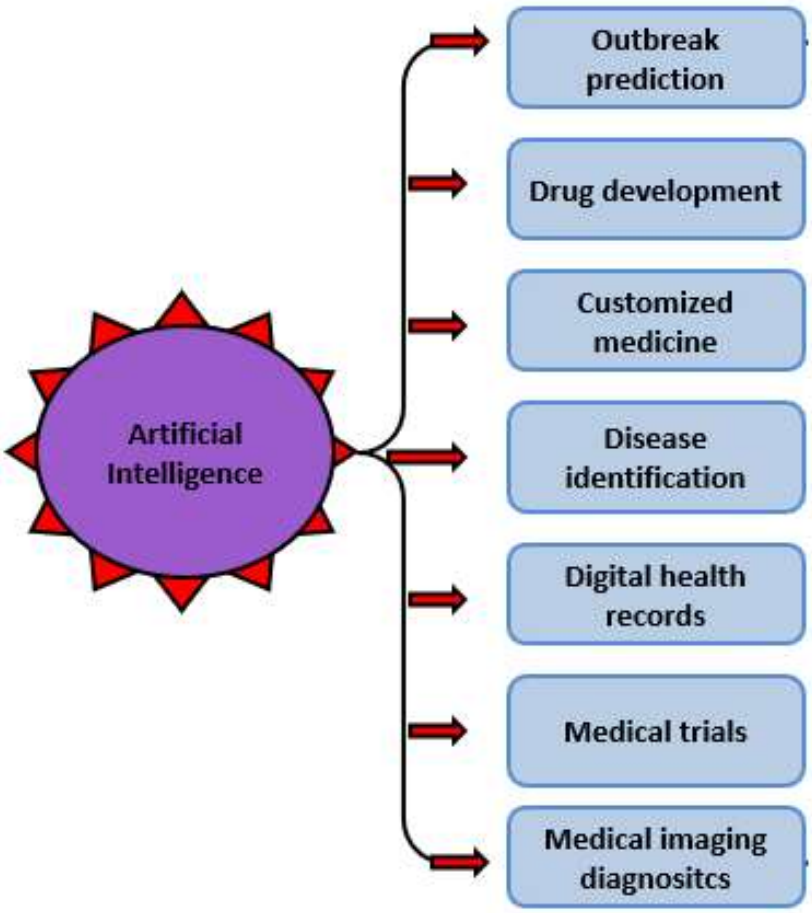


Figure 1. Role of AI in health system.

In addition, several AI techniques have been used to detect illnesses needing early detection, like skin, liver, heart, and Alzheimer's disease. AI techniques can have an impact on the creation of new medications, intensive care, their clinical validation, and many other aspects of cancer therapy [7,8]. Pradhan et al. (2020) assessed several adaptable algorithms of machine learning for lung cancer diagnosis in relation to the internet of things. To use a machine learning system to forecast various diseases, they analysed several publications. Based on the current approaches, they also defined and illustrated some future directions [9]. In general, AI has a cutting-edge strategy in the field of precision medicine also referred to as "personalized medicine," and now a days, it is receiving considerable attention. It entails customizing illness prevention and therapy to account for variations in people's genetic makeup, habits, and environments [10]. Furthermore, numerous methods employed for disease diagnosis with more accuracy includes decision tree, fuzzy logic, SVM (support vector machine), Boltzmann machine, support vector machine (SVM), logistic regression and artificial neural network etc., are employed to identify diseases with greater accuracy. Using a backpropagation neural network, Dabowsa et al. (2017) were able to diagnose skin diseases with the best degree of accuracy [11].

Role in medical diagnostics

Medical diagnostics, the process of evaluating illnesses or disorders by analysing test results, medical backgrounds, and symptoms, are used to identify the cause of a medical problem and correctly diagnose the disease so that the right treatment can be given. This might involve different diagnostic procedures such as blood tests, biopsy surgeries, and imaging tests such as MRIs, CT scans, and X-rays. Healthcare professionals can choose the optimal treatment for their patients based on the results of these tests. In general, all the diagnostic test related to health care system provide information not only limited to disease diagnosis but also about progression of effect of treatment in order to prevent the mishappening in future. By virtue of AI, the diagnostic process and access of information is getting quiet fast and accurate with more efficient manner. Thus, incorporation of AI programs in medical diagnostics assist medical practitioner in examining various digital images or reports such as DXAs, S-rays, MRIs, CT scans, pathological reports and ultrasound etc., in more efficient and accurate manner in less time [12,13].

AI has the ability to examine extensive patient information, such as medical 2D/3D pictures, biosignals (ECG, EEG, EMG, and HER), vital signs (like body temperature, pulse rate, breathing rate, and blood pressure), demographic details, medical background, and laboratory test outcomes. This could help with making decisions and give precise prediction outcomes. This can assist medical professionals in making better decisions about patient treatment. The variety of information from patients, including different types of data like images, signals, and text, is a good way to make better decisions when diagnosing. Healthcare providers can improve their understanding of a patient's health and the reasons for their symptoms by using different sources of data. Pooling information from various sources can result in a more precise assessment and a more comprehensive understanding of a patient's well-being, reducing the likelihood of an incorrect diagnosis. Healthcare workers can improve the treatment and control of long-term diseases by using multiple forms of data to monitor a patient's condition over time. Currently, healthcare providers that use Explainable XAI can detect potential health problems early on, before they get worse and become life-threatening, due to the use of multiple types of medical data. Furthermore, it has been conceived that by automating repetitive tasks with XAI technology, doctors or healthcare professionals can focus on more patient care related to complex clinical conditions [14].

Role in Dental Care

AI technology could have a big impact on many different parts of dental treatment. Accurate diagnosis is one of the main areas where AI can have an impact. AI can help dentists find patterns and provide precise diagnoses by analyzing massive datasets. This capacity allows for early intervention and treatment planning along with accurate diagnostic feature, all this eventually enhance patient outcomes. Both bettering treatment planning and dental processes can be greatly aided by AI. Customized intervention recommendations can be made by AI-driven systems through a thorough examination of patient clinical information and past results. This facilitates the workflow for dental care practitioners while simultaneously increasing treatment precision. Oral surgeons and practitioners

are getting benefits from AI based interventions instead of spending time in administration task. Thus, AI making them free for more important task related to patient treatment by automating regular tasks and offering evidence-based recommendations Patient education and their engagement are also supported by AI so that patient can easily understand their oral health, available treatment and recommendation options as an individualized and case specific manner. This in turn facilitates the patient overall to get satisfaction in their oral health treatment with more perfection [15].

Virtual consultation platform assisted by AI system has been found to be more patient friendly as patient from distant area can get proper information, advice and treatment option about their dental health from specialized dental expert without meeting them physically. Furthermore, availability of teledentistry, AI chatbots and virtual support system can resolve the personalized queries of patients, providing them suitable and appropriate treatment recommendations, boosts the dental services and thereby enhances the easily approachable and convenient services to the patient related to oral health disorder [16]. Thus, the patient ultimately benefits from better dental health outcomes that result from this active participation.

Role in Physiotherapy

Promising uses of AI can be found in the physiotherapy industry. Physiotherapists can improve patient outcomes, customize therapy programs, and improve their diagnostic skills by utilizing AI technologies. AI-maneuverer structures can examine movement patterns, medical histories, and results in order to assist physiotherapists in creating customized rehabilitation plans for their patients. In addition to increasing therapy efficacy, this individualized approach promotes patient participation and adherence to rehabilitation guidelines. By evaluating movement data and finding tiny patterns and irregularities that the human eye can find difficult to notice, AI technologies have the potential to revolutionize the diagnostic process in physical therapy. By recognizing these patterns, AI can help physiotherapists diagnose musculoskeletal disorders with accuracy and develop individualized therapy programs that address the specific requirements of each patient. In addition, AI-powered systems can analyse massive amounts of data, combining past rehabilitation results with intervention reactions, to suggest tailored therapy regimens. Physiotherapists are supported by AI in optimize prognostic tactics and customize exercise schedule as per needed for individual patient according to their specific profile and treatment responses. Thus, specific required treatment strategy can be framed for each patient individually [17].

In addition to diagnostic and treatment planning skills, AI has the potential to improve patient engagement, adherence to strategy associated with rehabilitation. Physiotherapists can provide their patients with individualized instructional content, exercise regimens, and progress tracking with the aid of AI-powered solutions. This personalized development encourages patients to actively participate in their recovery, which in turn promotes motivation and a sense of accountability, leading to improved rehabilitation outcomes [18].

Healthcare associated Ethical Concerns in AI

It has been encountered that the role of AI in the field of medical science is vast and its application involve the use and assess of compiled electronic data related to MRI, biochemical findings of diagnostic lab reports, preventive medicine and all the healthcare service-related data. The use of patient and health service-oriented data is always associated with various legal and ethical concerns. In communities, AI has extended their wings in an impressive manner to improve the patient treatment and its related outcomes, however, in general, it is not affordable to all. Many under developed and developing countries have not access to latest and emerging technologies as well. In addition, challenges occur while using AI cannot be ignored e.g. data protection, data privacy, ethical concerns, patient information sheet along with their consent form, advice (both social and medical) and empathy-sympathy. Therefore, while integrating AI involved in healthcare system, practitioners and surgeons will have to remember the inclusion of major medical principles related to ethical issues such as freedom, beneficence, nonmaleficence and fairness in all dimensions related to medical professionalism [19].

Healthcare practitioners must handle ethical issues, data secrecy problems, and biases involved in the utilization of various AI technologies into the area of physiotherapy. Physiotherapists can use these technologies to provide patient-centred, individualized, and efficient rehabilitation care by adhering to ethical principles and using AI ethically. This will ultimately improve the provision of physiotherapy services. By virtue of transformed patient involvement, improved treatment procedures and diagnostic patterns, AI plays a dynamic role in the field of physiotherapy. Moreover, involvement of AI technology, can provide deeper insights into patient data, movement patterns, and treatment outcomes, to the physiotherapists. This can lead to the development of more specific, better and individualized rehabilitation strategies for their patients [20].

The reliance on AI for medical decision-making is another problem. Healthcare professionals must have both a personal touch and critical thinking skills in order to provide high-quality care. The function of physiotherapists in developing individualized treatment programs based on each patient's needs and preferences may be diminished if AI tools are used excessively. Achieving a balance between using AI to gain insights and maintaining vital human components in healthcare delivery is crucial. Concerns of data privacy and security are also raised by the integration of AI into physical therapy, since AI is dependent on a large quantity of patient data, including genetic information and sensitive medical descriptions. To effectively protect patient information, physiotherapists need to navigate a complicated web of laws and regulations pertaining to data privacy. The potential bias present in AI algorithms is another thing to think about [21].

Healthcare disparities and inequities may inadvertently be perpetuated by AI trained on biased or small datasets. Physiotherapists are need to assess AI training data sources attentively and take proactive measures to reduce biases that can compromise their ability to provide all patients with just and equitable therapy. Even though AI has a lot of potential for physiotherapy, medical professionals must

integrate AI with caution and critical thinking. Physiotherapists can guarantee that AI-enhanced care stays ethical, patient-centered, and compliant with customized rehabilitation principles by recognizing and resolving these challenges [22].

Role in Intellectual property rights

Intellectual property (IP) rights and the medical sciences, both have a significant and transformative link in the modern era. IPR can be applicable in all the innovative developments of surgical instruments, therapeutic techniques, and chemicals with medical qualities. As the advancement in medical sciences occur due to involvement of AI system, the health care industry has more opportunity to develop enhanced creative and inventive approach at faster rate. The legal landscape around the intersection of AI and intellectual property rights is intricate, dynamic, and fraught with important philosophical and legal questions. In order to protect creative and inventive approach of human, IPR laws were designed but these laws are facing difficulty now due to involvement of AI in developing new AI created tasks and inventions. This calls into question the notion of authorship and inventorship in the era of AI [23].

The subject of copyrights concerns whether AI-generated creations, such as novel shapes, arts, and patterns, as well as literary works, may be protected, and if so, who is entitled to do so. Regarding patents, the discussion focuses on whether AI is capable of being considered an inventor and how AI-generated innovations in the healthcare industry fit within the traditional definitions of novelty and non-obviousness. AI can generate and use their own new brand names and logos. In addition, healthcare industry also face difficulties in another section of IPR i.e. trademarks. Previously, the rights of artistic and literary work has been granted to human authors but now paradigm shift in copyright law occurs due to the unique ability of AI in such type of works. AI-generated works question the basic idea of "authorship," such as the creation of novel surgical instruments, medication component formulations, and literary texts. Authorship and Ownership: Which party holds the copyright for works generated by AI? This is one of the main concerns. The usual interpretation of originality and creativity in the healthcare industry—two concepts that are essential to copyright law—is called into doubt by this query. Evaluating whether AI-produced works adhere to the originality and inventiveness requirements outlined in copyright laws. This entails reassessing these terms' legal definitions in the light of AI in the healthcare system. Economic Rights and Moral Rights examine whether AI should have moral rights including the right to integrity and credit, as well as how rights like replication, adaptation, and distribution pertain to works created by AI [24-26].

Conclusion

Rapid technology breakthroughs and related healthcare concerns have created a dynamic environment at the nexus of AI and the healthcare sector. AI will surely push the boundaries of present medical science frameworks as it develops, requiring constant technological reform and adaptation. Medical professionals may provide advanced, cutting edge, customized care that enhances patient outcomes and revolutionizes the medical sciences by ethically and professionally utilizing AI. Future healthcare, however, will have to strike a balance that is both commercially

and morally feasible between the results of various diseases and the recommended course of treatment. To address the global character of AI technology and medical sciences, there will be a growing demand for international collaboration in the development of harmonized standards and regulations. Furthermore, there are several chances for improving diagnostic precision, expediting treatment planning, streamlining workflow, and encouraging patient involvement and education through AI integration in allied healthcare. It is essential that providers of allied health consider the ethical implications, potential biases, and data privacy concerns associated with AI in the fields of diagnostics, rehabilitation, and dental care in order to ensure the equitable and responsible provision of allied healthcare services. Nevertheless, despite AI's great potential and rapid advancement in the medical and health care industries, this achievement has set new guidelines for medical ethics and intellectual property rights. Because of this, we should be aware that its disadvantages can outweigh its benefits. To overcome this problem, experts must consider humanity, ethics and IPR protection.

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Conflict of interest

There is no conflict of interests. All authors are equally contributed.

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Authors Contributions

Conceptualization and designed the review, M.H.S. and R.S.; resources, abstract screening and data extraction, S.B.; writing—original draft preparation, G.K and R.S.; writing—review and editing, R.S.; edited and added major contents to the manuscript, S.B.; supervision and project administration, R.S.

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