



AI and Medical Education — A 21st-Century Pandora's Box

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ChatGPT (Chat Generative Pre-trained Transformer), OpenAI's chatbot powered by artificial intelligence (AI), has become the fastest-growing Internet application in history.¹ Generative

AI, which includes large language models such as GPT, has the ability to produce text resembling that generated by humans and seemingly to mimic human thought. Medical trainees and clinicians already use this technology, and medical education doesn't have the luxury of watchful waiting; the field needs to grapple now with the effects of AI. Many valid concerns have been raised about AI's effects on medicine, including the propensity for AI to make up information that it then presents as fact (termed a "hallucination"), its implications for patient privacy, and the risk of biases being baked into source data.² But we worry that the focus on these immediate challenges obscures many of the broader implications that AI could have for medical education — in particular, the

ways in which this technology could affect the thought structures and practice patterns of medical trainees and physicians for generations to come.

Throughout history, technology has disrupted the way physicians think. The invention of the stethoscope in the 19th century helped spark the development and refinement of the physical exam, which led to the emergence of physicians' self-conception as diagnostic detectives.³ More recently, information technology has reshaped clinical reasoning schema, as Lawrence Weed, the inventor of the problem-oriented medical record, famously argued: the way physicians structure data affects how we think.⁴ Modern billing structures, quality-improvement systems, and the current electronic health record (along


with the malaise associated with it) were all profoundly influenced by this approach to record keeping.

In the months since its release in the fall of 2022, ChatGPT has shown the potential to be at least as disruptive as the problem-oriented medical record, having passed both licensing and clinical reasoning exams and approximating the diagnostic thought patterns of physicians. Higher education is currently wrestling with "the end of the college essay," and medical school personal statements are sure to follow. Major health care companies are partnering with technology firms to deploy AI widely and rapidly throughout the U.S. health care system, including by integrating it into electronic health records and voice-recognition software. Chatbots intended to replace physicians for some medical encounters will imminently be commercially available.

Clearly, the sands of medical education are shifting — and have

already shifted — beneath our feet, which leaves the discipline with an existential choice: Do medical educators take an activist approach to integrating AI into physician training, deliberately preparing the physician workforce for the safe and appropriate use of this transformational technology in health care? Or do we allow external forces governed by incentives for prioritizing operational efficiency and profits to determine what that integration looks like? We believe strongly that curriculum designers, program and institutional leaders, and accreditation bodies must begin to account for AI.

Medical schools face a dual challenge: they need to both teach students how to utilize AI in their practice and adapt to the emerging academic use of AI by students and faculty. Medical students are already starting to apply AI in their studying and learning, generating disease schema from chatbots and anticipating teaching points. Faculty are contemplating how AI can help them design courses and evaluations. The whole idea of a medical school curriculum built by humans is now in doubt: How will a medical school provide quality control for components of its curriculum that didn't originate from a human mind? How can schools maintain academic standards if students use AI to complete assignments? To adequately prepare students for the future clinical landscape, medical schools need to begin the ar-

 **An audio interview with Adam Rodman is available at NEJM.org**

duous process of incorporating didactics on the use of AI into clinical skills courses, lessons on diagnostic reasoning, and training in systems-based practice. As a first step, educa-

tors could identify local thought leaders and content experts and task them with defining an approach for adapting curricula to integrate AI. Such adapted curricula should then be rigorously assessed and published — work that has already begun.⁵

At the graduate medical education level, residents and fellows need to be prepared for a future in which AI tools are integral components of their independent practice. Trainees will have to become comfortable working with AI and will have to understand its capabilities and limitations, both to support their own clinical skills and because their patients are already using it. For example, ChatGPT can produce advice on cancer screening in patient-friendly language, though not with 100% accuracy. AI queries by patients will inevitably lead to an evolution of the patient–doctor relationship, just as the proliferation of commercial genetic-testing products and online medical advice platforms changed discussion topics during clinic visits. Current residents and fellows have 30 to 40 years of practice ahead of them and will need to adjust to evolutions in clinical care.

Medical educators could focus on structuring training programs to help residents and fellows build “adaptive expertise” in AI, which would allow them to respond to future waves of change. Governing bodies such as the Accreditation Council for Graduate Medical Education could incorporate expectations regarding AI education into common program requirements, which would form the basis for curricular standards and compel individual programs to make changes to their training approaches. Finally, phy-

sicians already in practice will need to develop familiarity with AI; professional societies could lead the way in preparing their members for new health care realities.

Concerns about AI's role in medical practice aren't trivial. Medicine has a millennia-long history of cognitive apprenticeship. How will this model be affected by the reality that medical students will use AI-powered chatbots from their first day of training? Learning theories emphasize that effortful study and deliberate practice are essential to growth of knowledge and skills. When any question can be immediately and reliably answered by a chatbot at the point of care, how will doctors become effective lifelong learners? Ethical precepts are the bedrock of medical practice. What will health care look like when medicine is assisted by AI models that filter ethical decisions through opaque algorithms? The professional identity of physicians has been inextricably linked to our cognitive work for nearly 200 years. What will it mean to practice as a physician when much of that cognitive work could be offloaded to AI? None of these questions can currently be answered, but we need to be asking them.

Philosopher Jacques Derrida outlined the concept of a pharmakon, something that can either heal or harm, and AI technology poses both opportunities and threats. Because of the stakes — the future of health care itself, we believe — medical education as a field should lead the way when it comes to integrating AI into clinical practice. This process won't be easy, especially given the pace of change and the lack of guiding literature, but Pandora's

box has already opened. If we don't shape our own future, powerful technology companies will happily shape it for us.

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Expanding Access to Health Care for DACA Recipients

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Deferred Action for Childhood Arrivals (DACA), a program created by means of executive action in 2012 by then-President Barack Obama, provides temporary protection from deportation for certain undocumented non-citizens who were brought to the United States as children. In the more than 10 years since it was established, DACA has proven to be a successful noncitizen-integration program. It has permitted recipients to obtain employment authorization, thereby allowing access to employer-sponsored health insurance, and has expanded access to educational opportunities. Studies have identified citizenship status as an important social determinant of health, with DACA recipients often being found to have lower barriers to health care than undocumented people without DACA status.¹ DACA has also been associated with improved mental health among U.S.-citizen children in mixed-status families, which suggests that the program's benefits extend beyond recipients to their family members.²

An estimated 34% of the roughly 580,000 current DACA

recipients remain uninsured, however, and even those with insurance tend to be underinsured as compared with U.S. citizens, since they are more likely to work in sectors in which employers often don't provide health plans with comprehensive coverage.³ DACA recipients are excluded from publicly funded federal health insurance programs, including Medicaid and insurance affordability programs established by the Affordable Care Act (ACA). Although some states and local jurisdictions have created health insurance programs for noncitizens who are excluded from federal programs, access to coverage for DACA recipients is uneven. Undocumented noncitizens — including DACA recipients — disproportionately rely on Emergency Medicaid, a federally funded program that covers only emergency medical conditions, which states have considerable flexibility to define. DACA recipients can also purchase private health insurance outside the ACA marketplaces, without federal subsidies that make insurance more affordable.

In April 2023, the Department

of Health and Human Services (HHS) issued a proposed rule that would modify the definition of “lawfully present” in regulations governing who is eligible for federal health insurance affordability programs. This change would allow DACA recipients to participate in the ACA's health insurance exchanges as early as November 2023, the start of the next open-enrollment period. Although recipients of deferred action (including people granted deferred action on a discretionary basis) are generally considered lawfully present and therefore eligible to participate in the exchanges, HHS had specifically excluded DACA recipients from this category. The proposed rule would eliminate the “DACA carve-out,” thereby giving recipients access to federally funded insurance affordability programs on the same terms as other people who have been granted deferred action.

The proposed rule can be viewed in the context of other federal efforts to expand access to health care for noncitizen populations in recent decades. The current structure of citizenship-based