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TELEMEDICINE AND DIAGNOSTIC ARTIFICIAL INTELLIGENCE: EVOLUTION, PROSPECTS, AND SOCIAL CHALLENGES

TELEMEDICINA E INTELIGENCIA ARTIFICIAL DIAGNÓSTICA: EVOLUCIÓN, PERSPECTIVAS Y DESAFÍOS SOCIALES

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Abstract: This article examines the evolution of telemedicine as one of the key fields in modern medicine, utilizing information and communication technologies to provide medical services remotely. The study's goal is to analyze the historical development of telemedicine and its impact on medical practice, as well as assess the prospects of using Diagnostic Artificial Intelligence (Diagnostic AI) in telemedicine. The research methodology includes discourse analysis, based on the works of Michel Foucault and Gilles Deleuze, allowing the examination of medical institutions as mechanisms for controlling and normalizing patient behavior. The study concludes that telemedicine significantly improves access to healthcare, reduces costs, and enhances treatment efficiency. Diagnostic AI represents a new phase in telemedicine, capable of accelerating and improving diagnostic processes, though its implementation is accompanied by significant ethical and social challenges. The novelty of this article lies in critically examining the role of telemedicine and diagnostic technologies in contemporary society, with a focus on their disciplinary functions and the influence on the relationships between patients and healthcare professionals. The conclusion emphasizes the importance of further study and regulation of Diagnostic AI in medical practice to minimize risks and ensure equitable access to healthcare.
Keywords: telemedicine; artificial intelligence; diagnostic artificial intelligence; Google; AMIE; OpenAI; evolution; prospects; social challenges.

Resumen: Este artículo examina la evolución de la telemedicina como uno de los campos clave en la medicina moderna, utilizando tecnologías de la información y la comunicación para proporcionar servicios médicos de forma remota. El objetivo del estudio es analizar el desarrollo histórico de la telemedicina y su impacto en la práctica médica, así como evaluar las perspectivas de uso de la Inteligencia Artificial Diagnóstica (IA Diagnóstica) en la telemedicina. La metodología de investigación incluye el análisis del discurso, basado en los trabajos de Michel Foucault y Gilles Deleuze, lo que permite examinar las instituciones médicas como mecanismos para controlar y normalizar el comportamiento del paciente. El estudio concluye que la telemedicina mejora significativamente el acceso a la atención médica, reduce los costos y mejora la eficiencia del tratamiento. La IA diagnóstica representa una nueva fase en la telemedicina, capaz de acelerar y mejorar los procesos de diagnóstico, aunque su implementación está acompañada de importantes desafíos éticos y sociales. La novedad de este artículo radica en examinar críticamente el papel de la telemedicina y las tecnologías de diagnóstico en la sociedad contemporánea, con un enfoque en sus funciones disciplinarias y la influencia en las relaciones entre pacientes y profesionales de la salud. La conclusión enfatiza la importancia de seguir estudiando y regulando la IA diagnóstica en la práctica médica para minimizar los riesgos y garantizar un acceso equitativo a la atención médica.
Palabras clave: telemedicina; inteligencia artificial; inteligencia artificial diagnóstica; Google, AMIE; OpenAI; evolución; perspectivas; retos sociales.

Introduction. The Social Institution of Medicine

The phenomenon of medicine and the discourse surrounding it are not static or complete projects; they evolve over time, across various cultures and societies. For instance, one major revelation for Western European society at the turn of the 19th and 20th centuries was the recognition of female sexuality (e.g., in the works of Sigmund Freud, such as “Studies on Hysteria” or “Three Essays on the Theory of Sexuality”). Michel Foucault, arguably the most renowned “archaeologist of knowledge,” proposed the concept of the clinical gaze in his book “The Birth of the Clinic” (Foucault, 2003). Through this lens, we observe a shift from viewing diseases

as abstract entities to studying illness as something visible and diagnosable within the human body.

This transition, on one hand, transforms the phenomenon of medicine itself and its social presence, while on the other hand, it sets the direction for the discursive practices and social relations that form around it. Following Foucault's insights, we can trace several stages in the historical transformation of medical discourses:

1) Classical Medicine (17th – 18th centuries): Characterized by a purely medical view of disease, where diseases were treated as individual entities, independent of the patient. Physicians, inspired by natural sciences, aimed to classify and systematize diseases, much like botanists classify plants. Symptoms were considered external manifestations of internal diseases, and the physician's task was to interpret these symptoms accurately.

2) Clinical Medicine (Late 18th – Early 19th centuries): During this period, the clinic as a disciplinary institution was born. The focus shifted from abstract diseases to the specific body of the patient, where diseases could be localized, connected to certain organs and tissues, and diagnosed, even through dissection. This new paradigm of bodily observation contrasted with the patient's subjective experience.

3) Biopolitics (19th – 20th centuries): Medicine became a tool of power, aimed at controlling individual bodies and populations. At this stage, state healthcare institutions were established, serving not only to treat patients but also as mechanisms for controlling public health (Foucault, 2008). For example, psychiatry forms the understanding optics through which the norms of behavior and the degrees of deviation from them are illuminated; patients of psychiatric clinics in such optics are transformed into objects of disciplinary control, where the task of medicine is not so much in treatment as in the normalization of deviant behavior. In sum, medicine is integrated into the state machine, oriented toward

maintaining and even improving the health of the nation, but mainly in statistical indicators.

Later, pointing to the transition from disciplinary systems to societies of control, G. Deleuze developed the Foucauldian concept, noting the medicalization of everyday life, when everyday practices (nutrition, physical activity, sleep) become objects of medical attention, moving from the private to the public sphere, more accurately subject to measurement and control; and the technologization of medicine, as a result of which medicine is transformed into a complex network, where health management is carried out through information platforms that collect and analyze data about patients in real time (Deleuze, 1992).

This technological turn is the implementation of telemedicine, which is now a legitimate area of medicine that uses contemporary information and communication technologies to provide medical services and patient consultations at a distance. Telemedicine has maintained its relevance over the past decade; the most striking illustration of this is still the COVID-19 pandemic, when access to traditional health services became difficult around the world.

The so-called telemedicine "body" includes indirect consultations, patient health monitoring, emergency cases and educational programs as integral elements. For example, consultations allow patients to receive answers to their queries from doctors online, without the need for direct physical contact. The importance of such a procedure increases for people living in remote or hard-to-reach areas. But consultations also help reduce the actual load on medical institutions (supra-individual utility) and reduce the waiting time for an appointment (individual utility).

Dissemination of smart devices across individual households is another element of telemedicine. Using mobile devices and sensors, patients can remotely monitor key health indicators (blood pressure, blood sugar, heart rate). This data is automatically transmitted to

doctors, which allows them to promptly respond to deviations from the norm. In emergency situations, telemedicine technologies allow the victim to promptly contact a doctor who can provide first aid, give recommendations for stabilizing the condition or decide on the need for hospitalization. Moreover, today telemedicine is increasingly used to train medical workers. Online courses, webinars and other educational resources help improve the qualifications of medical personnel and inform the population.

Telemedicine is a spectacular illustration of evolving disciplinary institutions; it significantly improves access to medical care for the general population, reduces health care costs, and increases the effectiveness of treatment. At the same time, the need to ensure the security of personal data, protect patient privacy, and standardize telemedicine services is growing exponentially. In addition, over the past five years, non-human actors have increasingly been included in the doctor-patient relationship. As recently as the end of the 20th century, the functions of a machine in a medical context were limited to analyzing the data it received. Today, a machine claims to be a "specialist" capable of providing professional services in consulting a patient, diagnosing him, and supporting his treatment.

Diagnostic AI: A New Milestone in Telemedicine Opens New Challenges

Artificial intelligence implementing diagnostic goals in medical discourse (so-called Diagnostic AI) is one of such agents. Diagnostic AI is one of the most promising areas in medicine and information technology. Its application covers a range of tasks: from interpreting images and analyzing genetic data to predicting treatment results and supporting medical decisions.

Artificial intelligence in medicine began with the first expert systems in the 1960s. However, a technological leap has only been made in the last decade in the context of machine learning, in the areas of deep learning and big data processing. Modern AI-based diagnostic systems are able to analyze huge amounts of data, which significantly exceeds human capabilities, and provide doctors with recommendations based on this data. One of the key breakthroughs has been the development of AI systems for analyzing medical images. For example, a study by analysts from India showed that such systems can identify pathological changes in images with an accuracy comparable to or even superior to the capabilities of experienced radiologists (the article specifies that systems trained on MRI or CT data are able to recognize cancer in the early stages, which significantly increases the chances of successful treatment) (Mathur et al., 2022).

The use of AI in diagnostics has a number of obvious advantages. Firstly, it is the high speed and accuracy of data processing, which is especially important in the context of a shortage of qualified medical personnel and an increasing burden on healthcare (Pinto-Coelho, 2023). Secondly, AI can help minimize the human factor, which often leads to diagnostic errors (Russell & Norvig, 2021). However, the implementation of Diagnostic AI is associated with a number of challenges and limitations. One of the main problems is the trust of doctors and patients in AI systems. Extensive clinical trials and certification of such systems are needed to ensure their reliability and safety. This formalizes the ethical problems in the use of AI in real medical practices, founded, on the one hand, by the confidentiality of patient data, and on the other hand, by the question of the responsibility of AI for the decisions made (in general, about the legitimacy of applying the criteria of responsibility to software) (Floridi, 2023).

In any case, the ethical issues surrounding the use of diagnostic AI touch on several areas at once. One of the key issues is ensuring fair access to new technologies. There is a risk that such systems will be used predominantly in developed countries, while developing countries may be left without access to these achievements (the very formulation of the problem repeats the classic plot of class struggle, transcribed by McKenzie Wark on the "hacker" material (Wark, 2004). An equally fundamental question is who is responsible for the decisions made by AI. If the system makes a mistake, who will be held accountable: the developers, the doctors using the system, or the intelligent system itself (Jobin, et al., 2019)?

AMIE: Preliminary results of testing the Google's neural network

Diagnostic AI is a revolutionary tool that has the potential to significantly improve the quality of medical care and make diagnostics more accessible and accurate. However, successfully implementing AI in medical practice requires addressing a number of technical, ethical, and social issues. Articulate Medical Intelligence Explorer (AMIE), Google's medical neural network, demonstrates this paradox of technological development and ethical turbulence.

The development and testing of AMIE, an innovative system based on large language models (LLM) designed to conduct medical diagnostic dialogues, is discussed in the paper "Towards Conversational Diagnostic AI" by researchers from Google Research and Google DeepMind (Tu, et al., 2024). The authors define the goal of the study as the creation of artificial intelligence capable of improving the availability and quality of medical care by introducing advanced technologies into the diagnostic process and

generating AI recommendations for the treatment of a specific patient (Tu, et al., 2024, p. 3). They clarify that dialogue between a doctor and a patient is the basis of medical practice. Moreover, up to 80% of diagnoses are made on the basis of anamnesis obtained during communication with the patient (see, for example, Peterson, 1992). However, according to experts, the contemporary healthcare system around the world faces many challenges, including a shortage of qualified doctors, especially in remote and disadvantaged areas, as well as the high cost of medical services (see, for example, Roshan & Rao, 2000). In response to the identified problems, the AMIE neural network was developed, which uses a modern architecture on LLM base. At the input AMIE receives text information in the form of a question or complaint of the patient; based on the initial information and answers to clarifying questions at the output the neural network issues from two diagnoses corresponding to the indicated symptoms, clarifies the most probable of them and offers the patient specific prescriptions.

AMIE was trained using a rich dataset. These included real medical dialogues to create a database that closely resembles real-life doctor-patient interactions; multiple-choice medical questions to improve AMIE's ability to generalize and solve clinical problems of varying complexity; and expert medical summaries to provide a system with reliable and validated information for diagnosis and decision-making (Tu, et al., 2024, p. 4–5).

One of the key aspects of AMIE training was the self-learning method, which is widely used in modern neural networks (see, for example, OpenAI, et al., 2024 or Google, 2024). In a simulated environment, AMIE interacts with other AI agents, simulating interactions with patients and receiving constant feedback. This allowed the system not only to record errors, but also to improve its skills with each new dialogue, gradually moving towards the expert level. To test the effectiveness and accuracy of the AMIE system, a

blinded study was conducted in which the system was compared with primary care physicians based on interactions with "simulated" patients. The results showed that AMIE demonstrated higher diagnostic accuracy compared to doctors directly. In particular, the system outperformed physicians on 28 of 32 performance indicators assessed by experts and on 24 of 26 indicators assessed by simulators playing the role of patients (Tu, et al., 2024, p. 12–15). These results confirm that AMIE is capable of not only supporting high-quality medical dialogues, but also making a significant contribution to improving the quality of diagnostics, especially in cases where the physician may be limited in time or resources.

The authors of the study emphasize the advantages of using AMIE, including:

1) Availability: AMIE can operate around the clock, providing support to patients regardless of time and location; 2.

2) Data consistency and objectivity: the system minimizes human errors associated with fatigue, stress, or personal biases of medical personnel;

3) Potential for learning and self-improvement of the neural network itself: AMIE is able to adapt to new data and medical discoveries, which makes it a productive tool in the context of constantly evolving medicine (Tu, et al., 2024, p. 17–21).

At the same time, the researchers noted several limitations identified during the operation of the neural network. The key one was the text interface on which AMIE was launched; messages about the patient's condition in text format were rated by doctors as unusual and inconvenient; traditional methods of interaction with patients, direct conversation, remain familiar to them. Despite the successful results in the simulation, the authors point out the need for further testing of the system in real conditions to assess its practical applicability and safety. And in this case, as noted earlier,

ethical issues arise related to the use of AI in matters of human life and health.

Google developers note the growing potential in the development of AI systems for medical dialogues. In the future, according to their forecast, AMIE may become an important component of telemedicine platforms, especially in conditions of limited access to qualified medical care. The development of such systems also opens the door to new research and improvements in the field of medicine, promoting a personalized approach to treatment. The article "Towards Conversational Diagnostic AI" itself became another step forward in the field of medical AI. The researchers proposed a system that can change the understanding of diagnostic processes and improve the availability of quality medical care around the world. The study by Google employees yielded positive results, which, however, require further detailed development in order to integrate AMIE and similar systems into real medical practice, minimizing possible risks and ethical issues.

"House M.D.": Telemedicine via "TV"

Diagnostic AI is a contemporary telemedicine tool that is at the forefront of technological developments. However, in the history of telemedicine, including its current state, we find less technologically advanced, but quite effective tools that draw the attention of a wide audience to health and rare diseases. For the global audience, a kind of harbinger of interest in health was an "unhealthy character", Dr. House (the series "House M.D."). The main character of the series, Dr. Gregory House, a brilliant and cynical diagnostician, encountered rare and complex medical cases, which attracted the attention of a wide audience to specific aspects of diagnosis and treatment.

The case of "House M.D." can be considered from several key positions, which claim some correlation between the series and the awareness of the general audience about their health. First of all, the series caused a surge of interest in the medical profession, especially in the specialty of medical diagnostics. Many viewers were inspired by the image of House, and this led to an increase in the number of applicants choosing medical specialties in the 2000s worldwide (Strauman, & Goodier, 2011).

Even though the series often simplified real medical situations, "House M.D." introduced viewers to a number of rare diseases and demonstrated the importance of a comprehensive approach to diagnosis. Viewers learned about diseases such as lupus, sarcoidosis, and Cushing's syndrome, which increased their overall awareness of a variety of medical problems. The series emphasized the importance of a thorough analysis of symptoms and medical history for an accurate diagnosis. According to analysts, after watching the series, most respondents became more attentive to their own health and learned which symptoms may be signs of serious diseases (Casado & Saborido, 2010). Doctors, in turn, noted that patients who watched the series became more demanding of their own diagnostic process; they began to discuss their symptoms with doctors more actively, which simultaneously improved and complicated the treatment process (Ibid.). In sum, "House M.D." provoked a broad audience's interest in medical science and gave viewers basic knowledge about complex medical cases. However, in particular cases, the idea of the diagnostic process in a so-called dramatic wrapper led to inflated expectations of patients from medicine and doctors in real life.

Neuralink and Alex's victories

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Understanding the breadth of technical and technological integration in contemporary medicine goes far beyond telemedicine. For example, chipping and implantation nowadays open up the possibility of full or partial autonomy for paralyzed patients. In August 2024, Neuralink published a progress update on the second participant in the PRIME study aimed at assessing the safety and functionality of an innovative device, a fully implantable and wireless brain-computer interface (BCI) Link (*PRIME Study Progress Update*, 2024). The basic goal of the study is to provide people with tetraplegia (paralysis of all four limbs) with the ability to restore autonomy and control digital devices using their thoughts.

In July 2024, the second PRIME participant, Alex, underwent successful surgery to receive a Link implant at the Barrow Institute of Neurosurgery. Alex was discharged the following day and is recovering uneventfully. Alex began using Link to control a computer cursor, completing the task in under five minutes after first being connected. Within hours, he had set a new world record for accuracy and speed of BCI-assisted cursor control on a Webgrid task, surpassing achievements using other assistive technologies. Alex, a former automotive technician, used the Link implant on the second day after surgery to work with the computer modeling

software Fusion 360. He was able to design and 3D print amount for his Neuralink charger, allowing him to continue working on projects without significant assistance. This demonstrates the potential of Link to support users with disabilities to recover and develop their skills and interests. Alex also tested Link in games, first-person shooters, that require the simultaneous use of multiple joysticks and buttons. Before Link, Alex used the Quadstick, a mouth joystick with pressure sensors. However, this controller limited his ability to move and aim at the same time. Using Link in combination with the Quadstick, Alex can now do both at the same time, which has greatly improved his gaming experience.

Today, Neuralink continues to expand Link's capabilities, working to decode complex movements and improve the device's functionality to provide full control of a mouse and game controller. Algorithms are also being developed to recognize writing intent, which will help speed up text entry, as well as interact with the physical world, such as controlling a robotic arm or wheelchair. The PRIME study and the success of its second participant highlight significant progress in the development of brain-machine interfaces. In the future, Link could be an important step towards restoring freedom and independence for people with disabilities, helping them to regain and improve their quality of life. These results inspire confidence in the possibility of applying similar technologies to a wide range of users with medical limitations, offering new perspectives in the field of assistive technology.

Conclusions. In some ways Michel Foucault was right…

In 1975, Foucault introduced the concept of a disciplinary society into scientific circulation, where power is exercised through control over people's bodies and behavior with the help of various

institutions. Hospitals, schools, and prisons are aimed at the so-called normalization of individuals and the establishment of discipline over them. Disciplinary power, according to Foucault, does not suppress a person directly, but directs and regulates his actions, turning him into a "disciplined" subject.

Diagnostic AI can be considered as a current example of a disciplinary institution that operates within the healthcare system. In Foucault's discourse, medical neural networks perform control and normalization functions, simultaneously influencing the behavior of healthcare workers and patients. Diagnostic AI allows for continuous monitoring of the patient's health. Just as observation was the central element of control in hospitals in the 18th and 19th centuries, today diagnostic AI can monitor physiological parameters, diagnose deviations, and offer treatment recommendations. This permanent monitoring can be considered an analogue of Bentham's "panopticon", where the subject (in this case, the patient) is always under observation, which stimulates self-regulation (for example, when the machine reports that an insufficient number of steps were taken today). Diagnostic AI uses large volumes of data to analyze patients' conditions and identify deviations from the norm. In this context, the norm becomes a key concept: the AI system determines what is "healthy" and what requires medical intervention. AI as a disciplinary institution contributes to the standardization of medical practice, reducing variability in diagnoses and treatments, which can lead to unification of approaches in medicine.

Among other things, Foucault argued that power and knowledge are inextricably linked: disciplinary institutions produce knowledge, which is then used to maintain power. Diagnostic AI generates and accumulates medical data, which is then used to make treatment decisions. Doctors, medical institutions, and even patients rely on this data, making diagnostic AI an important source of power in modern healthcare. This knowledge structures medical practice,

influencing how doctors interact with patients and how patients perceive their health. Diagnostic AI can also be viewed through the lens of bio-power; diagnostic AI influences medical decisions by regulating access to treatment and guiding patient behavior through recommendations and diagnoses. This raises important ethical questions about who controls these systems and how they are used to govern billions of people.

Diagnostic AI is currently the newest format of telemedicine. As a disciplinary institution, it functions as a mechanism for controlling, normalizing, and managing people's minds and bodies. It introduces new forms of surveillance and standardization that influence the behavior of both patients and health care professionals, creating new forms of discipline and objectification. The proposed analysis, among other things, aimed to highlight the importance of critically examining the role of telemedicine and diagnostic technologies in contemporary society, especially in the context of power, ethics, and health management of the social actors.

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