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EDITORIAL

The artificial intelligence revolution in medical education

Newton Kara-Junior[1], Christian Valle Morinaga[2], Denise Greff Machado[2]

1. Faculdade de Medicina, Universidade de São Paulo, São Paulo, SP, Brazil.
2. Faculdade de Medicina Sírio-Libanês, São Paulo, SP, Brazil.

Throughout history, medical education has undergone several revolutions. One of the most significant began with the Flexner Report[1], published in 1910. Abraham Flexner, an American educator, evaluated medical schools in the United States and Canada, criticizing the poor quality of medical education at the time and recommending a model based on science, well-structured laboratories, and supervised clinical learning. This report influenced medical education in Brazil, leading to the adoption of a rigid curriculum[2-4].

In Brazil, the Flexnerian model prevailed until 2001, when the National Curriculum Guideline (NCG) proposed changes, discouraging fragmented hospital-centered teaching and introducing a minimum curriculum based on objectives—indicating the essential content for medical training. In 2014, a new NCG[5] brought another transformation by recommending competency-based education and active teaching/learning methodologies, encouraging students to develop critical thinking and clinical problem-solving skills.

Objective-based education prioritizes content delivery structured by the teacher or curriculum, focusing on knowledge of the human body and diseases. Competency-based education, in turn, aims to develop practical skills applicable to real-world settings, preparing physicians to meet society's needs.

In addition, medical education has incorporated key concepts such as:

– Humanization of medicine, valuing empathetic contact with patients and addressing ethical, psychological, and social aspects of care;
– Evidence-based medicine, ensuring that physicians know how to critically interpret and apply scientific research, avoiding decisions based solely on tradition or personal experience.

Currently, the most recent revolution in medical education is driven by Artificial Intelligence (AI). Tools such as ChatGPT are making learning more accessible, interactive, and efficient[6], supporting question-and-answer-based learning, enabling students to review medical concepts, and providing detailed explanations about diseases, treatments, and clinical procedures, without the need to search through multiple sources.

On the other hand, AI is also transforming the role of educators, making teaching more dynamic and efficient, with benefits such as:

– Creation of personalized teaching materials, speeding up the production of summaries, exam questions, and presentations;
– Simulation of clinical cases, allowing students to practice diagnosis and decision-making in simulated environments;
– Automation of administrative tasks, where processes such as grading objective exams, organizing schedules, and providing automated feedback can be streamlined, freeing up teachers' time to focus on practical teaching.

A major criticism and possible limitation of using these tools to optimize student learning and critical thinking is the risk of generative AIs spreading inaccurate information. However, in a supervised academic environment, teachers can assess the reliability of the provided content.

Nevertheless, it is essential to adapt medical training to include best practices in the use of artificial intelligence. Students must understand the fundamentals of online information retrieval, the potential biases in the process, the tool's limitations, and the risk of "hallucinations," as well as develop strategies to use AI critically[7,8].

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Corresponding author: Newton Kara-Junior
Email: newtonkarajr@ig.com.br

In the context of generative artificial intelligence, the term "hallucinations" refers to the production of false, inaccurate, or nonexistent information presented convincingly by the tool. This phenomenon is inherent to the functioning of language models, which, by predicting the most likely sequence of words, can generate responses that are coherent in form but incorrect in content. These "hallucinations" may take different forms, from fabricated data to nonexistent bibliographic references, and are especially problematic when the user trusts the response without verifying its accuracy.

In particular, the trap of AI-generated "hallucinations" can mislead both experienced professionals and those in training. As generative models become capable of performing increasingly complex tasks, the risk of "hallucinations" also increases, reaching up to 20% in some studies[9]. Using the tool as a complementary resource—especially in contexts where the user already has consolidated knowledge—combined with careful prompt design and restriction of consulted databases, represents an effective strategy to mitigate this risk.

In a preliminary version of a research, Kosmyna[10] showed, by dividing volunteers tasked with writing texts under electroencephalographic monitoring, that the use of ChatGPT generates neural connectivity patterns markedly different from those observed in the absence of the tool. Participants who did not use AI exhibited stronger and broader neural networks, while those who used it showed weaker neural, linguistic, and evaluative performance. This finding may support the hypothesis of reduced cognitive autonomy associated with systematic AI use[11], where excessive user reliance leads to overlooking even basic errors. This risk becomes even more concerning in the context of medical training.

However, the most relevant finding of Kosmyna's study emerged in the final stage of the experiment. After three consecutive writing sessions with AI, participants were asked to write without the tool. On the other hand, those who had written three sessions without AI were invited to use it in the final stage. In this context, the group that began using AI after three sessions without prior exposure performed better: they demonstrated greater memory of the produced text and used the tool more tactically, reflected in more cohesive neural signatures. These results reinforce the idea that, when well applied pedagogically, AI can serve as an ally in consolidating learning.

More than a century after the Flexner Report redefined the course of medical education by emphasizing science and rationality as pillars of training, we are experiencing a new turning point. The incorporation of artificial intelligence, while it may threaten to reduce cognitive autonomy, also reveals—when properly applied—pedagogical potential capable of strengthening memory, fostering more sophisticated learning strategies, and consolidating essential competencies. It is therefore the responsibility of medical schools to ensure that AI is integrated as an ally in the educational process, without undermining critical thinking, intellectual autonomy, and the ethical commitment that sustain medical practice.

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