IeJSME 2021 15 (3): 1-4

Editorial

AI in Healthcare: Applications and Challenges

Elaine Wan Ling Chan

The availability and complexity of data in healthcare provide endless opportunities to leverage artificial intelligence (AI) for more precise and efficient treatments for patient care. AI is defined as "the capacity of machines to mimic the cognitive function of humans"[1]. The term was first used in the 1950s and since then for many years, it had been tested and used to improve diagnostic test accuracy using a narrow type of AI called "computer aided diagnosis (CAD)".[1-2] Recently, with the evolution of AI and machine learning towards convolutional neural networks and deep learning, AI applications expanded further beyond diagnostics. It had the potential to transform patient care, administrative processes within healthcare providers and drug discovery. As compared to traditional analytics and clinical decision-making skills, AI algorithms are based on training data, providing unprecedented insights into diagnostics, patient care process, patient outcome and treatment variability.[1,3-4] In future, AI is poised to be the main engine that drives advancement across the care continuum, accelerated by the staggering rate at which the volume of available medical data continues to increase.

AI in healthcare generally refers to the use of machine to review, analyse, interpret and suggest solutions to complex medical problems based on medical data that was ingested in an automated manner. AI had been used in the diagnosis and treatment of diseases in which rule-based system was first developed in the 70s to diagnose blood-borne bacterial infections.[1,4] However, these rule-based systems do not have the precision of algorithmic systems developed using machine learning. Algorithmic clinical decision support systems could easily adapt to the changes in medical knowledge and are capable of handling huge data and knowledge based on genomic, proteomic and other 'omic-based' approaches to diagnosis and treatment. They are driving the era of probability and evidence-based medicine.[1-5]

As a collection of technologies, AI could be applied to both structured and unstructured healthcare data. Traditionally, expert system based on the 'if-then' rules were widely used for clinical decision support system. A series of rules in the field of study is constructed based on knowledge of human experts. However, most often when there are many rules, the rules will end up conflicting with each other. Moreover, if the domain knowledge changes, it is challenging and time-consuming to change the rules.[1] Hence, it is slowly being replaced by approaches based on machine learning algorithms. The most popular AI technique is machine learning, a statistical technique of training models with data. An example of simple machine learning models like the support vector machine is widely used for structured data in predicting the disease or treatment outcome based on a training dataset consisting of patient attributes. As the outcome variable is known, it is termed supervised learning.[1] A more complex form of machine learning is the neural network, mimicking the way neurons process signals with inputs, outputs, and weighted features, which associate input with outputs. It has been used for categorisation of structural data, for example in the determination of a patient risk of having a disease.[1,5] The most complex machine learning technique is deep learning. It contains many levels of features that predict the outcome within

Institute for Research, Development and Innovation, International Medical University, Bukit Jalil, 57000 Kuala Lumpur, Malaysia

Address for Correspondence:

Dr Elaine Chan Wan Ling, Institute for Research, Development and Innovation, International Medical University
Bukit Jalil, 57000 Kuala Lumpur, Malaysia. Email: elainechan@imu.edu.my

the neural network. Deep learning is commonly used in image processing for the detection of clinically relevant features in medical images beyond what that could be detected by the human eye. In addition, deep learning is also used for speech recognition as a form of natural language processing. The main application of natural language processing in healthcare involves the classification of clinical reports and published research articles. It is used to process the unstructured clinical notes, reports and conduct conversational AI.[1,5]

Nowadays, the primary and foremost use of AI in healthcare is through diagnosis of patients using medical imaging. Manual inspection of images obtained from imaging techniques such as X-Ray, MRI and CT Scan is often difficult to identify microscopic abnormalities, and this requires highly trained and skilled experts in the field. The demand for medical imaging is increasing and in future there will be a shortage of experts in the field.[2,6] However, with the advent of deep learning technologies in AI, AI will be a tool to fill the demand gap and enable better detection of abnormalities that would otherwise go undetected.[1] It is almost certain that in future radiology and pathology images will be analysed by a computer with the rapid advancement of AI in medical imaging. However, to ensure the effective adoption in clinical practice, it is paramount to ensure that AI findings are associated with clinically meaningful outcomes. The ability of the AI to distinguish benign abnormalities and clinically relevant lesions are crucial in reducing a false positive rate that might come as a cost of better image sensitivity.[6]

AI has also emerged in the field of drug discovery. The route for a new drug from research laboratories to patient is a costly, complex, and long one. In the past years, there has been a substantially large amount of data available in assessing drug compound activities, but mining of the large-scale chemistry data is needed to search for potential drug compounds.[4] AI had been used to streamline the drug discovery and drug repurposing processes to significantly cut both the cost and time to market for new drugs. AI can recognise hit and lead compounds, predict new therapeutic use, shorten the time required to validate drug target, and assist in the optimisation of the drug structure design. AI had been effectively used in different parts of drug discovery, including chemical synthesis, and drug design, screening, and repurposing. AI not only speeds up the time of the product to market, but it will also improve the quality and overall safety of the production process, making it more cost-effective.[4,7]

Another interesting application of AI in healthcare is genomics and precision medicine. Recently, genetic information from a population pool is widely available due to the cheaper and easier access to full genome sequencing. With the genetic information, AI algorithms could be used to find correlations and predict treatment responses for individual patients. In addition to genetic information, other biomarkers such as protein expression, metabolic profile and gut microbiome could be analysed with AI for precision medicine. Precision medicine is used to customise the treatment plan for an individual based on the individual's genetic make-up and surrounding environment. Nowadays, massive amount of data from an individual is made available with the use of wearable sensors and "OMICS" whereby AI could analyse and interpret these data with incredible efficiency. AI algorithms such as machine learning, deep learning and artificial neural network are the primary tools behind the development of precision medicine.[1] Recently, promising results had been shown in predicting

the disease risk of cancer and cardiovascular disease using prediction algorithms with high degree of accuracy and precision.[1,4,8]

AI has also been used to improve the administrative processes in healthcare for example, clinical documentation, management of medical records and claims processing. Machine learning algorithms which use probabilistic matching to verify claims could save time, money , effort of insurers, providers and governments.[1] Chatbot had also been used for appointment bookings and telehealth though there are concerns on the willingness of patient in revealing confidential information and health condition to a machine.[9]

Overall, AI can transform many areas of healthcare and addresses imperative healthcare challenges. Accumulating evidence have shown that the performance of AI algorithms is on par or better than experts in analysing medical images and providing diagnosis or treatment recommendations based on symptoms and biomarkers from electronic medical records.[1,4] However, in the past, patient care decision had been made almost exclusively by humans. Moreover, AI algorithms like deep learning used in image analysis are not possible to be explained. There is no explanation on how an image has to a diagnosis of cancer as compared to that determined by a clinician.[1] Hence, the use of AI in healthcare involves ethical issues that need to be addressed like the lack of empathy between AI and patients, the questions of responsibility, transparency, and data privacy.[1,4]

For AI to be adopted widely in clinical practice, the developed AI software needs to be approved by regulators, integrated into the electronic health record system, standardised in a manner with similar product function in a similar fashion. One of the main challenges is the current perspective that AI will replace clinicians. This must be changed to promote wider adoption of AI in healthcare settings. In fact, AI will augment the effort of clinicians to care for patients. Unique human skills such as empathy and persuasion will be taken on by human clinicians while AI will provide the information needed.[1,10]

There will be many challenges with AI in healthcare ranging from ethical, medical to technological. Eventually, most of these challenges faced in adoption of AI in healthcare setting will be overcome. However, the ethical challenges will take longer than it will take for the technologies themselves to mature. Hence, it is expected to see limited use of AI in the next 5 years but more extensive use within 10 years.

Keywords: *Artificial Intelligence, healthcare applications, machine learning, diagnosis*

REFERENCES

1. Davenport, T., and Kalakota, R. (2019). The potential for artificial intelligence in healthcare. Future healthcare journal, 6(2), 94–98. https://doi.org/10.7861/futurehosp.6-2-94
2. Fujita, H. (2020) AI-based computer-aided diagnosis (AI-CAD): the latest review to read first. Radiological Physics and Technology 13, 6–19. https://doi.org/10.1007/s12194-019-00552-4
3. Sudipto Datta, Ranjit Barua and Jonali Das (December 12th 2019). Application of Artificial Intelligence in Modern Healthcare System, Alginates - Recent Uses of This Natural Polymer, Leonel Pereira, IntechOpen, DOI: 10.5772/intechopen.90454. Available from: https://www.intechopen.com/chapters/70446
4. Bohr, A., and Memarzadeh, K. (2020). The rise of artificial intelligence in healthcare applications. Artificial Intelligence in Healthcare, 25–60. https://doi.org/10.1016/B978-0-12-818438-7.00002-2
5. Jiang, F., Jiang, Y., Zhi, H., et al (2017). Artificial intelligence in healthcare: past, present and future. Stroke and Vascular Neurology, 2. doi: 10.1136/svn-2017-000101
6. Oren, O., Gersh, B.J., and Bhatt, D.L. (2020). Artificial intelligence in medical imaging: switching from radiographic pathological data to clinically meaningful endpoints. The Lancet: Digital Health, 2(9), E486-E488. https://doi.org/10.1016/S2589-7500(20)30160-6
7. Paul, D., Sanap, G., Shenoy, S., Kalyane, D., Kalia, K., and Tekade, R. K. (2021). Artificial intelligence in drug discovery and development. Drug Discovery Today, 26(1), 80–93. https://doi.org/10.1016/j.drudis.2020.10.010
8. Subramanian, M., Wojtusciszyn, A., Favre, L. et al. (2020). Precision medicine in the era of artificial intelligence: implications in chronic disease management. Journal of Translational Medicine, 18, 472. https://doi.org/10.1186/s12967-020-02658-5
9. Mierzwa, S., Souidi, S., Conroy, T., Abusyed, M., Watarai, H., & Allen, T. (2019). On the Potential, Feasibility, and Effectiveness of Chat Bots in Public Health Research Going Forward. Online journal of public health informatics, 11(2), e4. https://doi.org/10.5210/ojphi.v11i2.9998
10. Char, D.S., Shah, N.H., Magnus, D. (2018). Implementing machine learning in health care – Addressing ethical challenges. New England Journal of Medicine, 378:981–3.