Commentary

Artificial Intelligence: A Singapore Response

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The world is in the midst of a new industrial transformation with the rise of artificial intelligence (AI).[1] Physicians and health systems will increasingly need to adapt amidst skyrocketing demand for health services due to multiple converging socioeconomic trends that include an ageing population in many countries. This trend is exacerbated by heightened expectations as the quality of health services improves and life expectancy increases. As the number of young health professionals and workers is reduced, AI shows great potential to disrupt the delivery of health services and to revolutionalise patient treatment to meet this need.

Application of AI-Augmented Healthcare

AI has been used in health services since the 1970s and has gone through several hype-and-bust cycles. Nonetheless, the convergence of several trends in the world today heralds an exciting new era in the use of AI. These include an exponential increase in computing power, rise in investment capital, explosion in data creation and capture and development of deep learning (DL) techniques which utilised multilayered neural networks to create conditions that improve accuracy of AI detection. In 2014, GoogLeNet—a convolutional neural network—classified 15 million Internet images into >20,000 categories at near-human accuracy that caused much worldwide sensation.[2]

Since DL neural networks are not limited by human fatigue and are able to process large amounts of information round the clock, they can be deployed to perform a large variety of repetitive, cognitive tasks across the entire health sector. The future of health servcies that are augmented by AI systems holds immense potential, and researchers in Singapore are well-placed to participate in their creation.[1]

Radiologists are early adopters of AI in medicine since they have been using DL to detect and classify pneumonia,[3] tuberculosis[4,5] and fractures[6] on radiographs, and for tumour auto-segmentation and imaging workflow optimisation.[7] DL algorithms are now used to upsample data from low-dose computed tomography (CT) studies to yield high-quality images that are comparable to conventional CT scans, thereby reducing radiation exposure in patients.[8]

AI-based image analysis solutions have also been deployed in pathology laboratories to predict tumours that result in poorer outcomes.[9] After a team from National Neuroscience Institute used DL to classify brain glioma specimens into histological grades, they proceeded to adapt their work by using it to classify breast histology images, thereby showing the use of transfer learning across tissue types.

Researchers in Singapore National Eye Centre (SNEC) have also used DL systems to detect diabetic retinopathy in digital retinal photography with excellent accuracy.[10] Such efforts have been extended to include other conditions such as glaucoma and age-related macular degeneration.[11] They are also used in under-resourced African countries to revolutionalise eye screening and to reduce the incidence of preventable blindness.[12]

Similar technologies can also predict cardiovascular risk factors from retinal images, an outcome that was not previously thought possible by human readers.[13] Researchers at National Heart Centre Singapore have assimilated demographic, clinical, electrocardiographic and imaging data to diagnose coronary artery disease by using AI.[14] Predictive analytics that aggregate data from diverse sources, including medical history and environmental parameters, can also have the potential to revolutionalise public health and preventive medicine.

AI to Augment Health Professionals

Despite its immense potential, a few limitations that are inherent in AI need to be addressed before it can be implementated on a wide scale. The value proposition of DL lies in its ability to draw its own conclusion and

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method of interpretation. However, its decision-making logic is often not clear—the well known “Black Box” problem. Thus, the opacity of AI decision-making presents potentially serious accountability issues. To complicate matters, it is now possible to develop adversarial systems that can corrupt raw imaging data to confuse AI into making erroneous diagnoses.[15] Consequently, clinically trained human oversight and validation are still indispensable in the prevention of poor patient outcomes.

Another limitation of DL is the dependence on a large amount of data that is well annotated and of good quality in an effective neural network. Experienced clinicians are needed to select, validate and label data precisely and accurately, and to ensure that DL systems use external data that is applicable to local patient populations. Even after the adoption of AI, doctors in Singapore need to continually audit, retrain and revalidate AI applications.

Finally, clinical AI solutions that are currently available have been designed for niche implementation and to focus on specific tasks; a general AI solution does not appear to be on the horizon at any time soon. Therefore, a wide gamut of different but specific AI tools may be needed for different clinical scenarios. Health professionals will soon need to also help patients navigate these complexities and make sense of AI outputs. Consequently, there is a need to customise medical systems that can allow judicious implementation of AI algorithms in controlled clinical environments to ensure safe and effective care for patients in Singapore.[7] This is true of each stage in the development of AI, from the identification of real clinical needs at the inception of a DL system to clinical data labelling, system validation, implementation in the clinical setting, helping patients to make sense of their data and, finally, audit of pooled outcome measures.

A Bright, Not Dystopian, Future

Health professionals who once entertained unfounded fears of being replaced by AI can now look forward to embracing the potential that an AI-augmented health system brings. In a recent survey of attitudes towards AI among radiology residents and faculty in Singapore, most respondents were confident that human radiologists will not be replaced. They were also motivated to advance their knowledge of AI and to become involved in related research.[16]

In the brave new world of AI-augmented health services, health professionals must adapt to their evolving role in patient care. Traditional health roles will move from mere technical expertise in diagnosis and therapy to a greater emphasis on patient-centric care that focuses on the emotive and less tangible needs of patients and their families. AI will also empower patients to be active participants in care provision, as real-time data collected from their wearable or implantable sensors can alert doctors to actionable knowledge and contribute to a growing pool of training data for AI systems. AI systems can even be used to operate robotics and smart machinery to automate routine health procedures, thereby freeing up limited manpower to provide more holistic patient care. As more repetitive clerical work is handled by intelligent computer systems, there is more time to address the ideas, concerns and expectations of patients and to become more humanistic in clinical practice.

On the flip side, a dystopian future can be imagined: unbridled, error-prone AI systems that are unchecked by ethics, operating in a workspace cohabited with a burnt-out, demoralised and disempowered workforce. Such a scenario does not benefit patients or health systems. As the provision of health servcies becomes more intricately woven with the flow of data and information, health providers must be seen as guardians of patients’ information and as indispensable guides to help make sense of countless—and occasionally unintelligible—reports. Doctors must raise their data literacy and competency to manage health information, and to combine bedside knowledge with bench-side capabilities to create quality AI-augmented health solutions.[17] Singapore can be at the forefront of designing and implementing ethical and robust data strategies across health systems to ensure the data and interests of patients are protected.[18] Ethics, professionalism and advocacy may become even more vital to good clinical practice.

In conclusion, the health sector is on the cusp of a new and exciting age. Health professionals must strengthen their mindsets, practice and capabilities. Singapore can lead the way in the implementation of real AI solutions that benefit patients and champion their interests in this brave new age. Patients may not need a sophisticated AI who knows, but they definitely need an AI-augmented doctor who cares.

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