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Artificial intelligence in medicine

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Abstract

Artificial intelligence is progressively transforming medical practice, in many cases serving as an important tool for screening, diagnosis, treatment, and patient follow-up. If used appropriately, and with the participation of physicians in its design and development (physician in the loop), it can even improve physicians. This article addresses the interface between artificial intelligence, in its many variants, and medicine. The issue of the inevitable impact of artificial intelligence on the physician-patient relationship is examined, particularly considernig the evolution of medical interview transcription systems. Ethical, regulatory, and good governance considerations concluded to be essential in the design and implementation of artificial intelligence, and recommends a cautious approach to artificial intelligence in medicine, in accordance with the precautionary principle.

Keywords: Bioethics. Artificial intelligence. Medicine. Physician-Patient Relations. Robotics.

Resumo

Inteligência artificial na medicina

A inteligência artificial está a transformar progressivamente a prática da medicina, sendo em muitos casos importante ferramenta de rastreio, diagnóstico, tratamento e acompanhamento de doentes. Se adequadamente utilizada, e se houver a participação de médicos em sua concepção e desenvolvimento (*physician in the loop*), pode tornar os médicos ainda melhores. Este artigo aborda a interface entre a inteligência artificial, em suas múltiplas variantes, e a medicina. Aprecia-se a problemática do impacto inevitável da inteligência artificial na relação médico-doente, em especial face à evolução dos sistemas de transcrição de entrevista médica com o paciente. Conclui-se que considerações éticas, regulatórias e de boa governança são essenciais no desenho e implementação da inteligência artificial, assim como recomenda-se atitude prudente sobre a inteligência artificial na medicina, de acordo com o princípio da precaução.

Palavras-chave: Bioética. Inteligência artificial. Medicina. Relações médico-paciente. Robótica.

Resumen

La inteligencia artificial en la medicina

La inteligencia artificial está transformando progresivamente la práctica de la medicina, siendo en muchos casos una herramienta importante para el cribado, el diagnóstico, el tratamiento y el seguimiento de los pacientes. Si utilizada adecuadamente y con la participación de médicos en su diseño y desarrollo (*physician in the loop*), la inteligencia artificial puede hacer que los médicos sean aún mejores. Este artículo aborda la interfaz entre la inteligencia artificial, en sus múltiples variantes, y la medicina. Se analiza la problemática del impacto inevitable de la inteligencia artificial en la relación médico-paciente, especialmente ante la evolución de los sistemas de transcripción de las entrevistas médicas con el paciente. Se concluye que las consideraciones éticas, normativas y de buena gobernanza son esenciales en el diseño y la implementación de la inteligencia artificial, y se recomienda una actitud prudente sobre la inteligencia artificial en la medicina, de acuerdo con el principio de precaución.

Palabras clave: Bioética. Inteligencia artificial. Medicina. Relaciones médico-paciente. Robótica.

Update

The authors declare no conflict of interest.

Artificial intelligence (AI) is progressively transforming medical practice, in many cases serving as an important tool for screening, diagnosis, treatment, and patient follow-up. If used appropriately, and with physician participation in its design and development (physician in the loop), it can and should improve physicians. However, there is a growing risk documented in the literature that the lack of AI explainability may lead physicians to become excessively dependent on automated systems, to the point of compromising their professional autonomy.

The main objective of this article is to address the interface between AI, in its multiple variants, and medicine—not only clinical medicine, in its different medical areas, but also other life and health sciences. A second objective is to examine the issue of the inevitable impact of AI on the physician-patient relationship, considering the evolution of medical interview transcription systems, as well as the medical legal implications of the widespread adoption of AI in medicine. To this end, we address the potential of AI in health care management, in hospitals, primary health care or public health care, and the predictable benefits for humanized and quality medical care resulting from releasing physicians from administrative tasks.

The essence of the physician-patient relationship

Medicine and other health-related professions, such as dentistry, psychology, or physiotherapy, are intrinsically human, in which trust is the basis for a unique encounter, as is the relationship between physicians and patients. Since Hippocratic times, physicians have undertaken the commitment, by professional duty, to full dedication to patients and building of a solid clinical relationship, fiduciary in nature.

Over two millennia, this implied that clinical interviews would unfold with time and privacy, and that physicians would be excellent clinicians, but also that they would play advocacy roles, that is, defending patients before the community [1]. Medical ethics and the codes that provide its principles reflect such architecture of duties and obligations, and the inalienable duty of medical secrecy ensures that information patients transmit to physicians in an environment of total trust is reliable and corresponds to the essence of their clinical history.

However, the evolution of healthcare systems worldwide has led to paradoxical and unpredictable consequences. For example, the pressure for higher productivity in public health care systems—as in the case of the Unified Health System (SUS) in Brazil or the National Health Service (SNS) in Portugal—results in reduced patient consultation time, sometimes only a few minutes, which affects the foundations of the physician-patient relationship; or the fact that the digital transition in healthcare and the creation of the Electronic Health Record have led to the paradoxical situation of physicians spending a large part of the clinical interview time in digitally recording data obtained in the anamnesis, rather than in consultation proper.

In other words, there are at least two negative systematic consequences for medicine. On the one hand, patients report that physicians lack time to establish an effective physician-patient relationship. Greater reliance on digital systems affects the necessary visual interaction with patients, and non-verbal communication is also seriously impaired. Currently, physicians spend more time on administrative tasks, including making clinical records during the anamnesis, than building an authentically human relationship with patients, as used to happen in the past.

On the other hand, if this situation affects patients, it is no less deleterious for physicians. Quantitative studies [2] show that physicians spend 35–40% of their time on electronic documentation, which correlates with high burnout rates. Several hospitals already use human personal assistants—medical scribes—for administrative and clinical documentation in order to improve efficiency and patient care. The use of AI assistants for documentation can reduce this time by up to 20%, with improvement in professional satisfaction scores [3].

With the motto “AI for the Good of All,” the 2024–2028 Brazilian Artificial Intelligence Plan (PBIA) has an estimated investment of R$23 billion by 2028, with one of the central areas of action being the modernization of the SUS. Some initiatives include the following: 1) voice-based electronic health record in the SUS (transcription of medical teleconsultations); 2) AI for drug

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purchase decision-making; 3) optimization of diagnostics in the SUS; 4) AI in oral health; and 5) well-cared-for older adults [4]. The ongoing digital transition in Brazil [5] and the predictable sustainability of the costs of implementing AI in the SUS require adequate strategic planning for the widespread implementation of these systems, as well as firm regulation and supervision. Modern legislation must be introduced, as appears to be the case with Bill 2,338/2023 [6], already approved by the Federal Senate, given that clinical practice is significantly dependent on different information and communication technologies (ICT), such as telemedicine or digital applications such as chatbots [7]. A recent study demonstrated that, to optimize administrative efficiency and reduce physician dissatisfaction and burnout in clinical practice, using AI to answer patient messages sent to clinicians via a patient portal can be especially useful. In fact, for the most part, patients prefer messages written by AI, but their satisfaction decreases when they learn AI wrote them. This highlights the importance of deepening the physician-patient relationship, and AI can help achieve this goal [8].

Telemedicine refers to the use of electronic information and communication technologies to provide health care when distance separates the participants, physician and patient [9]. It refers to providing real-time remote clinical services using audiovisual electronic media [10]. Traditionally, physicians already resorted to remote technologies, such as the telephone, to provide care to patients [11]. Since then, there have arisen ethical issues, which remain current, such as the potential distortion of the physician-patient relationship by physical separation of the parties, the breach of the duty of confidentiality, the difficulty in protecting patient personal data, the adequate recording of the clinical interview, in addition to more general issues, such as fee collection or medical-legal implications [12]. The use of the telephone is routine, even today, for accessing pre-hospital emergency medical care, through contact and triage centers.

The Federal Council of Medicine (CFM), in its Resolution 2,314/2022 [13], defines telemedicine as *medicine practice mediated by Digital, Information, and Communication Technologies (DICT), for the purposes of care, education, research, disease and injury prevention, management, and health promotion*, which can be used in real-time online (synchronous) or offline (asynchronous). The following modes are legitimate and appropriate: teleconsultation, teleinterconsultation, telediagnosis, telemonitoring or telesurveillance, telesurgery, teletriage, and teleconsulting.

In fact, the evolution of ICTs has provided important innovations in this domain, including telesurgery, in which the surgeon remotely, i.e., at a distance, guides robotic instruments to perform surgery. It should be noted that this is not mere advice, as in past telephone consultations (frequent, for example, in pediatrics), but actual consultations for diagnostic and therapeutic purposes, where ethical precepts are naturally even more demanding regarding privacy, data protection, storage and recording of sensitive information, or sharing of information with professional peers. This implies adapting patient consent processes for processing of personal data, such as radiology images, and thus evolving from generic consent to informed and specific consent [14].

Moreover, especially after the COVID-19 pandemic, the use of these technologies has become commonplace for teaching, vocational training, public health, or even for the operational management of health, due to their comfort and convenience, but also because, if implemented appropriately, they improve access to healthcare without compromising the quality of care. In fact, from an ethical-social perspective, modern AI systems can have an enormous effect on the interface between clinical medicine and the management of hospitals and other health care units [15]. In other words, with the implementation of modern operational management, or the use of AI combined with telemedicine, for example, access to healthcare can be guaranteed for several patients who are traditionally excluded from the system due to lack of resources.

Other digital tools more or less driven by AI, such as the generative chatbot, will have significant consequences on the physician-patient relationship and health care management. Chatbots are a specific piece of software that simulates human conversation, written or spoken, in any language, via website, message, telephone, or mobile application. Typically, a chatbot works based on question and answer prompts.

More recently, there has been the emergence of conversational AI, a broad set of technologies that enable machines (robots, for example) to understand and process human language and respond to the interlocutor interactively, in the form of voice or text. Enormous volumes of data are generally used as inputs to imitate human interactions in very different contexts. In medicine, chatbots are currently used, particularly in public health, health education, symptom assessment, triage, medication management, or as telemedicine support. It should be noted that all these technologies exist simultaneously and in total interdependence and interoperability with social networks, blogs, websites, e-mail, images, videos, or audio [16]. In different medical specialties, chatbots help patients schedule appointments, contribute to self-care by answering health-related questions, and can even be useful in promoting health literacy. However, despite the significant potential presented by chatbots in medicine, they entail important risks, which include: providing incorrect or outdated information, difficulty in recognizing emergencies, privacy issues in storing sensitive data, limitations in understanding complex clinical contexts, and a variable accuracy rate depending on the specialty and complexity of the cases.

Thus, it is observed that the traditional physician-patient relationship is undergoing a profound and constant mutation, requiring the adjustment of this technological evolution to the principles of medical ethics, and not the other way around [17]; furthermore, it is also necessary that these new technologies comply with data protection and individual privacy legislation, such as the General Data Protection Law in Brazil [18] or the General Data Protection Regulation in Europe [19].

However, paradoxically, AI can be an extraordinarily positive revolution in this domain. The advent of modern AI-written patient handoff notes, that is, the digital record of the clinical interview mediated by AI, without physician intervention in the writing, therefore hands-free, is a remarkable advance in the consolidation and deepening of the physician-patient relationship [20]. By releasing physicians from administrative tasks, enabling full concentration on patient care and preventing professional burnout, this "medical summarization" condenses complex patient information with evident benefits for everyone.

For medical, ethical, and legal reasons, some aspects must be considered. On the one hand, there must be intense medical supervision in the conception and design of these applications, that is, there must always be a physician in the loop. Furthermore, barring exceptional reason, only the attending physician should be able to alter these notes, in accordance with the duty of secrecy and the confidentiality of the medical act. Therefore, there is major expectation as to the usability, both in daily clinical practice and in emergencies, of these new applications, of AI assistants, in the transcription of physician-patient consultations.

However, it is expected that this transcription or summarization of the patient's medical condition, including differential diagnosis, may quickly evolve into the recommendation of auxiliary diagnostic means or even the preparation of a treatment plan, which raises the need for special ethical and medical-legal assessment. Modern AI systems in medicine, when clashing with the required professional autonomy, represent an enormous challenge for medical ethics. However, the ongoing digital transition can provide numerous benefits to medicine and the physician-patient relationship. For example, it has been suggested that the process of obtaining informed consent can be substantially improved with generative AI by providing the "average patient" with improved readability and intelligibility of the informational document, for example, for surgery [21], and pilot studies suggest that AI improves the understanding of informed consent due to simplified language and visual aids. However, only a small percentage of patients understand technical terms adequately even with AI assistance, which underscores the need for specialized human validation.

Beyond the impact on the most diverse areas of medicine, AI has the potential to contribute to better healthcare for traditionally vulnerable populations, such as older adults, persons with disabilities, or end-of-life patients. For example, AI, especially when combined with other technologies, can be highly useful in improving communication with vulnerable populations, such as persons with severe hearing loss who communicate through visual methods, like sign language or lip-reading. However, a critical, often overlooked aspect is algorithmic bias, by which AI systems can perpetuate or intensify current health care inequalities. Algorithms trained predominantly with data from specific populations may exhibit inferior performance in minority groups, exacerbating disparities in medical care. The implementation of AI in medicine should include regular audits to trace and mitigate these biases, including ethical impact assessments for AI systems.

On the other hand, there are AI systems under development that enable predicting what a person with diminished capacity would decide if they were unable to express themselves and there was no legal representative who could effectively make a "substituted judgment" [22]. The combination of behavioral data obtained through different means, such as social media, with health data, such as those found in electronic health records, could be an alternative for interpreting the will of an incapacitated patient. Although most often this application of AI at the end of life should not be an alternative to advance directives, in the form of a living will or the appointment of a healthcare proxy [23], it can support and improve such decision-making. This apparent contradiction between the benefits and risks of AI is resolved with the implementation of hybrid human supervision models. The literature suggests that *human-in-the-loop* systems preserve medical autonomy when they [24]: 1) maintain transparency about AI limitations; 2) require human validation for critical decisions; 3) provide adequate training to professionals; and 4) implement technical safeguards against excessive dependence.

The physicians' progressive AI dependence, beyond representing a challenge to 21st-century medicine, is expected to profoundly alter the medical-legal regime of medical accountability, given that physicians are required to respect the *leges artis* determined by evidence-based medicine [25]. Only when it is proven that a physician acted with lack of skill, recklessness, or negligence, that is, that they were at fault for the outcome, can legal and medical accountability be attributed for a certain negative consequence. However, if physicians are AI "co-pilots"—for example, if, in robotic surgery, the lack of AI explainability reaches such a level that it is not possible for common physicians to make a truly personal decision (Blackbox phenomenon)—another means will have to be found so the legitimate rights of patients are complied with in case of a poor outcome and, simultaneously, physicians are not attributed accountability that, in fact, is not theirs.

Diagnosis, treatment, and surgical robotics

There is practically no area of medicine where AI does not already have a profound impact today [26]. In primary health care, in hospitals, in the public or private sector, AI is essential in the operational management of organizations, in data storage, in electronic health records, in diagnostic support, in image interpretation, as well as in patient treatment, including the use of surgical robotics. Also, continuous care for elderly patients and even palliative care—areas traditionally considered intrinsically humanizingare currently impacted by the influence of AI at various levels, starting with the monitoring that humanoid robots will carry out with enormous effectiveness and total availability [27].

This evolution raises obvious ethical issues, especially regarding the autonomy of physicians and patients, which can be seriously compromised if the necessary precautions are not taken to ensure adequate patient information. It is also necessary to ensure equity in citizens' access to these technologies and on a global scale [28]. For example, the recent evolution of precision medicine denotes the need to ensure that the benefits of its implementation are universally shared. This is a problematic issue of enormous relevance and must be addressed as quickly as possible.

Precision medicine refers to the adjustment of medical diagnosis and treatment to a subpopulation with some genetic homogeneity and that presents susceptibility to a certain disease or a similar response to a certain drug [29]. Although it is not a novel concept, the AI drive is notorious and is considerably expanding the

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scope of its intervention. In close connection with other areas of medicine and science—such as genomics, epigenomics, proteomics, metabolomics, pharmacogenetics—and with the processing of patient data and biomarkers, from health records, AI designs complex algorithms that direct medical practice to specific population groups. It cannot be forgotten that, while genetic influence is essential, social and environmental determinants are equally important, with an impact not only on medicine practice but also on public health. The objective is to obtain health gains by combining molecular information with health data.

Precision medicine also enables medicine to be progressively personalized, predictive, preventive, and even participatory (4P Medicine) [30], which, being a significant evolution, will surely be exponentially enhanced by modern AI systems. Although 4P Medicine represents important advances, its implementation through AI faces significant limitations, including algorithmic bias and unequal access. This model, having the potential to be the universal gold standard, cannot be reserved for a few people, namely, those who belong to population groups with specific genetic traits and who, in life's lottery, have greater purchasing power and therefore attract Big Pharma and Big Tech, such as the Caucasian populations of North America and Europe.

This means that, in science and health, AI should foster global equity and justice, rather than compound social exclusion stemming from limited access to medical innovations [31]. In a way, AI-mediated access to healthcare can be considered a global public good and, as such, requires a robust regulatory framework for its implementation [32].

This impact of AI is already experienced in different areas of medicine and life sciences, and all of them will be transversally affected, even if some are, from the outset, more susceptible to immediate effects [33-39], such as those presented below:

- blood analyses: pattern recognition, identification of abnormal morphology and evaluation of other blood cell characteristics, early detection and classification of diseases (leukemia);
- radiology: image analysis by AI (X-rays, ultrasound, computed tomography, nuclear magnetic resonance), mammography interpretation, lung neoplasm detection, stroke diagnosis, brain tumor detection, quantitative analysis, predictive analysis;
- oncology: personalized treatment, image analysis, predictive analysis, automatic tumor detection, radiotherapy, precision medicine, new drug discovery, melanoma detection;
- pathology: image analysis, digital pathology, AI-assisted diagnosis, predictive analysis, cancer diagnosis, histological analysis, immunohistochemical interpretation, prostate cancer detection;
- cardiology: AI-supported diagnosis, image analysis, arrhythmia detection, echocardiogram interpretation, cardiovascular risk assessment, coronary artery disease diagnosis;
- neurology: predictive analysis, AI-assisted diagnosis, image analysis, Alzheimer's disease diagnosis, Parkinson's disease diagnosis, multiple sclerosis detection, epilepsy detection;
- otorhinolaryngology: image and video interpretation, automatic diagnosis of voice and sleep disorders, tele-endoscopy, sound and voice analysis, hearing rehabilitation, automatic communication with patients, including people with profound deafness;
- dermatology: image analysis, predictive analysis (melanoma), skin lesion analysis, acne, psoriasis, and eczema diagnosis;
- ophthalmology: diagnosis, monitoring, and treatment of glaucoma, diabetic retinopathy, macular degeneration, cataracts, refractive errors, retinal detachment, strabismus, eye cancer, image analysis, disease course prediction, intraocular lens power calculation, or intravitreal injection planning;
- nutrition: precision/personalized nutrition, predictive analysis (obesity, diabetes, or heart disease), virtual assistance (eating habits), autonomous algorithms for meal planning, predictive diagnostics;
- dentistry: dental imaging (X-rays, computed tomography), treatment planning, orthodontics,

prosthetics (creation of 3D models for teeth and jaws), periodontology, endodontics, oral pathology, dental robotics.

Robotic surgery is another area in full development in all fields of medicine, such as urology, ophthalmology, neurosurgery and otorhinolaryngology [40]. AI is expected to be progressively decisive, possibly even becoming indispensable.

However, some applications are currently already an example of the important evolution in this domain [41]. It should be noted that this evolution is a *continuum*, and not a disruptive moment in time. Robotic surgery has been performed for several years, both in person and remotely by a surgeon. Regarding telesurgery (remote surgery, at a distance), for example, there is no significant paradigm difference compared to traditional surgery. Even though there is physical dissociation between the surgeon who makes the diagnosis and remotely conducts the surgery and the proxy surgeon, that is, the substitute who effectively performs the operation, the responsibility always lies with the former.

However, the most important surgical steps are still not conducted by an electronic device, since traditional surgeons are not simple technicians who rely on data, but rather a person who uses their technical knowledge and human skills, their touch and their empathy in the relationship with patients: that is, the surgical act is just one component of the entire interaction with patients, to whose peculiarities physicians adjust. Telesurgery tends not to achieve this adjustment, especially with the advancement of automation that results in total autonomy of the surgical robot. Once again, it is essential that the surgeon be in control so as not to reinforce the dehumanization in the physician-patient relationship.

Although autonomous robotic surgery is largely in the experimental phase, there is evidence of its short-term effect in areas such as venous puncture, hair implantation, intestinal anastomosis, total knee replacement, or radiosurgery [42]. In a first phase, robotic surgery is an extension of minimally invasive surgery, in which surgeons operate remotely but in the same operating block. Specialized surgical instruments are used as an extension of the surgeon's movements, especially in abdominal and thoracic surgery, thanks to complex algorithms that enable them to mimic the surgeon's movements. Even highly complex surgical interventions are already targeted by autonomous AI robotic surgery. For example, cochlear implantation, that is, the placement of a sophisticated electronic implant in the inner ear [43]. The advancement in dental surgery, in turn, is already significant. In Xi'an, China, an independent robot, without human involvement, placed two 3D-printed dental implants. The significant increase in mass production of humanoid robots will be a decisive factor in their generalization in the healthcare sector.

From an ethical and also medical-legal perspective, informed consent must be obtained in writing. Consent must be obtained by the surgeon in charge, but, in specific situations, such as when the surgeon in charge is at a distance, consent may be obtained by the assistant surgeon, i.e., the one who is with the surgical robot and the patient. It should be noted that, for now, the surgeon is accountable for the outcome of the surgery and its consequences. There is a long learning curve in surgery using traditional methods, a curve that remains or deepens in robotic surgery. The implementation of robotic medical practice must include intensive training in AI and surgical robotics, in addition to the necessary adaptations in intraoperative decision-making [44]. Informed consent in AI systems poses unique challenges [45], including the difficulty in explaining complex algorithms in accessible language, the need for dynamic consent for systems that learn continuously, and issues regarding patient digital literacy. Furthermore, there must be consideration of the patient right not to be subjected to decisions based exclusively on automated processing, as provided for in data protection legislation in different countries.

However, with the progressive automation of surgical robotics, it may be asked who is, in fact, the accountable agent in medical-legal litigation: the responsible surgeon, the assistant surgeon (the one assisting the robot), the company that built and marketed the device, the engineer who designed it, the hospital that makes it available to physicians and patients, or the robot itself (currently, it is raised the possibility of true cybernetic legal personality). If intraoperative complications arise and if a robot is not considered accountable, whose fault will it be? As a rule, surgeons—not robots—are considered responsible agents. These issues must be carefully assessed, always considering the need to establish bonds of trust between AI systems and society in general [46]. However, the attribution of legal personality to AI systems is still controversial and lacks consolidated precedents. The European Parliament rejected a related proposal in 2021. The current regulatory focus is on the accountability of developers and operators, in addition to the development of modern "no-fault" civil liability systems, so patients are compensated under any circumstances [47].

Today, AI has a growing effect on diagnosis, predictive diagnosis, AI-guided biopsy, predictive analysis, treatment and treatment planning, follow-up (virtual coaching), surgical robotics, among many other areas of intervention in medicine. In any case, it is essential that medicine and physicians achieve the best of both worlds. On one hand, there must always be a physician in the AI loop. On the other hand, the unknown evolution of AI in medicine should alert medicine to the need for a cautious strategy consistently with the precautionary principle.

It is an ethical and legal principle that advocates a prudent approach to scientific and technological innovation; the intention is not hindering science and development, but making technological development transparent. There must be emphasis on caution and the need for a reflective pause to assess the potential impact of new technologies [48]. The application of this principle should be guided by four central goals: a) implementation of preventive measures in the face of uncertainty; b) transfer of the burden of proof to the proponents of a given technology; c) proposal of alternative scenarios regarding potential damages; and d) promotion of active public participation in the debate.

This principle is evoked when there are doubts about the safety of a technology—such as AI in medicine—and the magnitude of its effect cannot be predicted. It is a central element of risk-based regulation, as evidenced, for example, in the AI Act, the European Union Regulation on AI [49]. There is a consensus today that, in medicine, physicians and organizations that use AI systems in health care and medical practice should always consider six ethical principles [50]: a) justice; b) universality; c) traceability; d) usability; e) robustness; and f) explainability.

In other words, for AI to be considered trustworthy, there must be respect for a set of internationally validated ethical principles [51] and achievement of the broadest international consensus on best AI practices in medicine and on its impact on the most diverse aspects of human activity [52].

Final considerations

In this article, we noted the need for medicine to closely follow the evolution of artificial intelligence in health care, given its predictable impact on the physician-patient relationship and on the very concept of medical practice. In fact, it is fundamental that AI is always under human supervision (human in the loop) and that physicians are always involved in the design, development, and application of new AI systems in medicine (physician in the loop), taking into consideration the universally shared ethical and civilizational values.

However, there is concern that a lack of knowledge, information, and trust as to AI, associated with a potential change in the professional identity of medicine, may condition the autonomy and freedom of physicians and the quality of the physician-patient relationship. Artificial intelligence should be a copilot of physicians, and never the other way around. Therefore, ethical, regulatory, and good governance considerations are concluded to be essential in the design and implementation of artificial intelligence; thus, similarly essential is a prudent and expectant attitude towards AI in medicine, consistently with the precautionary principle and the prudence that can be required in these circumstances.

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