Concept article

Artificial intelligence in health and science: an introspection

Inteligência artificial na saúde e ciência: uma introspecção

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ABSTRACT | INTRODUCTION: Whenever there has been a technological revolution, there have been advantages and disadvantages associated with it. Artificial intelligence is now going through this phase of uncertainty. There are groups that agree and embrace this new technology, and others that simply refuse to let it into our daily lives. **OBJECTIVE:** The purpose of this reflection will be to understand the advantages and disadvantages of the use of artificial intelligence in health and science.

KEYWORDS: Artificial Intelligence. Health. Science.

RESUMO | INTRODUÇÃO: Sempre que houve uma revolução tecnológica, existiram sempre vantagens e desvantagens associadas. Atualmente, a inteligência artificial está a passar por essa fase de incerteza. Existem grupos que concordam e abraçam essa nova tecnologia, e outros que simplesmente se recusam a deixá-la entrar no nosso cotidiano. **OBJETIVO:** O objetivo desta reflexão será entender as vantagens e desvantagens do uso da inteligência artificial na saúde e na ciência.

PALAVRAS-CHAVE: Inteligência Artificial. Saúde. Ciência.

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The technological revolution of the last few decades has been nothing short of remarkable, with computers and the internet at the forefront of this change. Computers have been around since the mid-20th century, but it wasn't until the 1990s that they became more accessible to the general public. With the rise of personal computers, people could use them for more than just data processing, and the internet soon followed. This development allowed for unprecedented connectivity and information sharing, which has since grown exponentially. One of the most significant impacts of the technological revolution was the development of search engines. The development of search engines in the late 1990s and early 2000s brought about both excitement and concerns among the public and experts alike. While search engines made it possible to access vast amounts of information with unprecedented ease, there were also fears about privacy, security, and the accuracy of information found online.[1]

As the technology and internet grew, and more data became available, artificial intelligence (AI) started to become a reality. AI refers to the development of machines that can perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and natural language processing. One of the most significant advances in AI has been the development of machine learning, which allows machines to learn from data and improve their performance over time. One of the most well-known examples of AI is the language model called ChatGPT. ChatGPT is a large language model trained by OpenAI, based on the GPT-3.5 architecture. It has the ability to understand and generate natural language, which has enormous implications for human-computer interaction. ChatGPT has been used for a variety of applications, from chatbots to content creation, and has been trained on massive amounts of data to ensure that it can understand and respond to a wide range of inputs.[1]

AI is a technology that has many potential benefits, but also comes with risks and concerns. Some of the disadvantages of AI include[1]: job displacement (some jobs may become automated, leading to job loss or retraining for some workers; this can have significant social and economic consequences), bias (as AI system is trained on user data, this data can be biased, not representative of the entire population, leading to discrimination or misinformation, biasing decision-making), lack of empathy (AI lacks the emotional intelligence of humans, which can be a disadvantage in some situations, such as customer service or therapy; AI can be trained to mimic human emotions and responses, it is still fundamentally different from human interaction), complexity (AI systems can be complex and difficult to understand, leading to challenges in maintenance and repair; this can be particularly problematic if the AI system is responsible for critical tasks, such as medical diagnosis or air traffic control), and security risks (as AI systems become more connected to the internet, they can be vulnerable to cyber-attacks, potentially causing significant damage). Obviously, this generates some fears that AI could become superintelligent, autonomous, invade privacy, and perpetuate unethical practices.[1] However, there are also overall advantages, such as[1]: increased efficiency (can perform tasks much more quickly and accurately than humans, leading to greater efficiency in many industries), cost savings (can help businesses save money on labor costs), predictive analytics (can analyze large amounts of data rapidly and identify patterns, helping to make predictions and inform decision-making), personalization (can be used to personalize user experiences through their individual preferences, increasing customer satisfaction and loyalty), and safety (can be used in hazardous or dangerous environments to reduce the risk of injury to humans).

Specifically in healthcare and science, AI can be used to benefit[1-3]:

1. Medical imaging: AI can be used to analyze medical images such as X-rays, CT scans, and MRIs, helping to detect and diagnose diseases more accurately and quickly. This can lead to earlier detection and treatment of diseases, improving patient outcomes. With a low level of doubt of their capabilities and with a high level of enthusiasm, it is expected that, in a couple of years, AI may have the potential to overcome traditional practices in this field. However, there is a need for continual improvement of AI algorithms to address the risk of false positives or negatives.

2. Drug discovery: AI can be used to analyze large amounts of data on drugs and diseases, identifying new drug targets and potential treatments. This can accelerate the drug discovery process, potentially leading to more effective treatments for a larger range of diseases. However, its true abilities are still uncertain, and it has not yet fully overcome traditional practice. Human supervision (validation and safety concerns) during clinical trials remains a significant disadvantage. More experiments and real-world data are required for its refinement.

3. Personalized medicine: AI can be used to analyze patient data, including genetic information and medical history, to develop personalized treatment plans. This can lead to more effective treatments that are tailored to each individual patient, improving outcomes and reducing side effects. Nevertheless, data privacy and security challenges need to be addressed. Additionally, one important key in patient management is the practitioner-patient relationship, and the AI still presents a lack of empathy and compassion. Therefore, nowadays AI is a good practice adjunct, but still does not overcome traditional practice. It is recommended the development and integration of more robust AI models specific for human interaction.

4. Telemedicine: AI can be used to improve telemedicine services, allowing healthcare professionals to remotely monitor and treat patients. This can improve access to healthcare for patients in remote or underserved areas, reducing the burden on healthcare systems. The enthusiasm among the clinical and scientific communities are rising however, limited physical examination capabilities still pose a significant challenge. The association of the advancements in remote monitoring technologies can enhance telemedicine's capabilities.

5. Scientific discovery: AI can be used to rapidly analyze large amounts of scientific data, helping to identify patterns and make predictions. This can lead to new scientific discoveries and insights, accelerating scientific progress. The enthusiasm about the future of AI in science is high, however there are still some doubts, namely in interpreting complex data. Improving AI algorithms for data interpretation is necessary to fully realize its potential in scientific discovery.

Unfortunately, mainly due to its recent development, there is not yet enough data to know the level of evidence for these indications.[1] The future looks promising for AI in science development and clinical context. Multinational companies have already started to develop products for healthcare, such as Med-PaLM 2 (Medical Platform for AI-assisted Learning and Monitoring – Google)[2] or PaLM-E (Platform for AI-assisted Learning and Monitoring Embodied – Google).[3] As an example of their potentialities, Med-PaLM 2 achieved an accuracy of 85.4% on the US Medical License Exam (USMLE) questions, matching expert test-takers.[2] Moreover, PaLM-E can synthesize and communicate information from medical images (such as x-rays and mammograms), helping provide an accelerated and better patient care.[3] But despite this collaborative effort, AI is still far from being fully implemented in daily healthcare setting. The main reasons include[1,2]: short-term costs; still some "bugs" to overcome, leading to a constant need for improvement (almost as "beta" versions); poor studies development; uncertainty of the long-term outcomes; healthcare practitioners and settings still have some difficulties to accept the replacement of the more traditional practices. Table 1, summarizes the AI in the current scientific and clinical context.

Table 1. AI in the scientific and clinical context

Applicability	Doubt	Enthusiasm	Evidence Level	Overcomes Traditional Practice?	Advantages	Disadvantages	Potential Improvements
Medical imaging	Low	High	Uncertain	Possibly yes	Improved accuracy and speed of diagnosis	Risk of false positives or negatives	Continual refinement through larger datasets
Drug discovery	Moderate	Moderate	Uncertain	No	Accelerated identification of potential drugs	Needs human supervision of the experiments and studies development (for validation and safety concerns).	Integration of real-world data and other scientific equipment for validation
Personalized medicine	Moderate	Low	Uncertain	No	Improved patients' outcomes and reducing side effects, by providing tailored treatments based on individual patient' data	Lack of empathy and compassion, and data privacy and security challenges	Development of robust AI models for human interaction
Telemedicine	Low	Moderate	Uncertain	Possibly no	Improved access to healthcare	Limited physical examination capabilities	Advancements in remote monitoring technologies
Scientific discovery	Moderate	High	Uncertain	No	Fast large data analysis	Challenges in interpreting complex data	Enhancement of AI algorithms for data interpretation

Applicability: specific areas or domains where AI can be applied.
Doubt: level of confidence or knowledge of AI. Levels: Low; Moderate; High; Uncertain.
Enthusiasm: level of excitement, interest, and positive anticipation of AI. Levels: Low; Moderate; High; Uncertain.
Evidence: level of supporting evidence or scientific validation available of AI. Levels: Low; Moderate; High; Uncertain.
Overcomes Traditional Practice: level of the potential of AI to surpass/outperform the conventional/traditional methods/approaches. Levels: No; Possibly no; Possibly yes; Yes.
Advantages: positive aspects or benefits associated with the use AI.
Disadvantages: drawbacks, limitations, or challenges associated with the use of AI.
Improvements: areas or aspects within a specific indication where advancements, enhancements, or refinements can be made to further optimize or maximize the benefits of AI.

Source: the author (2023).

In conclusion, AI has enormous potential to benefit healthcare and science, by providing new tools and insights that were previously impossible. AI can improve outcomes, accelerate research, and reduce costs. Nevertheless, as AI continues to develop and advance, it is important to carefully consider its potential benefits and challenges, and to work to ensure that it is used ethically and responsibly.

Conflicts of interest

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) were declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

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