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EDITORIAL

Thoughts on artificial intelligence use in medical practice and in scientific writing

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In the era of computers and digital transformation, a solution for generating evidence-based medicine is the use of synthetic data derivatives with the incorporation of artificial intelligence (AI) and machine learning (ML). Randomized trials and registry studies could be facilitated by sharing data between scientists. AI and ML are promising in a variety of medical fields to improve patients' care in the diagnosis, management, research, and system analysis. However, clinicians are expected to continue to play a vital role in research; AI will not make clinical data redundant, but it will help generate more and make their values more precise [1].

Currently, anyone with access to the internet has free access to AI applications that could produce synthetic research, as well as to translate books and papers, and to construct research manuscripts, abstracts, and letters to the editor. In this setting, AI methods may offer benefits to journals, publishers, readers, and patients [2].

AI in medicine

AI has an incredible potential that will revolutionize all aspects of life, including technology and medicine. In the latter, AI is expected to be extremely useful to collect, store, and synthetize patients' data using AI-based platforms for medical data management such as Google Health®, Augmedix®, CloudMedX Health®, Babylon Health®, Corti®, and MedPaLM®, to organize healthcare logistics, to improve working conditions, and to forecast pandemics using algorithms that can analyze a substantial amount of medical information and research data that humans are unlikely to do [3–5].

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AI has the potential to automate tasks that are currently performed by humans; any new industry will incorporate the latest AI and robotic innovations as soon as they appear. This may generate fears that AI will replace humans or may lead to a significant reduction in the need for certain jobs. In medicine, some specialties such as radiologists, pathologists, anesthesiologists, neurologists, surgical assistants, and general practitioners could possibly be replaced or empowered by AI methods. In these specialties, AI may help by providing medical diagnosis and standard recommendations, monitor patients, and record personal information and reports. Surgeons are included in this evolution—in the future, AI software and robotic surgeons may be seen to perform simple or less complex surgical operations without human assistance (autonomous AI surgical robots, in contrast to currently available robotic and image guided elective procedures in adult reconstruction surgery). AI software will probably become an integral part of the healthcare system.

The medical professionals should not be afraid of AI; complex digital technologies in medicine will always require competent medical professionals, and new medical areas are expected to appear. In the end, AI will not replace physicians; medical professionals who use AI will replace those who do not [6]. Ethical debate and decisions will remain human.

According to Hintze, cited by http://www.coursera.org, a website specialized in teaching, there are four main types of artificial intelligence [7].

1. *Reactive machines* are task specific AI systems without memory. One action delivers the same reaction. Machine learning models like deep learning currently used in radiology take patient data and use it to deliver recommendations. In order to perform, these systems need the peripheral tools (optic, image, radiation related to machines already in use such as CT-scanner or MRI machine) and the task decided by the human doctor (screen for abnormalities in this image or in this series of images). The quality of the reactive artificial intelligence is dependent on the accuracy of the tools

that harvest data and on the decisions of the medical professional. They perform faster than humans and are extremely efficient; however, not 100% accurate, errors could always occur, and calibration of tools and regular check of the computer activity are required. System maintenance is crucial in these new expert systems.

2. *Limited Memory* is the second step in the evolution of AI. This algorithm imitates brain connections and learns; it gets smarter as it receives more data to train. Deep learning improves image recognition and is already used in some radiology departments. Humans learn on success and on failures. Limited memory machines learn by accumulation of data.

The first two types of AI currently exist and used in practice. We published a special issue of the journal with research in robotics and artificial intelligence [8].

The future of AI systems will probably include the two following steps:

3. *Theory of mind* machines should react in a social manner, understanding intentions and predict behaviour. This will be a complex evolution that imitates the human brain that learns with experience and creates neuronal networks.

4. *Self-awareness* will be a revolution in the machine building and use; it would include self-conscience and acknowledgement of the AI existence. This opens a new gate in the evolution of the human species as probably the machines could help themselves to grow and allow or not to be shut down. Science-fiction publications and movies are full of examples; we do not know exactly how those systems will behave or react, and surgeons or medical professionals will probably interact very little with these features. We shall remain friendly users of this technology.

All AI systems are built based on the human brain behaviour. We do not know other ways of creating knowledge. Experience and networking interfere with ethics and culture; the AI systems will skip some parts and be efficient. We create the tools that we need and AI is one way of creating tools and intelligence, always based on human needs and experience. We are unable to imagine how artificial systems will eventually grow and develop alone based on machine experiences and AI decisions.

AI in orthopaedics

Orthopaedic surgery is amenable to take advantage of AI. Combining technology with surgical skills, orthopaedic surgeons who are taking advantage of it can drastically improve patients' outcomes. As the amount of patients' data increases rapidly, efficient process and analysis of all gathered information in order to conduct research and decide on the best therapies for any given orthopaedic disease are a very challenging task [8–10].

There are many potential advantages to the incorporation of AI in orthopaedic practice, including diagnostics, implants selection, techniques execution, and research and administrative considerations. Orthopaedic surgeons are witnessing increasingly more advanced AI technology including navigations and robots, preoperative planning, templating, and intraoperative input tools [11]. Robotic surgery in orthopaedics will be a common technology that is expected to expand more. Although patients have shown a great amount of enthusiasm for robots and navigations, this has been in most cases false and unsubstantiated, driven by private practice collateral issues and advertisement. Therefore, patients finally will prefer orthopaedic surgeons to be around during the treatment process, especially when considering the high cost of robotic- and computer-assisted surgical operations. In the same scenario, the physician–patient relationships do not seem likely to change much in terms of sympathy, compassionate care, and informed consent.

Importantly, AI implementation in medicine and orthopaedics is not without ethical and medico-legal considerations, e.g., if AI software misses a diagnosis, a physician makes a wrong diagnosis based on an AI application; an autonomous AI surgical robot experiences a surgical complication, or synthetic data generation ends with scientific misconduct (fraud) [12]. It is not clear how medico-legal issues that apply on humans will apply to AI. Even if AI is held responsible, it could prove difficult to find a responsible party, as many individuals and companies contribute to the creation of AI systems. This could leave the physician as the only easily identifiable target in liability suits [13].

AI in medical writing and editing

There has been an increasing interest in the use of AI in medical writing [10, 14–17]. Radiology has the leading specialty in terms of volume of yearly publications and overall citations, followed by psychiatry and neurology [14]. The amount of orthopaedic research papers with the application of AI is growing [10, 15–17]. Most studies use AI to aid diagnostic decision support and to predict an aspect of a patient's care. More recently, research has focused on algorithms predicting patient outcomes post-surgery. Most papers focused on the spine followed by knee and hip surgery. The countries of origin in the majority of publications were the USA, Canada, and China [15]. However, despite the academic interest, incorporation of AI into clinical practice remains limited [15]. AI technology is currently used to translate medical books, to check the writing for clarity and spelling, and to evaluate for misconduct mainly plagiarism and collateral issues in authorship. Yet, it still lacks the knowledge to review the content of a paper and to consider the rationale, accuracy, comprehensiveness, and intent of

writing, as Editors do. Although some AI software is capable to write novel research, some with a 0% of plagiarism, AI methods cannot be listed as authors in papers [2]. Importantly, AI requires data/patients, even if synthetic, and data sharing that currently are difficult to bypass.

At International Orthopaedics, we acknowledge that artificial intelligence is becoming part of medicine, including medical writing and publishing. Our purpose is to publish quality research, and we encourage novel methods to conduct research provided that they are clearly described and explained. The use of AI in medical writing and editing would ideally deliver valuable insights in medical research and science.

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