How AI Will Change Medicine

Text by A/Prof Tan Cher Heng and Prof Benjamin Seet

Foresighting plays a key role in driving the research and development strategy for any organisation. This guides how we make bets on new technologies that have the potential to change the future. However, there is little need for foresighting when it comes to the use of artificial intelligence (AI) in medicine.

AI will change clinical practice – from screening to diagnosis, how decisions are made in the clinic, guiding treatments and even surgery. AI will play a part in how we capture clinical data, how healthcare professionals learn, how they access knowledge and, with developments in generative AI, how we educate and communicate with patients.

The potential and opportunities are immense, with as much hype as there are practical uses in the clinic. But there are also hoops, hurdles and technical challenges that limit the pace and extent whereby AI technology can be implemented and scaled in our health systems.

Local state of play

AI is starting to make its presence felt in our hospitals. We encounter AI in health apps, smart devices and research projects. Singapore alone has close to 200 digital health start-up companies – a large number of which incorporate machine learning or AI as part of their offerings.

With computer vision technology, automated screening of retinal images is now possible. Of note, the Singapore Eye Lesion Analyser (known as SELENA+) has enabled accurate detection of eye diseases using fundal photographs. Jointly developed by the Singapore Eye Research Institute and the National University Singapore, this has changed primary eye care, reducing the need for ophthalmologists to screen every case.

The recent deployment of AimSG (an AI-powered medical imaging diagnostics platform) will see rapid adoption of chest radiography algorithms that aid in triaging patients in primary and emergency care settings. This will help to flag up cases requiring urgent attention while the doctor awaits the radiologist's full report. A similar tool was successfully deployed at Tan Tock Seng Hospital (TTSH) and National Centre for Infectious Diseases to screen for pneumonia during the COVID-19 pandemic, with a rate of one X-ray image read every three seconds.

FathomX, a local start-up, is seeking to deploy its mammogram solution in both the National University Hospital System and National Healthcare Group (NHG) clusters. This could remove the need for a second radiologist reader for screening mammography without affecting the detection rate for breast tumours. In endoscopy, AI can improve the level of sensitivity for detecting colonic polyps and lesions. Such tools are especially relevant for the Healthier SG initiative, as these tools would help to cope with the anticipated surge in cancer screening workload.

The ability of AI models in predicting outcomes can help to better stratify the population for different treatment interventions and optimise the allocation of limited healthcare resources. Mesh Bio, another local start-up, is collaborating with TTSH to develop digital twin systems to characterise diabetes states and to predict disease progression. In the domain of rehabilitation, TTSH is deploying gamification and intelligent

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systems to customise treatment protocols for patients.

Ambient usage of AI could allow real-time and non-intrusive speech-to-text transcription in the clinic consultation setting. This can substantially reduce the data entry and computing load on clinicians while facilitating a structured data entry approach to clinic notes, thereby also creating new possibilities for future AI development.

Recent advances in large language models have created opportunities for AI to conduct self-supervised learning on well-curated data sources to enhance both patients' and healthcare professionals' education. Foundation models can rapidly plough through the myriad of multi-modal information available in electronic medical records, to provide clinicians with recommendations that are in line with clinical best practices.

Practical implementation

For us to effectively deploy AI in clinical practice, clinicians need to have basic AI literacy and understanding of how AI models are developed. Developers have the responsibility to ensure that their models are robust and explainable, so that clinicians and patients will accept and adopt the technology.

Algorithms need to be trained on clean and representative datasets that are properly annotated and subsequently validated with local data before being put into use. Risks of bias and model drift have to be mitigated.

Ideally, there would be not only seamless integration of the AI model into existing enterprise information technology systems, but also smooth operation of the model within the clinic workflow. Using the example of chest radiography, an AI model would be able to support clinical decision-making by delineating potential abnormalities into "critical" (eg, pneumothorax), "abnormal" (eg, cardiomegaly) and "normal". These decisions must be clearly conveyed to and understood by the clinician, while patients need to be advised on the risks and benefits of the models in use.

The Ministry of Health has stipulated important considerations and best practices for AI model development and deployment. The current focus is on the safe and responsible use of such technologies and information. In view of the field's nascency, the relevant legislature and guidelines would be expected to evolve over time as well.

Managing expectations

While there is a lot of interest about AI in medicine, we need to have a balanced approach to technology adoption.

An important guiding principle is that the patient should remain at the centre stage. While most app developers and code writers have claimed that their solutions will change clinical practice, we need an evidence-based approach to systematically evaluate the costs and benefits of adopting any such technology. The clinical demand and utility have to be clear, so that we do not end up with a "technology push" seeking new applications and solutions.

Many AI projects end up as a departmental- or institutional-level project that cannot be scaled for wider use. These projects encounter challenges that include interfacing with hospital electronic medical records and enterprise information systems, data privacy, cybersecurity, high-performance computing capacity, and incompatibility between different applications and platforms. Any attempt to bring an AI project to the mainstream could become protracted and require large amounts of resources, which makes sustainability and affordability important considerations.

There are also structural issues to contend with, including standards, quality assurance, accountability, liability and reimbursement models. Developments in these areas have not caught up with the pace of technology development, which could become exponential with recent advances in generative AI.

Even if we have overcome the technical challenges, there are still the issues of how clinicians and patients would adapt to and accept the use of AI in the clinic. There are underlying issues such as those of trust and confidence, as well as how much autonomy to accord to a machine algorithm. Clinicians and administrators would have to be trained to work with the AI system, while a new "AI workforce" would also have to be established to provide back-end support.

To take on some of these issues, the Lee Kong Chian School of Medicine, Nanyang Technological University and NHG plan to jointly set up a centre for AI in medicine. The centre seeks to develop and test AI solutions for patient care and healthcare services delivery, as well as to address policy, structural and human interface issues for medical AI.

Until then, the AI tool that perhaps we need is one that can tell us which AI technology can make a real-world difference to healthcare providers and patients. ◆

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