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Artificial intelligence: ethical and future challenges

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Abstract

This narrative literature review addresses the evolution and use of artificial intelligence in health care, with a focus on advancements such as image interpretation in diagnostics and the use of robots in hospitals. Ethical issues are discussed, including data privacy and algorithmic bias, emphasizing ethical principles and regulations such as the Brazilian General Data Protection Law. The challenge of bias is illustrated, highlighting the need to eliminate discrimination in systems, and the complexity of responsibility and transparency in medicine is addressed, with a focus on the importance of understanding algorithms to avoid medical errors. The relevance of the debate on the positive potential of artificial intelligence is underscored, stressing the need to tackle ethical dilemmas to ensure the ethical and responsible use of technology in the future.

Keywords: Artificial intelligence. Ethics. Medicine.

Resumo

Inteligência artificial: desafios éticos e futuros

Esta revisão narrativa da literatura aborda a evolução e a aplicação da inteligência artificial na saúde, com ênfase em avanços como interpretação de imagens para diagnósticos e uso de robôs em hospitais. Questões éticas, incluindo privacidade de dados e viés algorítmico, são discutidas, enfatizando princípios éticos e regulamentações, como a Lei Geral de Proteção de Dados, no Brasil. O desafio do viés é exemplificado, ressaltando a necessidade de eliminar discriminação nos sistemas, e aborda-se a complexidade da responsabilidade e transparência na medicina, com foco na importância de compreender algoritmos para evitar erros médicos. Ressalta-se a relevância do debate acerca do potencial positivo da inteligência artificial, reforçando que é preciso enfrentar dilemas éticos para garantir o uso ético e responsável da tecnologia no futuro.

Palavras-chave: Inteligência artificial. Ética. Medicina.

Resumen

Inteligencia artificial: desafíos éticos y futuros

Esta revisión narrativa de la literatura aborda la evolución y la aplicación de la inteligencia artificial en la salud, con énfasis en avances como la interpretación de imágenes para diagnósticos y el uso de robots en hospitales. Se discuten cuestiones éticas, incluida la privacidad de los datos y el sesgo algorítmico, enfatizando los principios éticos y las regulaciones, como la Ley General de Protección de Datos, en Brasil. Se ejemplifica el desafío del sesgo, resaltando la necesidad de eliminar la discriminación en los sistemas, y se aborda la complejidad de la responsabilidad y la transparencia en la medicina, centrándose en la importancia de comprender los algoritmos para evitar errores médicos. Se destaca la relevancia del debate acerca del potencial positivo de la inteligencia artificial, reforzando que es necesario enfrentar dilemas éticos para asegurar el uso ético y responsable de la tecnología en el futuro.

Palabras clave: Inteligencia artificial. Ética. Medicina.

Update

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Artificial intelligence (AI) has played an increasingly important role in recent years. Machines are no longer limited to performing physical tasks; they also execute intellectual functions that require what is considered intelligence. The concept dates back to the 1950s, when the British mathematician Alan Turing proposed the famous Turing test in his paper "Computing Machinery and Intelligence [1]." Nonetheless, a decisive milestone was the Dartmouth College Conference held in the summer of 1956, which is widely recognized as the beginning of AI as a field of study [2].

At first, AI was mainly applied to solving real-world problems by programming the knowledge of experts into computer programs. Such programs, known as expert systems or knowledge-based systems, were developed based on interviews with specialists in specific fields. However, there were limitations, such as subjectivity and a lack of cooperation from experts [3].

Today, the potential benefits of AI generate great excitement, with machines learning to drive autonomous cars and automated translators becoming increasingly accurate. Additionally, AI is present in everyday tasks such as reading emails, doing the laundry and recommending movies on streaming platforms [4].

In health care, AI has been used in various academic research projects with promising results. Algorithms are being developed to interpret X-ray imaging [5], mammograms [6], CT scans [7] and MRIs [8], and to identify diseases such as Alzheimer's [9]. In addition, AI is being used in pathology [10] to identify cancerous lesions [11], interpret retinal imaging [12] and detect arrhythmias [13] and other medical conditions.

AI-equipped robots are also being used in hospitals and clinics, such as the robot created by iFlytek, which passed the national medical licensing exam in China [14]. Another example is the Brazilian software Laura, which uses AI to identify the risk of hospital infections [15]. These applications have shown the potential of AI in health care.

The swift development of data processing and storage technologies has driven the growth of AI. And, as problems become more complex and the volume of data increases, there is a need to develop advanced and customized computational tools based on machine learning that rely less and less on human intervention. However, such development raises concern about whether AI will be beneficial and fair, especially regarding ethics and the impact on society, considering legal and liability issues.

The goal of this paper is to undertake a narrative literature review with an exploratory approach by analyzing articles with information about the use of AI in healthcare services and its ethical implications.

Ethical aspects

According to one traditional branch of philosophy, ethics is exclusive to humans, and things in themselves are not necessarily good or bad. "Technology is amoral," stated Bill Gates in an interview. He added: "It is up to us to think deeply about new technologies and how they should or should not be used," as quoted by Garattoni [16]. However, the challenges posed by AI have reignited the debate about human exclusivity in ethics.

From the outset, the interaction between humans and machines has sparked controversy. In 1950, the American writer and biochemist Isaac Asimov addressed the complexity of this issue in his work *I, Robot* [17] and created a classic by formulating the three laws of robotics: 1) a robot may not injure a human being or, through inaction, allow a human being to come to harm; 2) a robot must obey the orders given it by human beings except where such orders would conflict with the first law; and 3) a robot must protect its own existence as long as such protection does not conflict with the first or second law. Later, he added a fourth law, known as the Zero Law [17], which states that a robot may not harm humanity or, through inaction, allow humanity to come to harm.

Recently, five ethical principles have gained prominence in major AI regulatory initiatives and discussions: beneficence, non-maleficence, autonomy, justice and explainability [18]. These ethical principles, defined as values or general guidance for human behavior, serve as a basis for evaluating moral action and provide a general framework for decision-making in ethical matters.

Problems related to algorithm ethics

Data privacy

With the advancement of technology, people are increasingly connected and producing a growing amount of data generated from various sources, such as cell phones, cars, credit card transactions, content choices on streaming services and internet of things devices. This information is stored by various companies, which create databases with user information.

Due to human limitations, it is practically impossible to undertake a comprehensive analysis of these data, as it would take an enormous amount of time to fully evaluate them and formulate structured conclusions. However, with the rise of AI and the increase in processing capacity, these data can be analyzed in different ways in a short period of time.

Moreover, a growing concern today regards what is done with information stored in large databases. Large companies such as Meta (formerly Facebook) have faced legal action for sharing data without proper consent.

In the data breach scandal involving 50 million Facebook users, whose information was collected by the company Cambridge Analytica through algorithms, confidential data about their behavior on the social networking site were used to guide election campaign strategies. This case is a striking example of the ongoing discussion about surveillance, privacy and algorithms [19].

People are daily flooded with ads right after browsing online, whether to purchase something or out of mere curiosity. Thanks to advanced processing capabilities, data related to health, diet, exercising and even sites frequented by people using smartphones and other devices may reveal previously unknown trends and health information. However, different companies may have access to such information, and often people are unaware of how and by whom it will be used.

Due to growing concerns about data security, bodies such as the World Health Organization (WHO) brought out a global report in 2021 containing six key principles to ensure that AI works in the public interest in all countries [20]. Additionally, the Organization for Economic Cooperation and Development (OECD) produced a set of intergovernmental recommendations to guide states in regulating AI, maintaining its innovation, reliability, safety and respect for human rights and democratic values.

Thirty-eight member countries have endorsed the OECD Council Recommendations on AI, a document that establishes principles to be followed internally [21]. Several other countries are also designing their own legislation to ensure greater security and transparency in the use of private information by companies.

In the European Union, for example, the European Parliament enacted a resolution on February 16, 2017, with recommendations on civil law rules related to robotics. The resolution aims to organize rules among member states to ensure safety in AI development, as well as the protection of fundamental rights of individuals and companies, without inhibiting investment, innovation and use [22].

In Brazil, Law 13709/2018, known as the General Data Protection Law (LGPD), was created with the aim of protecting fundamental rights to freedom and, more specifically, privacy. Additionally, the Senate established the Committee of Jurists Responsible for Supporting the Drafting of a Substitute Bill on Artificial Intelligence in Brazil (CJSUBIA), which is working on the development of Brazilian legislation related to AI use.

There are also several bills (PL) in progress to regulate AI, namely: PL 5051/2019 [24], PL 21/2020 [25], PL 872/2021 [26] and PL 759/2023 [27]. The importance of this issue is made clear by the number of bills in progress, which emphasizes the need for legal regulation in this emergent field.

Bias in artificial intelligence

The growing use of AI raises significant concerns about bias, whether existing or amplified by systems that use this technology. Understanding this phenomenon requires analyzing how machines learn, which may involve a predefined step-by-step procedure known as an algorithm, similar to studying with books or guidance from teachers.

In addition, there is the machine learning approach, which does not directly teach but provides instructions on how to learn based on

examples and data, with greater autonomy in the learning process. Data play a key role in this context, and the more reliable data available for training, the better the resulting model.

However, algorithms are not free from values and assumptions, as operational parameters are set by developers and configured by users who seek specific outcomes, potentially prioritizing certain values and interests over others. Even within the set parameters, ethically acceptable behavior is not automatically guaranteed [28,29].

Among various well-known examples of bias is a beauty contest held in 2016 that used a jury composed of AI-generated robots, with thousands of people from various countries submitting their photos for evaluation [30]. The result drew attention because, out of the 44 winners, only one had dark skin, sparking heated debate about how the system was capable of perpetuating biases, producing unintended and sometimes skewed and even racist results.

The analysis revealed that the system's training database consisted of images of Hollywood actors and actresses, who were predominantly white. The developers had not intended to favor any ethnic group, but had neglected to check the training data for bias [31].

A relevant example of bias related to health care occurred with a program used by a large American health insurance company. The goal was to identify patients who needed additional care, enabling a multidisciplinary team to monitor them preventively to avoid expensive treatments, such as intensive care unit (ICU) hospitalizations. The system was based on how often patients sought medical care and the costs of appointments and hospitalizations. To avoid racial bias, the data did not include information about their race [32].

However, the analysis revealed that most patients identified as needing additional care were white. Further investigation revealed that due to financial constraints, Black patients used health insurance less frequently, resulting in fewer data points available for the system to identify patterns of severity in their care. This highlights how bias and prejudice can be hidden in the data and hard to be detected [32].

Other examples of AI bias include job advertisements for highly paid positions, which are less likely to be shown to women [33], searches for distinctly Black-sounding names, which are more likely to trigger ads related to arrest records [34], and image searches for positions like CEO, which produce fewer images of women [35]. Additionally, facial recognition systems, widely used in law enforcement, perform worse in recognizing the faces of women of any color and Black individuals [36].

Eliminating bias and ensuring fairness in AI-based systems has become an increasingly significant challenge. It is essential to acknowledge that the data are not neutral, as they reflect human decisions that may be biased. Therefore, training databases should be reliable and free from bias. Companies like Google and IBM are working to develop technical methods that enable the evaluation and mitigation of bias in their datasets. In addition, regulatory bodies and governments are developing specific policies and regulations to address bias in AI, acknowledging the need for transparency and accountability in this constantly evolving field [37,38].

Accountability and transparency in artificial intelligence

Current technological advancements are playing a key role in medicine, with the increasing use of AI-based smart equipment. Such innovations are essential in diagnostic medicine, where the interpretation of results, traditionally performed by physicians, is now supported by highly specialized and automated algorithms.

As provided in the Code of Medical Ethics (CEM), physicians *are obliged to use all available scientifically recognized means of health promotion, prevention, diagnosis and treatment of diseases at their disposal, in favor of patients* [39]. This highlights that neglecting to use available resources constitutes a clear violation of the CEM. However, the lack of transparency and complexity of the algorithms can make it difficult for healthcare providers to understand the system's conclusions.

As a result, physicians may hesitate to use AI systems they do not fully understand, hindering their effective integration into clinical practice. Moreover, poor understanding may increase the risk of errors when professionals are unable to identify incorrect decisions, complicating the

attribution of responsibility in cases of medical errors and creating legal and ethical challenges.

According to Law 3,268/1957 [40], which regulates medical councils, and Law 12,842/2013 [41], which reaffirms the former and is known as the Medical Act Law, diagnosing diseases is the exclusive prerogative of properly qualified physicians registered with the Regional Councils of Medicine (CRM). Therefore, physicians cannot shirk responsibility for diagnosing diseases, as this is a fundamental part of their profession.

Given the complexity of AI systems, making physicians accountable may result in an unfair distribution of responsibilities. This is due to the complex reality surrounding medical accountability in relation to traditionally used parameters [42,43].

Legal experts argue that the analysis should consider whether the damage caused by the AI system resulted from negligence, lack of skill or misconduct on the part of users and that physicians should not be held accountable for damages caused by autonomous agents. This is because smart systems have autonomy and access to data, enabling them to make independent decisions.

Such complexity in identifying and assigning responsibility for damages resulting from algorithmic activities is a multifaceted challenge. Detecting the damage, determining its cause and, most importantly, identifying who should be held accountable for such damages are complex tasks.

Various human actors are involved, including programmers, manufacturers, designers and users, and the ethical issue of responsibility is closely linked to the theme of transparency. Only non-opaque algorithms make it possible to identify the individuals responsible for the process and potential errors. In this context, a continuous effort is essential to ensure that AI systems in medicine are transparent, understandable and subject to regulations that consider the ethical and legal challenges arising from technological evolution, so that they can continue to play an increasingly significant role.

Final considerations

The advancement of AI has transformed the world, enabling machines to perform complex and rational tasks that were once considered the exclusive domain of humans. Although the roots of AI can be traced back to the 1950s and 1960s, its impact has become especially significant in recent decades as technological advancements have led to the development of increasingly sophisticated systems.

Today, this technology pervades everyday life, influencing industries from auto manufacturing to precision medical diagnostics. Hospitals and clinics can now exploit autonomous systems to enhance patient health and well-being.

However, this rapid growth does not come without challenges. The increasing complexity of the problems and the colossal amount of generated data require greater autonomy of computational tools. In this context, machine learning plays a central role, enabling systems to acquire knowledge and make decisions with minimal human intervention.

While AI promises significant benefits, it also raises ethical concerns, such as privacy, algorithmic bias and accountability. As AI continues to advance, society must engage in thoughtful discussions and design sensible regulations to ensure its ethical and fair use. The benefits are undeniable, but the full potential of AI will only be realized if those involved are prepared to face the challenges and adopt responsible approaches.

References

1. Turing AM. Computing machinery and intelligence (1950). In: Lewis HR, editor. Ideas that created the future. Boston: MIT Press; 2021. p. 147-64.
2. Patel VL, Shortliffe EH, Stefanelli M, Szolovits P, Berthold MR, Bellazzi R, Abu-Hanna A. The coming of age of artificial intelligence in medicine. Artif Intell Med [Internet]. 2009 [acesso 22 maio 2024];46(1):5-17. DOI: 10.1016/j.artmed.2008.07.017

3. Mendes RD. Inteligência artificial: sistemas especialistas no gerenciamento da informação. Ciênc Inf [Internet]. 1997 [acesso 22 maio 2024];26(1):39-45. DOI: 10.1590/s0100-19651997000100006
4. Faceli K, Lorena AC, Gama J, de Almeida TA, Carva ACPLF. Inteligência artificial: uma abordagem de aprendizado de máquina. Rio de Janeiro: LTC; 2021.
5. Nam JG, Park S, Hwang EJ, Lee JH, Jin K-N, Lim KY *et al*. Development and validation of deep learning-based automatic detection algorithm for malignant pulmonary nodules on chest radiographs. Radiology [Internet]. 2019 [acesso 22 maio 2024];290(1):218-28. DOI: 10.1148/radiol.2018180237
6. Wu N, Phang J, Park J, Shen Y, Huang Z, Zorin M *et al*. Deep neural networks improve radiologists' performance in breast cancer screening. IEEE Trans Med Imaging [Internet]. 2020 [acesso 22 maio 2024];39(4):1184-94. DOI: 10.1109/TMI.2019.2945514
7. Shadmi R, Mazo V, Bregman-Amitai O, Elnekave E. Fully-convolutional deep-learning based system for coronary calcium score prediction from non-contrast chest CT [Internet]. In: Proceedings of 2018 IEEE 15th International Symposium on Biomedical Imaging; 4-7 abr 2018; Washington. Washington: IEEE; 2018 [acesso 22 maio 2024]. p. 24-28. DOI: 10.1109/ISBI.2018.8363515
8. Crimi A, Bakas S, editors. Brainlesion: glioma, multiple sclerosis, stroke and traumatic brain injuries: 7th Internacional Workshop, BrainLes 2021, held in conjunction with MICCAI 2021, virtual event, September 27, 2021: revised selected papers [Internet]. Part I. Cham: Springer International Publishing; 2022 [acesso 22 maio 2024]. DOI: 10.1007/978-3-031-08999-2
9. Ding Y, Sohn JH, Kawczynski MG, Trivedi H, Harnish R, Jenkins NW *et al*. A deep learning model to predict a diagnosis of Alzheimer disease by using 18F-FDG PET of the brain. Radiology [Internet]. 2019 [acesso 22 maio 2024];290(2):456-64. DOI: 10.1148/radiol.2018180958
10. Chang HY, Jung CK, Woo JI, Lee S, Cho J, Kim SW, Kwak TY. Artificial intelligence in pathology. J Pathol Transl Med [Internet]. 2019 [acesso 22 maio 2024];53(1):1-12. DOI: 10.4132/jptm.2018.12.16
11. Brinker TJ. Deep learning outperformed 136 of 157 dermatologists in a head-to-head dermoscopic melanoma image classification task. Eur J Cancer [Internet]. 2019 [acesso 22 maio 2024];113:47-5. DOI: 10.1016/j.ejca.2019.04.001
12. Fauw J, Ledsam JR, Romera-Paredes B, Nikolov S, Tomasev N, Blackwell S *et al*. Clinically applicable deep learning for diagnosis and referral in retinal disease. Nat Med [Internet]. 2018 [acesso 22 maio 2024];24(9):1342-50. DOI: 10.1038/s41591-018-0107-6
13. Hannun AY Rajpurkar P, Haghpanahi M, Tison GH, Bourn C, Turakhia MP, Ng AY. Publisher correction: cardiologist-level arrhythmia detection and classification in ambulatory electrocardiograms using a deep neural network. Nat Med [Internet]. 2019 [acesso 22 maio 2024];25(3):530. DOI: 10.1038/s41591-019-0359-
14. Saracco R. Congrats Xiaoyi: you are now a medical doctor. IEEE Future Directions [Internet]. 2017 [acesso 22 maio 2024]. Disponível: https://bit.ly/4bH91G7
15. Instituto Laura Fressatto. Quem somos [Internet]. 2019 [acesso 22 maio 2024]. Disponível: https://institutolaura.org/quem-somos
16. Garattoni B. Bill Gates indica 5 livros para você ler neste final de ano. Superinteressante [Internet]. 2016 [acesso 22 maio 2024]. Disponível: https://bit.ly/461cwGd
17. Asimov I. Eu, robô. São Paulo: Aleph; 2014.
18. Floridi L, Cowls J. A unified framework of five principles for AI in society. Harv Data Sci Rev [Internet]. 2019 [acesso 22 maio 2024];1:2-15. DOI: 10.1162/99608f92.8cd550d1
19. Confessore N. Cambridge Analytica and Facebook: the scandal and the fallout so far. New York Times [Internet]. 4 abr 2018 [acesso 22 maio 2024]. Disponível: https://nyti.ms/3W5Xmeg
20. World Health Organization. Ethics and governance of artificial intelligence for health: WHO guidance [Internet]. Geneva: World Health Organization; 2021 [acesso 22 maio 2024]. Disponível: https://bit.ly/3XXDAEg
21. Organisation for Economic Co-operation and Development. Recommendation of the Council on Artificial Intelligence. OECD Legal Instruments [Internet]. 2019 [acesso 22 maio 2024]. Disponível: https://bit.ly/4bKBb35

22. Parlamento Europeu. Resolução do Parlamento Europeu de 16 de fevereiro de 2017, que contém recomendações à Comissão sobre disposições de Direito Civil sobre Robótica [Internet]. 2017 [acesso 22 maio 2024]. Disponível: https://bit.ly/3S8tSen

23. Brasil. Lei nº 13.709, de 14 de agosto de 2018. Lei Geral de Proteção de Dados Pessoais (LGPD). Diário Oficial da União [Internet]. Brasília, nº 157, p. 59-64, 15 ago 2018 [acesso 22 maio 2024]. Seção 1. Disponível: https://bit.ly/3VVwttm

24. Brasil. Projeto de Lei nº 5.051, de 2019. Estabelece os princípios para o uso da inteligência artificial no Brasil. Senado Federal [Internet]. 2019 [acesso 22 maio 2024]. Disponível: https://bit.ly/460iLdr

25. Brasil. Projeto de Lei nº 21, de 2020. Estabelece princípios, direitos e deveres para uso de inteligência artificial no Brasil, e dá outras providências. Câmara dos Deputados [Internet]. 2020 [acesso 22 maio 2024]. Disponível: https://bit.ly/4cHC39S

26. Brasil. Projeto de Lei nº 872, de 12 de março de 2021. Dispõe sobre o uso da inteligência artificial. Senado Federal [Internet]. 2021 [acesso 22 maio 2024]. Disponível: https://bit.ly/3zH4J4i

27. Brasil. Projeto de Lei nº 759, de 2023. Regulamento os sistemas de inteligência artificial e dá outras providências. Câmara dos Deputados [Internet]. 2023 [acesso 22 maio 2024]. Disponível: https://bit.ly/4d3PctP

28. Kavoori AP. Review: Lisa Nakmura, Cybertypes: race, ethnicity and identity on the internet (New York&London: Routledge, 2002), 169pp. ISBN 0415938368/0415938376 (pbk). Converg Int J Res New Media Technol [Internet]; 2002 [acesso 22 maio 2024];9(1):123-4. DOI: 10.1177/135485650300900108

29. Brey P, Soraker JH. Philosophy of computing and information technology. In: Meijers A, editor. Handbook philosophy of technology and engineering sciences [Internet]. Amsterdam: Elsevier; 2009 [acesso 22 maio 2024]. p. 1341-407. DOI: 10.1016/B978-0-444-51667-1.50051-3

30. Beauty.AI [Internet]. [s.d.] [acesso 22 maio 2024]. Disponível: https://beauty.ai

31. Pearson J. Why an AI-judged beauty contest picked nearly all white winners. VICE [Internet]. 2016 [acesso 22 maio 2024]. Disponível: https://tny.im/X4xZ0

32. Obermeyer Z, Powers B, Vogeli C, Mullainathan S. Dissecting racial bias in an algorithm used to manage the health of populations. Science [Internet]. 2019 [acesso 22 maio 2024]; 366(6464):447-53. DOI: 10.1126/science.aax2342

33. Datta A, Tschantz MC, Datta A. Automated experiments on ad privacy settings: a tale of opacity, choice, and discrimination. Proc Priv Enhancing Technol [Internet]. 2015 [acesso 22 maio 2024]; 2015(1):92-112. DOI: 10.1515/popets-2015-0007

34. Sweeney L. Discrimination in online ad delivery. Commun ACM [Internet]. 2013 [acesso 22 maio 2024];56(5):44-54. DOI: 10.1145/2447976.2447990

35. Kay M, Matuszek C, Munson SA. Unequal representation and gender stereotypes in image search results for occupations. In: Begole B, Kim J, editors. CHI'15: proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems [Internet]. New York: Association for Computing Machinery; 2015 [acesso 22 maio 2024]. p. 3819-28. DOI: 10.1145/2702123.2702520

36. Klare BF, Burge MJ, Klontz JC, Vorder Bruegge RW, Jain AK. Face recognition performance: role of demographic information. IEEE Trans Inf Forensics Secur [Internet]. 2012 [acesso 22 maio 2024];7(6):1789-801. DOI: 10.1109/tifs.2012.2214212

37. Wexler J, Pushkarna M, Bolukbasi T, Wattenberg M, Viegas F, Wilson J. The what-if tool: interactive probing of machine learning models. arXiv:1907.04135 [Preprint]. 2019 [acesso 22 maio 2024]. DOI: 10.48550/arXiv.1907.04135

38. Bellamy RKE, Dey K, Hind M, Hoffman SC, Houde S, Kannan K *et al*. Al fairness 360: an extensible toolkit for detecting, understanding, and mitigating unwanted algorithmic bias. arXiv:1810.01943 [Preprint]. 2018 [acesso 22 maio 2024]. DOI: 10.48550/arXiv.1810.01943

39. Conselho Federal de Medicina. Código de Ética Médica. Resolução CFM nº 2.217, de 27 de setembro de 2018, modificada pelas Resoluções CFM nº 2.222/2018 e 2.226/2019 [Internet]. Brasília: CFM; 2019 [acesso 22 maio 2024]. Disponível: https://tny.im/S9McE

40. Brasil. Lei nº 3.268, de 30 de setembro de 1957. Dispõe sobre os Conselhos de Medicina, e dá outras providências. Diário Oficial da União [Internet]. Rio de Janeiro, p. 23013, 1 out 1957 [acesso 22 maio 2024]. Disponível: https://tny.im/s1AW8

41. Brasil. Lei nº 12.842, de 10 de julho de 2013. Dispõe sobre o exercício da medicina. Diário Oficial da União [Internet]. Brasília, p. 1º, 11 jul 2013 [acesso 22 maio 2024]. Disponível: https://tny.im/DwLsM

42. Dadalto L, Pimentel W. Responsabilidade civil do médico no uso da inteligência artificial. Revista Iberc [Internet]. 2019 [acesso 22 maio 2024];2(3):1-21. DOI: 10.37963/iberc.v2i3.86

43. Roberto E. Responsabilidade civil pelo uso de sistemas de inteligência artificial: em busca de um novo paradigma. Internet e Sociedade [Internet]. 2020 [acesso 22 maio 2024];1(1):121. Disponível: https://tny.im/L46K

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Jhadson Silva Leonel collected and analyzed the data and contributed to designing the research and writing the paper. Camila Ferreira Silva Leonel contributed to the formatting, proofreading and writing of the paper. Jonas Byk contributed to designing the research, analyzing data and writing the paper. Silvania da Conceição Furtado contributed as course supervisor.

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