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Letter to editor

Error Assessment of Artificial Intelligence Results: What We Need to Do in Medical Education

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Dear Editor,

McCarthy initially utilized artificial intelligence (AI) in 1955 (1). AI is a machine endowed with intelligent capabilities, including comprehension, reasoning, processing, learning, and communication, enabling it to execute various professional tasks or assist individuals in their endeavors (2).

Products founded on AI play a crucial role in identifying and resolving human problems, particularly those pertaining to healthcare provision. Presently, AI finds extensive application in various domains such as imaging, pathology, surgery, endocrinology, orthopedics, and ophthalmology, offering healthcare services at reduced costs and time, enhanced accuracy, and broader patient coverage (3). According to the World Health Organization, the utilization of AI is projected to benefit an additional one billion individuals through improved access to health services, emergency healthcare for an additional one billion people, and enhanced overall health and well-being for one billion more individuals (4).

Apart from the advantages of employing AI in medicine, numerous challenges lie ahead. These include transforming the doctor-patient relationship, ensuring patient confidentiality and data security, addressing issues of transparency, inadequate facilities and infrastructure, concerns regarding accountability and responsibility, inherent biases in data input, and physicians' unfamiliarity with the algorithms utilized in these systems (5, 6). Notably, a significant challenge revolves around medical students' (future physicians) limited familiarity with the process of assessing AI outcomes in clinical settings. Given that the accuracy of results, their applicability to clinical decision-making, prescription practices, and other therapeutic interventions serve as the foundation for deploying AI in clinical environments, comprehensive education on these aspects should be integrated into students' curricula to equip them with the necessary skills to tackle forthcoming challenges.

Evaluating the accuracy of AI outcomes in clinical settings comprises three fundamental components:

1) Accuracy of input data,

2) Sufficient volume of data within the database,

3) Assessment of result accuracy by considering the patient's signs, symptoms, and evidence-based medicine (3, 7, 8).

Simultaneously, it is imperative to instill in students, during their studies, the significance of accurate input data and the evaluation of results based on clinical evidence. These principles should be incorporated into the educational curriculum to establish trustworthiness in the final outcomes. Hence, the ensuing discussion will focus on the aforementioned two aspects:

Checking the accuracy and quality of primary input data: The reliability and trustworthiness of results obtained from AI systems rely on comprehensive, accurate, consistent, and readily available primary data that exhibits the desired validity and reliability (3).

When considering the quality of initial data entry, two types of errors may occur: measurement error and representation error. Measurement error pertains to inadequately measured data, often resulting in underrepresentation. Conversely, representation error arises when the population data, intended to be encompassed by the AI system, is inaccurately or incompletely entered. To mitigate these errors and ensure validity, reliability, and data quality, physicians must meticulously measure the primary data before inputting it into the database. In this context, reliability refers to the stability and consistency of measurement results, while data validity addresses whether the data accurately captures the intended information (3, 9). To guarantee the accuracy of results and uphold data quality, it is essential to provide students with comprehensive training beyond the core curriculum. This additional training should encompass various aspects, including proper data entry techniques, the underlying mechanisms of AI, fundamental theories such as machine learning, assessment of data reliability and validity, and interdisciplinary brainstorming sessions involving engineers, education experts, and statisticians. These initiatives aim to familiarize students with the subject matter and ensure they possess the necessary skills to evaluate and enhance the quality of data entered into the system, thereby enhancing result accuracy.

Assessing the accuracy of AI results based on clinical evidence: Once an adequate volume of data has been secured in the database and the quality and accuracy of the input data have been verified, the critical aspect of utilizing AI in clinical settings involves reviewing and evaluating the final outcome generated by AI. It is imperative that a physician assesses the result. This evaluation process is predicated on three fundamental pillars: evidence-based medicine, understanding the pathophysiology of diseases, and considering the signs, symptoms, and familial medical history of patients.

During this stage, the physician, possessing knowledge of AI algorithms, thoroughly considers the system-generated results while simultaneously delving into the pathophysiology of diseases and differential diagnoses. Additionally, they attentively assess the disease's signs and symptoms, take into account the patient's family medical history, and proficiently apply evidence-based medicine (EBM). Through this comprehensive evaluation (8, 10), the physician arrives at a final diagnosis and initiates the appropriate therapeutic interventions.

To ensure doctors possess comprehensive and adequate familiarity with disease pathophysiology and evidence-based medicine (EBM), it is imperative to emphasize the integration of AI in the medical education curriculum. Despite the increasing utilization of AI in medicine and medical education, it remains crucial to prioritize learning the pathophysiology of diseases and biomedical sciences. Furthermore, expanding the training in clinical reasoning, EBM, and critical thinking throughout various stages and courses of medical education, particularly for undergraduate students, can enable future physicians to make accurate therapeutic decisions based on AI. Additionally, such training equips them with the ability to identify and address potential erroneous outcomes provided by AI, thereby ensuring the adoption of appropriate solutions.

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