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Artificial intelligence in medicine

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Introduction

Driven by the economic benefits of tireless labour, machines have been replacing human workers since the industrial revolution. Historically, tasks such as manufacturing have been most susceptible to automation. However, due to recent advances in computing, such as machine learning, cognitive tasks, such as decision-making, are becoming increasingly susceptible to automation through AI. A range of industries are being overblown by AI, from technologies such as self-driving cars, through to software that writes plain English news stories from arranged data.

Artificial intelligence in medicine: automated diagnosis and treatment decisions

Turning to the healthcare industry, The British Medical Association states that diagnosis "largely differentiates doctors from other health experts." However, this 'unique' role of analysis is ultimately a pattern-recognition algorithm. Information is gathered and compared with predefined categories we call diseases. If a patient's pattern of symptoms, signs and test results match that of a known disease, then we categorise and treat them accordingly. Clearly, this process could be performed by an appropriate AI. Indeed, IBM have already created an AI known as Watson, that is able to perceive, 'understand', and make decisions based on usual language. In addition to defeat the champions of Jeopardy! (Jeopardy is an American television game show competition.In this, the contestants are presented with over-all knowledge clues in the form of responses, and must phrase their answers in the form of questions), it is used at Memorial Sloan Kettering Cancer Centre to aid diagnosis and produce management plans to study and treatment of tumours ofpatients. In disparity to humans, who can only learn from personal experience, Watson synthesises information from thousands of medical reports, patient records, clinical trials and medical journals. Furthermore, Watson does not eat, sleep, takes holiday, or get sick. According to principal investigator, David Ferrucci, Watson is already "out-diagnosing" medical residents in certain situations. Similarly, Isabel—a web-based clinical decision support system (CDSS)— suggested the correct diagnosis in 96% of 50 consecutive cases published in the New England Journal of Medicine. This is comparable with human doctors, who have been shown to make the correct diagnosis in 95% of outpatients. Notably, specialties that use images for diagnosis are mainly amenable to appropriation by AI. This is exemplified by an algorithm that 'learned' from a database of normal and abnormal images to diagnose and classify diabetic retinopathy as accurately as human doctors. Similarly, when applied to following diagnosis, the doctor and patient must decide on appropriate treatment. This process relies on the doctor applying their clinical acumen to a particular problem, in combination with available evidence and patient preferences. As a result, there is emergent use of treatment CDSSs that range from simple information resources, to 'intelligent' algorithms that suggest detailed evidence-based treatment recommendations. An 'intelligent' antibiotic CDSS is fully integrated with the electronic health record. In a recent prospective cohort study in Singapore, use of ARUSC halved mortality rates in patients who were initially started on empiric antibiotics. Similarly, Watson is currently making useful patient-specific treatment. Clearly, when making treatment decisions, humans and machines combined are superior to humans alone. A dataset of 340 brain magnetic resonance images, an algorithm developed at the University of Malaya classified images as either 'healthy' or 'diseased' with 100% accuracy. Even aspects of the physical examination can be performed by AI, with a computer-vision algorithm classifying a group of 55 patients as either 'healthy' or 'Parkinson's disease' based on automated analysis of handwriting with 79% accuracy. Although these solutions are intended to be physician assistants as opposed to physician substitutes, these findings have huge implications for us because diagnosis, our defining role, could be performed better, faster and more inexpensively by AI in the near future.

Where does this leave the doctor?

As these systems become smarter, diagnosis and routine treatment decisions could, in principle, be performed independently by AI. As a result, the social clinician would only need to perform tasks that are beyond the ability of AI, such as communicating with patients, performing procedures, or making the final treatment decision in combination with the patient. Therefore, the clinician does not need to be a doctor. ---

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The cerebral tasks, which require many years of medical school training and decades of clinical experience, would no longer be the role of the doctor. This would be more apparent in the hospital setting, where there is a greater emphasis on the diagnostic processas opposed to primary carewhere the connection between doctor and patient is often more important. However, everywhere, health professionals requiring less intensive training than doctors, such as clinical nurse specialists, could be trained to 'fill the gaps' where AI remain less capable. For example, in history-taking, physical examination or basic procedures. Indeed, it has been shown that with appropriate training, nurse practitioners are comparable to physicians when treating patients in primary care. There may be a role for a small number of doctors to oversee processes, but the current role of a doctor as an expensive problem solver would become largely redundant.

Conclusion

Over the coming years, AI will challenge the traditional role of the doctor. Human doctors make errors simply because they are human, with an estimated 400,000 deaths associated with preventable harm in the US per year. Furthermore, the relentless growth of first world health care demands in an economically-constrained environment necessitates a new solution. Therefore, for a safe, sustainable healthcare system, we need to look beyond human potential towards innovative solutions such as AI. Initially, this will involve using task-specific AI as adjuncts to improve human performance, with the role of the doctor remaining largely unchanged. However, in the longer term, AI should consistently outperform doctors in most cognitive tasks. Humans will still be an important part of healthcare delivery, but in many situations less expensive, fit-for purpose clinicians will assume this role, leaving the majority of doctors without employment in the role that they were trained to undertake.

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