Cardiology and Humanism in the Age of Artificial Intelligence: A Challenge to Become More Human

Cardiología y humanismo en tiempos de inteligencia artificial: un desafío para ser más humano

"The fault, dear Brutus, is not in our stars, but in ourselves."
William Shakespeare

Modern medicine is undergoing an unprecedented transformation in which Artificial Intelligence (AI) is evolving from a mere technical tool into a proactive support system capable not only of processing language, analyzing images and movement, but also of predicting or describing clinical patterns, enabling multimodal integration, performing simulations, and supporting automation and management. The true challenge in clinical practice lies in understanding AI so that it can be guided toward the common good, transparency, and unwavering respect for human dignity.

Humanism in medicine is the school of thought that holds that medical practice cannot be reduced to a mere application of science and technology but must instead be deeply rooted in empathy, respect for human dignity, and a holistic understanding of the patient.

In this regard, humanism should not be seen as a hindrance to technology, but rather as its ethical compass. AI is not neutral; it reflects the values and ideology of those who create it. Therefore, the development of medical AI requires what we might call "Digital Humanism."

Integrating humanism into technological development means "educating the algorithm with values." While AI surpasses us in speed and computational power, it lacks physical embodiment, dignity, and above all, moral consciousness. It cannot distinguish between right and wrong or assume responsibility for the consequences of its decisions.

Recognizing the need to foster a more rigorous discussion on the integration of digital medicine and AI, the Digital Health Council of the Argentine Society of Cardiology (SAC) was established in 2022. In April 2026, the first Digital Health Consensus was presented. (1)

Two recent international events highlight the importance of this issue. In May 2025, Pope Leo XIV published the encyclical *Magnifica Humanitas* on safeguarding the human person in the time of artificial intelligence. (2)

Last June, G7 leaders, together with the European Union, held a landmark working session on AI at the summit in Évian-les-Bains, France. For the first time, beyond the political framework, they met with leading AI developers and chief executive officers. The discussions focused on technological sovereignty, the safe development of advanced AI models, and the protection of children.

As cardiologists, we are enthusiastic about the future of AI in medicine and firmly convinced of the importance of understanding and shaping it so that it becomes a tool that enhances the value of the human person. Furthermore, given the central role of AI together with the aspiration to transcend the limits of the human condition, we have an opportunity to discuss the future impact of emerging trends in transhumanism and posthumanism.

WHAT IS AI?

AI is a branch of computer science that develops systems capable of learning from data and performing complex tasks that normally require human intelligence. AI encompasses *machine learning*, which enables computers to learn from data without being explicitly programmed, and *deep learning*, an advanced *machine learning* technique that uses artificial neural networks inspired by the human brain. (1,3)
Machine learning works as follows:

1. Supervised learning: The system analyzes correctly labeled data and learns to identify different patterns and improve its predictions when presented with new data.
2. Unsupervised learning: The system is provided with a dataset without predefined labels and must identify patterns on its own, without requiring labeled data.

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3. Reinforcement learning: Combines aspects of both supervised and unsupervised learning. The system learns through interactions with its environment, receiving rewards or penalties based on the actions it takes.

AI has advanced at an accelerating pace over the past century and has grown exponentially over the last decade. (4) Looking back, Alan Turing, in his paper Computing Machinery and Intelligence, proposed the "Turing Test" as a criterion for determining whether a machine could simulate human intelligence. (5)

In 1943, the neurophysiologist Warren McCulloch and the mathematical logician Walter Pitts introduced the artificial neuron model and proposed that neurons could be modeled as binary units (active or inactive) capable of computing any logical function. (6)

It was John McCarthy who coined the term "artificial intelligence." Together with Herbert Simon, Marvin Minsky, and Allen Newell, they laid the foundations for this discipline at the historic 1956 Dartmouth Conference.

In 1958, Frank Rosenblatt developed the perceptron, a practical implementation of an artificial neural network consisting of an input layer, a hidden layer, and an output layer. Each node computed a weighted sum of its inputs and applied an activation function to generate an output. (7)

The 1986 paper by David Rumelhart, Geoffrey Hinton, and Ronald Williams popularized the backpropagation algorithm. By implementing the chain rule, it solved the problem of updating the weights in the hidden layers of a multilayer neural network. Using a mathematical optimization method known as gradient descent, the algorithm iteratively adjusts the network's weights in the direction that minimizes the overall error, thereby improving the predictive performance of different models. (8)

The year 2012 marked the beginning of the large-scale deep learning revolution. Advances in computing infrastructure enabled machines to learn autonomously at unprecedented levels. The digital revolution was driven by several simultaneous developments: faster graphics processing units (GPUs), increased storage capacity, the availability of big data, the emergence of cloud computing, advancements in communication networks (broadband and fiber optics), the introduction of Tensor Processing Units (TPUs) and other specialized chips, and reduced energy costs per operation.

"Attention Is All You Need" was a groundbreaking scientific paper published in 2017 by Google researchers. It introduced the Transformer architecture, which dispenses with recurrent neural networks and relies exclusively on attention mechanisms to understand context and the relationships between words. (9) The architecture introduced in this paper laid the foundation for the subsequent development of large language models (LLMs), including the GPT (Generative Pre-trained Transformer) family of models, which use neural networks to generate human-like text and are capable of conversing, programming, translating, and reasoning logically.

In 2018, Google DeepMind introduced AlphaFold, a groundbreaking AI system that predicted the three-dimensional structure of proteins from their amino acid sequences. (3)

Within medicine, after medical imaging, cardiology is the second specialty in which AI has been most extensively developed. The thoughtful integration of algorithms provides invaluable tools for expanding human capabilities and optimizing medical care in the pursuit of precision, efficiency, and reproducibility. (10)

Some examples of these developments include:

- Precision diagnosis and early screening: Recent studies have shown that AI tools achieve area under the curve (AUC) values greater than 0.90 for the detection of cardiovascular diseases, demonstrating robust accuracy across a variety of modalities. AI-optimized electrocardiographic models have proven highly effective in identifying the risk of atrial fibrillation, cardiomyopathies, and asymptomatic left ventricular dysfunction. (11)
- Training and procedural guidance: Deep learning algorithms assist non-expert professionals in acquiring diagnostic images, such as echocardiograms, thereby reducing technical training requirements.
- Optimization and administrative relief: Automation of diagnostic test ordering, automated summaries of medical records, real-time transcriptions ("ambient notes"), and the generation of discharge reports substantially reduce clinician's administrative burden.
- Critical monitoring: In intensive care units, machine learning models have accurately predicted the onset of shock, enabling earlier intervention. Other potential applications include the use of facial thermography analyzed by neural networks to noninvasively detect low cardiac output in critically ill patients. (12,13)

Each of these predictive models has a greater impact on diagnosis than on the prediction of events, given the importance of time as an uncertainty variable. It is important to emphasize that most of these studies lack multicenter validation, and comparative studies evaluating different models remain scarce.

Furthermore, integrating AI into clinical workflows is a work in progress, and we are still in the early stages of digital medicine, where aspects such as connectivity, interoperability, and scalability remain major challenges. For example, in an imaging laboratory, AI could be useful in reducing measurement variability caused by intra- and inter-observer differences, assisting with the standardization of image acquisition and improving image quality, helping to optimize image interpretation and post-processing times, shortening report turnaround times, addressing both overdiagnosis and underdiagnosis, increasing the volume of imaging studies, identifying imaging features (radiomics) imperceptible to the human eye, and, of course, optimizing workflows, scheduling, billing, and the management of relevant information. (10,14)

CLINICAL, ETHICAL, AND EPISTEMIC RISKS

Alongside its benefits, the unregulated use of AI poses critical risks that must be actively identified and mitigated: (1,11,14,15)

- Epistemic opacity: Many algorithms operate as a "black box," where the decision-making process is not transparent, hindering clinical validation and raising ethical and legal questions regarding liability.
- Diagnostic and interpretive failures: Biases inherent in training data, algorithmic hallucinations (false information presented as factual), and sycophancy (the tendency of AI systems to conform to users' assumptions) pose direct risks to patient safety.
- The illusion of knowledge: Research has shown that current LLMs lack the ability to distinguish between belief, factual knowledge, and objective truth, leading to critical errors when processing false information.
- Loss of professional skills (deskilling): There is a risk that clinicians may relinquish their independent clinical judgment in favor of the convenience of allowing machines to make decisions for them. Adapting Hegel's "master-slave dialectic," there is a risk that physicians, by delegating complex tasks to AI, may become dependent on these systems and lose their practical skills and critical judgment.
- Dehumanization and disconnection: Replacing human conversation and therapeutic contact with mere digital connectivity and computational efficiency distances us from the true essence of healing.

THE POTENTIAL RISKS OF UNREGULATED AI. BEYOND MEDICINE

There are other aspects of AI that could affect the future of humanity. (14) Broadly speaking, transhumanism advocates the enhancement of human beings through technology with the goal of optimizing human performance and capabilities. Likewise, posthumanism, at its most extreme, criticizes anthropocentrism and proposes a form of hybridization between humans, machines, and the environment, ushering in a new evolutionary stage for humanity. (2) The decisions made over the coming decades will shape not only the future of AI but also our future as a species. From this perspective, leaving the evolution of AI in the hands of a few could have several negative consequences:

- Dehumanization in decision-making
- Concentration of power and global imbalance
- Threat to truth and democracy
- Impact on employment and new forms of exploitation
- Psychological and educational risks
- Arms race and impersonal warfare
- Environmental degradation

In *The Wealth of Nations*, Adam Smith established that labor is the true source of wealth and that capital is the engine that allows wealth to multiply. The division of labor and the accumulation of capital are the fundamental pillars that drive a country's economic growth. (16) With the advent of AI, a third factor has emerged: the management of both global data and individual citizens' data.

Currently, the development of AI is driven predominantly by competition among the United States, China, and Russia, as well as by private transnational actors with resources surpassing those of many governments, creating concentrations of power that are often opaque, difficult to regulate, and prone to generating new forms of domination and inequality.

In this regard, AI can act as a powerful multiplier of disinformation by enabling the manipulation of images, videos, and narratives that distort reality. This undermines social trust and the foundations of democracy, which depend on fidelity to the facts.

Likewise, automation can lead to mass unemployment and relegate workers to rigid, repetitive tasks, eroding their capacity for innovation.

Among young people, the early and unsupervised use of these tools can affect attention and emotional regulation and encourage reliance on immediate answers—a tendency that undermines critical thinking and the desire to patiently seek the truth.

Access to personal data poses the risk of creating a digital panopticon that raises serious dilemmas regarding individual privacy and freedom, and where human experience could become the raw material for commercially driven predictions.

Beyond speculative theoretical positions, transhumanism and posthumanism are two perspectives that will gradually shape the collective imagination and, consequently, guide social, economic, and political decisions. In this regard, an amoral AI that does not recognize the value of human life is at risk of contributing not only to a culture of waste but also to a loss of recognition of the human person as an ontological being.

TOWARD A CONSTRUCTIVE DIGITAL HUMANISM

To build a future where technology is a pillar rather than a threat, the medical community must guide its practice by adhering to several fundamental principles.

- Validation as a human act: AI processes and analyzes data at extraordinary speed, but it lacks moral consciousness, physicality, the ability to distinguish between right and wrong, and the capacity to feel empathy or establish a genuine therapeutic friendship. Ethical judgment, ultimate responsibility, and clinical decision-making remain exclusively the physician's .

- Critical training and leadership: it is imperative to actively prepare for this transition. Medical education must prepare physicians to continuously guide and audit AI algorithms according to sound ethical values.
- Prioritizing human dignity: technology must be implemented in an equitable, transparent, and thoughtful manner so that it becomes an agent of inclusion that brings physicians closer to the patient rather than creating technological barriers between them.
- Restoring conversation: following Sherry Turkle's reflections, we must not sacrifice deep conversation for mere digital connection. Technology should free time to strengthen the physician-patient bond. (17)
- Empowered clinical judgment: AI can detect patterns that were previously invisible, but its success depends on thoughtful and equitable deployment. AI can process data, but only physicians can give it meaning within each patient's unique life story. (18) The kind of attention we give to the world changes the world to which we give our attention. If our attention is merely technical, we will dehumanize the patient; if AI free our attention for genuine openness to others and active listening, we will elevate medical practice.

AI is not an inevitable fate to which we must resign ourselves, but a historic opportunity to rediscover what defines us as physicians. Therefore, the future of cardiology depends not only on the sophistication of its machines, but on the physician's ability to remain the guardians of our humanity. The ultimate goal is a model of clinical practice in which technology enhances precision, while physicians preserve judgment, ethics, and empathy.

The present and future of medical practice lie in our hands, and AI may challenge us to become more human, rather than allowing us to fall into the gravest existential risk of "treating the disease better and the person worse."

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REFERENCES

1. Benitez S, Benzadón M, Cintora F, Perea G, Daquarti G, Filipini E y cols. Consenso de Salud Digital. Rev Argent Cardiol 2026;94:1-65. https://doi.org/10.7775/rac.es.v94.s6
2. León XIV. (2026). Magnifica humanitas: Sobre la custodia de la persona humana en el tiempo de la inteligencia artificial [Carta encíclica]. Libreria Editrice Vaticana. https://www.vatican.va.
3. Sigman M., Bilinkis S. Artificial. La nueva inteligencia y el contorno de lo humano. Ciudad Autónoma de Buenos Aires: Debate 2023. 1° edición. Penguin Random House Grupo Editorial.
4. https://es.wikipedia.org/wiki/Anexo:Cronolog%C3%ADa_de_la_inteligencia_artificial.
5. Turing AM. Computing Machinery and Intelligence. Mind 1950;49:433-60. https://doi.org/10.1093/mind/LIX.236.433
6. McCulloch, W. S., Pitts, W. A logical calculus of the ideas immanent in nervous activity, Bulletin of Mathematical Biophisics 1943;5:115-33. https://doi.org/10.1007/BF02478259
7. Rosenblatt F. The perceptron: a probabilistic model for information storage and organization in the brain. Psychol Rev 1958;65:386-408. https://doi.org/10.1037/h0042519
8. Rumelhart D, Hinton G, Williams R. Learning representations by back-propagating errors. Nature 1986;323:533–6. https://doi.org/10.1038/323533a0
9. Vaswani A, Shazeer N, Parmar N, Uszkoreit J, Jones L, Gomez AN, et al. Attention is all you need. Advances in neural information processing systems. 2017;30.
10. Jain SS, Elias P, Poterucha T, Randazzo M, Lopez Jimenez F, Khera R, et al. Artificial Intelligence in Cardiovascular Care-Part 2: Applications: JACC Review Topic of the Week. J Am Coll Cardiol 2024;83:2487-96. https://doi.org/10.1016/j.jacc.2024.03.401
11. Niazai A, Jamil H, Hameed M, Sheikh S, Nisar MR. Artificial intelligence in cardiovascular diagnostics: a systematic review and descriptive analysis of clinical applications and diagnostic performance. BMC Cardiovasc Disord 2025;25:849. https://doi.org/10.1186/s12872-025-05327-x
12. Jentzer JC, Patel S, Gajic O, Herasevich V, Lopez-Jimenez F, Murphree DH, et al. Early prediction of shock in intensive care unit patients by machine learning using discrete electronic health record data. J Crit Care 2025;88:155093. https://doi.org/10.1016/j.jcrc.2025.155093
13. Atamañuk AN, Gandino IJ, Fernández HE, Melchiori RE, Gómez L, Bilbao J, Torres NA, Ross G, Baratta S. Análisis de termografía de infrarrojos mediante inteligencia artificial para diagnóstico no invasivo de bajo gasto cardíaco en pacientes críticos. Rev Argen Cardiol 2026;94:xx-xx. https://doi.org/10.7775/rac.es.v94.i4.21036
14. Harari YN. Nexus. Una breve historia de las redes de información desde la Edad de Piedra hasta la IA. Ciudad Autónoma de Buenos Aires. Debate 2024. 2° edición. Penguin Random House Grupo Editorial.
15. Benett MS. Una historia de la inteligencia: los cinco momentos evolutivos de nuestro cerebro que determinan el futuro de la inteligencia artificial. Ciudad Autónoma de Buenos Aires: Tendencia 2025. 1° edición. Ediciones Urano.
16. Smith, A. (2002). La riqueza de las naciones. (Trad. C. Rodríguez Braun). Alianza Editorial.
17. Sherry Turkle. En Defensa de La Conversación. Ático de los libros. Barcelona, 2017.
18. Charon R. Medicina Narrativa. Honrando las historias de enfermedad (traducido por Silvana Marrón, Juan Carlos Claro y Carlos D. Tajer). Libros del Zorzal 2024.