IMPLICATIONS OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE APPLICATIONS AND SERVICES

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ABSTRACT

The rising complexity and volume of data in healthcare will necessitate the increasing usage of artificial intelligence (AI). Healthcare organizations, insurance providers, and biotech firms are all using various forms of AI today. Applications can be broken down into several major groups, including diagnostic and therapeutic guidance, patient participation and adherence, and back-end tasks. While AI has the potential to do healthcare tasks as well as or better than humans, barriers to adoption will delay the mainstream use of AI in the healthcare industry for some time. Ethical issues posed by the widespread adoption of AI in healthcare are also discussed.

KEYWORDS: Artificial intelligence, clinical decision support, electronic health record systems

1. INTRODUCTION

One of the pioneers of contemporary AI and computing, Alan Turing was born in 1950. The "Turing test" assumed that for a computer to be considered intelligent, it must be able to execute cognitive tasks at a human level.[1] Interest in artificial intelligence exploded in the 1980s and 1990s. To better serve their patients, healthcare facilities around the country have begun implementing AI tactics including fuzzy expert systems, Bayesian networks, artificial neural networks, and hybrid intelligent systems.

When comparing 2016's AI research funding across industries, healthcare applications received the largest share.[2]

There are two distinct categories of artificial intelligence used in healthcare: digital and physical.[3] Virtual elements can include anything from electronic health record systems to artificial neural network-based treatment decision support. The physical aspect addresses the use of robots in medicine, including surgical assistance, intelligent prosthetics for the disabled, and care for the old.

Clinical correlations and insights are the backbones of evidence-based medicine, which is built on drawing connections and patterns from the available body of knowledge. In the past, we would apply statistical approaches to discover such connections and trends. Both flowcharts and a database approach help computers learn how to make accurate diagnoses.

The doctor will ask a series of questions about the patient's medical history and symptoms before arriving at a diagnosis using the flowchart-based method. Due to the vast array of symptoms and pathologies seen in clinical practises, this calls for massive amounts of data to be sent into machine-based cloud networks. Machines can only do so much in terms of observation and data collection during a patient interaction, therefore the results are limited.

To train a computer to distinguish clusters of symptoms and specific types of clinical and radiological imaging,

the database approach uses deep learning and pattern recognition. One such effort is Google's Artificial Brain Initiative, which began development in 2012.

By analyzing increasing numbers of photos, our algorithm learned to recognize cats from YouTube videos. After only three days of training, it had a 75% success rate at identifying images of cats.[4,5]

2. LITERATURE REVIEW

Hao et al.'s research involve text mining for the health sciences. Simply explained, text mining is the process of using a computer to automatically extract information from several text resources with the purpose of gaining access to previously unknown data. It is possible to think of text mining techniques as an application of data mining to textual information. The role of text mining in the healthcare industry is expanding.

Data mining and machine learning (ML) are also crucial to the research by dos Santos et al., which aims to solve public health issues.

Based on the findings of this study, public health can be thought of as the study and practise of minimising health risks for a population as a whole. Information that would have been impossible to find could be unearthed with the use of data mining and ML methods. Both of these papers are connected to the field of "medical big data."

Using the definition provided by Liao et al., "big data" has become a popular "buzzword" in both the corporate and scientific industries to describe vast amounts of digital data collected from a variety of different sources. The healthcare sector is a treasure trove of information (medical big data). The analysis of this data can be aided by data mining and machine learning techniques, which can then provide valuable insights for healthcare providers and their patients.

Recent research by Choudhury et al. provides a thorough evaluation of ML's application to geriatric care, with a focus on studies that show its efficacy in treating mental health and vision problems.

Tran et al. zero in on the worldwide development of AI studies in healthcare. Their bibliometric research sheds light on emerging themes and methods in the field of artificial intelligence.

The use of surgical robots has skyrocketed in recent years, as reported by Connelly et al. Their bibliometric research shows the widespread use of robotic surgery in domains as varied as urology, colon and rectal surgery, cardiothoracic procedures, orthopaedics, oral and maxillofacial surgery, and neurosurgery.

Additionally, Guo et al.'s bibliometric analysis offers a comprehensive look at AI-related publications through to December 2019. This study explores real-world uses of AI in healthcare, providing insight into the ways in which algorithms might aid clinicians. There is also a developing line of inquiry into AI.

By systematically reviewing the AI literature, Choudhury and Asan have made a significant scientific contribution that might be used to warn patients about potential dangers. Thirty-three research including clinical warnings, clinical reports, and medication safety technology are reported. Given the significant interest in this area of study, this analysis departs in several keyways from the existing literature. Its goal is to give in-depth analysis, with a focus on the business, management, and accounting sectors rather than the medical and health literature alone.

3. IMPLICATIONS FOR THE HEALTHCARE WORKFORCE

The worry that AI would cause the automation of occupations and the major displacement of the labour has received a lot of attention. In a joint study by Deloitte and the Oxford Martin Institute, they predicted that 35% of UK jobs would be lost to AI automation in the next 10–20 years. While other studies have demonstrated that some types of work can be automated, the rate at which this occurs may be limited by factors other than technology.

The benefits of automation extend far beyond the simple replacement of human work, and its legislative and social approval are also important factors. As a result of these factors, the real number of jobs lost may be less than 5%.

So yet, no human healthcare workers have been replaced by AI, as far as we know. To some extent, this is because AI has had very little footprint in the business thus far, and because it is challenging to integrate AI into clinical procedures and EHR systems. Radiology and pathology, for example, deal mostly with digital information and hence seem less vulnerable to automation than other healthcare positions that require direct patient interaction.

However, it is expected that AI will take some time to fully permeate sectors like radiology and pathology. Despite our argument that deep learning and other technologies are improving their capacity to diagnose and categorize images, we still think jobs in fields like radiology are safe for the foreseeable future.

To begin, radiologists' duties extend beyond simply analysing pictures. Radiology AI systems are like other AI in that they specialize in a certain task. Deep learning models are trained in universities and startups to recognize specific types of images, such as nodules on CT scans of the chest or bleeding on MRIs of the brain. Only a small fraction of these activities is now possible for AI, but thousands of such limited detection tasks are needed to accurately identify all potential discoveries in medical pictures. Not only do radiologists perform diagnostic imaging procedures, but they also advise on patient care, define the technical parameters of imaging examinations to be performed (specific to the patient's condition), correlate image findings with other medical records and test results, and communicate with patients about their experiences and outcomes.

Also, clinical procedures utilizing AI-based picture work are not yet at an everyday-use stage. The likelihood of a lesion, the likelihood of malignancy, the features of a nodule, or its location are all areas of interest for various providers of imaging equipment and deep learning algorithms. These specialized areas of study would make it challenging to integrate deep learning algorithms into standard medical care.
Third, for deep learning algorithms for picture identification, 'labelled data', or millions of photographs from patients who have gotten a definitive diagnosis of cancer, a broken bone, or other

pathology, is required. However, radiological pictures are not collected in a single, label-searchable database.

Finally, major shifts in medical regulation and health insurance are required for widespread adoption of automated image analysis.

Problems in pathology and other technologically focused medical fields are not unique. As a result of them, artificial intelligence is not projected to significantly impact the healthcare industry's labour market during the next two decades. Employment opportunities related to the use and advancement of AI technologies may potentially expand. However, with employment levels remaining steady or rising, it's safe to assume that advances in artificial intelligence won't significantly cut healthcare expenses any time soon.

4. ARTIFICIAL INTELLIGENCE FOR HEALTHCARE: APPLICATIONS

By addressing the third research question (RQ3), this subsection should help broaden the scope of the study.

Using the topic dendrogram, researchers will provide a framework for growth that considers four important factors. Artificial intelligence has revolutionised the medical field. Doctors and other medical professionals have found success with the use of artificial intelligence in a variety of healthcare settings, including health information systems, geocoding health data, epidemic and syndromic surveillance, predictive modelling and decision support, and medical imaging. In addition, the authors used the four dominating macro-variables identified through the bibliometric analysis as their focus while writing their papers. As a result, the following subsections will attempt to provide light on the controversy surrounding the use of AI in healthcare. Fig. 1 depicts these constituent parts.

Fig. 1. Dominant variables for AI in healthcare.

Health services management

The potential for AI methods to aid in managing health care in their entirety is an important consideration. The job of doctors, nurses, and administrators can be aided by these programs. AI systems, for instance, can regularly (if not instantly) update doctors on the latest findings in the medical literature, textbooks, and clinical practices [2, 10]. During the COVID-19 era, when constant information interchange is required for proper global pandemic management, the efficacy of these applications is becoming increasingly crucial. Among its many potential uses, this technology might be used in coordinating patient information tools and facilitating relevant conclusions for health risk alarms and health outcome prediction. Healthcare facilities, including hospitals, can benefit from AI applications in a number of ways.

- When necessary, data is promptly available to clinicians.
- Nurses can improve patient safety during drug administration.
- By maintaining open lines of communication with their careers, hospitalized patients can better understand their conditions and treatment options.

Logistics optimization is another area where AI may help out, for example by helping to bring pharmaceuticals and equipment to life in a just-in-time supply system based entirely on predictive algorithms. Intriguing software can also aid in the education of healthcare professionals. The difference between urban and rural health care could be narrowed with the help of this evidence. Finally, AI has the potential to aid health services management in making more effective use of the wealth of information available in electronic health records by predicting data heterogeneity across hospitals and outpatient clinics, checking for outliers, performing clinical tests on the data, standardising patient representation, enhancing future models' ability to predict diagnostic tests and analyses, and establishing transparency by providing benchmark data for assessment.

Predictive medicine

Artificial intelligence (AI) applications in disease prognosis, diagnosis, therapy, and outcome evaluation are another area of interest. Since AI is able to find patterns in unstructured data, it can aid in the medical fields of diagnosis, therapy, and prognosis. It paves the way for doctors to embrace prevention rather than treatment. Better healthcare outcomes can be predicted by identifying risk factors and drivers for each individual patient. New medicines, patient monitoring, and individualised treatment regimens are all aided by the use of AI technology. Better patient care is provided when doctors have more time and clearer information. Prediction models for pharmaceuticals and tests that track patients over their lifetimes might be generated automatically with AI, which could significantly alter the medical industry.

Clinical decision-making

The ability of AI applications to aid clinicians and researchers in making evidence-based decisions is a major theme that emerged from the keyword analysis. According to Jiang et al., AI can help doctors make critical clinical decisions by either assisting them or completely replacing them in certain functional domains of healthcare. Bennett and Hauser argue that algorithms can improve clinical assessments by speeding up the process and increasing the amount of care provided, which in turn can reduce the cost of health services. So AI can help make it easier for doctors to do their jobs and streamline their processes. In conclusion, Redondo and Sandoval discover that algorithmic platforms can offer virtual aid to doctors by teaching them to comprehend the semantics of language and identify human-like solutions to problems arising in business process enquiries.

Patient data and diagnostics

Patient data and diagnostics present another difficult area of AI applications. Researchers in the medical field can benefit from using AI methods to process the massive amounts of patient data (medical big data). Clinical activities create data that AI systems can manage, including screening, diagnosis, and treatment allocation. In this approach, medical professionals can gain an understanding of parallel topics and the relationships between certain characteristics of those topics and desired outcomes.

These tools enable the analysis of raw data, yielding insights that can be used to improve the care of individual patients. They can aid in diagnosis by giving clinicians a more complete picture of the patient's health, which is especially useful for complex procedures like high-speed body scans.

Then, artificial intelligence can be used to reconstruct a patient's body in 3D.

Table 1: Current applications of artificial intelligence in healthcare

Technology	**Application scheme**	**Application area**
Robotics	Provide high-quality treatment by improving the precision and accuracy of the surgical procedures.	Medical device, Health IT
Digital secretary	Find the golden hour of appropriate intervention by continuously monitoring the patient condition indicators and alerting the nurse when necessary.	Medical device, Health IT
Machine learning	Predict and analyze patterns based on the data affecting treatment results. Reduce the uncertainty in the medical treatment decision-making by processing large volumes of diagnostic medical images through self-learning.	Diagnostic medical image, Health IT
Image processing	Quickly process large amounts of medical images and apply the findings in judging the disease type and negative and positive test results.	Diagnostic medical image, Health IT
Natural language processing	Convert long unstructured text data, such as medical charts, to be easily read and interpreted.	Medical device, Health IT
Voice recognition	Capture patient voice and language and store important information in electronic medical records.	Medical device, Health IT
Statistical analysis	Predict patient treatment results through rapidly analyzing large amounts of patient health record data.	Medicine, Health IT
Big data	Provide personalized recommendations to the patients and	Medicine,

Technology	Application scheme	Application area
analysis	therapeutics by processing large amounts of data maintained by healthcare institutions.	Health IT
Predictive modeling	Predict treatment outcomes, such as predicting risky diseases, by applying mathematical models.	Medicine, Health IT

5. RESULTS

Drug dosage algorithms and adverse effect warnings when prescribing multidrug combinations are already in use, as are online appointment scheduling, online check-ins at medical centres, digitization of medical records, reminder calls for follow-up appointments and immunization dates for children and pregnant women. The various uses of AI in healthcare are visually shown in [Figure 2] as a pie chart.

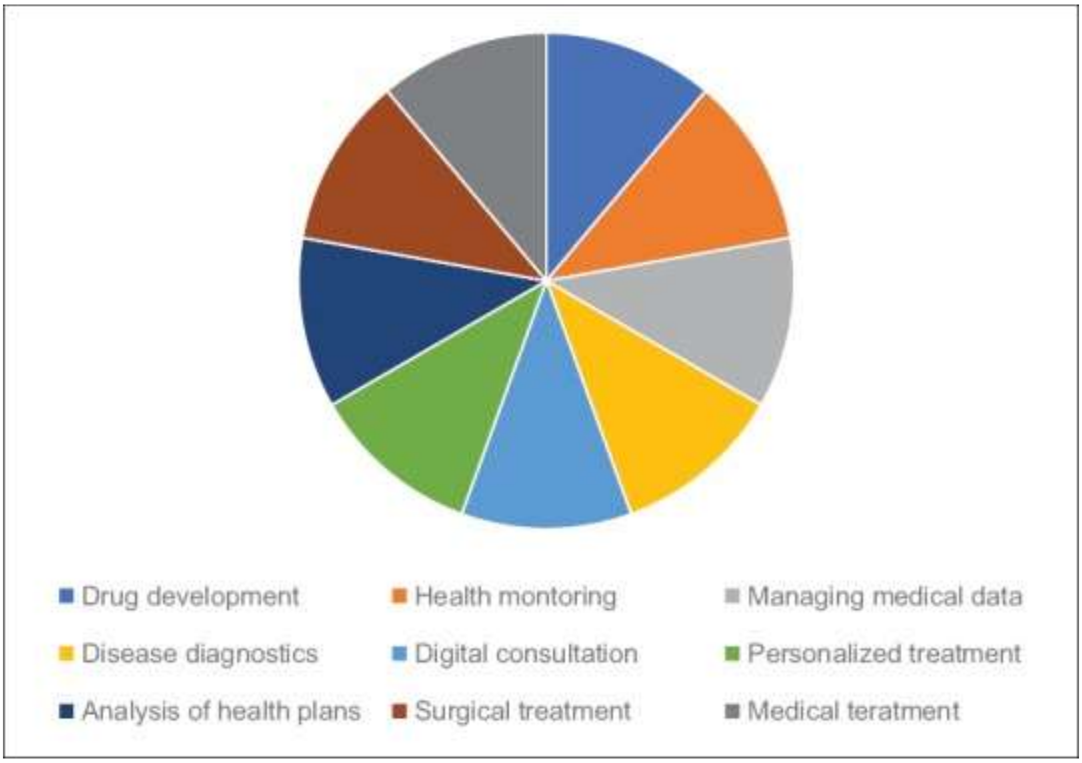

Fig. 2. Applications of Artificial intelligence in Health care

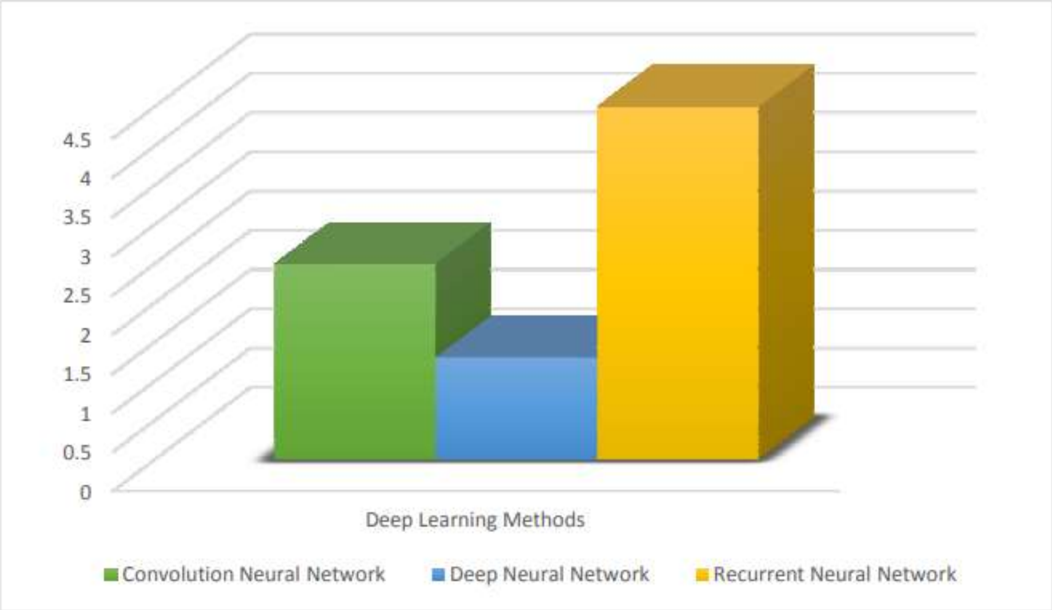

Fig. 3. Use of Deep Learning methods.

Table 2: Applications and the field of the response.

Rating	Artificial intelligence (AI) application	Field of application	Responses of "rather applies" or "fully applies", n (%)
1	Identification of drug interactions	Medication and therapy	280 (92.4)
2	Early alarming of deterioration of patient status	ICU[a]/anesthesia	267 (88.1)
3	Analysis of x-rays, CT[b], MRT[c], sonographies	Imaging procedures	263 (86.8)
4	Analysis of ECGs[d] and EEGs[e]	Other diagnostic procedures	257 (84.8)
[...]			
22	Assessment of prognosis of nonmalignant diseases	Prognosis assessment	177 (58.4)
23	Automatic anesthesia administration	ICU/anesthesia	172 (56.8)
24	Triage in emergency care	Other diagnostic procedures	142 (46.9)
25	Diagnosis of psychiatric diseases	Other diagnostic procedures	62 (20.5)

[a]ICU: intensive care unit.
[b]CT: computed tomography.
[c]MRT: magnetic resonance tomography.
[d]ECG: electrocardiogram.
[e]EEG: electroencephalogram.

CONCLUSION

As with other promising emerging fields, such as genomics and teleconsultation, the application of AI in healthcare settings is experiencing rapid growth. While scientific research should continue to be rigorous and transparent in its pursuit of innovative answers to better modern healthcare, health policies should now focus on tackling the ethical and financial difficulties connected with this cornerstone of the progress of medicine.

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