THE ROLE OF ARTIFICIAL INTELLIGENCE IN MODERN MEDICINE AND IMPLICATIONS FOR THE DOCTOR'S ROLE

Kevin Ko

Leicester Medical School

Introduction

The discipline of medicine is one which prides itself on continuously renewing and refining its techniques in response to the introduction of emerging technologies, striving to ensure that the possible patient outcomes can be achieved. This is as it should be, as evidence-based practice is a hallmark of high-quality, contemporary health care.[1,2] However, would such eagerness to integrate new technology be equally as evident, if it has the potential to entirely replace the modern-day doctor? This topic shall be the focus of this work, which will discuss the role of AI in medicine and explore whether it is possible to replace human doctors or, any other aspect of medical care with robots.

The Role of Artificial Intelligence in Medicine

AI has evolved significantly since the early computer age where its performance was suboptimal to that of humans, projected to soon surpass our ability to reason during complex tasks (see Figure 1). When considering the role of AI in medicine, thoughts are likely to be dominated by AI in its physical form – especially in the field of surgery. This is perhaps warranted, as, over the last three decades, the de Vinci robotic surgical system has transformed surgical practice.[3,4] Surgeons are now able to perform minimally invasive procedures and achieve a degree of accuracy that is only achievable by working in partnership with AI.[5] AI-assisted surgery reduces surgical trauma and rates of wound infection, is associated with improvements in postoperative pain and offers an enhanced cosmetic outcome.[5,6] In specialities such as gynaecology especially, the role of AI cannot be overstated, enabling surgeons to demonstrate a respect for tissue and augment their skill to drive huge improvement's in women's outcomes.[4,6,7] Other, well-established roles for AI in medicine include programmes to identify hits during drug development, clinical decision-making support tools and algorithms analyse patients records to identify those at high risk of disease.

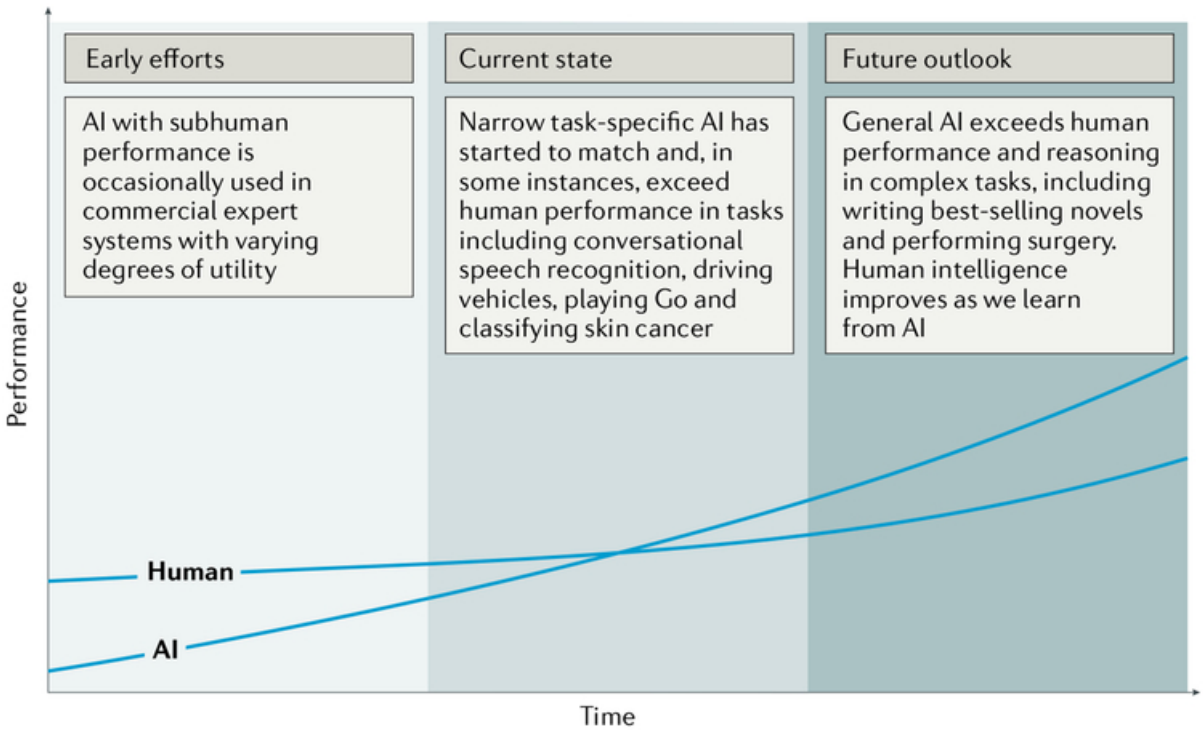

FIGURE 1: PLOTTING THE EVER-INCREASING PERFORMANCE LEVELS OF ARTIFICIAL INTELLIGENCE AND HUMAN INTELLIGENCE, THROUGH THE TIME PERIOD BEGINNING AT THE EARLY COMPUTER AGE, AND EXTRAPOLATING INTO COMING DECADES. AT FIRST, EARLY AI ONLY OFFERED SUBHUMAN PERFORMANCE AND AN INCONSISTENT LEVEL OF SUCCESS (SOURCED FROM AMISHA ET AL. (2019)[1]

Alternatively, AI is also being used to provide services where doctors would otherwise be entirely unavailable, facilitating telemedicine that enables doctors to assess patients even in acute care settings.[6,7] Thus, until recent years, the role of AI in medicine has certainly acted to complement that of the human doctor's role, augmented their performance or efficiency and indeed, to the benefit of patients; but, up until recent years, the role of AI in medicine has not significantly impacted the scope and nature of the doctor's role.

Could Artificial Intelligence Supplant the Human Doctor?

Although, this is likely to soon change, as computational power has grown at an exponential rate.[1,3,5] The most advanced forms of AI now engage in deep learning methods, such as using neural network models to mimic the process of human thought.[9] AI now has the potential to acquire knowledge and learning in a speed and manner that far surpasses that of a human being - and without the extensive years of training. Thereafter, unlike humans, AI is also not vulnerable to the numerous factors that affect the performance of human doctors, such as burnout, fatigue and high workloads. Thus, there is also a moral imperative to support such

provisions, given the significant shortages in the availability of doctors means that AI can far exceed any humans potential to meet demand for care; and due to the potential to offer safer and better-quality services for certain aspects of medical care.[4,8]

For example, in 2017, Esteva et al.[10] demonstrated that one such neural network model now has the ability to diagnose various forms of skin cancer as accurately as a board-certified dermatologist. This technology can easily be made available on smartphones and given that over 6.3 billion people will possess smartphone subscriptions by 2021, this means that AI could potentially assume the role of skin cancer diagnosis.[9] Similarly, in radiology, AI is equally as accurate, more efficient and less prone to error than human radiologists; to the extent that there has been frequently cited concern that AI could wholly replace the requirement for radiologists.[11,12] Some of the most advanced forms of AI even possess the ability to engage in meaningful conversations, thereby inferring the potential for AI to engage in conversations that would normally be conducted by psychiatrists.[13,14] Indeed, AI already demonstrates promising performance in both the prediction and detection of mental health disorders such as depression and schizophrenia.[15,16] Thus, this has led to contentious debate and concerns regarding whether AI could act as substitutes to human doctors across all fields of medicine especially as the performance levels of AI exceed that of human beings.[1, 3, 17, 18]

However, despite these advances, this work would argue that while AI may alter the responsibilities of the doctor's role - and sooner than we think; a machine could never entirely replace a human doctor, due to a number of key reasons. Foremost, patients will never ascribe all of the basic attributes required to form a patient-doctor relationship to a machine.[17,19] In turn, the patient-doctor relationship then acts as the gateway to all doctoring activities, ensuring that patients seek medical care, disclose sensitive information during assessments and use medical professionals as a source of psychological support during periods of poor health and wellbeing.[19] This is perhaps best manifested in the primary care setting, where the human interactions between doctor and patient influence a plethora of subsequent outcomes. [20, 21]

For example, there is now an ever-growing body of research determining that a patient's perceptions of the quality of the doctor-patient relationship mediate their compliance with

self-management and health-seeking behaviours.[22, 23] Subsequently, self-management and health-seeking behaviours are then two of the most pervasive determinants of wider health and wellbeing outcomes.[24,25] The four, fundamental attributes of the doctor-patient relationship are loyalty, trust, knowledge and regard; and therefore, this work posits that even with the introduction of AI that could act as a doctor, these are principles that are intrinsically human in nature and that most patients would likely find difficult to ascribe to non-human entity. [20, 21] To establish a therapeutic patient-doctor relationship, patients cite that they require their physician to be empathetic, which by its very natures denotes that a doctor must be able to relate to human experiences.[19, 22]

In further support, there is a growing body of evidence to suggest that patients voice a high level of distrust regarding AI involvement in any aspect of their care. Despite the resounding benefits of robotic-assisted surgery, participants stress a continued preference for human doctors.[26] An international study surveyed 12,000 patients from across Europe, the Middle East and Africa found that 63% of respondents would not consent to robotic-assisted techniques if undergoing major invasive surgery. Only 53% responded that they would give consent to robotic-assisted surgery for a minimally invasive procedure. [27] In fact, some argue that even the complementary role of AI has already had an adverse effect patient, causing physicians to have less interaction with their patients – as algorithms replace the need for doctors to engage in clinical processes.[23]

Should AI replace human doctors, this also raises ethical implications regarding other aspects of the doctor's role. Ethical practice denotes that doctors are wholly accountable for their actions, granted a moral responsibility for where a medical error does occur.[28] Should an AI doctor make a medical error, what does this mean in terms of attributing moral responsibility for any consequences. AI is typically developed by multiple persons across multiple agencies and thus, attributing blame would be highly complex – termed the 'problem of many hands'.[29] Furthermore, the very benefit of AI is its ability to create systems that surpass that of human intellectual ability and thus, cannot be easily scrutinised to truly determine their performance.[27] Essentially, whether AI was conforming to the standards of governance that rightly influences the medical practises of people, and the design and execution of processes

could not be validly measured. Thus, this poses the second, perhaps most important factor that should prevent AI supplanting human doctors.

Conclusion

Nonetheless, it would appear that the recent advancements in the application of AI technologies are likely to shift the role of human doctors, and significantly alter the landscape of their practise. Where virtual AI has the ability to offer superior diagnostic and clinical decision-making services; this will shift the role of human doctors to one of being an intermediary, bridging the gap between patients and the use of such AI. However, it does not feasible that AI could wholly replace human doctors, still requiring their input to provide a 'human face' to the medical profession and perhaps most importantly, machines will never possess the ability to establish the intrinsically human aspects of the doctor-patient relationship. However, this work asserts that a number of factors denote that AI could not replace human doctors due to both the clear moral dilemmas that arise in affording AI complete autonomy over the entirety of the medical process; nor is society likely to afford an AI doctor the confidence and trust to do so. Thus, for the foreseeable future, this essay concludes that AI shall remain within the realms of the utopian vision for its use in medicine, changing the landscape of doctors' roles, rather than replacing human physicians.

References

1. Amisha, Malik P, Pathania M, Rathaur V. Overview of artificial intelligence in medicine. Journal of Family Medicine and Primary Care. 2019;8(7):2328.

2. Hamet P, Tremblay J. Artificial intelligence in medicine. Metabolism. 2017;69:S36-S40.

3. Buch V, Ahmed I, Maruthappu M. Artificial intelligence in medicine: current trends and future possibilities. British Journal of General Practice. 2018;68(668):143-144.

4. Bouquet de Joliniere J, Librino A, Dubuisson J, Khomsi F, Ben Ali N, Fadhlaoui A et al. Robotic Surgery in Gynecology. Frontiers in Surgery. 2016;3:26.

5. Leal Ghezzi T, Campos Corleta O. 30 Years of Robotic Surgery. World Journal of Surgery. 2016;40(10):2550-2557.

6. Weinberg L, Rao S, Escobar P. Robotic Surgery in Gynecology: An Updated Systematic Review. Obstetrics and Gynecology International. 2011;2011:1-29.

7. Liu H, Lawrie T, Lu D, Song H, Wang L, Shi G. Robot-assisted surgery in gynaecology. Cochrane Database of Systematic Reviews. 2014;2014(12):CD011422.

8. Mintz Y, Brodie R. Introduction to artificial intelligence in medicine. Minimally Invasive Therapy & Allied Technologies. 2019;28(2):73-81.

9. Davenport T, Kalakota R. The potential for artificial intelligence in healthcare. Future Healthcare Journal. 2019;6(2):94-98.

10. Esteva A, Kuprel B, Novoa R, Ko J, Swetter S, Blau H et al. Dermatologist-level classification of skin cancer with deep neural networks. Nature. 2017;542(7639):115-118.

11. Hosny A, Parmar C, Quackenbush J, Schwartz L, Aerts H. Artificial intelligence in radiology. Nature Reviews Cancer. 2018;18(8):500-510.

12. Pakdemirli E. Artificial intelligence in radiology: friend or foe? Where are we now and where are we heading?. Acta Radiologica Open. 2019;8(2):205846011983022.

13. Tran B, McIntyre R, Latkin C, Phan H, Vu G, Nguyen H et al. The Current Research Landscape on the Artificial Intelligence Application in the Management of Depressive Disorders: A Bibliometric Analysis. International Journal of Environmental Research and Public Health. 2019;16(12):2150.

14. Tran B, McIntyre R, Latkin C, Phan H, Vu G, Nguyen H et al. The Current Research Landscape on the Artificial Intelligence Application in the Management of Depressive Disorders: A Bibliometric Analysis. International Journal of Environmental Research and Public Health. 2019;16(12):2150.

15. Cho G, Yim J, Choi Y, Ko J, Lee S. Review of Machine Learning Algorithms for Diagnosing Mental Illness. Psychiatry Investigation. 2019;16(4):262-269.

16. Cho G, Yim J, Choi Y, Ko J, Lee S. Review of Machine Learning Algorithms for Diagnosing Mental Illness. Psychiatry Investigation. 2019;16(4):262-269.

17. Shah N. Health Care in 2030: Will Artificial Intelligence Replace Physicians?. Annals of Internal Medicine. 2019;170(6):407.

18. Jiang F, Jiang Y, Zhi H, Dong Y, Li H, Ma S et al. Artificial intelligence in healthcare: past, present and future. Stroke and Vascular Neurology. 2017;2(4):230-243.

19. Aminololama-Shakeri S, López J. The Doctor-Patient Relationship With Artificial Intelligence. American Journal of Roentgenology. 2019;212(2):308-310.

20. Chipidza F, Wallwork R, Stern T. Impact of the Doctor-Patient Relationship. The Primary Care Companion For CNS Disorders. 2015;17(5).

21. Irving G, Neves A, Dambha-Miller H, Oishi A, Tagashira H, Verho A et al. International variations in primary care physician consultation time: a systematic review of 67 countries. BMJ Open. 2017;7(10):e017902.

22. Irving G, Neves A, Dambha-Miller H, Oishi A, Tagashira H, Verho A et al. International variations in primary care physician consultation time: a systematic review of 67 countries. BMJ Open. 2017;7(10):e017902.

23. Taber J, Leyva B, Persoskie A. Why do People Avoid Medical Care? A Qualitative Study Using National Data. Journal of General Internal Medicine. 2014;30(3):290-297.

24. Grady P, Gough L. Self-Management: A Comprehensive Approach to Management of Chronic Conditions. American Journal of Public Health. 2014;104(8):e25-e31.

25. Henderson C, Evans-Lacko S, Thornicroft G. Mental Illness Stigma, Help Seeking, and Public Health Programs. American Journal of Public Health. 2013;103(5):777-780.

26. Müller V, Bostrom N. Future Progress in Artificial Intelligence: A Survey of Expert Opinion. Fundamental Issues of Artificial Intelligence. 2016;27:555-572.

27. PWC. What doctor?Why AI and robotics will define New Health. London: PWC; 2017.

28. MacKenzie C. What Would a Good Doctor Do? Reflections on the Ethics of Medicine. HSS Journal. 2009;5(2):196-199.

29. Wachsmuth I. Robots Like Me: Challenges and Ethical Issues in Aged Care. Frontiers in Psychology. 2018;9:432.