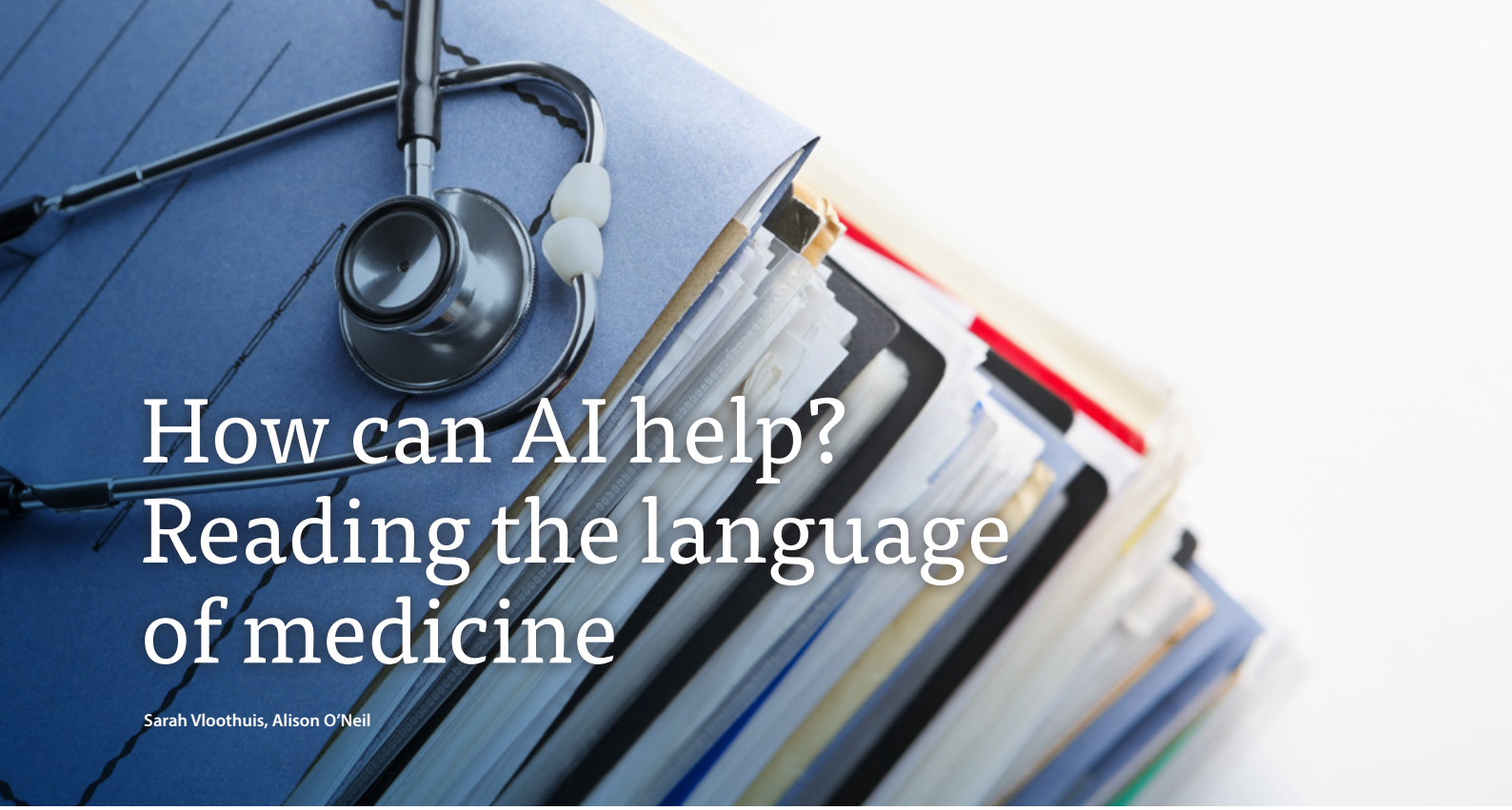


How can AI help? Reading the language of medicine

Sarah Vloothuis, Alison O'Neil

The era of digital patient records is upon us and new digital services to document a patient's medical journey are emerging – everything from GP referral letters and lab test results, to biopsy images and discharge summaries from hospital admissions. When a patient arrives at hospital in an emergency situation, clinical staff already have key – sometimes game-changing – information available to them. But when time to treatment is of the essence, how do clinicians quickly see the facts they need to save lives? At Canon Medical Research Europe in Edinburgh, this thorny challenge is being investigated by a team who are using a branch of Artificial Intelligence called 'Natural Language Processing' (NLP) to interpret medical text and pull out relevant information, creating a new diagnostic pathway for clinicians which is faster to access, easier to navigate, and ultimately more accurate than they have had before.

"When you're facing a body of text, reading and digesting information can take time."

Reducing 'door-to-needle' time in stroke treatment

Working within the Industrial Centre for AI Research in Digital Diagnostics (or iCAIRD), Canon Medical are researching new technology solutions for stroke diagnosis. By supporting better workflow and assisting clinical decision making, they hope to bring down 'door-to-needle time' – the time elapsed between admission and treatment in a type of stroke called 'ischaemic'. Ischaemic strokes make up around 85% of all confirmed diagnoses and happen when a blockage in blood flow leads to reduced oxygen supply to brain tissue. "The most important thing is to try to remove that clot, or occlusion, as soon as possible. Doing so restores blood to the deprived regions and maximises the amount of salvageable tissue," explains Clinical Researcher Shadia Mikhael. "The sooner you can remove the occlusion, the greater the chance of recovery." Current clinical guidelines state that after four and a half hours, treatment for an ischaemic stroke fails to have an impact – so time is of the essence.

Alongside all other elements that slow down proceedings, such as patient transfers and language barriers, painstakingly reading through piles of medical notes is a huge problem and an obvious barrier to fast and accurate treatment decisions. AI Scientist Maciej Pajak explains: "if you're a radiologist looking at a CT scan or a pathologist looking at pathology slides, quite often the abnormality in the image jumps out at you. However, when you're facing a body of text – or even worse, multiple documents that must be opened and reviewed one-by-one – reading through and digesting the information can take a long time." Additionally, Shadia adds, "Stroke patients, who are often elderly, frail and with a history of long-term chronic disease, can come in with massive piles of discharge letters."

The language of medicine

NLP is not a new technology. Those of us who use personal assistants, such as OK Google, Siri, Alexa or Cortana are using it every day – an algorithm identifies, extracts and converts our human language into a format that can be analysed. But, like humans, to get to this point, the algorithm needs to be 'taught' the language it is processing by exposing it to as many examples as possible. "You can take all of Wikipedia, for example and do some really smart training on that," Maciej explains. but in the context of medical applications, it's not an easy task,

as the language is specialist and confidential patient records are difficult to access. Medical data is also rife with idiosyncrasies, as an understandable need for speed causes typos and misspellings. Then there is the clinician's famous love of an acronym ¬– does 'ASD' mean 'Atrial Septal Defect' or 'Autism Spectrum Disorder'?

Canon Medical's AI scientists have already created a state-of-the-art algorithm for classifying medical reports and have partnered with Prof. Sotirios Tsaftaris of Edinburgh University (Canon Medical/Royal Academy of Engineering Research Chair in Healthcare AI) to develop an explainable model. "This is a breakthrough algorithm where we have shown that we can incorporate medical knowledge – in this case information from the International Classification of Diseases (ICD) – into the design of our model, to get higher accuracy," explains Team Lead, Alison O'Neil. "This ability to make use of existing medical knowledge in our AI algorithms will be key to learning to recognise rare diseases where we do not have a large set of historical examples to train the machine learning system."

Over the next year the team continue their research and focus on text algorithms that specifically support clinical decisions in the treatment of acute stroke. There are also challenges to address in adapting the solutions developed to other environments – non-English speaking countries, for example. However, the field of NLP has seen rapid progress and the future looks bright for AI development in text. Maciej gives Google Translate as a good example of how far machine translation has come in a short amount of time. "And it's just one of many NLP applications; we also have text generation, automatic summarisation, question answering, classification of sentences and documents. The methods are often based on similar underlying mathematical principles, such as deep neural networks. It's a quickly developing field and really transforming the way text is being used."

Trust and human decision-making

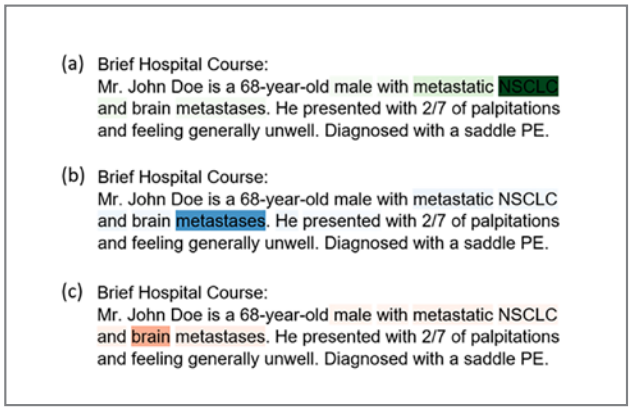
With AI always comes natural concerns around how it changes the landscape into which it is introduced. Dr. Ken Sutherland, President of Canon Medical Research Europe describes their role as "turbo charging clinicians", that is, "making their job as easy as possible and supporting the decision-making process". This is the core principle that underpins the work of the AI Research team. Even at this early stage of development, they are planning how humans interact with this technology. Clinicians will be able to drill down from the AI algorithm output and discover its source, giving both reassurance and context to the relationship. "Let's say you get a summary of multiple documents.

"Clinicians will be able to drill down from the AI algorithm output."

When you click on a sentence it could show a list of all the places where it took the information from," Maciej explains. "And you can agree or disagree with it," adds Shadia. "It's presenting the facts and they are making the decisions."

The team are keen to stress that this is only the beginning. Through effective collaboration and adaptation of state-of-the-art techniques they have already achieved a huge amount in just a year. But in the true style of medical professionals, they look to the purpose: "So far we have improved on an established benchmark by five percent. That's great, but ultimately we want to improve patient outcomes so we need to look at how clinicians would use the algorithms and come up with trustworthy algorithms that address their needs."

Canon Medical Research Europe would like to thank Prof. Keith Muir at Queen Elizabeth University Hospital in Glasgow and Prof. Sotirios Tsaftaris of Edinburgh University for their ongoing collaboration and support. //



Canon are working on explainable algorithms where the clinician can drill down and see the explanation of the AI algorithm predictions.

An onsite administration team in most hospitals adds International Classification of Diseases (ICD) codes to patient medical records.