

Implications of artificial intelligence for medical education



Although digital health¹ has occasioned huge changes for medicine, the issues it provokes have yet to be integrated into teaching and learning across the medical education continuum. This question is all the more pressing given that the rise of artificial intelligence (AI) systems, discussed here as a specific example of healthcare's digitalisation, are associated with a fundamental paradigm shift in teaching. Whereas 20th-century medical education models relied on experimental results evolving into a recognised standard that then informed textbook teaching, today this sequencing no longer holds. The speed at which new health AI technologies are developing, being introduced into clinical practice, and being used by patients requires equipping doctors to deal appropriately with experimental techniques that have not yet become part of a generally accepted body of knowledge. Agile teaching and educated guesswork about which treatments will benefit patients the most are crucial for enabling physicians to lead the introduction of such technologies without simply being forced to react to them.

Part of the task at hand is to ask how existing educational frameworks can be realistically updated to take into account 21st-century realities. As a rule, medical educators work with competency frameworks, of which several competing models exist, whereby a competence can be considered the suitable performance of several professional roles. Following Ellaway, we view such frameworks as theories outlining "a series of propositions and relationships that collectively define an ideal", and therefore consider that they must be continuously tested and challenged.² Today, the various abilities that physicians require to adequately meet patients' health-care needs are all affected by AI-enabled systems.³

No one can predict the future ways in which technology will develop, but medicine serves common human needs, such as promoting patient well-being and making adequate health care available to all.⁴ Meanwhile, we have a good picture of what patients want and need with regard to their own care, and how their preferences could be better integrated into medical education. As some patient advocates have written, this includes being considered full-value partners by medical educators, as well as "sensing that your doctor truly cares about what

you are going through, and really does want to help", and has the ability to "fully contextualise and appreciate the patient's values, wishes, and preferences".⁵ As care has evolved to become more of a partnership, in which patients and their families have a key role to play in their treatment, physicians ought to collaborate with patients to develop and understand the patient's own relationship with AI and big data, which can vary dramatically. Moreover, they must work with patients from different backgrounds to develop sensitivities to problems of social justice and expert systems-driven solutions.

By way of illustration, take one respected and widely used instrument, the Canadian Medical Education Directives for Specialists (CanMEDS) Physician Competency Framework, which has the advantage of being a practical and effective lever for change.⁶ Moreover, many of the roles depicted in CanMEDS are reproduced in other frameworks, such as the Accreditation Council for Graduate Medical Education (ACGME) in the USA, which underscores the broader importance of our observations. CanMEDS is also an appealing theoretical framework because none of the physician roles it describes—communicator, collaborator, leader, health advocate, scholar, professional, and medical expert—are at risk of being (entirely) replaced by machines, because they are non-technical by definition, and not reducible to rational or objective criteria. Of the roles, six are conceptually based in the social sciences and humanities, and the role of medical expert is to integrate the remaining six, that is to have knowledge of connectedness and what belongs together, something machines are likely to accomplish only partially.⁷

At the same time, changes brought about by AI affect all physicians' roles.⁸ Take the role of communicator, and the fact that the traditional physician-patient encounter has "been altered into a triadic relationship by introducing the computer into the examination room".⁹ Physicians need to acknowledge the large variety of patients' responses to big data and AI-supported objects, including concerns regarding privacy, disempowerment, and a lack of desire to know everything

As a collaborator, physicians should be taught to accept and build on the fact that health AI technology and the wider accessibility of knowledge empowers some other health professions (eg, psychologists, physiotherapists,

and nurses), as well as patients themselves, questioning physicians' previous status as holders of exclusive knowledge.

As a leader, physicians must work with patients to make the implementation of AI technologies transparent and accountable, contributing to a culture that makes explicit the commercial and other interests of those developing and advocating for digital technologies.

As a health advocate, physicians can work with patients and disadvantaged groups to establish whether the use of expert systems—such as robot carers—is an empowered choice or rather related to broader socioeconomic access problems. They ought to improve education and clinical practice by advocating for more diverse teams in those settings, as these are better able to identify instances in which AI solutions mask larger systemic problems.

As a scholar, physicians will benefit from improved digital literacy and continuous learning about AI, mathematical modelling, decision theory, and so on. This is linked to an awareness of biases in data, and how these undermine any claims about how AI models are able to produce objective, neutral results. They should draw on the work of patient scholars to understand better different realities and kinds of knowledge, including the subjective aspect of illness.

As a professional, physicians should accept a fundamental change in professional identity which requires them to incorporate tools from engineering, data, and information sciences into their skill sets. Meanwhile, physicians should also acknowledge that patients have the final say in whether an eHealth practice benefits them, whereas physicians have a responsibility to provide the necessary guidance and advice to support patients' decisions.

As medical experts, physicians must be able to work together with patients to create and translate the importance of integrated knowledge, that is knowledge of what belongs together, social relationships, and

how illness relates to a patient's life, something that is inaccessible to machines.¹⁰

Making sure that it is patients who benefit the most from the surge of AI health technology will remain a key challenge in years to come, and new approaches in medical education that improve the digital literacy of physicians and better integrate patients' views will be crucial. This is all the more necessary since AI-driven transformations involve going beyond previously accepted models of the usually slow and gradual process of generating evidence-based gold standards for clinical practice. In turn, this means that patients' wishes are a crucial measure for anticipating how AI technologies contribute to their health and well-being.

VR is a recipient of the Branco Weiss Fellowship. MM and JG declare no competing interests.

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- 1 Elenko E, Underwood L, Zohar D. Defining digital medicine. *Nat Biotechnol* 2015; **33**: 456–61.
- 2 Ellaway R. CanMEDS is a theory. *Adv Health Sci Educ Theory Pract* 2016; **21**: 915–17.
- 3 Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. *Nat Med* 2019; **25**: 44–56.
- 4 The Goals of Medicine. *Hastings Cent Rep* 2016; **26**: 7.
- 5 Mittelman M, Markham S, Taylor M. Patient commentary: Stop hyping artificial intelligence—patients will always need human doctors. *BMJ* 2018; **363**: k4669.
- 6 The Royal College of Physicians and Surgeons of Canada. CanMEDS Framework. <http://www.royalcollege.ca/rcsite/canmeds/canmeds-framework-e> (accessed Dec 24, 2019).
- 7 Kuper A, Veinot P, Leavitt J, et al. Epistemology, culture, justice and power: non-bioscientific knowledge for medical training. *Med Educ* 2017; **51**: 158–73.
- 8 Masters K. Artificial intelligence in medical education. *Med Teach* 2019; **41**: 976–80.
- 9 Assis-Hassid S, Reyhav I, Heart T, Pliskin JS, Reis S. Enhancing patient-doctor-computer communication in primary care: towards measurement construction. *Isr J Health Policy Res* 2015; **4**: 4.
- 10 Wingert L. *Gemeinsinn und Moral: Grundzüge einer intersubjektivistischen Moralkonzeption*. Frankfurt am Main: Suhrkamp, 1993.