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Review Article

Applications of Artificial Intelligence in Medicine

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Abstract

Artificial intelligence (AI) with machine learning tools are used to search, store, and analyze medical data to benefit both physicians and the health of patients in various ways. With the advancement in machine learning algorithms and bioinformatics techniques, AI has become an essential part of modern healthcare society. AI algorithms and deep learning applications support clinicians with managing health records, making diagnoses and clinical decisions, prescribing medication, determining mental health, and imaging analysis. Clinicians gain rapid access to information and research relevant to the needs of the patients. As some algorithms compete with and sometimes outperform clinicians, it is necessary to fully integrate this technology into daily medical practices. However, we must recognize the strengths and weaknesses of AI, and obtain the perspectives of experts outside the medical field to enable the inclusion of the ethical, philosophical, sociological, psychological, behavioral, and economical aspects of machine behavior when understanding the evolving interaction of machines with humans, so that it can be used for advantageous purposes. AI technology cannot be considered a replacement for physicians, rather it can act as multiple task-oriented device support to ease the burden on clinicians so that they can provide better care of life to patients at every level.

Introduction

Artificial intelligence (AI), Machine learning (ML), and other latest statistical approaches have untapped growing resources and provided new opportunities to benefit patients with improved diagnostic accuracy, reliable prognosis prediction, precision treatment, and accurate operational efficiency for health systems.[1–4] Fledgling AI/ML technologies included image-based diagnostic applications that showed early clinical promise for personalized treatment. Deep learning (DL) algorithms improve the accuracy in diagnosing retinal pathology, and natural language processing (NPL) extracts the information from structural and unstructured data text embedded in health records.[5] Statistical methods are used to develop the clinical correlations and establish the interrelations with samples from the existing data. For patient diagnosis, there are two techniques: the flowchart and database approaches. The flowchart approach translates a series of questions according to the patient's history and subsequently comes to a probable diagnosis by combining history with present symptoms. A large amount of data is fed to the ML-based cloud with an extensive range of symptoms and diseases that medical practitioners have come across in routine medical examinations.[6] Recently, the healthcare industry has begun using modern computer science and informatics-based approaches along with AI systems to support medical staff in the clinical setup and ongoing research of chronic diseases. AI has deployed efficient and precise technology to find cures for patients suffering from chronic diseases. AI algorithms have several advantages over the traditional approaches of analytics and clinical decision-making. AI systems can understand the training data set more precisely and further help physicians with novel insights into treatment flexibility, care processes, diagnostics, and the outcomes of patients' results.

Currently, AI is being applied to clinical decision support and image analysis in medical settings. Clinical decision support tools help clinicians decide on treatment, medications, and other requirements of patients by giving them rapid access to highly relevant information. AI tools are used to analyze computerized tomography scans, X-rays, nuclear magnetic resonance imaging (MRI), and other medical images for lesions or other markers that can help radiologists achieve accurate diagnoses. The research and results from AI predictions are used to benefit clinicians, researchers, and patients. Gradually, AI has become a major player in the digital health support arena and is reshaping advancements in modern medicinal technology.[7]

Standard medical practice using technology will very soon replace traditional methods by accumulating large datasets generated

Keywords: Artificial intelligence; Medicine; Machine learning; diagnosis; Clinical decision.

Abbreviations: AI, Artificial intelligence; CAD, computer-assisted diagnosis; ChatGPT-3.5, Generative Pretrained Transformer 3.5; CNN, Convolutional Neural Network; CT, Computerized Tomography; DL, Deep learning; ECG, electrocardiogram; ECO, Echocardiogram; EHR, electronic health record; HAIM, Holistic AI in Medicine; ML, Machine learning; MRI, nuclear magnetic resonance imaging; NN, Neural Network; O2, Oxygen; ReLU, Rectified Linear Unit; RNN, Recurrent Neural Network; US, Ultrasound.

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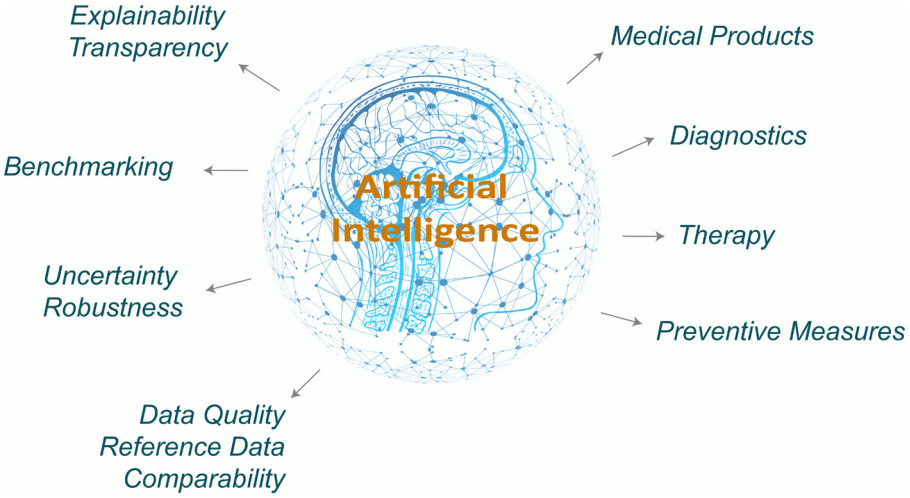

Fig. 1. Overview of artificial intelligence applications in medicine.

in hospitals and stored in electronic medical records through tests and medical imaging allowing AI to perform highly-data-driven medicine. Such applications are continually changing the clinical problem-solving approaches of both doctors and researchers. An overview of artificial intelligence applications is shown in Figure 1.

Although not all algorithms can compete and outperform clinicians effectively, they must still be utilized to ensure improvements in daily medical practices in a variety of tasks. Even though these algorithms can have a meaningful impact, numerous concerns must be addressed first. Just as doctors learn from completing assignments, taking practical exams, performing observations of patients' diseases, and previous experience, AI algorithms have efficient learning processes that use trained datasets to analyze given patterns and speech recognition, perform analysis of images, and make appropriate decisions accordingly. However, human intervention is required, as the computer must be told exactly which image the algorithm should look for. AI algorithms perform well when doing tedious tasks, and can sometimes outperform humans in the tasks they are trained to do. The effective computer system is labeled with structured data with each data point having a label or annotation that is recognizable to the algorithm. Once the algorithm finds enough data point sets and their labels, the performance is analyzed to ensure accuracy. This is done by inputting test data to which the programmers already know the answers, allowing them to assess the ability of the algorithm to determine the correct answer. Based on the output, the algorithm is modified and fed with more data or rolled out to help make decisions more accurately. Algorithms used in medicine require either numerical (pulse rate or blood pressure) or image-based (MRI scans or biopsy tissue sample images) data as input.[7] Algorithms learn from such data and produce either a probability or a classification. Given heart rate and blood pressure data, an algorithm could easily detect the possibility of having an arterial clot, or the probability of having cancer through the labeling of an imaged tissue sample. Finally, the performance of an algorithm in diagnosis is compared to a physician's assessment, so that the treatment can be started by extracting the accuracy of a combination of results. Developed by researchers at Seoul National University Hospital and College of Medicine, the AI algorithm called DLAD (Deep Learning based Automatic Detection) is used to analyze chest radiographs and detect abnormal cell growth for cancers.[8] Another learning algorithm, LYNA (Lymph Node Assistant, https://blog.research.google/2018/10/applying-deep-learning-to-metastatic.html) developed by Google Healthcare is used to identify metastatic breast cancer tumors from the biopsy of a lymph node.

Methods in existing research findings

AI is already utilized in the online scheduling of appointments, online check-ups, computerized medical records, follow-up calls, and vaccination date alarms for children and pregnant females, based on ML algorithms. ML algorithms alert patients to the adverse effects of multidrug usage. Radiology is at the forefront of maximizing the benefits of AI.[9] For example, clinical imaging (image acquisition and storage) and computer-assisted diagnosis (CAD) have been used in breast screening. In some cases, the predicted results are not accurate as recent studies have shown that CAD support diagnostics are based on true positive prediction, sensitivity and specificity, and the false-positive diagnosis results in unnecessary incorrect results.[10] Recently, a medical AI-based model called generalist medical AI was proposed and will be capable of multitasking using a very small or no task-specific labeled dataset.[11] The model was built on large, diversified datasets, which can flexibly interpret the various medical outputs such as data imaging, electronic health records (EHRs), lab outputs, multiomics, and graphical or medical text.

In a study, AI radiology tools help to identify fast false exams in computed tomographies, X-rays, and MRIs in high-volume settings, and label abnormal exams, even at hospitals with limited manpower.[12] A decision support system DXplain[12] was designed for medical students and listed predictable differentials based on complex indicators (https://blog.research.google/). GermWatcher was used to detect and investigate infections in a hospital.[13]

The wider applications of AI in medicine also include therapeutic facilities. CBTpsych.com developed an online AI therapy program that has helped patients treat their anxiety using therapeutic approaches.[14] The AI-based Da Vinci robotic system has transformed the surgical fields of urological and gynecological surgeries. A surgeon's hand movements are mimicked by robotic arms operated by a computer system with a precise 3D view and magnification options for enhanced accuracy, which allow the surgeon to perform minute incisions.[3]

Another AI web system is a collaborative design by Buoy Health and the Boston Children's Hospital which provides advice to parents for their sick children by answering questions about medications and whether any symptoms require a doctor visit (https://www.bizjournals.com/boston/news/2018/08/22/boston-childrens-website-to-feature-self.html). The National Institute of Health created the AiCure app to monitor the medications of patients via their smartphone webcams, hence reducing individualistic rates.[15] Fitbit, Apple, and other health trackers have helped patients monitor their pulse rates, fitness, and sleep levels. A few apps have even added a new electrocardiogram (ECG) tracing feature to help and support patients to receive treatment much earlier than usual by monitoring their activities. These advanced features can alert doctors regarding any variations allowing them to provide consultation with greater ease. The Netherlands has used AI applications for the analysis of its healthcare system by uncovering mistakes in treatment and ineffectiveness in workflow to avoid unnecessary crowds in hospitals. Many other advances in various phases of development have already helped the healthcare industry. IBM's Watson Health is furnished with features to efficiently identify symptoms of heart disease and cancer. The Partnership in AI-Assisted Care features a smart health support system with ICUs designed with multiple sensors. The apps can sense any behavioral changes in elderly people living alone and ICU patients.[16,17] The Partnership in AI-Assisted Care is also advancing its features of intelligent hand hygiene support and healthcare conversational agents. Hand hygiene support will use depth sensors with the help of computer vision technology to achieve perfect hand hygiene to avoid hospital-acquired infections.[18] Siri, Google Now, S Voice, and Cortana are a few healthcare conversational projects that respond to mental issues, interpersonal violence, and health-related questions from mobile phone users allowing patients to seek early care. A virtual nurse Molly provides follow-up care to discharged patients allowing doctors to focus on more pressing cases.

AI has not only benefitted other industries, it has helped physicians to rationalize tasks, improve the efficiency of operations, and simplify complex procedures. Major Companies such as Microsoft invested $40 million over five years of funding in 2020 for innovations in healthcare industries. Undoubtedly, AI has begun changing the healthcare industry with AI expansion taking place throughout the healthcare sector, and, as such, questions about the supremacy and restrictions of this technology have become ever more relevant.

Results of these findings

AI is having a major effect on every aspect of primary and advanced health care. AI-enabled computer applications help caregivers in primary health care to better diagnose patients and provide precision protocols for each individual. AI applications also facilitate the storage and analysis of patient information on EHR systems presenting it to the physician along with a sound understanding of patient's medical needs in less time. This is saving physicians a great deal of time previously spent on deskwork and EHR systems giving them more time for physical presence with their patients. AI has not only reduced the amount of physicians' deskwork and freed up their time for primary healthcare but also increased ingenuity, accuracy, and efficacy. AI is also being used to find and develop new drugs and investigate the repurposing of existing drugs for use against specific diseases, as clinical trials are costly and time-consuming. AI is facilitating "precision medicine" as it can screen existing medications and suggest treatment targeted at individual patients. AI can outperform dermatologists in classifying skin diseases accurately AI systems can learn from successive cases and can handle multiple cases efficiently in less time compared to human learning processes.[19] However, in some cases, AI-based decision-making approaches are not in agreement with the expert's opinion, such as identifying pulmonary tuberculosis on chest radiographs.[20] The increased usage of AI technology has also reduced the number of job opportunities, which is a major concern for the health industry. In addition, although human behavior can be translated by analytical and logical algorithms, it is difficult for machines to translate human attributes such as the ability to conceptualize, interactive and communication skills, sensitive intelligence, and creativity. Moreover, AI predictions are not always accurate. In a study, 640,000 digital mammograms were reviewed in the Digital Mammography DREAM challenge with the help of several high-end processing computers.[21] The observed results were approximately equal to those of the bottom 10% of radiologists with a specificity of 0.81, sensitivity of 0.80, and area under the receiver operator curve (ROC) of 0.87. It is evident, however, that AI will play a major role in the healthcare industry in the future and thus it is essential to train medical staff regarding its concepts and applicability. AI functions efficiently in a technology-based workspace to cultivate soft skills such as empathy in machines. Primary care physicians must become well-versed with the advanced technology of future AI to ensure their progress in the medicinal world.

Rather than focusing on complete replacements for human intervention, a mutually beneficial balance between the effective use of AI, human power, and the decision-making of trained primary care physicians should be struck. Replacing humans with AI in the field of medicine brings major ethical concerns with limitations, and thus it is better to extract the maximum benefits that can be derived from this advanced technology. It has been observed that AI can positively impact the practice of medicine, with high-speed processing of information for research or helping clinicians to make better decisions.

Current applications of artificial intelligence in medicine

The first AI application in medicine concerned the early detection of atrial fibrillation. AliveCor's atrial fibrillation and smartphone-based ECG monitoring were approved by the FDA in 2014 with their KardiaMobile device having potential applications for ambulatory patients.[22] The FDA approved another Apple smartphone application for ECG monitoring and atrial fibrillation detection.[23] These devices have their limitations, however, as they may produce false positive results due to the movement of artifacts, and for elderly patients suffering from atrial fibrillation, they bring the inconvenience of adopting wearable devices. Although the results were not, generally, accurate, AI has been used to predict the risk of cardiovascular diseases such as acute coronary syndrome and heart attack and alert patients accordingly.[24,25] AI tools can also interpret pulmonary function results and make predictive decisions.[26] For patients with diabetes, AI support devices enable continuous monitoring of glucose and provide information on the direction and rate of change of blood glucose levels.[27] The FDA-approved Medtronic, for example, has smartphone apps to monitor the glucose level in patients.[27] These smartphone devices help diabetes patients optimize their blood glucose control reducing the stigma associated with hypoglycemic episodes. However, sometimes the notification also increases anxiety levels when patients are unable to regulate their glucose levels.[28] Albeit with limited applications, AI tools are seen in nephrology where they can predict the decline

of glomerular filtration rates in patients with polycystic kidney disease,[29] and provide risk alerts for progressive IgA nephropathy.[30] AI tools also have wide-ranging applications in the clinical setting of gastroenterology where the use of convolutional neural networks and other deep learning models can process endoscopy and ultrasound images to locate abnormalities.[31] AI tools can diagnose diseases and predict the outcomes, which helps physicians accelerate the treatment process for diseases such as gastroesophageal reflux disease,[32] atrophic gastritis,[33] gastrointestinal hemorrhage,[34] esophageal cancer,[35] Ulcerative colitis,[36] metastasis in colorectal cancer[37] and epidermoid carcinoma.[38] In 2018, the FDA approved "Embrace" a wearable device that can detect generalized epilepsy seizures and alert physicians and caregivers with the necessary information and patients' locations.[39] Wearable sensors are also used to assess gait, posture, and tremors in patients with multiple sclerosis, Parkinson's disease, Parkinsonism, and Huntington's disease.[40] One FDA-approved AI-based algorithm can diagnose cancer in computational histopathology with great accuracy. Another AI area of application is the field of imaging-based diagnosis,[41] which normally requires rigorous clinical trials,[42] or can only be used strictly under medical supervision. AI systems exploit multiple data sources and input modalities to quickly deliver more accurate results. A unified Holistic AI in Medicine (HAIM) framework was used to generate and test AI multimodal inputs. Results predicted that the HAIM framework offers a favorable pathway for future multimodal systems in clinical and operational settings (Fig. 2).[43,44]

In recent years, computational pathology has also shown promising results for better solutions to whole-slide images, multiomics data, and clinical informatics. It has specified three major domains for connecting patients and doctors-local labs, scan centers, and web access for data processing and retrieval AI has now unlocked the information by using advanced digital communication networks to improve clinical workflow efficiency,[44] diagnostics, and the ability to produce personalized treatment plans for patients. Computational pathology has reduced errors in classification, prognosis, and diagnosis and further suggests better treatment methods. It is also able to analyze demographic information, digital pathology images, -omics, and laboratory results accurately.[45] AI tools contribute to almost all aspects of the clinical workflow, from diagnosis to prognosis and precision treatment. Clinical data from various sources are included in mathematic models to generate diagnostic inferences and predictions enabling physicians to make quick and optimal treatment decisions.[46,47] Deep neural networks (HER2, ER, and Ki67) are used for automated biomarker assessment of breast tumor images.[48] There are not many other tools that act as novel convolutional neural network-based mammography–histology–phenotype–linking–model and are used to connect and map the features and phenotypes between mammographic abnormalities and their histopathological representation. With EHR systems, mathematical algorithms are used to access a particular disease with various factors.[49,50] Such integrated data has given doctors deeper insights into treatment at different stages of the disease and/or for different types of patients. Data-driven smartphone apps, her, and laboratory information systems are used to integrate data,[51,52] algorithms, and analytics to deliver high-quality and efficient care. Computation-driven decision-making processes based on AI and machine learning have opened the door for decision-making processes for all, not only specialists. However, decision-making in medicine that now includes experts from other fields raises ethical and security concerns.[53]

Computational pathology requires access to health databases to create training data sets that are more comprehensive but the strict protection of patient privacy and personal data policies creates a barrier in that respect.[54] Complex real-time and in-depth datasets in multiomics are used to extract important information such as novel and useful biomarkers, which are essential for the early detection of disease and treatment. The highly advanced statistic/computational models have revolutionized a large amount of clinical and health-related data. The growing data-rich pathomics has led to the rapid development of AI-assisted computational pathology. AI assistance improves the sensitivity and accuracy of the diagnoses as well as the turn-around time. Despite the challenges,[55] 75% of pathologists across 59 countries believe that computational pathology will be a great asset in changing and improving the current healthcare system.

Advantages of AI applications in medicine

AI can positively impact the practice of medicine in various manners, whether through speeding up the pace of research or helping clinicians make better decisions. A few examples of AI applications are given in the following subsections.

AI in disease detection and diagnosis

ML models are used to observe risk factors in patients by examining the vital signs of patients receiving critical care. AI models can alert clinicians in cases of emergency by assessing the input data. Even complex conditions such as sepsis can be detected by a predictive AI model for premature babies, which is 75% more accurate in detecting severe sepsis. For example, Innocens BV by IBM uses AI models to predict sepsis in endangered newborns (https://www.ibm.com/blog/innocens-bv-uses-ai-to-protect-vulnerable-newborns/).

AI in medical imaging

The artificial neural network has proven to be as effective as many radiologists in detecting symptoms of diseases accurately. A greater number of medical images can be stored with the help of computational resources allowing clinicians to more easily keep track of a patient's history. Such vital pieces of information are also highly useful for the treatment process.

Accelerated drug development

Since the development process of new drugs is complicated, expensive, time-consuming, and challenging, computer-aided drug discovery technology is being used in the discovery and development of novel drugs to study their physiochemical and biological properties. Such data-driven approaches have helped in the identification of repurposed drugs for treating disease as they include low-risk compounds, with a potentially lower cost and shorter timelines. AI helps in creating better drug design and new combination therapies based on the patient history and many major challenges for big data in the drug industry can be overcome with the help of AI.

Error reduction

AI can improve the safety of patients and AI safety tools can ensure accurate decision-making with improved error detection and drug management. AI-powered tools have made life easy for physicians and healthcare workers.

Provide real-time data

AI tools provide accurate information for diagnosis and other medical areas promptly. With AI, medical professionals can be sup-

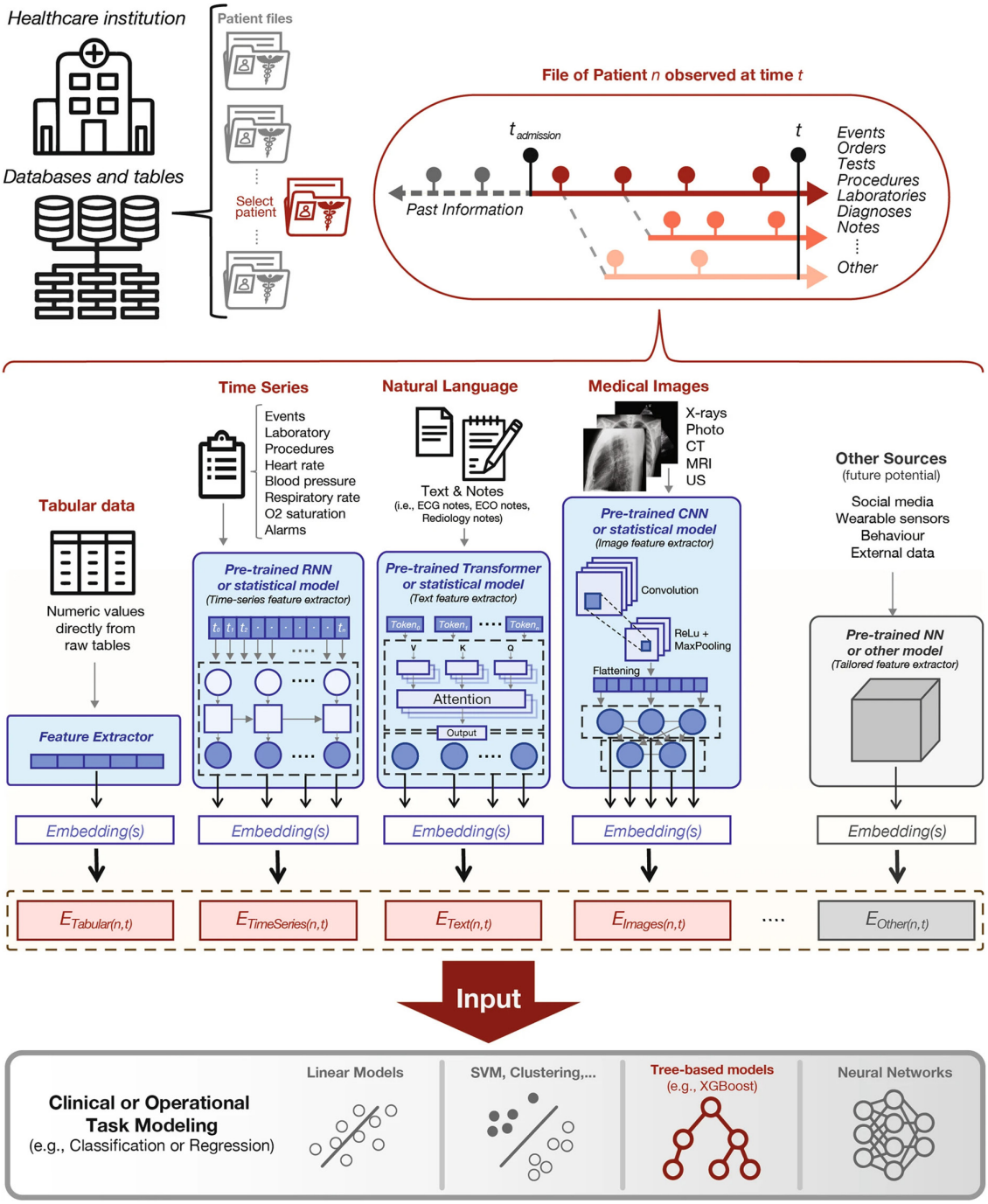

Fig. 2. The schematic framework for holistic artificial intelligence in medicine (HAIM).[44] Databases and tables resources are taken from healthcare institutions as HAIM-MIMIC-MM combined from MIMIC-IV and MIMIC-CXR-JPG. (Cites from Soenksen, LR. et al. npj Digital Medicine, 2022;5:149). CNN, Convolutional Neural Network; CT, Computerized Tomography; ECG, Electrocardiogram; ECO, Echocardiogram; MRI, Magnetic Resonance Imaging; NN, Neural Network; O2, Oxygen; ReLU, Rectified Linear Unit; RNN, Recurrent Neural Network; US, Ultrasound.

ported with swift and accurate data to accelerate and improve critical clinical decision-making. Authentic results lead to improved protective steps, cost-effectiveness, and reduced patient wait times leading to improved physician-patient relationships. As the data is available to patients on their mobile phone apps, they can also monitor their own condition. Various AI apps help patients with diet planning, exercise, anxiety reduction, and connecting to patients with similar types of diseases all over the world. Mobile alerts can inform medical staff of urgent situations and emergencies. Advanced AI technologies can access and accumulate much larger amounts of data than traditional methods of collecting and storing medical records.[56]

Streamlined tasks

Healthcare practices are changing everywhere. AI innovative tools are helping with collecting healthcare records, appointment scheduling, translating clinical details, and tracking patient histories. AI tools have streamlined the tedious and meticulous tasks associated with medicine. As it is easier to identify significant visual markers with the help of intelligent radiology technology, hours of intense analysis are saved. AI tools can automate appointment scheduling, caring and tracking of patient recommendations in an efficient manner.[46] AI tools can manage insurance reviews and help hospitals address incorrect claims before insurance companies refuse payment leading to minimized costs. The rigorous and time-consuming process of handling insurance claims has reduced considerably benefiting both insurance workers and hospital Staff. AI has enabled faster payments and greater claims accuracy helping both potential and existing patients.

Save time and resources

Automated AI tools have provided medical professionals with more time to see more patients for diagnosis and treatment. AI has increased productivity considerably helping hospitals to make considerable cost-savings. The medical necessity determination has also improved. Natural Language Processing and DL algorithms can assist physicians in reviewing hospital cases and avoiding denials more efficiently. They have further increased the time for medical professionals to utilize them in vital productivity hours and resources. They can reduce medication errors, customize health insurance, prevent fraud, and support the administrative and clinical workflows efficiently.

Research assistance

AI allows researchers to access large pools of data from various sources worldwide. Real-time data with wide sources of information can be used by clinicians all over the world. Medical research labs are developing useful and individualized software packages for navigating and extracting useful information from this large collection of data. Software companies and start-ups are providing AI tools to help track the progress of patients, recover crucial diagnosis data, and contribute to this information through shared networks.[46] Social media apps are used to share data worldwide and connect to other similar healthcare agencies for learning and sharing information.[57]

Reduced the physician stress

Latest reports indicate that due to excess workloads, physicians feel stressed because of their deadlines and other workplace conditions. However, physicians' long working hours and stress have been reduced with AI solutions that align courses of action, automate functions, share data instantly, and organize performances. They have reduced the workload and pressure and helped medical staff to easily manage multitasking.

Precision treatment

Personalized care has now become easier with AI support. AI models can learn and remember preferences and provide customized real-time recommendations to patients in a personalized way. AI tools can find the solutions for many challenges and treatment responses for many diseases. With AI-assisted tools, precision medicine can be provided for the treatment of diseases. As machine learning, statistical learning, and soft-computing approaches have become the new standard in the bio world, there is a great need to use this technology for the treatment of diseases. These AI approaches are moving closer day by day toward diagnosis, prognosis, and treatment, opening the window to precision medicine. Since AI is a major player in the transformation of healthcare to precision medicine, the innovative approaches of AI will help patients in a great way in the near future. Rather than relying on information taken from each patient's case, AI-powered virtual assistants can offer clinicians a vast amount of information around the clock based on the patient's medical history, and personal requirements.

Clinical trial efficiency and informed patient care

With AI tools, the appropriate datasets have been updated and medical code searches have been speeded up considerably. Clinical workflows with medical AI can make appropriate care decisions using this valuable information. Clinicians' research time is reduced with proof-based observations about treatments and procedures even when the patients are present. The transparent data can also be easily shared with the patients.

Provide circumstantial relevance and increase doctor-patient engagement

DL and Natural Language Processing tools filter relevant information according to patients' needs, reducing the time and effort medical professionals must spend on searching for it. Chatbots provide 24/7 support, replying to patients' queries and guiding them even when caregivers are not available. However, although AI tools have provided a wealth of opportunities, there is growing ethical concern in the medical community as to how much trust should be placed in AI and how much freedom it should be given to work without human intervention. Many major issues with medical AI remain unanswered by the scientific community and a lack of well-defined guidelines for its usage exists.[58,59]

Limits of AI in medicine

The requirement for human surveillance

Despite their efficacy, AI applications still require considerable human surveillance. Robotic surgery requires the intervention of health practitioners who can bring vital behavioral observations to help diagnose or prevent medical complications. Although AI applications in the healthcare industry are already a few decades old, the field is continuing to mature. Even now, it will take years of education to fully train medical professionals in this field. Subject Matter Experts' advice related to the relevant data and improved explainable AI will provide healthcare staff with trusted and valuable decisions.[60]

Overlooking of social variables

AI assistance in the medical field has improved patients' physical conditions while some related apps contribute to healthcare in other ways. For example, socio-economic and historical factors are taken into account when making appropriate recommendations for particular patients. These applications make recommendations based on previous data, without taking into account patients' economic resources or other personalized preferences. Incorporating an AI system also brings privacy issues: influential brands can freely control the collection and utilization of data. Hospitals face setbacks when seeking channel data from mobile devices. These regulatory and social norms prohibit the ability of AI tools to facilitate medical practices.[61]

Leads to unemployment

As AI has reduced clinicians' work time, costs, and pressure, it is anticipated that it could lead to unemployment. This would result in displaced trained staff who have already invested learning, resources, and time in healthcare education, presenting impartial challenges. The World Economic Forum 2018 report has projected a net sum of 58 million jobs, but the same study found that 75 million jobs will be replaced or pulled down by AI by the same year (https://www.weforum.org/press). As AI is associated with many different sectors; many jobs have been eliminated due to repetitive tasks. Though AI promises to improve various sectors of healthcare and medicine, it is essential to consider the social consequences of introducing this technology.

Possible imprecisions

AI medical data is heavily dependent on millions of existing cataloged diagnosis cases. In the case of scant information existing about a particular illness, its statistics, or environmental factors, an accurate diagnosis may not be possible and these factors also tend to influence the prescription of a particular medicine. Moreover, for prescriptions, information regarding determined populations and reactions to treatments may not be present. This will lead to issues with the treatment of patients belonging to certain populations. Although AI is constantly progressing and finding ways to fill this data gap, it is important to mention that particular populations may be excluded from existing areas of knowledge.

Sensitivity to security risks

Dependent on large data networks, AI systems are particularly susceptible to security risks. Decision makers in security systems have expressed certainty that offensive AI has now become a threat to some industries. Cyber-attacks now include these smarter and more accurate AI data systems and with each achievement and defeat, they become more difficult to predict and prevent. With smarter AI systems, such attacks will become more challenging for many industries in the future.

Future directions

As advanced AI models quickly evolve, potential new models are being designed to encompass multi-modal medical information and assist doctors with complicated medical decision-making. Recently, a study conducted to evaluate the performance of Generative Pretrained Transformer 3.5 (ChatGPT-3.5) in brain glioma adjuvant therapy decision-making aimed to assess the effectiveness of AI by comparing ChatGPT-3.5's recommendation with expert recommendations in aiding complex brain tumor decision-making.[62] Right now the performance of ChatGPT-3.5 is not able to replace the opinions of medical experts, but as the performance showed variations related to the diagnosis accuracy, therapy plan, therapy dosage, consideration of functional status, and overall performance, it can still serve as a useful supplementary tool. Since AI language models are continuously improving, it is possible that in the future, advanced algorithms will also assist in improving the patient's experience of care, enhance caregiver experience, and reduce the rising cost of care among many others.[63] As AI results directly correlate to human ethical judgment, it can be used as a support system in the major domain. However, whether humans can work with AI in a socially acceptable and humanitarian manner in clinical informatics and remain ethical poses a major challenge, which has still not been confronted at the scientific level.[64–67]

Conclusion

The potential of AI can be used to improve healthcare systems. Automation of tedious tasks with AI tools can lessen the burden of clinicians allowing for enhanced doctor-patient interactions. Improving data accessibility will help medical professionals to take the right steps to prevent illness. Through real-time AI data, improved diagnoses can be easily and rapidly performed, and administrative errors reduced. The technology has become more applicable and well-informed with the involvement of small and medium-sized enterprises. AI tools are being progressively applied in the healthcare industry, and the challenges and limitations continue to be encountered and overcome. Still, some human surveillance is required for the increasingly calculated cyber-attacks. Despite some limitations and challenges with AI, it will provide extraordinary benefits to the healthcare industry in the future.

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Conflict of interest

There is no conflict of interests for this manuscript.

Author contributions

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