Summary – Sypnosis

Dr. Ignacio H. Medrano

AI: the future of medicine?

AI is a term used to describe the use of computers and other technology to simulate intelligent behaviour and critical thinking that mimic the cognitive functions of a human being.[1] Research into the application of AI techniques in medicine has been ongoing for several decades; in 2016, most AI investment went into research in the healthcare sector.[1] The potential applications of AI in medicine are vast and, ultimately, it is likely to have a significant impact on patient care and clinical decision-making in rheumatology.[2]

There are potential applications for AI-based technologies in almost every aspect of modern life. One well-known example of AI is the programme Google Translate, which can automatically translate text to and from a multitude of languages. Google Translate uses an algorithm based on machine learning, an AI technique, which is programmed to learn from a set of solved problems. This approach removes the need for any understanding of grammar or syntax and allows the algorithm to infer the rules of any language and apply them to solve unseen problems.

AI-based technologies are emerging within healthcare settings, but more research is needed before the full potential of AI is realised across a wide range of clinical applications. Automated analysis of medical imaging is one area where AI may have particular value, as manual analysis of these images is resource intensive and can be subject to interobserver variability.[3] In 2016, a deep-learning algorithm was developed that detected diabetic retinopathy and macular oedema in retinal fundus images with a high degree of specificity and sensitivity.[4] Based on these findings, in 2018, the FDA permitted marketing of the first AI-based medical device that could be used in a primary care physician's office to detect cases of diabetic retinopathy.[5] AI techniques also have the ability to extract unexpected patterns and associations from medical images. For example, a deep-learning algorithm has been developed that can predict cardiovascular risk factors (such as age, gender and systolic blood pressure) from retinal fundus images.[6] Previously, it had not been considered that these factors could be identified from retinal images.[6] This demonstrates the power of AI techniques to go beyond human interpretation to see associations between multiple variables that the human brain cannot detect.

Other applications of AI in medicine have been investigated, including the use of laboratory data, medical records and molecular biology outputs to aid in diagnosis, treatment selection and prediction of prognosis. For example, a model based on demographic and laboratory data was developed to predict treatment non-response in patients with Crohn's disease.[7] AI systems have also been used to assist with selection of an appropriate antibiotic prescription.[8] Numerous AI-based technologies have been approved by the FDA across fields including oncology, cardiology and emergency medicine.[9]

Future applications of AI in medicine could include examining associations between genotype and phenotype, as well as using AI to extract and analyse clinical data from electronic health records (EHRs). EHRs contain large amounts of real-world patient data in both a structured form (information such as International Classification of Disease [ICD] codes), as well as in a free-text arrangement (e.g. the narrative from the healthcare provider notes).[11] It can be challenging to identify or classify patients with certain conditions using structured information alone, as their use can vary substantially across healthcare systems. This is a particular issue when trying to identify patients with axial spondyloarthritis (axSpA) from EHRs, as the evolving disease concept means there has historically been a lack of specific ICD codes. To overcome this issue, a technique called natural language processing was used in one study to extract key disease concepts from free-text data in EHRs.[11] This data was then combined with structured ICD code data to develop algorithms designed to identify patients with a high probability of having axSpA. When identifying patients with axSpA, the algorithms that incorporated free-text data outperformed the algorithms that used ICD codes alone.[11] Algorithms incorporating data derived from natural language processing expand the amount of EHR data that can be analysed and offer exciting opportunities for clinical research in the future.

AI in healthcare is a rapidly evolving field, but it is important to proceed cautiously and responsibly. In a recent proof-of-concept study, a deep-learning algorithm was used to detect patients with atrial fibrillation based on facial video images.[12] The approach was able to identify patients with atrial fibrillation with a high degree of accuracy and could facilitate high-throughput screening in settings such as hospital waiting rooms.[12] However, the non-contact nature of this type of examination raises important questions and concerns about patient consent, privacy and confidentiality.[13] As technology advances, regulation will be required to ensure that tools are used appropriately and ethically.

1. Amisha, Malik P, Pathania M, Rathaur VK. Overview of artificial intelligence in medicine. J Family Med Prim Care. 2019;8(7):2328-31.
2. Gossec L, et al. EULAR points to consider for the use of big data in rheumatic and musculoskeletal diseases. Ann Rheum Dis. 2020;79(1):69-76.
3. Liu X, et al. A comparison of deep learning performance against health-care professionals in detecting diseases from medical imaging: a systematic review and meta-analysis. Lancet Digit Health. 2019;1(6):e271-97.
4. Gulshan V, et al. Development and validation of a deep learning algorithm for detection of diabetic retinopathy in retinal fundus photographs. JAMA. 2016;316(22):2402-10.
5. U.S. Food and Drug Administration. FDA permits marketing of artificial intelligence-based device to detect certain diabetes-related eye problems. 2018. Available at: https://www.fda.gov/news-events/press-announcements/fda-permits-marketing-artificial-intelligence-based-device-detect-certain-diabetes-related-eye. Last accessed: 14th June 2021.
6. Poplin R, et al. Prediction of cardiovascular risk factors from retinal fundus photographs via deep learning. Nat Biomed Eng. 2018;2(3):158-64.
7. Waljee AK, et al. Development and validation of machine learning models in prediction of remission in patients with moderate to severe crohn disease. JAMA Netw Open. 2019;2(5):e193721.
8. Didelot X, Pouwels KB. Machine-learning-assisted selection of antibiotic prescription. Nat Med. 2019;25(7):1033-4.
9. Benjamens S, et al. The state of artificial intelligence-based FDA-approved medical devices and algorithms: an online database. NPJ Digit Med. 2020;3:118.
10. Kundu S, et al. Enabling early detection of osteoarthritis from presymptomatic cartilage texture maps via transport-based learning. PNAS. 2020;117(40):24709-19.
11. Zhao SS, et al. Incorporating natural language processing to improve classification of axial spondyloarthritis using electronic health records. Rheumatology (Oxford). 2020;59(5):1059-65.
12. Yan BP, et al. High-throughput, contact-free detection of atrial fibrillation from video with deep learning. JAMA cardiology. 2020;5(1):105-7.
13. Turakhia MP. Diagnosing with a camera from a distance-proceed cautiously and responsibly. JAMA Cardiol. 2020;5(1):107.