ARTIFICIAL INTELLIGENCE IN MEDICINE: THE NEED TO SEE BEYOND

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Abstract: The article's theme centers on the ethical and legal challenges inherent in the intersection of Artificial Intelligence (AI) and Medicine. Avidya, a fundamental concept in Buddhism, symbolizes the nature of reality as a blind man navigating with a cane, embodying a lack of profound understanding of reality. This analogy is used to illustrate our endeavor to transcend mere groping in the dark, aiming for a deeper comprehension that transforms blindness into a catalyst for enhancing other senses. In this context, AI brings us closer to the emerging paradigm of "4P medicine,"[1] characterized as preventive, personalized, predictive, and proactive. In the healthcare sector, AI's potential extends to assisting with diagnosis, prognosis, formulating public policies, and devising targeted treatments based on genetic data. The central research question explores how to develop ethical and legal solutions for AI's application in Medicine, with a forward-looking perspective that encompasses the diverse abstract and individual normative directives of the respective knowledge domains. This article delves into the ethical challenges posed by AI in healthcare, which become apparent only when an interdisciplinary perspective is adopted. This approach facilitates the integration of concepts and regulations, focusing on the 'how-to' aspect and transcending the limitations (avidya) of a solely legal analysis. The first section addresses AI and legislative initiatives. The second section discusses new technologies, with a specific focus on AI in healthcare. The third section unveils challenges that emerge from broadening our understanding of AI through an interdisciplinary lens. Given the topic's complexity, particularly its sensitive application in healthcare, the article identifies ethical and economic hurdles in implementing this novel technology in medicine. The research methodology is theoretical, descriptive, and exploratory, utilizing technical bibliographic procedures, including a systematic literature review on the "Web Of Science" platform and an analysis of legislative texts.

Keywords: Artificial Intelligence; new health technologies; ethic; Medical Law; Avidya.

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[1] Moreno-Sanchez, Pedro A. *An automated feature selection and classification pipeline to improve explainability of clinical prediction models.* Finland, 2021, IEEE 9th International Conference on Healthcare Informatics (ICHI).

INTRODUCTION

The concept of Avidya in Buddhism, which pertains to the nature of reality, is symbolized by the image of a blind man feeling the ground with his cane. It can be conceptualized as a "loss of vision." However, Avidya does not signify ignorance or a mere absence of information; instead, it represents a lack of deeper perception of reality. Lama Padma Santem explains:

> The manifestation of avidya produces closure. When one thing appears, it produces a concealment, because we fail to see others, and this concealment also goes unnoticed – avidya generates the concealment of concealment. It is the narrowness of vision – a narrowness that seems spacious, as an entire panorama unfolds, images appear, apparently concrete visions, at the same time that other options for experiences are hidden by the experience of the images that appear. Avidya allows us to operate in the world, but always through delusion. When an object arises, delusion and the impulse for corresponding action arise.[2]

This study analyzes the ethical challenges of using artificial intelligence (AI) in healthcare, which are only unveiled when we adopt an interdisciplinary perspective rather than focusing solely on a legal viewpoint. It encourages us to look beyond the present and see the future. This approach symbolizes the transition from groping in the dark to using blindness as a catalyst, thereby sharpening our other senses for a deeper understanding. The complexity of this topic, especially considering its sensitive application in healthcare, necessitates an interdisciplinary analysis and approach. This is essential for identifying both ethical and economic obstacles in implementing this new technology in the medical field.

Artificial intelligence is a technology that combines "data, algorithms, and computational capacity" to mimic human intelligence.[3] It enables machines to learn and function in "complex environments" as efficiently as humans. In AI, technology evolves through its operation, gaining the capability to mimic many human actions and perform tasks previously exclusive to humans.[4] This is known as self-learning capacity, where the

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[2] Samten, Lama Padma. *A roda da vida como caminho para a lucidez.* São Paulo: Peirópolis, 2010, 41, freely translated.

[3] Facchini Neto, Eugenio, and Roberta Scalzilli, *Pode a Ética Controlar o Desenvolvimento Tecnológico? A Caso da Inteligência Artificial, à Luz do Direito Comparado*, in Cristiano Colombo, Wilson Engelmann & José Luiz de Moura Faleiros Junior (ed.), Tutela Jurídica do Corpo Eletrônico (Indaiatuba: Editora Foco, 2022).

[4] Facchini Neto, Eugenio, and Roberta Scalzilli, *Pode a Ética Controlar o Desenvolvimento Tecnológico? A Caso da Inteligência Artificial, à Luz do Direito Comparado*, in Cristiano Colombo, Wilson Engelmann & José Luiz de Moura Faleiros

machine grows and evolves with experience.[5] One of the most notable features of AI is its ability to imitate "human doing" behaviors, ranging from trivial tasks to those of great complexity, "linked to mathematical models."[6]

This innovative technology aligns with the principles of new medicine, focused on preventive, personalized, predictive, and proactive treatment.[7] In healthcare, AI can be utilized in myriad ways, such as aiding diagnosis, reducing false positives, exploring treatment options, prognostication, patient screening, optimizing the fight against hospital infections, treatments based on genetic data, reading and interpreting tests, managing health data, medical research, and prevention, among others. Through AI, tasks traditionally performed by humans are automated, "evaluating and judging events, situations, and cases, identifying differences and similarities," and even "estimating, anticipating, and predicting."[8]

However, despite AI's benefits in healthcare, a critical examination of its potential challenges is imperative. The research question is: How can we construct ethical and legal solutions for the application of AI in Medicine, while considering the diverse abstract and individual normative commands of the respective fields of knowledge?

The first part of this work will discuss AI and legislative initiatives, both globally and nationally. The second part will focus on new technologies and AI in the healthcare sector. The third part will reveal the challenges encountered when expanding our understanding of AI's challenges through an interdisciplinary approach. A systematic literature review conducted on the "Web of Science" platform, using the terms "Ethical use of artificial intelligence in healthcare" between 2020 and 2023, across fields including medical ethics, computer science, AI, and robotics, and ranking the top 10 studies using MethodiOrdinatio, revealed certain setbacks minimally discussed in legal literature concerning AI challenges, particularly in healthcare.

A theoretical, descriptive, and exploratory research methodology was

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Junior (ed.), Tutela Jurídica do Corpo Eletrônico (Indaiatuba: Editora Foco, 2022).

[5] Colombo, Cristiano, and Wilson Engelmann, *Inteligência Artificial em Favor da Saúde: Proteção de Dados Pessoais e Critérios de Tratamento em Tempos de Pandemia*, in Henrique Alves Pinto, Jefferson Carús Guedes & Joaquim Portes de Cerqueira César (ed.), Inteligência Artificial Aplicada ao Processo de Tomada de Decisões (Belo Horizonte, São Paulo: D'Plácido, 2020), 225-245.

[6] Floridi, Luciano, and Federico Cabitza. *Intelligenza Artificiale: L'uso delle Nuove Macchine* (Firenze: Giunti Editore, 2021), 28-29.

[7] Nogaroli, Rafaella, and Miguel Kfouri Neto. *Inteligência Artificial na Análise Diagnóstica: Benefícios, Riscos e Responsabilidade do Médico,* in Miguel Kfouri Neto & Rafaella Nogaroli (ed.), Debates Contemporâneos em Direito Médico e da Saúde (São Paulo: Thomson Reuters Brasil, 2020).

[8] Floridi, Luciano, and Federico Cabitza. *Intelligenza Artificiale: L'uso delle Nuove Macchine* (Firenze: Giunti Editore, 2021), 28-29.

utilized, incorporating bibliographic, documentary, and legislative reviews, including on the "Web Of Science" platform.

I. ARTIFICIAL INTELLIGENCE AND THE CONSTRUCTION OF A LEGAL FRAMEWORK

The ability of a computer system to make autonomous decisions is known as artificial intelligence (AI).[9] It encompasses a range of technologies integral to the Fourth Industrial Revolution, aiming to fulfill societal needs and potentially forging a new society[10], referred to as "society 5.0." In this era, the Internet of Things (IoT) will significantly impact the connections between people and objects, bridging the online and offline worlds and creating a synergy between humans and machines.[11] Additionally, the transition from physical to digital realms has fostered the fusion of these spaces, culminating in an *Onlife* Experience. [12] This all-encompassing experience alters self-perception, societal constructs, and our understanding of reality, blurring the lines between the territorial, physical, and geographic realms and the digital, remote, and data-driven realities.

The European Union's Artificial Intelligence Regulation Proposal conceptualizes an "AI System" as a "set of objectives defined by humans" to "create results, such as content, predictions, recommendations or decisions, that influence the environments with which it interacts."[13] This field of computer science focuses on developing algorithms capable of tasks that usually require human intelligence. AI enables the creation of machines with cognitive abilities comparable to or surpassing human capabilities, proficient

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[9] Tripathi, Swapnil, and Chandni Ghatak, Artificial Intelligence and Intellectual Property Law, 7 *Christ University L.J.* 83-97 (2018), https://doi.org/10.12728/culj.12.5.

[10] Colombo, Cristiano, and Wilson Engelmann, *Inteligência Artificial em Favor da Saúde: Proteção de Dados Pessoais e Critérios de Tratamento em Tempos de Pandemia*, in Henrique Alves Pinto, Jefferson Carús Guedes & Joaquim Portes de Cerqueira César (ed.), Inteligência Artificial Aplicada ao Processo de Tomada de Decisões (Belo Horizonte, São Paulo: D'Plácido, 2020), 225-245.

[11] Facchini Neto, Eugenio, and Roberta Scalzilli, *Pode a Ética Controlar o Desenvolvimento Tecnológico? A Caso da Inteligência Artificial, à Luz do Direito Comparado*, in Cristiano Colombo, Wilson Engelmann & José Luiz de Moura Faleiros Junior (ed.), Tutela Jurídica do Corpo Eletrônico (Indaiatuba: Editora Foco, 2022).

[12] Floridi, Luciano. *The 4th Revolution: How the Infosphere is Reshaping Human Reality* (Oxford: Oxford University Press, 2014), 43.

[13] European Union, *Proposal for a Regulation of the European Parliament and of the Council Establishing Harmonised Rules on Artificial Intelligence (Artificial Intelligence Regulation) and Amending Certain Legislative Acts of the Union* (Aug. 26, 2023), available at eur-lex.europa.eu/legal-content/PT/TXT/HTML/?uri=CELEX:52021PC0206.

in complex environments and, in some cases, outperforming humans.[14]

AI's self-learning capacity means that the technology evolves and improves through experience[15], allowing it to replicate many human behaviors and execute tasks previously exclusive to humans. AI operates on data, which is its primary resource. The intricate algorithmic system enables AI to function through data storage and processing.[16]

Alan Turing, a pioneer in algorithmic programming, famously questioned, "Can machines think?"[17] However, it was John McCarthy in the 1950s who coined the term "artificial intelligence." He defined it as a program processing information in a way that mimics human responses to similar inputs.[18] It's important to distinguish between traditional artificial intelligence, prevalent since the 1950s, and more recent developments like machine learning and deep learning. Machine learning, a common method for creating AI systems, allows them to learn from data without explicit programming[19], identifying patterns in provided data[20] through exposure.[21] Algorithms are capable of predicting, standardizing and subjecting the system to training.[22] Deep learning, a subset of machine learning, draws inspiration

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[14] Facchini Neto, Eugenio, and Roberta Scalzilli, *Pode a Ética Controlar o Desenvolvimento Tecnológico? A Caso da Inteligência Artificial, à Luz do Direito Comparado*, in Cristiano Colombo, Wilson Engelmann & José Luiz de Moura Faleiros Junior (ed.), Tutela Jurídica do Corpo Eletrônico (Indaiatuba: Editora Foco, 2022).

[15] Colombo, Cristiano, and Wilson Engelmann, *Inteligência Artificial em Favor da Saúde: Proteção de Dados Pessoais e Critérios de Tratamento em Tempos de Pandemia*, in Henrique Alves Pinto, Jefferson Carús Guedes & Joaquim Portes de Cerqueira César (ed.), Inteligência Artificial Aplicada ao Processo de Tomada de Decisões (Belo Horizonte, São Paulo: D'Plácido, 2020), 225-245.

[16] Colombo, Cristiano, and Wilson Engelmann, *Inteligência Artificial em Favor da Saúde: Proteção de Dados Pessoais e Critérios de Tratamento em Tempos de Pandemia*, in Henrique Alves Pinto, Jefferson Carús Guedes & Joaquim Portes de Cerqueira César (ed.), Inteligência Artificial Aplicada ao Processo de Tomada de Decisões (Belo Horizonte, São Paulo: D'Plácido, 2020), 225-245.

[17] Turing, Alan. Computing Machinery and Intelligence, 59 *Mind* 236 (Oct. 1950), 433-460.

[18] Tripathi, Swapnil, and Chandni Ghatak, Artificial Intelligence and Intellectual Property Law, 7 *Christ University L.J.* 83-97 (2018), https://doi.org/10.12728/culj.12.5.

[19] Dourado, Daniel de Araujo, and Fernando Mussa Abujamra Aith, A Regulação da Inteligência Artificial na Saúde no Brasil Começa com a Lei Geral de Proteção de Dados Pessoais, 22 *Rev. Saúde Pública* 56:80 (2020).

[20] Peixoto, Fabiano Hartmann, and Roberta Zumblick Martins da Silva, *Inteligência Artificial e Direito*, in Direito, Racionalidade e Inteligencia Artificial, vol. 1 (Curitiba: Ed. Alteridade, 2019), 21.

[21] Facchini Neto, Eugenio, and Roberta Scalzilli, *Pode a Ética Controlar o Desenvolvimento Tecnológico? A Caso da Inteligência Artificial, à Luz do Direito Comparado*, in Cristiano Colombo, Wilson Engelmann & José Luiz de Moura Faleiros Junior (ed.), Tutela Jurídica do Corpo Eletrônico (Indaiatuba: Editora Foco, 2022).

[22] Wolkart, Erik Navarro. *Análise Econômica do Processo Civil: Como a Economia, o*

from neural networks[23], enabling machines to learn using more complex algorithms and mimicking the human brain's processing and inference abilities.[24]

Luciano Floridi has critically analyzed the term "Artificial Intelligence," arguing that AI represents a "divorce" between action and the need for intelligence, rather than a "marriage" between engineering and biology. He presents the formula "IA = *agere sine intelligere*," meaning acting without intelligence.[25] Floridi highlights that historically, acting, intelligence, and intentionality were inseparable, but an artificial agent might be causally, not morally, responsible for its actions, akin to an earthquake.[26] This brings new ethical discussions to the fore.

The European Commission has proposed numerous initiatives to establish the first European Union regulatory framework for AI, targeting various sectors and aiming to "classify risks" at different levels.[27] The European Parliament advocates for AI systems to be safe, transparent, traceable, non-discriminatory, environmentally friendly, and under human supervision.[28]

An amendment to the Proposed Regulation on Artificial Intelligence in June 2023 marked a significant shift, emphasizing the adoption of human-centered and reliable AI, while protecting health, security, fundamental rights, and democracy from its potential harms.[29] This embodies the principle

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Direito e a Psicologia Podem Vencer a Tragédia da Justiça (São Paulo: Revista dos Tribunais, 2019), 706.

[23] Facchini Neto, Eugenio, and Roberta Scalzilli, *Pode a Ética Controlar o Desenvolvimento Tecnológico? A Caso da Inteligência Artificial, à Luz do Direito Comparado*, in Cristiano Colombo, Wilson Engelmann & José Luiz de Moura Faleiros Junior (ed.), Tutela Jurídica do Corpo Eletrônico (Indaiatuba: Editora Foco, 2022).

[24] Facchini Neto, Eugenio, and Roberta Scalzilli, *Pode a Ética Controlar o Desenvolvimento Tecnológico? A Caso da Inteligência Artificial, à Luz do Direito Comparado*, in Cristiano Colombo, Wilson Engelmann & José Luiz de Moura Faleiros Junior (ed.), Tutela Jurídica do Corpo Eletrônico (Indaiatuba: Editora Foco, 2022).

[25] Floridi, Luciano, and Federico Cabitza. *Intelligenza Artificiale: L'uso delle Nuove Macchine* (Firenze: Giunti Editore, 2021), 150.

[26] Floridi, Luciano, and Federico Cabitza. *Intelligenza Artificiale: L'uso delle Nuove Macchine* (Firenze: Giunti Editore, 2021), 150.

[27] European Union, *Parliament Negotiates First Rules for Safer Artificial Intelligence* (Aug. 2023), available at https://www.europarl.europa.eu/news/pt/press-room/20230609IPR96212/parlamento-negoceia-primeiras-regras-para-inteligencia-artificial-mais-segura.

[28] European Union, *Parliament Negotiates First Rules for Safer Artificial Intelligence* (Aug. 2023), available at https://www.europarl.europa.eu/news/pt/press-room/20230609IPR96212/parlamento-negoceia-primeiras-regras-para-inteligencia-artificial-mais-segura.

[29] European Union, *Parliament Negotiates First Rules for Safer Artificial Intelligence* (Aug. 2023), available at https://www.europarl.europa.eu/news/pt/press-

of Human Centrality, prioritizing human considerations over technological advancements.[30]

In Brazil, article 20 of the General Personal Data Protection Law (LGPD) of 2018 is the first normative directive explicitly addressing AI. While LGPD's context is personal data protection, it also legislates on AI by addressing automated decisions. However, not all automated decisions result from AI, as they may simply follow a predefined instruction sequence without learning or adaptation. Nevertheless, AI typically involves automated decision-making and thus falls under the purview of LGPD's article 20, contributing to the national legal framework on intelligent decisions.[31] Article 20 affirms the right to review automated decisions and the data subject's right to an explanation, with potential audits by the National Data Protection Authority to examine any discriminatory aspects.

Two legislative proposals on Artificial Intelligence (AI) are currently under consideration in Brazil, offering significant insights for this study. The first proposal, PL 21 of 2020, outlines several key provisions: 1) The definition of an AI system, as specified in Article 2, which excludes applications for automated decisions without learning, "guided exclusively by predefined programming parameters that lack the system's capacity to learn and interpret the external environment"; 2) The imperative to "respect ethics" and the "encouragement of self-regulation through the adoption of codes of conduct and good practice guides," as stated in Article 4; 3) A list of principles in Article 5, including the "Centrality of the Human Being," which emphasizes "respect for human dignity, privacy, protection of personal data, and fundamental rights when the system addresses human-related issues"; 4) Guidelines for Public Power, under Article 6, covering "I - sectoral action: actions by public power must be undertaken by the competent body or entity, considering the specific context and regulatory framework of each sector"; "III – risk-based management"; and "IV – social and interdisciplinary participation."[32] This bill, consisting of ten articles, serves

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room/20230609IPR96212/parlamento-negoceia-primeiras-regras-para-inteligencia-artificial-mais-segura.

[30] Colombo, Cristiano, and Guilherme Damasio Goulart. *Inteligência Artificial em Softwares que Emulam Perfis dos Falecidos e Dados Pessoais de Mortos*, in Gabrielle Bezerra Sales Sarlet, Manoel Gustavo Neubarth Trindade & Plínio Melgaré (ed.), Proteção de Dados: Temas Controvertidos, vol. 1, 95-114 (Indaiatuba: Foco, 2021), 95-114.

[31] For the purposes of this topic, it is recommended to read Colombo, Cristiano et al., *Inteligência Artificial Aplicada ao Setor Empresarial na Oferta de Bens e Serviços: Princípios, Riscos e Recomendações Práticas*, Gráfica RJR (Porto Alegre, 2023), at https://www.academia.edu/104802736/Intelig%C3%AAncia_Artificial_aplicada_ao_setor_empresarial (accessed Aug. 2023).

[32] Brazil, *Projeto de Lei No. 21/2020 (2020),* available at https://legis.senado.leg.br/sdleg-getter/documento?dm=9063365.

as an important foundation for discussions on AI legislation in Brazil.

The second proposal, PL 2338 of 2023, is more extensive and detailed, comprising forty-five articles. Article 1 reveals its intent to establish general standards while acknowledging the need for sector-specific regulations due to AI's diverse applications. Article 2 describes its foundational principles, with the Principle of Good Faith guiding the application of others. Section I also emphasizes the Centrality of the Human Person, aligning with European experiences. Key principles relevant to this study include "III – human participation in the AI cycle and effective human supervision"; and "VI – transparency, explainability, intelligibility, and auditability"; crucial considerations for the patient-doctor relationship and the clarity, transparency, and inspectability of applications.

The proposal includes a chapter on the "Rights" of individuals affected by AI decisions, enabling those who utilize such technology, including in healthcare, to seek explanations and reviews of outcomes. A subsequent chapter addresses "Risk Categorization," banning AI activities involving "Excessive Risk" and specifically categorizing as "High Risk" under Article 17, "applications in health, including those aiding diagnoses and medical procedures," which directly relate to this study's focus. The proposal also covers governance, civil liability, communication of serious incidents, supervision, and inspection. The supervision and inspection chapter mandates the competent authority to "coordinate with public regulatory authorities in specific sectors of economic and governmental activities subject to regulation." Furthermore, according to PL 2338, "public bodies and entities responsible for regulating specific sectors of economic and governmental activity will coordinate their activities, in the corresponding spheres of activity", as well as

> the competent authority will maintain a permanent communication forum, including through technical cooperation, with public administration bodies and entities responsible for regulating specific sectors of economic and governmental activity, in order to facilitate its regulatory, supervisory and sanctioning powers.[33]

Senator Rodrigo Pacheco, in the legislative proposal's justification, refers to "co-regulation," indicating that the solutions should involve a confluence of different fields of knowledge. In summary, these bills recognize the importance of preserving principles and establishing a dialogue with sectoral authorities and regulatory bodies to develop concrete measures that transcend legal issues and address the practical aspects of each activity. Thus, some challenges of AI in healthcare can only be identified through an

[33] Brazil, *Projeto de Lei No. 21/2020 (2020),* available at https://legis.senado.leg.br/sdleg-getter/documento?dm=9063365.

interdisciplinary approach, overcoming the avidya that might arise from a solely legal perspective.

Regardless of regulation, the application of AI in decision-making pervades many aspects of daily life, including professions like medicine.[34] The next section will present some of the main technological advancements in healthcare, particularly in relation to AI.

II. NEW TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE IN HEALTHCARE

Healthcare is one of the sectors where the use of new technologies holds immense promise. Technological advancements have popularized telemedicine, enabling medical practice from a distance.[35] For instance, remote monitoring devices can now be attached to a patient's heart, transmitting real-time health data to their doctor.

Additionally, the Digital Era has ushered in a new generation of surgeons equipped with innovative technologies, including in the field of robotics.[36] In the early 90s, various robotic surgical systems were developed, such as RoboDoc, which performs vascular anastomoses, and Artemis, designed for remote manipulation.[37]

Since 2000, over six million surgeries have been performed globally using the Da Vinci robotic system. A notable example occurred in 2002 when a surgeon in the United States conducted the first telesurgery on a patient located thousands of kilometers away in France.[38] Artificial intelligence (AI) is increasingly vital in healthcare, offering technologies and techniques to enhance diagnosis, treatment, monitoring, and healthcare management.

The adoption of AI in medical applications coincides with a broader shift

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[34] Colombo, Cristiano, and Wilson Engelmann, *Inteligência Artificial em Favor da Saúde: Proteção de Dados Pessoais e Critérios de Tratamento em Tempos de Pandemia*, in Henrique Alves Pinto, Jefferson Carús Guedes & Joaquim Portes de Cerqueira César (ed.), Inteligência Artificial Aplicada ao Processo de Tomada de Decisões (Belo Horizonte, São Paulo: D'Plácido, 2020), 225-245.

[35] Sánchez-Caro, Javier, and & F. Abellán, *Telemedicina y Protección de Datos Sanitarios* (Granada, España: Comares, 2002).

[36] Nogaroli, Rafaella. *Responsabilidade Civil Médica e Consentimento do Paciente nas Cirurgias Robóticas Realizadas à Distância (Telecirurgias),* in Fernanda Schaefer (ed.), Telemedicina: Desafios Éticos e Regulatórios (Indaiatuba-SP: Editora Foco, 2022), 60.

[37] Skinovsky, James et al., Realidade Virtual e Robótica em Cirurgia - Aonde Chegamos e Para Onde Vamos?, 35 *Rev. Col. Bras. Cir*. 334-337 (2008), https://doi.org/10.1590/S0100-69912008000500011.

[38] Nogaroli, Rafaella. *Responsabilidade Civil Médica e Consentimento do Paciente nas Cirurgias Robóticas Realizadas à Distância (Telecirurgias),* in Fernanda Schaefer (ed.), Telemedicina: Desafios Éticos e Regulatórios (Indaiatuba-SP: Editora Foco, 2022), 61-62.

in conventional medical practice towards the "4Ps medicine"[39] concept: preventive, predictive, personalized, and proactive. This approach shifts the focus from merely treating illnesses to prioritizing actions for illness prevention and early diagnosis.[40] The applications of AI in healthcare are varied, including diagnosis, prognosis, public policy studies, exam screening and interpretation, health data management, prevention, treatment, medical research, and more. The Elizabeth Wende clinic in New York, specializing in breast diagnosis, utilizes algorithms to analyze mammograms, reducing false negatives by almost 40%. The AI system "Watson" assists in cancer diagnosis and treatment recommendations.[41] It is estimated that half of the doctors in the United States use the "Epocrates" software, which automates drug interaction analysis.[42] Machine learning, a subset of AI, is recognized as a potentially effective technology for analyzing complex health data and identifying early symptoms, crucial in combating epidemics.[43]

AI can also support decision-making for incapacitated patients unable to express their wishes. This is beneficial because advance directives are often inconclusive or nonexistent, and the patient's guardians or relatives may be influenced by their emotions in decision-making. Algorithms can calculate the most likely preferred treatment for incapacitated patients.[44] Annette Rid and David Wendler first proposed this in 2010, using the "PPP - Patient Preference Predictor," which employs patients' sociodemographic data (age, sex, marital status, previous health conditions, and experiences) to predict treatment preferences.[45]

Developing AI to support medical decisions, such as in cardiopulmonary resuscitation, offers advantages like the absence of stress factors, time pressure, personal biases, conflicts of interest, and fear of legal consequences

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[39] Moreno-Sanchez, Pedro A. *An automated feature selection and classification pipeline to improve explainability of clinical prediction models.* Finland, 2021, IEEE 9th International Conference on Healthcare Informatics (ICHI).

[40] Nogaroli, Rafaella, and Miguel Kfouri Neto. *Inteligência Artificial na Análise Diagnostica: Benefícios, Riscos e Responsabilidade do Médico,* in Miguel Kfouri Neto & Rafaella Nogaroli (ed.), Debates Contemporâneos em Direito Médico e da Saúde (São Paulo: Thomson Reuters Brasil, 2020).

[41] Susskind, Richard, and Daniel Susskind, *El Futuro de las Profesiones* (España: Talleres Editoriales Cometa S.A., 2016), 47.

[42] Susskind, Richard, and Daniel Susskind, *El Futuro de las Profesiones* (España: Talleres Editoriales Cometa S.A., 2016), 48.

[43] Ossa, Laura Arbalaez et al., A Smarter Perspective: Learning with and from AI-Cases, 135 *Elsevier* (Nov. 2022).

[44] Ferrario, Andrea et al., Ethics of the Algorithmic Prediction of Goal of Care Preferences: From Theory to Practice, 49 *J. Med. Ethics* 165-174 (Nov. 2023).

[45] Ferrario, Andrea et al., Ethics of the Algorithmic Prediction of Goal of Care Preferences: From Theory to Practice, 49 *J. Med. Ethics* 165-174 (Nov. 2023).

that could influence decision-making.[46] Furthermore, healthcare technological systems utilize nudging assumptions, such as apps sending notifications to prevent cognitive impairment progression in elderly patients.[47] A survey conducted in three U.S. hospital institutions revealed that both ChatGPT-3 and ChatGPT-4 successfully passed the neurological surgery specialization admission test, correctly answering 60% of the questions in the U.S. national medical qualification exam.[48]

Despite the numerous benefits of using AI in healthcare, a critical examination of its potential challenges is essential. The next section will analyze some of the main challenges associated with AI use across various fields (medical ethics, computer science, AI, and robotics), supported by the 10 highest-ranked works classified by MethodiOrdinatio[49] from a systematic literature review on the "Web of Science" platform. The review used the terms "Ethical use of artificial intelligence in healthcare" for publications between 2020 and 2023.

III. TO BROADEN PERSPECTIVES, AN INTERDISCIPLINARY APPROACH IS ESSENTIAL

The wide-ranging benefits of artificial intelligence (AI) applications in our lives are accompanied by risks and challenges, some of which have already been identified. Concerns about these effects are significant, and legal scrutiny suggests potential issues, including " discriminatory attitudes, potential violations of fundamental rights and manipulations in various forms."[50] It's crucial to consider contributions from other fields of knowledge, adopting an interdisciplinary approach to this discussion.

An economic aspect worth noting is the impact AI might have on health systems due to its potential for unprecedented predictive accuracy in

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[46] Biller-Andorno, Nikola et al., AI Support for Ethical Decision-Making Around Resuscitation: Proceed with Care, 48 *J. Med. Ethics* 175-183 (Mar. 2021).

[47] Capasso, Marianna, and Steven Umbrello, *Responsible Nudging for Social Good: New Healthcare Skills for AI-Driven Digital Personal Assistants*, Springer (Nov. 2021).

[48] Nogaroli, Rafaella. Implicações da IA na Medicina: ChatGPT Já Faz Diagnósticos e é Aprovado para Residência Médica, *Gazeta do Povo* (Apr. 13, 2023), available at https://www.gazetadopovo.com.br/opiniao/artigos/implicacoes-da-ia-na-medicina-chatgpt-ja-faz-diagnosticos-e-e-aprovado-para-residencia-medica/.

[49] MethodiOrdinatio is a systematic literature review methodology that guides the systematic search, collection and reading of scientific material, consisting of nine phases. http://reginapagani2011.wixsite.com/methodiordinatio

[50] Facchini Neto, Eugenio, and Roberta Scalzilli, *Pode a Ética Controlar o Desenvolvimento Tecnológico? A Caso da Inteligência Artificial, à Luz do Direito Comparado*, in Cristiano Colombo, Wilson Engelmann & José Luiz de Moura Faleiros Junior (ed.), Tutela Jurídica do Corpo Eletrônico (Indaiatuba: Editora Foco, 2022).

determining individuals' health risks.[51] While this can enhance health system planning, it also risks disrupting the economic balance of health plans, which rely on a solidarity-based contribution system. Typically, this system balances the costs between those who frequently use services and those in better health who use them less.

This balance is vital for the sustainability of health systems. If a health plan were to have only clients with poor health, the monthly premiums would become prohibitively expensive, potentially restricting access to these plans.

The possibility of the collapse of statutory and income-based health plans, as warned by Ulmenstein[52] in the context of the German healthcare system, may also apply to the Brazilian public and private healthcare systems. The high predictive accuracy of AI in healthcare could lead to "adverse selection,"[53] posing a threat to these systems.

In terms of biases, it is widely acknowledged that AI systems, despite being programmed for precise and logical decision-making, can exhibit discriminatory patterns reflective of human imperfections.[54] The potential for discrimination is inherent in algorithmic decision-making, independent of the programmers' intentions.[55]

As algorithms are dependent on their underlying data, the quality of automated decisions is directly linked to the quality of this data. If historical data contains biases, these discriminatory patterns are automatically replicated by the algorithm during processing.[56]

Smallman highlights an often-overlooked aspect: current ethical guidelines primarily address technology's impact on individuals, adopting a rights-based approach, but tend to overlook how technology significantly influences social structures. There is a notable oversight of "the power of artificial intelligence to truly shape social arrangements." Artificial

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[51] Ulmenstein, Ulrich von, et al., *Limiting Medical Certainties? Funding Challenges for German and Comparable Public Healthcare Systems Due to AI Prediction and How to Address Them*, Frontiers (Aug. 2022).

[52] Ulmenstein, Ulrich von, et al., *Limiting Medical Certainties? Funding Challenges for German and Comparable Public Healthcare Systems Due to AI Prediction and How to Address Them*, Frontiers (Aug. 2022).

[53] Ulmenstein, Ulrich von, et al., *Limiting Medical Certainties? Funding Challenges for German and Comparable Public Healthcare Systems Due to AI Prediction and How to Address Them*, Frontiers (Aug. 2022).

[54] Facchini Neto, Eugenio, and Roberta Scalzilli, *Pode a Ética Controlar o Desenvolvimento Tecnológico? A Caso da Inteligência Artificial, à Luz do Direito Comparado*, in Cristiano Colombo, Wilson Engelmann & José Luiz de Moura Faleiros Junior (ed.), Tutela Jurídica do Corpo Eletrônico (Indaiatuba: Editora Foco, 2022).

[55] Doneda, Danilo Cesar Maganhoto et al., Considerações Iniciais Sobre Inteligência Artificial, Ética e Autonomia Pessoal, 23 *Pensar*, n. 4 (2018), 5.

[56] Doneda, Danilo Cesar Maganhoto et al., Considerações Iniciais Sobre Inteligência Artificial, Ética e Autonomia Pessoal, 23 *Pensar*, n. 4 (2018), 5.

intelligence is a key factor in driving societal structural changes and should not be viewed merely as a healthcare tool.[57]

Drawing an analogy with automobiles, which are often seen simply as transport means, artificial intelligence is similarly considered just a tool for various applications. However, "you only have to look outside our windows to realize that cars have shaped every decision in our lives."[58] For instance, studies in robotics indicate that high technology costs necessitate more centralized healthcare, often to the detriment of localized and traditional care. This centralization can disproportionately affect low-income families, who generally have less access to transport[59], thereby exacerbating existing health inequalities[60] and leading to disparate treatments for different groups. This situation underscores the need for a return to "*algorethics*," a field dedicated to addressing ethical challenges in algorithm application. This includes the concept of embedding ethical values into machines and developing algorithms capable of making ethical evaluations in the face of new and unpredictable scenarios.[61]

In the realm of artificial intelligence (AI) applied to healthcare, there is evidence suggesting that its benefits are not uniformly distributed, potentially exacerbating existing societal biases and disproportionately affecting marginalized individuals and groups.[62] However, as highlighted by Aquino, who conducted interviews with a range of health professionals (including health workers, screening program managers, health representatives, regulators, data scientists, and developers), there is considerable debate regarding the presence of biases in healthcare AI. This disagreement itself underscores the challenges in addressing bias.[63]

The principles of transparency and explainability of algorithms, particularly in machine learning where algorithms have multiple layers, are critical. The complexity of these algorithms can obscure the factors driving

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[57] Smallman, Melanie. *MultiScale Ethics – Why We Need to Consider the Ethics of AI in Healthcare at Different Scales*, Springer (Nov. 2022).

[58] Smallman, Melanie. *MultiScale Ethics – Why We Need to Consider the Ethics of AI in Healthcare at Different Scales*, Springer (Nov. 2022).

[59] Smallman, Melanie. *MultiScale Ethics – Why We Need to Consider the Ethics of AI in Healthcare at Different Scales*, Springer (Nov. 2022).

[60] Stahl, Bernd Carsten. *A Systematic Review of Artificial Intelligence Impact Assessments*, Springer (Feb. 2023).

[61] Floridi, Luciano, and Federico Cabitza. *Intelligenza Artificiale: L'uso delle Nuove Macchine* (Firenze: Giunti Editore, 2021), 59-60.

[62] Aquino, Yves Saint James. Practical, Epistemic and Normative Implications of Algorithmic Bias in Healthcare Artificial Intelligence: A Qualitative Study of Multidisciplinary Expert Perspectives, *J. Med. Ethics* (Feb. 2023).

[63] Aquino, Yves Saint James. Practical, Epistemic and Normative Implications of Algorithmic Bias in Healthcare Artificial Intelligence: A Qualitative Study of Multidisciplinary Expert Perspectives, *J. Med. Ethics* (Feb. 2023).

decision-making. Understanding these factors is essential for patients to comprehend the logic behind automated decisions that influence their healthcare.[64]

Deep learning algorithms are capable of tasks like setting criteria for organ transplants, including allocation, matching donors and recipients, and predicting transplant patient survival. These algorithms might soon influence the order of transplant queues, potentially differing from those determined solely by human clinical criteria.[65]

However, it is important to highlight an aspect that seems to go unnoticed, but which was brilliantly highlighted by Ossa and which reinforces the importance of interdisciplinarity when dealing with the topic: the doctor and the medical student need to be trained "based on concrete examples of how the algorithm works" (for example, what data it feeds on – comorbidities, test results, vital signs, medication administered, etc.). In addition to transparency, this is the only way to make critical judgment possible for the doctor to "realize that the result of artificial intelligence may not be consistent with what is seen in clinical practice."[66]

Consequently, medical professionals require at least basic knowledge of AI applications to compare their clinical reasoning with AI suggestions. This comparison enables reflection on assumptions and potential biases, highlighting ethical concerns and existing issues in clinical practice.[67] Adapting the educational model for doctors to address the challenges posed by AI technology is essential. Incorporating scenarios that use AI in clinical practice "encourages ethical reflections and opportunities for interdisciplinary collaboration." [68]

Another notable aspect is the use of "nudging assumptions" in healthcare technology systems, such as apps designed to prevent cognitive impairment progression in elderly patients.[69] Companies are integrating personalized nudges into products, exemplified by Amazon's Alexa, which gathers user data and preferences to influence decision-making.[70] Therefore, the

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[64] Ossa, Laura Arbalaez et al., A Smarter Perspective: Learning with and from AI-Cases, 135 *Elsevier* (Nov. 2022).

[65] Dourado, Daniel de Araujo, and Fernando Mussa Abujamra Aith, A Regulação da Inteligência Artificial na Saúde no Brasil Começa com a Lei Geral de Proteção de Dados Pessoais, 22 *Rev. Saúde Pública* 56:80 (2020).

[66] Ossa, Laura Arbalaez et al., A Smarter Perspective: Learning with and from AI-Cases, 135 *Elsevier* (Nov. 2022).

[67] Ossa, Laura Arbalaez et al., A Smarter Perspective: Learning with and from AI-Cases, 135 *Elsevier* (Nov. 2022).

[68] Ossa, Laura Arbalaez et al., A Smarter Perspective: Learning with and from AI-Cases, 135 *Elsevier* (Nov. 2022).

[69] Capasso, Marianna, and Steven Umbrello, *Responsible Nudging for Social Good: New Healthcare Skills for AI-Driven Digital Personal Assistants*, Springer (Nov. 2021).

[70] Capasso, Marianna, and Steven Umbrello, *Responsible Nudging for Social Good: New*

responsible innovation of AI-driven digital personal assistants in healthcare should be aligned with a design approach focused on avoiding harm and promoting good.

Dialogue with Regional and Federal Councils of Medicine is crucial for developing regulations or co-regulations on AI in Brazil. As AI proliferates across various fields, sector-specific standards, informed by Council guidelines and good practices, are needed for case-specific solutions in healthcare.

General standards can guide AI applications, but the nuanced understanding of "medical doing" in healthcare is best evaluated by medical councils. The challenge lies in how an AI authority, dealing with multiple applications, can grasp the intricacies of medical procedures performed by AI and identify ethical duty violations. Multidisciplinary chambers are vital for comprehensively understanding these phenomena. Floridi's concept of HumanInside, articulated as "artificial *agere* + human *intelligere* = intelligent system," emphasizes the integration of human understanding with AI.[71]

Given the complexity and scope of AI, its potential benefits for healthcare, and the myriad challenges we must confront, it is necessary to move beyond a purely legal analysis (*Avidya*) of these challenges. Adopting an interdisciplinary approach that incorporates insights from medicine, health, ethics, robotics, programming, design, information technology, entrepreneurship, and public administration is crucial for a comprehensive understanding and effective application of AI in healthcare.

CONCLUSION

This paper aimed to analyze the application of artificial intelligence (AI) in the health sector, focusing on some ethical challenges that emerge when we adopt an interdisciplinary perspective rather than solely a legal one.

A systematic literature review conducted on the "Web of Science" platform, using the terms "Ethical use of artificial intelligence in healthcare" between 2020 and 2023, encompassed fields such as medical ethics, computer science, artificial intelligence, and robotics. Through the MethodiOrdinatio ranking, the study identified several underdiscussed setbacks in legal literature concerning AI challenges in healthcare.

One significant challenge is the potential disruption to the economic balance of health plans due to AI's high predictive accuracy in determining disease risks. This accuracy could lead to adverse selection and the possible collapse of Brazil's healthcare systems. AI, being a tool in various life

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Healthcare Skills for AI-Driven Digital Personal Assistants, Springer (Nov. 2021).

[71] Floridi, Luciano, and Federico Cabitza. *Intelligenza Artificiale: L'uso delle Nuove Macchine* (Firenze: Giunti Editore, 2021), 169.

aspects, also has the potential to drive significant societal changes. In robotics, for instance, the high cost of technology has led to a more centralized healthcare system, disadvantaging local care and potentially limiting access for low-income families.

Furthermore, a survey involving interviews with various professionals (health workers, screening program managers, health representatives, regulators, data scientists, and developers) revealed a disagreement about the existence of biases in healthcare AI. This disagreement itself presents a challenge in addressing the discriminatory effects of the technology.

Therefore, in addition to the legal perspectives on the ethical use of AI in healthcare, it is crucial to look beyond the confines of law, moving past avidya. This involves leveraging the expertise of professionals from diverse fields to ensure that the development and application of AI in healthcare are conducted interdisciplinary, centering on human welfare and adhering to the principles of beneficence and non-maleficence.

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