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AI-Enabled Health Systems: Transforming Personalized Medicine And Wellness

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Abstract: The field of medicine has been revolutionised by uses of artificial intelligence (AI). Based on a review of the existing literature, this investigation delves deeper into the significance of artificial intelligence in healthcare, examining its impact in six key areas: There are many different kinds of administration software used in the healthcare industry, including (i) imaging and diagnostics, (ii) online patient care, (iii) medical research and drug discovery, (iv) patient engagement and compliance, (v) rehabilitation, and (vi) other applications. The early diagnosis and containment of a coronavirus disease 2019 (COVID-19) outbreak, the provision of virtual patient care utilising AI-powered tools, the management of electronic health records, the improvement of patient engagement and compliance with the treatment plan, and the reduction of health care administrators' administrative workload are just a few examples of how artificial intelligence has made a significant impact on the healthcare industry. However, the scientific method includes AI into medical practise while simultaneously addressing a wide range of difficult logistical, moral, and sociological concerns.

1. Introduction

The long-term sustainability of health systems around the world is threatened by healthcare expenditures that have increased at an exponential rate, far outpacing GDP growth rates [1]. The 2019 coronavirus disease (COVID-19) pandemic epidemic and the ongoing crisis in Ukraine have shed light on this issue. Healthcare systems are struggling to meet rising demand for services in the face of limited resources, an ageing population, and a rise in chronic diseases. These factors have combined to make the situation more difficult. In addition to this, the COVID-19 epidemic is causing the health care systems in several nations, such as India, Brazil, and Indonesia, to break down completely.

Highly Reliable Organisations (HROs) are emphasised in this context since their services are typically handled by an accountable care organisation (ACO) or a health maintenance organisation (HMO). This is because, in order to provide adequate treatment and ensure compliance with industry standards, healthcare delivery systems must rely on well-established disease management pathways and proven care strategies. A Highly Reliable Organisation (HRO) is also highlighted by the "HRO" concept. Chronic diseases are becoming more common in the United States of America (USA). In particular, 60% of people have at least one chronic ailment, and 40% of individuals have more than two chronic diseases, leading to annual healthcare expenses of $3.3 trillion. This scenario has changed rapidly due to a new infectious disease that was initially discovered in Wuhan, China in 2019, and was officially named COVID-19 by the World Health Organisation on February 11, 2020 [2]. This illness was identified for the first time in 2019.

Since then, the healthcare sector has been undergoing a digital revolution, which will cause profound shifts in many of the bedrock principles of medical practise. COVID-19 may have caused this illness by placing a heavy burden on healthcare systems, their ancillary services, and their workforces around the world. In addition, the pandemic compelled various stakeholders in the healthcare industry to utilise digital technology [3,4]. During the period after the pandemic, significant headway was made towards establishing new norms and practises in the healthcare industry. For instance, the growing popularity of virtual healthcare systems and the associated technological developments have empowered the current generation's consumers (patients) to take an active role in making decisions about their healthcare. Despite this, significant obstacles could emerge along the route, and devising solutions to these problems would pave the path for the expedition to arrive at the forthcoming era of healthcare. Innovations in healthcare are driven by patients' individual experiences as well as their essential requirements. Their primary predispositions include the development of physician–patient

relations that are enabled by digital technology, so ensuring the supply of patient-centric amenities in any region of the world [5]. To provide increased levels of customer satisfaction, it is now necessary to deploy advanced digital gadgets. These devices make it possible to keep track of patients, monitor their health, and ensure that they take their medications as prescribed.

Mobile health (mHealth), health information technology (HIT), wearable devices, telehealth, telemedicine, mobile Internet devices (MIDs), and personalised medicine are all examples of digital health technologies (DHTs) [6]. Recent innovations in AI, the metaverse, and the data sciences are having an impact on smart health. Improved disease prevention, earlier detection of potentially fatal diseases, and remote management of chronic diseases are all possible because to these technologies that exist on the periphery of conventional care settings. Wirelessly observed therapy (WOT) is one such example since it uses a novel approach to tracking patient compliance with their prescribed medication. Offering and providing health services whenever and wherever they are needed is the most promising new method in this era of disruptive technology and least invasive therapy. A MID provides its owner with entry to useful tools like online services and social media. As a result of the widespread availability of MID-based applications, professionals now have access to a wide range of scientific databases, such as Medscape, Web of Science, and Scopus. Professionals and amateurs alike can use some social media platforms including YouTube, Facebook, WhatsApp, Wikipedia, and other IMAs, but not others like Twitter. In the era that follows COVID-19, digital health modalities that make use of AI in healthcare are developing at a rapid pace.

AI, ML, and DHT have started a revolution in the healthcare industry when COVID-19 harmed the global healthcare system. The events of late have made this more apparent than ever. In particular, AI is working to include cutting-edge technology like the IoT into the DHTs that end users rely on. With the increased use of AI and ML in medical settings, the Internet of Things is expected to mature into the intelligence of things. How the new information is used to fine-tune processes will have an effect on attitudes and actions. Furthermore, powered artificial intelligence (also known as intelligent medical technology) has been met with overwhelmingly positive reception from the general public. This is because it paves the way for patient independence by facilitating what is called the "4P model of medicine," which includes prognostic and preventative care as well as individualised and collaborative approaches. Incorporating AI into healthcare has already been shown to result in greater quality care that is delivered more rapidly and at a lower cost [7].

2. Literature Review

By granting clinicians access to patient data, digital health solutions provide a more holistic view of patient health. They facilitate clinicians' ability to provide patients with supplementary health information. There are concerns that SM and IMAs may have a greater psychological impact [8], despite the fact that there are significant opportunities to improve therapeutic outcomes and efficacy due to their extensive use by patients, the public, and professionals.

In addition, analytical algorithms made possible by big data can help healthcare practitioners enhance their clinical services by enhancing electronic health records. Big data is filtered on multiple criteria using AI technology to improve analytics [9]. The purpose of this review is to shed light on how AI is currently being used in the healthcare industry, specifically in the following key areas (Figure 1): (i) medical imaging and diagnostics; (ii) virtual patient care; (iii) medical research and drug discovery; (iv) patient engagement and compliance; (v) rehabilitation; and (vi) other administrative applications. The authors also outline many obstacles that must be overcome in order to deploy AI in the medical field. These findings contribute to the current body of literature and provide further insight into the benefits of utilising AI tools in the healthcare industry.

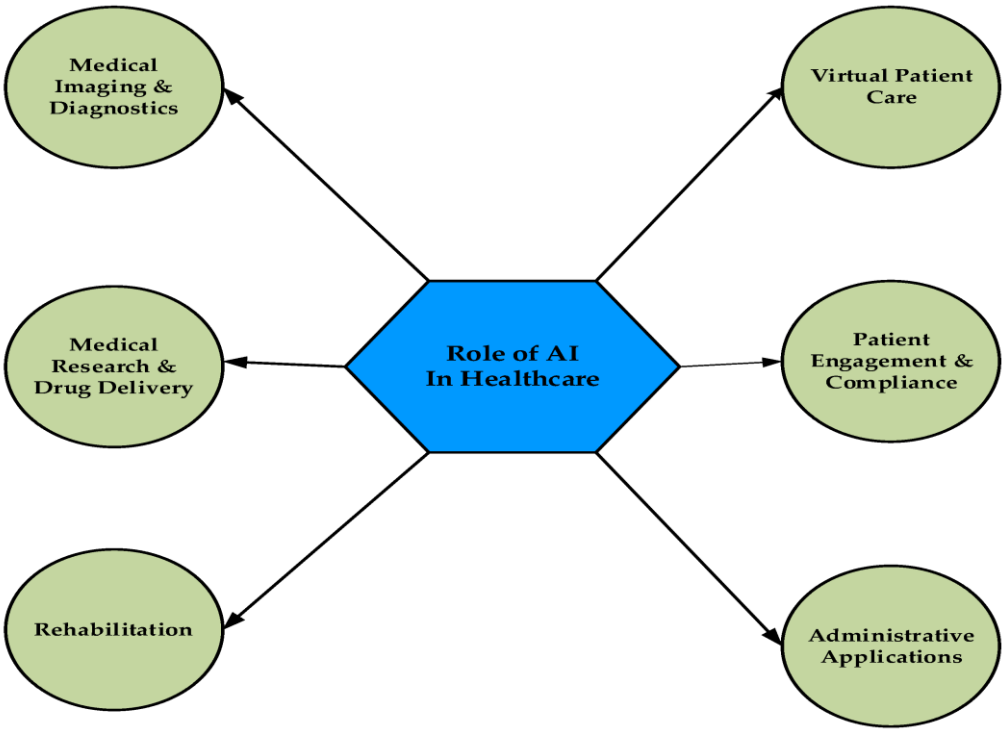

Fig 1: The application of artificial intelligence in numerous areas of medical care.

Radiologists are increasingly looking to artificial intelligence (AI) as a powerful tool for image processing in the early diagnosis of a variety of diseases and the reduction of diagnostic errors in the context of preventative measures. Similarly, artificial intelligence (AI) is an advanced and promising technology for assessing electrocardiogram (ECG) and echocardiography (ECHO) charts, which cardiologists use to help their decision making. Ischemic heart disease can now be diagnosed using echocardiography images thanks to the application of artificial intelligence on the Ultromics platform, as was recently reported in an Oxford hospital [10].

An innovative hybrid chest CT-built technique was proposed by Wang et al. [11] for the automatic detection of COVID-19. As a method of diagnosis utilising computer vision, a wavelet Renyi entropy (WRE) algorithm and a three-segment biogeography-grounded optimisation (3SBBO) approach have been developed. WRE, FNN, and the 3SBBO algorithm together make up this method.

Images are classified after being processed through WRE, 3SBBO, and FNN, in that order. Other methods of COVID-19 identification, such as those using a kernel-based extreme learning machine, an extreme learning machine fitted with a bat algorithm, and a radial basis function neural network, were outperformed by this method. Ultrasound (US) pictures are employed with the ViT to classify breast tissues as normal, malignant, or benign, as reported by Gheflati et al. [12]. It outperformed convolutional neural networks (CNNs) in classifying photos of US breasts.

Generative adversarial networks (GANs), a type of deep learning approach, are also having an impact on the field of radiology. Both the generator and the discriminator in a GAN are artificial neural networks, with the former's goal being to create synthetic images that are visually similar to actual ones, and the latter's job being to disclose the distinctions between the two. In radiology, a generative model can be used to recreate training photos and generate novel images that have the characteristics of those in the training dataset. For instance, a radiograph may be labelled as showing or not showing pneumonia based on the training of a discriminant model. In radiology, training the generator model in conjunction with the discriminator model has been shown to improve performance on tasks like aberrant identification, picture synthesis, and cross-domain image synthesis [13].

Even for seasoned radiologists, GAN-generated images of lung cancer lesions proved impossible to tell apart from the real thing [14]. Furthermore, GANs present a great chance to advance healthcare training and study. They are able to produce training aids and educational simulations in record time. For students who, say, have trouble differentiating "lower lobe collapse" from "consolidation," it might be helpful to give them visual representations of both concepts. As a result, students can benefit from synthetic data because it provides resources for extreme circumstances. The need for a true placebo group can be minimised and the number of treatment arms in clinical trials can be increased by developing synthetic control arms by modelling placebo groups based on historical data [15].

Computer-aided diagnostics research has also demonstrated superior sensitivity, accuracy, and specificity in identifying even the tiniest radiographic abnormalities, which could lead to better public health. While lesion detection is often cited as a measure of success in AI imaging studies, this can be deceptive because it ignores a lesion's biological severity or its nature/type. In addition, adopting non-patient-related radiological and pathological endpoints could enhance the expected sensitivity at the cost of rising false positives and possibly overdiagnosing by discovering minor anomalies that might resemble subclinical disease [16].

3. Challenges Faced In Healthcare And Wellness That AI Can Overcome

Many problems in healthcare could be alleviated with the help of artificial intelligence. The development and deployment of AI must take into account ethical and societal problems, such as data privacy, algorithm bias, and the possible influence on medical professionals and patients. Healthcare personnel must be trained to work collaboratively with AI technologies to provide the best treatment possible to patients and it is crucial that AI does not replace the human part of healthcare.

1. Diagnosis And Treatment

AI can help improve the precision and timeliness of diagnosis by assessing patient data such as medical history, test findings, and imaging scans. As a result, patients may receive more prompt and accurate therapy for previously undiagnosed or misdiagnosed illnesses. Likewise, AI can help with treatment selection by analysing patient data to find the best course of action given individual circumstances including illness stage, genetic make-up, and co-morbidities.

2. Access To Healthcare

AI-powered chatbots can help enhance access to medical treatment, especially in poor or rural areas where there may be a shortage of healthcare professionals or physical facilities. These resources can help people get the help they need for their mental and physical health without having to travel to a clinic or hospital.

3. Chronic Disease Management

Artificial intelligence can help in the treatment of chronic diseases by analysing patient data like glucose levels, blood pressure measurements, and medication adherence to spot trends and patterns that may suggest a change in a patient's condition. To better assist patients in managing their disease and lowering the risk of complications, this data can be utilised to create individualised treatment plans and innovations such drug adjustments or lifestyle changes.

4. Workforce Shortages

To help with the present shortage of healthcare staff, AI can automate routine tasks like appointment scheduling, medical record keeping, and patient triage. As a result, medical staff will have more time for patient care and less time spent on paperwork, allowing them to better diagnose and treat patients.

5. Medical Research

Through the analysis of vast amounts of data from clinical trials and medical studies, artificial intelligence (AI) can help accelerate medical research by identifying patterns and insights that humans might miss. This can aid in the advancement of medical knowledge, the discovery of new medicines, and the betterment of patient outcomes.

6. Patient Engagement

Patient health data, medication compliance, and real-time feedback and recommendations may all be tracked and monitored with the aid of AI-powered apps and wearables. In addition to assisting medical staff in keeping track of their patients' status, this can encourage individuals to take an active role in their care.

7. Preventive Healthcare

By analysing patient data to identify individuals who may be at risk for an illness based on their medical history, lifestyle data, and other characteristics, AI can assist detect and prevent health problems before they develop. This can help doctors and nurses catch problems before they become serious, allowing for more effective treatment and lower medical bills.

4. Scope Of Artificial Intelligence In Medical Science And Healthcare

AI has a wide variety of potential uses in healthcare and medical research, and its arrival in the industry is expected to have a profound impact in the near future. Diagnosis, therapy, healthcare management, and telemedicine are just some of the many subfields that make up the healthcare industry. Improvements in AI are anticipated to have a significant impact on healthcare delivery, with positive consequences for patient outcomes and cost management. Some of the most promising applications of artificial intelligence are listed below.

1. Medical Imaging

Cancer, heart disease, and neurological issues can all be detected and diagnosed more quickly and accurately using AI-powered picture analysis by medical professionals. Medical imaging analysis is one area where AI has proven useful; it can spot patterns and abnormalities that humans might miss, leading to faster and more precise diagnoses.

2. Electronic Health Records (EHRs)

Artificial intelligence (AI) can aid healthcare workers in making sense of EHRs by spotting trends and insights that may be missed by human analysis due to the sheer volume of data. By analysing EHR data, for instance, AI might help doctors proactively intervene with patients who have a higher chance of developing a given ailment due to their medical history or lifestyle choices.

3. Personalized Medicine

Using a patient's unique medical history, genetic information, lifestyle data, and other aspects, AI can assist medical providers in developing individualised treatment programmes. Artificial intelligence (AI) has several potential applications in healthcare, including the reduction of bad responses and the enhancement of patient outcomes by identifying the most effective treatments for a given patient based on their unique traits.

4. Chronic Disease Management

Artificial intelligence (AI) has the potential to improve the way patients with chronic conditions like diabetes, heart disease, and asthma are monitored and treated. Artificial intelligence can track a diabetic patient's blood sugar levels and tailor treatment and lifestyle suggestions to their specific need.

5. Drug Development

AI can assist speed up the drug development process by finding possible therapeutic targets, assessing drug candidates, and forecasting drug efficacy and safety. For instance, AI can analyse massive amounts of genetic and medical data to find novel therapeutic targets, and it can use data from clinical trials to make predictions about the medicine's safety and effectiveness.

6. Healthcare Operations

AI has the potential to improve patient flow, cut wait times, and optimise staff schedules, all of which are important factors in the overall efficiency of healthcare operations. For instance, AI may examine patient data to forecast the demand for particular treatments. This enables medical facilities to distribute their resources more effectively and cut down on wait times.

7. Telemedicine

Tools for telemedicine that are powered by AI can assist increase access to medical treatment, particularly in more remote or underdeveloped sections of the country. Patients can receive care online without having to go to a physical medicine centre, thanks to chatbots powered by AI that can, for instance, conduct basic medical consultations and triage patients based on their symptoms.

5. Conclusion

The proliferation of AI in the medical field has the potential to bring about a sea change in the provision of healthcare and to lead to better outcomes for patients. Current medical uses of AI range from image analysis to the development of electronic health records to the design of individualised treatment regimens to the provision of virtual assistance and the identification of new drugs. Particularly promising is the potential of AI in the field of medicine. Patient outcomes, diagnostic speed/accuracy, and the ability to tailor treatments are all areas where artificial intelligence could make a difference. It is likely that as AI continues to improve and grow more sophisticated, it may be able to build more tailored treatment plans for patients and make more accurate predictions about the outcomes of medical operations. However, as AI grows more pervasive in the healthcare industry, there are concerns that need to be addressed about data privacy, security, and ethics. These issues need to be addressed. In general, the proliferation of AI in medical settings gives patients with exciting new opportunities to enhance both the quality of their healthcare and their access to it.

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