ARTIFICIAL INTELLIGENCE IN MODERN MEDICINE

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ABSTRACT

The foundation of evidence-based medicine is the derivation of associations and patterns from the pre-existing collection of data in order to produce clinical correlations and insights. In the past, we have relied on statistical techniques to identify these trends and connections. Using flowcharts and database approaches, computers can learn how to diagnose patients. Artificial intelligence (AI) is the phrase for the application of technology to replicate intelligent behavior and smart thought that is comparable to that of humans. The current focus of these applications involves software for analytical purposes, natural language processing, voice recognition and machine vision.

AI is expanding into the field of public health and will have a significant impact on all facets of health care. Physicians are now better equipped to recognize patients who need extra attention and deliver individualized regimens for each case with the aid of AI-enabled computer programs. AI can be used by practicing doctors to take notes, evaluate patient conversations, and upload necessary data into Electronic Medical Record (EMR) systems. These programs will gather and examine patient information and give healthcare providers knowledge of the patients' medical requirements.

In the future, AI would be a crucial component of medicine. Thus, it is crucial to teach the new generation of medical students the ideas and applications of AI, as well as how to interact effectively with machines in the workplace for increased efficiency, while also developing soft skills like empathy in them.

**Introduction**

John McCarthy, the co-founder of Artificial intelligence (AI) and co-author of the document that coined the term AI, defined intelligence as “the computational part of the ability to achieve goals in the world”. Among the pioneers of contemporary computers and AI was Alan Turing (1950). The "Turing test" was founded on the idea that a computer can be considered intelligent if it can accomplish cognition-related activities at a level comparable to that of a human. A rising interest related to AI occurred in the 1980s and 1990s. In 2016, relative to other industries, healthcare applications received the largest share of funding in AI research.

Artificial neural networks, a branch of machine learning that takes inspiration from biological nervous systems, are now crucial in many AI applications. Neuronal connections are parameterized by weights that change as the system learns various input-output maps corresponding to tasks like pattern/image recognition and data classification. Neural networks analyze signals in layers of elementary computational units (neurons). Deep learning networks, which have more layers than typical one- or two-layer neural networks, can recognize subtler and more complex patterns. **Figure 1.0**



**Figure 1.0 Neural networks in machine learning**

A 2016 study found that doctors who utilized the services of electronic documentation, such as dictation assistance or medical scribe services, spent more time interacting with their patients directly than those who did not. Aside from reducing manual work and freeing up the time of the clinician, growing AI use in medicine also improves efficiency, precision, and productivity. The objective should be to create a delicate, mutually advantageous balance between a physician's human strengths and powers of judgment, and the efficient use of automation and AI. This is crucial as the possibility of AI totally replacing humans in the medical industry raises concerns that could otherwise limit its potential benefits.

Different clinical settings in the field of medicine have made use of artificial intelligence techniques such fuzzy expert systems, Bayesian networks, artificial neural networks, and hybrid intelligent systems. AI attempts simulation of man’s intellectual ability. The Netherlands employs AI to analyze their healthcare system to identify treatment errors and workflow inefficiencies so as to prevent needless hospitalizations.

**AI for the medical institution**

The history-taking process, in which a doctor asks a series of questions and then combines the reported symptom complex to arrive at a probable diagnosis, is translated using the flowchart-based technique. Given the wide diversity of symptoms and disease processes encountered in everyday medical practice, this necessitates sending a lot of data into machine-based cloud networks. Because the mechanical devices are unable to see and elicit the signs that can only be viewed by a doctor during the patient interaction, the results of this approach are restricted.

The database technique, on the other hand, makes use of the concepts of deep learning or pattern recognition, which entails teaching a computer to recognize particular groups of symptoms or specific clinical or radiological pictures through repeated computations. The 2012 debut of Google's artificial brain project serves as an illustration of this strategy. Based on 10 million YouTube videos, this system taught itself to recognize cats, and as it reviewed more and more photographs, its performance became better and better. It could anticipate an image of a cat with 75% accuracy after 3 days of learning.

The University of Massachusetts designed a system to assist with decision-making called DXplain in 1986. It provided a list of potential diagnoses based on the constellation of symptoms and is also used as a teaching tool for medical students to fill in the void created by conventional textbooks. The University of Washington created the Germwatcher system to track down and look for illnesses acquired during hospital stay.

An AI start-up called Niramai offers quick and inexpensive breast cancer screenings at clinics in rural India, where there is a severe lack of radiologists and labs. On the subject of using thermal imaging to diagnose cancer, it holds 26 international patents, several of which are currently offered on the market internationally, notably in the UK, the US, and Japan.

**Computer vision**

The term "computer vision" refers to the interpretation of images and videos by machines. Thanks to considerable advancements, robots are now capable of performing tasks like object and scene recognition at the level of humans. Image acquisition and interpretation in axial imaging is a significant area of healthcare-related computer vision research with applications in computer-aided diagnosis, image-guided surgery, and virtual lower gastrointestinal endoscopy. The field, which was primarily influenced by statistical signal processing, has recently undergone a considerable change in favor of more data-intensive machine learning (ML) techniques, including neural networks, with adaptation into new applications.

Current computer vision research is leveraging machine learning techniques to concentrate on higher level ideas like image-based analysis of patient cohorts, longitudinal investigations, and inference of more nuanced circumstances like surgical decision-making. Sixty seconds of high-definition surgical video is thought to have 25 times as much information as a high-resolution computed tomography picture, suggesting that a video may have a plethora of useful information. Consequently, although predictive video analysis is still in its infancy, this work shows that AI can be used to evaluate enormous volumes of surgical data in order to find or forecast adverse outcomes in real-time for intraoperative clinical decision assistance.

**AI in radiology**

The field of radiology has been the most open and receptive to utilizing new technology. With the advent of picture archiving and communication systems, computers that were first utilized in clinical imaging for administrative tasks like image acquisition and storage are now an essential part of the workplace. Computer-assisted diagnosis, or CAD, is frequently used in screening mammography. According to recent studies, CAD is not a very useful diagnostic tool in terms of positive predictive values, sensitivity, and specificity. Additionally, the radiologist may become biased by the false-positive findings, leading to pointless work-ups. According to a study, AI could be a huge help in radiology by not only promptly identifying negative exams but also by marking abnormal exams in computed tomography, X-ray, and magnetic resonance images, more so in high volume settings and in hospitals with limited human resources.

**Use of AI in surgery**

Initial attempts at the application of AI for the expansion of technical skills involved basic tasks such as suturing. Such initiatives have been essential in building a knowledge base for more difficult AI jobs. The Johns Hopkins University designed a Smart Tissue Autonomous Robot (STAR) that was armed with algorithms that allowed it to conduct autonomous ex-vivo and in-vivo bowel anastomosis in animal models on par with or better than human surgeons.

The surgical branches have undergone a revolution thanks to the Da Vinci robotic surgical system, particularly urology and gynecological procedures. The system's robotic arms replicate a surgeon's hand movements more accurately, and it features a 3D vision and magnification capabilities that let the surgeon make extremely small incisions.

During the pre-operative phase, a patient undergoing assessment for bariatric surgery might monitor their weight, blood sugar levels, meals, and activity using mobile apps and fitness trackers, with the information coming into their EMR. A better patient-specific risk score for operation planning and useful predictors for postoperative care could be produced by an automated review of all preoperative mobile and clinical data. A real-time study of intraoperative progress that incorporates EMR data with operating video, vital signs, instrument/hand tracking, and electrosurgical energy utilization would therefore allow the surgeon to improve their intraoperative decision-making. Intraoperative monitoring of these many sorts of data may enable the early detection and prevention of negative outcomes. Monitoring recovery and foreseeing difficulties may be made easier with the integration of pre-, intra-, and post-operative data. To enhance weight loss and the correction of obesity-related comorbidities, post-operative data from personal devices could still be combined with data from their hospitalization after discharge.

Engineers can give automated, computational solutions to challenges in data analytics that would otherwise be too expensive or time-consuming for manual approaches, while surgeons have the clinical acumen that can direct data scientists and engineers to address the correct questions with the right data. Every surgeon may be able to raise the standard of surgical care provided worldwide through the technologically enabled dissemination of surgical practice.

**AI for the pregnant and nursing women**

From the fourth month of pregnancy until the kid reaches the age of one, Kilkari (Hindi for a baby's gurgle) sends weekly, time-sensitive audio updates regarding reproductive, maternal, newborn, and child health (RMNCH) straight to families' mobile phones. It attempts to increase families' awareness of and adoption of potentially life-saving preventative health measures. A weekly call with pre-recorded audio content pertinent to their stage of pregnancy, childbirth, or the growth and development of the child is made to families who have registered in the government's databases, either Mother and Child Tracking System (ACTS) or Reproductive and Child Health (RCH).

Kilkari is voiced by Dr. Anita, the fictional doctor from Mobile Kunji. Kilkari serves as a frequent and more constant source of current, pertinent information for families in addition to the counseling visits that Frontline health workers (FLWs) make, reaching out to families who might otherwise be excluded and addressing problems that FLWs are hesitant to address. Kilkari was developed and initially introduced in Bihar in 2013, adopted by the Ministry of Health and Family Welfare of the Indian Government, and scaled out nationally in 2014.

**AI in the pediatric age group**

Since 2018, Buoy Health and the Boston Children's Hospital have been collaborating on a web-based AI system that gives parents guidance for their sick child by responding to inquiries regarding medications and whether certain symptoms necessitate a visit to the doctor.

Another significant medical development is the use of AI in routine neonatal care, particularly for the accurate monitoring of jaundice in neonates. For the purpose of monitoring newborn jaundice, a mobile phone-based information system was created, and machine learning algorithms including ridge regression, random forest support, least angle regression (LARS), fusion of least absolute shrinkage and selection operator (LARS-Lasso) Elastic Net, and vector regression were used. When predicting bilirubin levels in Aydin et al's neonatal jaundice detection system, the feature-extracted data sets are regressed using the k-nearest neighbor (KNN) and support vector regression algorithms.

Four machine learning models were used to create a diagnostic model for children with asthma, and it was discovered that three of them worked well with decision trees that had already been built. It was discovered that adding weighting, social and economic status, and weather data improved the performance of the models. Additionally, a model of pediatric community-acquired pneumonia has been successfully trained to identify several varieties of aberrant picture types in retrospect.

With encouraging results, several researchers have used AI to analyze the genetics of congenital cleft lip and palate. However, only a small number of prospective controlled studies consider machine learning models to be an integral element of pediatricians' daily tasks. There are currently no fully developed AI systems available for diagnosing diseases. Text mining is an essential tool for creating contextualized theories of useful use in the area of electronic health records. The foundation of delivering medical care for children is the pediatrician-patient interaction, and the use of AI not only increases operational effectiveness but also enhances the nature of this relationship.

**AI for the clinician**

The National Institute of Health (NIH) developed the AiCure App, which uses allows access via the webcam of a smartphone to track patient medicine usage and lower non-adherence rates. Aside from the innovations now in use, there are further developments that will make doctors more effective practitioners. A good example of this is IBM's Watson Health, which will be able to quickly diagnose the signs of cardiovascular and oncological diseases. Stanford University has designed a program AI-assisted care (PAC). Additionally, PAC is expanding its efforts to include healthcare conversational agents and intelligent hand hygiene support. In order to provide optimal hand hygiene for doctors and nursing personnel and reduce hospital acquired infections, hand hygiene support is integrating depth sensors to improve computer vision technology.

The first medical speech recognition AI product in India, called Augnito, was bootstrapped by 22-year-old, well-established healthcare company Scribe tech. Digital scribing is made possible by Augnito, which offers a cutting-edge AI-based speech-to-text solution. 'Augmented cognition' is what Augnito stands for, and it offers a better tool for medical transcribing. With Augnito, medical professionals can continue speaking as software instantly turns their speech to text. This helps to remove the obstacles to the use of EMR in healthcare settings.

When specialists differ on a regular basis such as when interpreting chest radiographs for pulmonary tuberculosis, AI-based decision-making techniques are applied. A number of researches have shown that modern systems that use artificial intelligence are more accurate at classifying doubtful skin lesions than dermatologists. This is due to the fact that AI systems can learn more from subsequent cases and can be exposed to many cases in a short period of time, which far outnumber that which a physician could review in a mortal lifetime.

A smartphone application called Nikshay is an integrated solution for managing tuberculosis in India. Nikshay was introduced in 2012 and has undergone significant development to help healthcare professionals and their support workers manage patients more easily and productively. Diagnostic tests, the start of the patient's therapy, co-morbidities, the last follow-up date, and the possibility to update treatment adherence are all included in Nikshay's comprehensive patient profile. Not only can you follow up with patients using Nikshay, but you can also check on their treatment compliance and schedule their appointments.

**AI for the healthcare consumer**

Heart rate, activity level, and sleep patterns may all be tracked by commercially available health trackers, and some have even added ECG tracings as a new feature. All of these modern innovations can notify the user of any variations and give the doctor a clearer picture of the patient's condition. In order to encourage patients to seek care sooner, healthcare conversational initiatives examine how Siri, Google Now, S voice, and Cortana respond to questions from mobile phone users about mental health, interpersonal violence, and physical health. A virtual nurse named Molly has been created to follow up with patients after they are released so that doctors can concentrate on more urgent cases.

An Indian government web gateway for COVID-19 vaccine registration is called CoWIN, or Covid Vaccine Intelligence Network. It shows available booking times for the COVID-19 shot in the neighborhood. On the website, users can make vaccine appointments and request immunization records, which can then be saved in Digilocker and serve as Vaccine Passports during the COVID-19 pandemic.

Patients can now order test kits, check for symptoms, seek advice, track their health, and communicate with doctors online using the multitude of applications available on the internet. In addition, the range of applications for AI now includes therapeutic services. An online course called AI-therapy uses cognitive behavior therapy as a therapeutic strategy to help people improve their social anxiety. It was created using a CBTpsych.com program at the University of Sydney.

**Limitations of Artificial intelligence**

The "magic bullet" of artificial intelligence cannot provide all the answers. In some cases, machine learning is bettered by traditional analytical techniques, or the results of adding ML are not enhanced. The use of AI depends, as with any scientific endeavor, on whether the right scientific question is being posed and whether the necessary data is available to provide a response. When ML is used improperly, there are costs as well as risks involved. **Figure 2.0**

The types and accuracy of the data that are accessible have an impact on the results of ML and other AI analyses. Due to their historical inadequate representation in clinical trial and patient registry populations, systematic biases in clinical data collecting might have an impact on the kinds of patterns AI sees or the predictions it might make. This can particularly have an impact on women and ethnic minorities.

Supervised learning depends on the labeling of data, which can be expensive to collect and which will produce subpar results. Examples of this include identifying the variables currently utilized in patient registries relevant to surgery.

AI software that can diagnose chest x-rays has been created using a publicly accessible National Institutes of Health (NIH) collection of chest x-rays and reports. In order to create labels for chest x-rays, Natural language processing (NLP) was used to mine radiology records. These labels were then used to train a deep learning network to recognize disease on images, with a specific focus on identifying a pneumothorax. However, Oakden-Rayner's in-depth examination of the dataset found that some of the findings might be attributable to incorrectly categorized data. Concerns were raised that the network was incorrectly classifying chest tubes as pneumothoraces, as the majority of the x-rays with pneumothorax labels also frequently contained chest tubes.

Although neural networks' automated nature enables the recognition of patterns that would otherwise go undetected by humans, it leaves human scientists with little ability to analyze how or why such patterns were identified by the computer. The use of AI in clinical practice can be impacted by factors such as algorithm accountability, the safety and authenticity of automated analyses, and the ramifications of these analyses on human-machine interactions. This is something that medicine has recognized very quickly. These worries have made it difficult to employ AI algorithms in a variety of practical domains, from autonomous vehicles to medicine, and they have driven data scientists to make AI findings easier to understand.

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| **Advantages** | **Disadvantages** |
| Efficiency, accuracy, precision | Loss of jobs |
| Decreased work load |
| Increased attention to the patient | Lack of human touch, empathy or emotional intelligence |
| Increased time on the critical cases |
| Saves money |
| Enhanced monitoring |
| **Figure 2.0 Advantages vs disadvantages of Artificial intelligence in medicine** |

**Conclusions**

Numerous applications of AI are already in use in the medical industry, including creating a schedule via online appointment, electronic check-in at medical facilities, storage of medical records in the digital form, sending reminders in the form of texts and calls for follow-up appointments, maintaining data on immunization dates for children and pregnant women, drug dosage algorithms, and cautions on adverse effects when advising multidrug combinations.

There are just as many opponents of this new era of AI-enhanced practice as there are supporters. Many aspiring doctors, practicing physicians, nursing personnel and paramedical staff are concerned about the declining prospects for employment caused by the rising use of technology. Machines may be able to translate human behavior analytically and logically, but they cannot develop human characteristics like critical thinking, interpersonal and communication skills, emotional intelligence, or creativity.

The full potential of AI is still unknown and may be difficult to foresee at this moment. Although a number of AI’s possible applications are still in their infancy and require further exploration and development, they have the potential to fundamentally alter the practice of medicine in previously unimaginable ways. For better healthcare delivery to the general public, medical personnel need to comprehend and acclimate themselves to these advancements.

**Reference**