EDITORIAL

AI in Medicine and Anesthesiology: Revolutionizing Healthcare Through Technology

IA em Medicina e Anestesiologia: A Revolução da Saúde Através da Tecnologia

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Artificial intelligence (AI) is the branch of computer science that enables machines to mimic functions typically associated with human intelligence, such as learning, reasoning, problem-solving, and decision-making and is considered one of the most transformative technologies of the 21st century.

In general terms, AI involves the development of algorithms and mathematical models that allow computers to analyze large amounts of data, recognize patterns, make predictions, or make decisions with minimal human intervention. In medicine, these capabilities hold immense potential, promising to improve diagnostics, optimize treatments, and ultimately enhance patient outcomes.

Far from being a merely theoretical concept, AI in medicine is already being applied in clinical practice, and according to the growing number of peer-reviewed scientific publications, it is already making a difference in several fields. From diagnosis to drug discovery and personalized medicine, AI is transforming the healthcare landscape by addressing some of its most pressing challenges, given the increasing demands on limited healthcare resources and the ever-growing complexity of medical data.

One of the most established applications of AI in medicine comes from the analysis of medical images and their diagnostic applications, whether radiology scans, eye fundus exams, or digitized histological preparations. Radiology and pathology greatly benefit from AI tools and their ability to generate predictions about the presence of anomalies in an image, which has been shown to increase diagnostic reliability and efficiency for screening radiologists[1] and pathologists[2] aided by this technology. Testimony to this is the growing number of AI tools approved for clinical use by the

U.S. Food and Drug Administration (FDA).[3]
For instance, pathology labs that routinely use this technology report fewer delays in diagnosing prostate biopsies.[4]

Beyond image analysis, the advent of the attention mechanism,[5] which allows an AI language processing model to focus on specific relevant parts for decision-making, fuelled the creation of large language models like ChatGPT. Using natural language processing technology, these models are capable of analyzing digital medical records and lab results to identify risk factors, suggest possible diagnoses, inclusion in clinical trials, and even propose evidence-based treatments. All of this saves time and relieves professionals traditionally in charge of these tasks from tedious work.

The long and costly process of drug development is also being accelerated by AI, as algorithms can analyze biological data, genetic information, and chemical compounds to predict how different molecules will interact with biological targets, effectively identifying potential drug candidates much faster than traditional methods. Additionally, AI-powered simulations can predict how a patient will respond to a new drug, allowing researchers to adjust compounds before moving on to expensive clinical trials. These predictive models reduce the need for trial and error in laboratories, making drug development more efficient.

In oncology, for example, AI is used to analyze a tumor genomic profile[6] and suggest the most effective treatment based on those findings. AI tools are also being used to predict how patients with chronic conditions like diabetes or hypertension might respond to different medications, allowing doctors to customize treatment plans that are both more effective and have fewer side effects.

Additionally, AI is revolutionizing preventive medicine. Ubiquitous wearable devices, such as smartwatches, continuously collect data on a patient's vital signs and physical activity. AI systems can analyze this data in real-time to detect early signs of disease, such as arrhythmias or sleep apnoea, often before the patient even realizes something is wrong. By alerting healthcare providers to potential issues, AI empowers both patients and doctors to intervene earlier and prevent more serious conditions from developing.

Just AI is being applied successfully in screening, diagnostics and therapeutics in several specialties, in anesthesiology the application of AI is also expanding. A review of some major anesthesia journals shows that the AI literature is growing quickly illustrating how this technology is becoming increasingly important.
For example, in perioperative medicine, medication administered during the perioperative period contributes to patient safety but can also be a source of error. Here, AI can be used to detect potential medication errors and provide decision support tools to clinicians in real-time, with the consequent effect on patient safety.[7,8] Also, AI facilitates personalized risk assessment and decision support, optimizing drug dosage predictions and anesthesia planning.[9]

In pain medicine, verbal report is frequently used for pain assessment, but this is potentially problematic for several reasons. In this sense, the development of objective, standardized and generalizable AI-based instruments offer significant and promising potential.[10]
Several papers have emerged about AI and drug administration control, deep of anesthesia monitoring or image-guided related to anesthesia, but most of the publications are on the prevention of anesthesia-related events.[11]
Additionally, in anesthesia education, AI can assist students by identifying knowledge gaps, providing personalized feedback and suggesting resources. Also, the practice of anesthesia procedures

can be done in a safe and controlled environment using virtual simulation environments created or assisted by AI tools.[12] In a recent survey about the use of AI in ultrasound-guided regional anesthesia for medical education, most anesthesiologists believed that the use of AI will reduce complications, but there are still some ethical concerns about privacy and data governance.[13] AI is transforming medicine and anesthesiology, offering new solutions to some of the biggest challenges in healthcare. From enhancing diagnostic accuracy and accelerating drug development to personalizing treatments and improving patient safety, AI is a powerful tool with the potential to improve patient outcomes and reduce healthcare costs.

Despite these promising aspects, a significant educational effort must take place to improve the physician's understanding of AI fundamentals, since AI is becoming yet another tool in the routine practice of the profession. Also, it is important to understand that AI does not operate in a vacuum, but rather it is intended to be used as an assistant to the physician, and not as an autonomous tool. The physician remains in control and oversees the appropriate use of all the tools at their disposal, including AI. For this reason, a comprehensive grasp of not only the potential benefits, but also the potential downsides of AI is paramount to understanding when human judgment should override AI to ensure patient safety is always benefitted.[14]

Yours Sincerely,

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