



Medicine at the dawn of Artificial Intelligence

La médecine à l'aube de l'intelligence artificielle

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Watch at almost any media, and you will have a good chance to hear the words "Artificial intelligence" (AI). Worldwide, AI is becoming a strong and essential tool in many industries. Since the early 90's of the last century, it has experienced an era of explosive growth across many areas as Robotics, natural language processing, understanding human speech, facial recognition, sensory AI in the internet of things, competing at the highest level in strategic game systems such as chess and Go, imperfect-information games like poker, self-driving cars, intelligent routing in content delivery networks, military simulations, and those are only some of the areas that has been improved with AI algorithms (1,2).

Yet, AI is not easy to define precisely since there is no consensus. So far, AI can be defined as the ability of computer systems to perform tasks commonly requiring intelligent beings (2). In PubMed, AI was introduced as a Medical Subject Headings in 1986 and was defined as "Theory and development of computer systems which perform tasks that normally require human intelligence. Such tasks may include speech recognition, learning; visual perception; mathematical computing; reasoning, problem solving, decision-making, and translation of language" (3). As for humans, AI is based on the ability to reason and learn from past experiences. The ability to reason logically is an important aspect of intelligence and has always been a major focus of AI research. In the few recent years, benefiting from improved computers' power, improved algorithms, and the exponential increase in the amount of collected data (big data), some AI solutions have matched the performance levels of human experts and professionals in performing several specific tasks. The aim of the present editorial was to summarize present AI advances in medicine, and to raise the challenges to be overcome for the future.

AI, this «science» which has fascinated mankind for so long in the most singular way possible, has just entered the world of medicine with great advances, yet not without obstacles. Medicine was early identified as one of the most promising application areas for AI. It is gradually changing the landscape of healthcare and biomedical research as it has enhanced clinical diagnosis and decision-making performance in several medical tasks. An AI algorithm was able to interpret Electrocardiograms, choose appropriate treatments and assist physicians in generating diagnostic hypotheses in complex patient cases (4–7). AI was able to successfully realize the detection

of several lung diseases as pulmonary tuberculosis, Coronavirus disease 2019, breast-tumors. AI was also useful in the detection of prostate cancer from biopsy specimens, the identification of breast cancer metastasis in lymph nodes (7–11). In 2017, convolutional neural networks trained on clinical images achieved dermatologist-expert level accuracy in diagnosing skin malignancy (13). Another team of researchers showed the performance of a neural network to recognize diabetic macular oedema and moderate to severe diabetic retinopathy and the system was then authorized for use by healthcare providers for earlier detection (14).

In 2020, 11118 referenced papers were published with the keywords artificial intelligence and medicine (Pubmed research). However, we must acknowledge that there are still many challenges to be overcome in order to turn all this cutting-edge scientific research into real-world applications for physicians. First, legal and ethical responsibility that raises the question of who will be responsible in case of an AI mediated error. Would it be the doctor, or the engineer who made the AI model, or the company that commercialized it. Moreover, could a cutting-edge AI ever be considered as an unauthorized practice of medicine? These questions at the day, justified the writing of this editorial. Second, the challenge of trust that have to be established between the physician, the AI support system and the patient. A trust that has unfortunately been undermined by Hollywood movies, but also by several recent court complaints about medical errors involving AI-based support systems. Third, since the use of big data is essential to make AI models work, we will have to meet confidentiality and sensitive data protection requirements, as well as the ethical issue of the data copyrights. Personal data protection laws are not equivalent across countries, and a country that puts too many restrictions and hard locks on the use of big data may find itself on the sidelines of the AI revolution. Forth, the complex validation process of an AI model is not yet consensual. Nobody can tell how neither when we can safely use a new AI model in the clinical setting. Fifth, the challenge of making different professions collaborating. Physicians, epidemiologists, engineers, entrepreneurs and decision makers must learn working together if we hope to achieve the goals of the new industrial revolution. Table 1 presents the five challenges to be overcome in order to turn AI scientific research into real-world applications for physicians and suggested answers.

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Table I. Five challenges to be overcome in order to turn artificial intelligence scientific research into real-world applications for physicians and suggested answers.

Present challenges	Suggested answers
Legal and ethical responsibility	Making stakeholders discuss about ethics. Policies and regulations
Trust between doctors, patients and AI support systems	Explain AI through public relation campaigns. Include AI into medical curriculum.
Confidentiality and sensitive data protection	New policies and regulations
The AI models validation process	Scientific consensus
Making different professions collaborate	Making academic collaborative microcosms

As for the rest of the world, several Tunisian doctors and engineers are already working on the construction and validation of AI models in several medical cutting-edge areas as intensive care and anesthesia. Doctoral theses were publicly presented about AI models generated and tested for the prediction of septic shock, non-invasive ventilation failure or mortality prediction in the intensive care. We believe that in the next few years, Tunisia should take and assume its place among the major nations of this new industrial revolution. To achieve this goal in the medical field of applied AI, we have to address all the five challenges, by integrating AI into medical curriculum, initiate new policies and regulations that will frame and facilitate AI access in our healthcare system, create collaborative microcosm between engineering and medical students, make all the stakeholders discuss about medical AI ethics and trust.

All is the future, and the future is now.

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