ARTIFICIAL INTELLIGENCE IN MEDICINE

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From the time of Frankenstein's Monster by M. Shelley to the classic
Myth of Pygmalion, from the story of the Prague Golem to the work of Karel Čapek,
Who coined the word, people have fantasised about the possibility of creating intelligent machines,
Most often, androids with human characteristics.
Because now humanity is on the verge of an era when more and more sophisticated robots,
Bots, androids, and other manifestations of artificial intelligence seem to be
are poised to unleash a new industrial revolution that is likely to leave no segment of society untouched,
It is vital for the legislature to consider its legal and
ethical implications and consequences without stifling innovation.
Resolution of the Commission on Civil Law Rules in the Field of Robotics of 16 February 2017

Abstract.
Incorporating artificial intelligence (AI) in medicine has significant potential for improving diagnostic precision, individualised treatment, and operational efficacy in healthcare. Integrating AI technologies presents intricate legal difficulties that must be resolved to guarantee safe and ethical application. Principal legal concerns are data privacy and security, owing to the sensitive nature of medical information and legislation like GDPR and HIPAA. Moreover, enquiries of liability and accountability emerge when AI-generated decisions lead to mistakes or negative consequences, prompting concerns about the liable parties: developers, healthcare practitioners, or institutions. Intellectual property issues concerning AI algorithms and data ownership further complicate the legal situation. Ethical considerations are essential, like informed consent and transparency in AI decision-making procedures. As artificial intelligence advances, it is imperative to establish comprehensive legal frameworks and standards to limit risks, safeguard patient rights, and cultivate confidence in AI-assisted healthcare. Resolving these legal challenges is essential for implementing AI in medicine, ensuring that innovation adheres to legal and ethical standards to benefit patients and healthcare practitioners.
Key words: AI, medicine, responsibility, patient, data, informed consent, doctor, ethical, intellectual property.

Part 1. Introduction. The artificial intelligence revolution is disrupting many industries, from manufacturing to agriculture, intellectual property, and retail. The rapid development of artificial intelligence is already changing medicine today, opening up incredible benefits in disease diagnosis, therapy, and medical research. Healthcare is a complex industry with many areas that need improvement, and it is no exception. The impact of artificial intelligence on medicine and healthcare delivery is already causing excitement and concern. The enthusiasm is inspiring hope for better treatment and its improvement. But it also brings uncertainty about what the doctor's

future will look like in an AI-driven world, and what ethical and legal implications this technology will bring (Cafaggi, 2020, p. 10).

Artificial intelligence (AI) is a branch of computer science that focuses on creating machines that can independently perform tasks typically associated with human cognition, such as "learning" and "problem solving". Artificial intelligence relies on tools identifying data patterns and encompasses various disciplines, including robotics and machine learning. In the context of medicine, artificial intelligence can be divided into physical and virtual fields:

- The physical domain, related to robotics, such as surgical navigation systems or machines used to provide mobility and rehabilitation for patients;
- Virtual industry, provided by machine learning, consists of mathematical algorithms that improve through self-iteration (iterator - a behavioural design pattern) with minimal human intervention. These algorithms are driving significant advances in speech and image recognition, the latter being particularly important in diagnostic imaging and laboratory medicine (Cafaggi, 2020, p. 10).

Today, society's transformation is driven by artificial intelligence. Text generators such as Chat GPT can write poems and essays, and even pass complex medical and legal exams, and write lawsuits faster than humans, but they also make mistakes; for example, in New York, on 22 June 2023, a US judge-imposed sanctions on two New York lawyers who filed a legal brief containing six fictitious references to cases generated by the ChatGPT AI chatbot. Manhattan District Judge P. Kevin Kastel ordered attorneys Steven Schwartz, Peter Loduk, and their law firm Levidow & Oberman to pay a fine of USD 5,000. The judge found that the lawyers acted in bad faith and made "acts of deliberate avoidance and false and misleading statements to the court" (Sara, Merken, 2023). Therefore, not everything can be entrusted to AI, which cannot replace humans by 100 percent.

In addition, these systems can create beautiful works of art in seconds, often accurately imitating famous artists and their styles, surpassing the quality and speed of human analogs. Today, businesses must implement a proactive and comprehensive strategy to protect their AI intellectual property rights. This approach should consider not only patent protection but also copyright and trade secret protection. This is especially true for those elements of intellectual property that are potentially not subject to patenting.

If used correctly, AI can help fashion brands protect their brands. AI technologies can be useful for tracking intellectual property assets and identifying infringers or copyright issues related to AI platforms. While this technology helps, it cannot completely replace human advisors. This technology can help lawyers file more patent and certificate applications faster. Every AI output, regardless of the use case, will need to be edited and evaluated by humans to improve and refine the content and prevent plagiarism and IPR infringement.

A key problem with copyright is that it requires originality, which is often attributed to human authors. Copyright protection may not be possible without human involvement in the creative process of AI-generated works. In 2019, the Beijing Court in China ruled that human production or creativity is a prerequisite for copyright protection, which could exclude AI software as an author (Report, 26.04.2023). Furthermore, in a decision published on 27 November 2023, a Chinese court ruled that content created by artificial intelligence can enjoy copyright protection (Keith Kelly of Sheppard, et al., 2023). Under Ukrainian copyright law, this decision in China is the first to explicitly contradict the necessity of human authorship, and it may have important implications in the future. It may raise the question of AI's liability for damage. At the moment,

there is no doubt about the responsibilities of AI. However, if artificial intelligence can generate profit, it may be liable for damage.

In 2023, a photo by photographer Boris Eldagsen titled "Electrician" won first place in one of the categories at the Sony World Photography Awards, organised by the World Photographic Organisation. The only problem is that it is not a photograph but an AI-generated image created with the DALL-E 2; he refused to accept the award, saying that AI created the photo (Giulia, Giaume, 2023). Since AI does not have the status of a legal entity, it is not currently recognised as the owner of any rights (intellectual property). Suppose it is not possible to identify the inventor or creator. In that case, the work may, in principle, become public domain, which raises the question of whether there may be alternative solutions to protect works created by AI under copyright law, including in medicine.

European Court emphasised the importance of international cooperation because the most acute risks to the world related to science and technology, such as climate change, the rapid loss of biodiversity, the development of dangerous technologies, such as autonomous weapons based on artificial intelligence, or the threat of weapons of mass destruction, especially nuclear weapons, are transnational and cannot be adequately addressed without robust international cooperation. States should promote multilateral agreements to prevent these risks from materializing or to mitigate their effects" (Case ECtHR, 9.04.2024). On 2 March 2022, the European Union Intellectual Property Office (EUIPO) published a "Study on the impact of artificial intelligence on the infringement and protection of copyright and designs" (Study on the impact of artificial intelligence, 2022). The authors of the study believe that the latest technologies, such as artificial intelligence and machine learning, are a "double-edged sword" and can be used effectively to both enforce and infringe intellectual property rights. For example, machine learning tools can be deployed to remove digital dots and watermarks used to track the distribution of unauthorised copies of copyrighted works online, as well as to create "deep fakes" developed using a special type of machine learning known as "generative adversarial networks". Generative Adversarial Networks (GANs) are algorithmic architectures that use two neural networks that compete against each other (thus "compete") to generate new, synthetic instances of data that may resemble real data. They are widely used to create images, video, and voice (Guide to Generative AI, 2023).

On the other hand, authorities can positively use the same technology. Once deep fakes have been identified, authorities can use AI bots to identify the components of deep fakes on social media that violate copyright and design. Similarly, computer vision applications can be implemented in the field of IP. For example, computer vision programs can determine whether videos are original or artificially created. To address these IP issues effectively, all parties must work together, including policymakers, service providers, developers, content creators, and business owners. AI developers must comply with legal regulations regarding data collection to train their models. This may include acquiring licences, providing payments to intellectual property owners, or sharing the revenue generated by the AI tool.

However, users of AI technologies should be careful in thoroughly investigating the origin of the training data. It is advisable to review the terms of service and privacy policy carefully. In addition, it is important to refrain from using AI technologies that cannot provide evidence of proper licensing from content providers or compliance with open-source licenses. Companies should provide employees basic training on using new AI tools while maintaining confidentiality and trade secrets. In the 2023 incident, Samsung employees accidentally leaked sensitive company data (trade secrets) by including the source code in a tip. Since ChatGPT stores data for educational

purposes, these Samsung trade secrets are now in the hands of OpenAI. In particular, Open AI states: "We remove any personally identifiable information from the data we intend to use to improve the model. We also use only a small sample of data for each customer to improve the model's performance." (Samsung, 2023). Effective data and privacy management is crucial, especially in the context of artificial intelligence (AI), which often depends on large amounts of data that may contain sensitive personal information. It is crucial to handle this data responsibly, ensuring that privacy is protected while fostering innovation and artificial intelligence development. Samsung has stated that if the data breach is repeated, it will ban employees from using ChatGPT.

Today, individuals positively embrace innovation, but it is important to learn how to use it responsibly to protect sensitive data and recognise the rights of those who have contributed to AI, as it may affect them. As AI becomes more integrated into people's lives, finding a balance between its development and implementation and IP rights is crucial (Soumitra, Dutta et. al., 2023, p.284).

The relationship between artificial intelligence (AI) and intellectual property (IP) can be complex, as IP rights such as patents, copyrights, and trade secrets can protect AI like any other creation. This can stimulate innovation and attract investment in AI research and development. If AI is developed by a team or in collaboration, it should be subject to licensing and IP agreements. This can ensure that those responsible for the creation and contribution receive proper recognition and compensation for their efforts. Artificial intelligence (AI) may have negative social and moral implications, including bias, prejudice, and job displacement. A study by the McKinsey Global Institute estimates that by 2030, at least 14% of workers worldwide may change their careers due to the development of digitisation, robotics, and artificial intelligence (Talmage-Rostron, 2024). It is crucial to consider these implications and ensure that the development and use of AI is carried out ethically and impartially. To have a harmonious relationship between artificial intelligence and intellectual property, their legal, moral, theoretical, and practical aspects must be carefully analysed and addressed. A fair and sustainable strategy for developing and protecting intellectual property can be created by addressing these issues and promoting honest innovation.

The author of the idea of artificial intelligence is the Spanish philosopher and 13th-century Catalan missionary Raymund Lullius. It is believed that he made the first attempt to build a logical machine. He intended to reduce all knowledge to basic principles and determine their point of unity. The author wrote his main work Ars magna (1305-1308; "Great Art"), which includes the treatises Arbor scientiae (The Tree of Knowledge) and Liber de ascensu et down intellectus (The Book of Ascension and Descent of the Intellect), in which he presented an attempt to symbolise concepts and derive propositions that form different combinations of possibilities. Lullius attempted to bring Christian apologetics to the level of rational discussion, mainly to meet the needs of the dispute with Muslims. Lullius used logic and sophisticated mechanical methods (Ars magna), including symbolic notation and combinatorial diagrams, to link all forms of knowledge, including theology, philosophy and natural science, as analogues of each other and as manifestations of the deity in the universe. Thus, Raymond Lullius used original logical methods to prove the dogmas of Christian theology (Llull, 2021).

The term "artificial intelligence" was coined by J. McCarthy in 1956 during a conference dedicated to this issue (Mintz Y., et. al., 2019, p.1). However, the assumption that machines can imitate human behaviour and think (or rather, use accumulated "knowledge" - accumulated information on a topic) was raised earlier by A. Turing, known for his imitation game. He developed the Turing test to distinguish humans from machines: a person corresponds with two

"interlocutors" whom he or she cannot see: another person and a computer. The "interlocutors" answer questions, and the task is to figure out which one is a human. The task of the machine is to imitate a human and mislead the user. In the 60s of the last century, computer programs that could pass this test appeared. One of them even successfully imitated a psychotherapist. Then, a patient with schizophrenia, and almost half of the psychiatrists who took part in the experiment, took the programme's answers for those of a real patient (Harnad, 2000). For example, ChatGPT often invokes its status as a large language model and thus would be unlikely to pass the Turing test. If an intelligent entity can fail the test, then the test cannot function as a definition of intelligence. It is even questionable whether passing the test would show that a computer is intelligent, as the information theorist Claude Shannon and the AI pioneer John McCarthy pointed out in 1956. Shannon and McCarthy argued that, in principle, it is possible to design a machine containing a complete set of canned responses to all the questions an interrogator could ask during the test's fixed time. Like PARRY, this machine would produce answers to the interviewer's questions by looking up appropriate responses in a giant table. This objection shows that, in principle, a system with no intelligence could pass the Turing test (Copeland, 2025).

Part 2. Artificial intelligence in daily life. Since then, computing power has increased to instantaneous computation and the ability to evaluate new data according to previously evaluated data in real time. Today, artificial intelligence is integrated into our daily lives in many forms, such as personal assistants, automated mass transit, aviation, computer games, the judicial system, and elections. For example, in recent years, courts in the UK and Ireland have permitted technology-assisted review, which uses predictive coding, for electronic disclosure in high-stakes civil action. Similar complex criminal cases would follow the logic. Again, the basis for using such powerful technology is that all parties have complete access. This reasoning greatly underestimates the complexity of assessing enormous and interrelated volumes of investigative data, whether with "merely" human intelligence or artificial intelligence (Case ECtHR, 04/09/2019). Also, the Constitutional Court of Romania stated that voters' right to form an opinion included the right to accurate information about candidates and the electoral process from all sources, including online, and to be protected from unjustified impact on voting behaviour based on unlawful and disproportionate acts. It noted that one candidate had benefited from aggressive promotion of his messages through mass-media platforms' algorithms, which had circumvented electoral legislation and led to misinformation and vote manipulation because the electoral materials promoting that candidate did not bear the specific signs of electoral advertising under Law no. 370/2004 on the election of the President of Romania, Article 37 of the Constitution, one candidate's non-transparent and manipulatory use of digital technologies and artificial intelligence created a clear inequality between that candidate and the others. It required the competent authorities to intervene, investigate, and impose lawful sanctions" (Case ECtHR, 11/02/2025).

The initial focus of artificial intelligence was on developing machines that could draw conclusions or make decisions that previously could only be made by humans. The first industrial robot, Unimate (Unimation, Inc., USA), joined the assembly line at General Motors in 1961 and performed automatic injection molding. Unimate could execute step-by-step commands. The Unimate 1900 series was the first mass-produced robotic manipulator for production automation. A few years later, in 1964, J. Weizenbaum introduced Eliza. Using natural language processing, Eliza could communicate using a match-and-replace methodology to mimic human conversation (surface communication), serving as the basis for future chatbots. Currently, Eliza is a well-known

artificial therapist. The bot tries to paraphrase the client's question and responds to specific keywords. Eliza responds with fixed phrases to keep the conversation going if a keyword is not found. In 1966, Shakey, the first electronic human, was developed. Created at the Stanford Research Institute, it was the first mobile robot capable of interpreting instructions. Instead of simply following one-step commands, Shakey could process more complex instructions and perform the corresponding actions independently. It was an essential milestone in robotics and artificial intelligence (Kaul, et al, 2020, p.808).

One of the first prototypes to demonstrate the possibility of applying artificial intelligence in medicine was a glaucoma consultation programme using the CASNET model. The CASNET model is a causal-associative network consisting of three components: patient observation, pathophysiological conditions, and disease classification. This model can apply disease-specific information to individual patients and advise physicians on patient management. Strategies for choosing a specific treatment are based on an individual observation pattern and diagnostic findings. It was developed at Rutgers University (USA) and officially demonstrated at the Academy of Ophthalmology meeting in Las Vegas, Nevada, in 1976 (Weiss et al, 1978, p.26).

MYCIN, a reverse-chain artificial intelligence system, was developed in the early 1970s. Based on patient information entered by doctors and a knowledge base of about 200 therapeutic decision rules coded and stored in the machine, MYCIN can list potential bacterial pathogens and recommend treatment options adjusted to the patient's body weight (Shortliffe et. al., 1975, p. 315).

MYCIN became the basis for later systems based on such rules, including INTERNIST-1, which was developed using the same structure but contained a broader medical knowledge base. INTERNIST-1 and its successor, Quick Medical Reference (QMR), are computer programs designed to provide healthcare professionals with diagnostic assistance in general internal medicine. Both programs are based on the INTERNIST-1 computerised knowledge base, which comprehensively describes 570 diseases in the field of internal medicine. The philosophy behind the development of each programme is different. Whereas INTERNIST-1 functions exclusively as a powerful diagnostic consultant, QMR acts more as an information tool, providing users with several ways to view and manage diagnostic information in the software's knowledge base. The programme can be seen as an electronic medical textbook at the lowest level. In addition, QMR can assist users in creating hypotheses in complex patient cases (Miller R.A., et al., 1986, p. 816).

Part 3. Expert systems and neural networks.

By the beginning of the 21st century, two artificial intelligence concepts had been applied in medicine: expert systems and neural networks.

An expert system is a computer system that in some way models human thought processes; uses knowledge, including medical knowledge, presented in a certain way; they are designed to draw logical conclusions and inferences on a given source set of knowledge with explanations in an understandable form. The main difference between expert systems and other software tools is the presence of a knowledge base in which knowledge is stored in the form of records in a specific knowledge representation language, which allows for easy modification and supplementation of the knowledge base in a form that is understandable to the experts who develop the expert system. Expert systems have some positive qualities and advantages over human experts, namely - consistency - professional qualities of a human expert may change significantly over time; - ease of transfer or reproduction of information - transfer of knowledge from one person to another is a long process, while transfer of artificial information is a simple copying of a programme or data file; - stability and reproducibility of

results - a human expert may make different decisions in similar situations due to emotional factors, while the results of an EC are stable; - cost of operation - the work of a qualified expert is not cheap, and EC are expensive to develop. - Expert systems in medicine should: - Model the behaviour of a competent doctor when solving a diagnostic problem, simulate methods of finding solutions; - Present the obtained solutions in a way that is understandable to both the doctor and the patient (Балута, В.С. and Степаненко, Є.А. (2017), p.298).

Neural networks can help computers make intelligent decisions with limited human assistance. This is because they can learn and model the relationships between input and output data that are nonlinear and complex. An artificial neural network (ANN) is a computer system that concurrently processes information across all components of a network of nodes (neurones). In artificial neural networks, individual neurones, or nodes, take input, process it, and generate output; the interconnected network of numerous neurones demonstrates intelligent and complex behaviours (Shiffman, 2014). The ANN is characterised as a data processing framework modelled after the information processing methods of the human nervous system (Stergiou & Siganos, 2014). Artificial Neural Networks (ANNs), as a component of artificial intelligence, endeavour to replicate the information processing capabilities of the human brain (Willamette, 2014). Artificial Neural Networks (ANNs) are designed to emulate the functions of the human brain's neural architecture. They are adaptive, flexible, and capable of changing and learning from various external and internal stimuli (Willamette, 2014). ANNs are computationally useful for real-time applications because of their quick response and parallel architecture. In biology and medicine, ANNs have been used to model biological systems of living organisms to examine their internal architecture. Even though the reasoning foundations of neural networks have a vast potential, scientists will achieve optimal output by combining them with computing. Putting a neural network into a computer allows it to make intelligent judgments (Nwadiugwu, 2020, p. 12). Neural networks have conquered the artificial intelligence market due to their learning ability. Neural networks in artificial intelligence are simplified models of biological neural networks. In computer form, neural networks represent a graph with three or more layers of neurons connected in one way or another. Connections have weights that play an important role in training neural networks. Training of a neural network consists in changing the "strength" of synaptic connections between neurons. For training, input data is fed to the neurons, processed on the inner layer, and the output is obtained. If the result is not satisfactory to the researchers, they change the weights of the connections and re-train the system. The more input data, the more reliable the answer (Nwadiugwu, 2020, p. 11).

In healthcare, neural networks are used for disease diagnosis, drug discovery, and personalised medicine. Healthcare professionals can use artificial neural networks to help analyse medical images, patient records, and genomic data to identify patterns and make predictions, leading to more accurate diagnoses and individualised treatment plans. Neural networks can also contribute to faster drug development by enabling the analysis of large-scale data sets (Cracking the Code, 2025). Takashi Kido proposed MyFinder as a personalised community computing to address the challenges of personalised genomic services, acting in conjunction with AI and shaping the personalised and engaged healthcare of the future (Hamet, et.al., p.537).

Initially, machine learning was aimed at imitating human intellectual activity. Today, in artificial intelligence training, this task has been relegated to the background, as it is obvious that it would be more rational to use the capabilities of artificial intelligence that humans lack: the

speed of information analysis, the amount of RAM, etc. According to Maksym Voynov, associate of the practice, AI is used in medical practice in various ways (Войнов, 2024):

- In disease detection and diagnosis. Artificial intelligence is used to increase the speed and accuracy of diagnoses, for example, in cardiology to detect cardiovascular risk and arrhythmias, in gastroenterology to detect colon polyps, in neurology to detect epilepsy and tremors, in endocrinology to monitor blood glucose levels continuously, and in other medical fields.
- Medical imaging. AI algorithms can analyse medical images with incredible speed and accuracy, detecting anomalies the human eye does not always notice, leading to more accurate and timely diagnostics. AI is used to detect signs of cancer, pneumonia, and other diseases and to recognise medical images, MRI scans, ultrasound reports, cardiograms, CT scans, etc.
- In clinical trials and drug development. Artificial intelligence can create new chemical formulas and select medicines to treat a particular disease in patients.
- To save time. AI can organise patient visits to a specialist at their request, create schedules, redirect people from one queue to another, etc. This allows doctors to save their time and work more productively.
- To reduce costs in the healthcare sector, which includes reducing the cost of care, providing individualised virtual healthcare, etc.

The most common use of artificial intelligence is in diagnostics and personalised medicine. However, it can also be used in certain industries, such as cardiology, ophthalmology, dentistry, etc.

Innovation can threaten privacy and confidentiality in two ways:

1. First, there may be increased pressure to repurpose and provide third parties with access to "anonymised" patient data and electronic health records for testing and developing AI systems.
2. Second, doctors may be encouraged to order additional tests and analyses not because of their clinical value, but rather because of their usefulness for training or testing AI systems. This has implications both in terms of rising healthcare costs and exposing patients to unnecessary risks of data breaches or other privacy violations. "The Oviedo Convention establishes a specific application of the right to privacy under Article 8 of the ECHR, which recognises the particularly sensitive nature of personal health information and establishes a duty of confidentiality for healthcare professionals. Any generation of data with disputed clinical value or clearly motivated by its usefulness solely for testing and developing artificial intelligence systems appears to violate the specification of the right to privacy enshrined in the ECHR.

For example, in 2017, MANDY, an automated process for receiving patients for primary healthcare, was created. The chatbot assists medical staff by automating the patient intake process. It interacts with the patient by conducting an interview, understanding their main complaints in natural language, and sending reports to doctors for further analysis. The system provides a mobile application for patients, a diagnostic unit, and a doctor's interface for accessing patient records. The diagnostic engine consists of three main modules: an analysis engine to understand patient symptom descriptions, a symptom and cause matching engine to identify possible causes, and a question generator to generate additional interview questions (Lin Ni, et. al., 2017, p.38).

Medical diagnostics apps can be helpful tools in today's overloaded healthcare system. For example, IBM Watson Health (IBM) provides many unique and revolutionary opportunities for solving problems related to medical diagnosis and treatment. Such medical applications can help doctors navigate a complex set of patient symptoms, laboratory data, and imaging results to develop "most likely" clinical diagnoses and treatment options. This type of software can ultimately improve patient outcomes and reduce healthcare costs. Two very important features of

the prototype software are the ability to provide multiple possible diagnoses and treatment options with relative confidence levels and to track the information used to make a recommendation.

Part 4. Personalised medicine (Stefanicka-Wojtas et al, 2023, p.380). The analysis of large, literally cosmic-scale data currently being carried out by various intelligent applications in global medicine is ultimately aimed at improving the efficiency of medical care for each patient and implementing such an important trend as personalisation of medicine. Possession of information about the enormous amount of possible pathophysiological factors in all their diversity and the ability to quickly compare them with the complaints and condition of a particular patient make it possible not only to suggest a diagnosis to the doctor, but also to select a drug taking into account possible side effects, the required dosage, and to control the treatment process (Schork, 2019, p.265).

NorthShore University HealthSystem, for example, has made progress in clinical implementation of personalised medicine by using pharmacogenomics and a family history tool to build a foundation for stakeholder engagement; using a broader population genomics platform to strengthen that foundation; and developing an internal bioinformatics platform to address data challenges. At NorthShore, the Neaman Centre for Personalised Medicine (NCPM) has implemented clinical applications that help overcome the barriers encountered in the "last mile" of implementing personalised medicine in the primary care network. The system uses electronic health records (EHRs) to manage CDS, which can help overcome the barriers between patient and doctor on the way to implementing genomics in healthcare. As healthcare systems with similar characteristics seek to implement personalised medicine in their institutions, NorthShore's experience may be instructive (Pritchard, 2021, p.530). The transformation of health organizations is also important. It is not only the training of nurses and doctors that is needed, but also the training of other professional groups that can be integrated into a hospital, to support the implementation of personalized medicine. One suggestion is the introduction of so-called case managers or patient companions, people who support patients in the system, especially if they have a very threatening disease. With the depth added by personalization in healthcare, there is a need for counselling for patients, and the question arises whether a doctor must do this or whether someone with a good medical training background might be able to help or provide guidance in the system (Stefanicka-Wojtas, 2023, p.380).

Unfortunately, there are also several barriers to the smooth implementation of FM, such as cost (the high cost of new biotechnologies can increase health inequalities and pose a challenge to the sustainability of health services, especially in low- and middle-income countries), complexity, the requirement for high-quality evidence and the need for further training, which have so far limited the clinical implementation of pharmacogenomic testing. In addition, data protection regulations and regulatory differences across Europe are problematic. Other issues that need clarification were discussed, such as regulatory requirements for evidence for pharmacogenomic testing and the need to develop multiple pathways and pharmacogenomic markers (Stefanicka-Wojtas, 2023, p.380).

PM has the potential to affect the healthcare system positively. In the future, with the personalized approach, each individual, on the day of their birth, will receive their complete genomic information to place into an individual medical record. This information would allow physicians and clinicians to implement more effective healthcare approaches based on patient exposure to different diseases (Mathur et. al., 2017, p.4).

Tess, created by clinical psychologists, is a mental health chatbot that supports people in difficult times and helps to increase resilience through text messages, similar to a correspondence with a psychologist. Studies have shown that communication with Tess has led to a significant reduction in symptoms: an average 28% reduction in depression and 18% reduction in anxiety (X2 Foundation, 2025).

Here are the benefits of artificial intelligence in medicine:

1. Reduces the mortality rate. By reducing the time patients wait for help from specialists, artificial intelligence in medicine reduces mortality rates and positively affects the quality of this care. With this help, doctors get more time to develop. There is no need to consider artificial intelligence in the medical field as an attempt to replace doctors. On the contrary, it attempts to help doctors make diagnostics more accurate. Since medical AI systems can learn from case studies, they offer doctors access to data related to the latest news in medicine, healthcare, and some research areas. Humans cannot combine learning the latest trends with treating patients. There is not enough time for this. That is why artificial intelligence systems are designed to become an important assistant for doctors.

2. Reduces patients' dependence on the level of development of social services. One way to use artificial intelligence in medicine is to allow robots to care for some patients. For example, therapeutic robots help patients with Alzheimer's disease improve their quality of life, reduce dependence on social services, and increase the time a person can stay at home without medical care. The realization of clinically feasible surgical robots will likely occur by the end of the 21st century. Combining AI with surgical robotics may permit the augmentation of surgical capability to optimize outcomes and increase access to care (Panesar, Sandip, 2019, p.225).

3. Reduces the number of medical errors. With an average of more than 80 patients a week, doctors cannot give everyone the same attention. In addition, the so-called human factor plays an important role. People make mistakes. Artificial intelligence in medicine is a way to eliminate mistakes related to human fatigue and relieve doctors of some of the monotonous tasks.

4. Reduces medical costs. Transferring data online means the patient does not need to be hospitalised. Medical records and effective diagnosis will reduce the cost of medical care and the number of errors associated with documentation.

5. Strengthens the field of invasive surgery. Surgical robotics is a tool that provides doctors with precision, comfort, and excellent visualisation. With such robots, surgeons receive assistance that shortens patients' hospital stays, reduces pain and treatment costs (Panesar, Sandip, 2019, p.225).

However, there is a downside to any progress caused by insufficient legal regulation of changed legal relations, which creates conditions for the threat of harm to the protected interests. Artificial intelligence increasingly performs tasks that humans previously could only perform, such as driving a car or even performing complex medical procedures. Moreover, artificial intelligence outperforms humans in these tasks. On average, it is also the best driver in some areas of medical diagnostics, drug development, and even medical treatment and surgery. Artificial intelligence is already, or may soon be, better than trained medical professionals. Unfortunately, even the best AI also tends to become less transparent, often leading to the so-called "black box", i.e.: the risk of cyber-attack, the risk of bias affecting patient health, and the risk of mismatch (as AI systems are still not sensitive enough to causality - as opposed to correlation, they can sometimes recommend courses of action that do not match the background situation of an individual patient, potentially leading to great harm (Kiener, 2020).

Perhaps the most challenging issue to address with today's technology is transparency. Many artificial intelligence algorithms, especially deep learning algorithms used to analyse images, are almost impossible to interpret or explain. If a patient is told that an image has led to a cancer diagnosis, they will likely want to know why. Deep learning algorithms, and even doctors who are generally familiar with their workings, may be unable to explain. AI systems will undoubtedly make mistakes in diagnosing and treating patients, and it may be difficult to establish responsibility for them.

Advances in artificial intelligence are revolutionising industries around the world, and its impact on the way we practice medicine will be no exception. Research into AI in areas such as clinical and diagnostic medicine already demonstrates the power of machine learning algorithms, and introducing AI into clinical practice is a promising development area. As technological advances contribute to the development of modern solutions to improve healthcare, serious concerns are being raised about the proper and secure use of data, as well as property rights and privacy considerations. In addition, a paradigm shift in clinical practice is associated with fears that artificial intelligence will replace human practitioners. However, the future of artificial intelligence in medicine is more about synergy than a power grab. Scientific progress, regulations, and healthcare policy will determine the widespread adoption of artificial intelligence in clinical practice. Just as the risks and benefits of anything in medicine are assessed, the same should be true for using artificial intelligence. If used appropriately and within a reasonable framework, the promise of this technology will pay off with the significant effort required to put it into practice (Cafaggi, 2020, p.12).

Such a vast area as artificial intelligence leads to a paradigm shift in legal relations from doctor-patient to doctor-machine-patient. This, in turn, leads to the need to address the issue of liability for medical errors in such legal relations. With regard to civil liability, this issue can be resolved by amending the legislation of Ukraine, namely, by introducing compulsory insurance for diagnostic errors of artificial intelligence that resulted in an incorrect diagnosis of a patient, provided that there are no signs of negligence on the part of the healthcare professional.Resolution of the European Parliament (European Parliament resolution, 6.10.2021) noted that AI development has made a big leap forward in recent years, making it one of the strategic technologies of the 21st century, with the potential to generate substantial benefits in efficiency, accuracy, and convenience, thus bringing positive change to Europe. Some countries, including several Member States, use more AI applications, or embedded AI systems, in law enforcement and the judiciary than others, partly due to a lack of regulation and regulatory differences that enable or prohibit AI use for certain purposes. In contrast, the increasing use of AI in criminal law is based in part on the promises that it would reduce certain types of crime and lead to more objective decisions. AI technology should put people at its heart, be worthy of public trust, and always work in the service of humans; AI systems should always be constructed so a human operator can shut them off. According to the Ethics Guidelines of the High-Level Expert Group on Artificial Intelligence, AI systems must be non-discriminatory, safe, explainable and transparent, and respect human autonomy and fundamental rights to be trustworthy; The Union and Member States have a critical responsibility to ensure that decisions about the life cycle and use of AI applications in the judiciary and law enforcement are transparent, fully protect fundamental rights, and do not perpetuate discrimination, biases, or prejudices; the relevant policy choices should respect necessity and proportionality. AI applications may offer great opportunities in law enforcement, particularly in improving the working methods of law enforcement agencies and judicial authorities and combating certain types of crime more efficiently, such as financial

crime, money laundering and terrorist financing, online sexual abuse and exploitation of children, and certain types of cybercrime, thereby contributing to EU citizens' safety and security. The development and operation of AI systems for police and judicial authorities involves multiple individuals, organisations, machine components, software algorithms, and human users in often complex and challenging environments; the applications of AI in law enforcement and the judiciary are in different stages of development, from conceptualisation to prototyping or evaluation to post-approval use; and new possibilities. The relationship between protecting fundamental rights and effective policing must always be an essential element in discussions on whether and how AI should be used by the law enforcement sector, where decisions may have long-lasting consequences on the life and freedom of individuals; whereas this is particularly important as AI has the potential to be a permanent part of our criminal justice ecosystem providing investigative analysis. AI is in use by law enforcement in applications such as facial recognition technologies, e.g. to search suspect databases and identify victims of human trafficking or child sexual exploitation and abuse, automated number plate recognition, speaker identification, speech identification, lip-reading technologies, aural surveillance (i.e. gunshot detection algorithms), autonomous research and analysis of identified databases, forecasting (predictive policing and crime hotspot analytics), behaviour detection tools, advanced virtual autopsy tools to help determine cause of death, autonomous tools to identify financial fraud and terrorist financing, social media monitoring (scraping and data harvesting for mining connections), and automated surveillance systems incorporating different detection capabilities (such as heartbeat detection and thermal cameras); whereas the aforementioned applications, alongside other potential or future applications of AI technology in law enforcement, can have vastly varying degrees of reliability and accuracy and impact on the protection of fundamental rights and on the dynamics of criminal justice systems; whereas many of these tools are used in non-EU countries but would be illegal under the Union data protection aquis and case law; whereas the routine deployment of algorithms, even with a small false positive rate, can result in false alerts outnumbering correct alerts by far. The use of AI in law enforcement bears some potentially high, and in some cases unacceptable, risks for the protection of fundamental rights of individuals, such as opaque decision-making, different types of discrimination, and algorithmic errors that feedback loops can reinforce, as well as risks to privacy and personal data, freedom of expression and information, and the presumption of innocence. AI systems used by law enforcement and the judiciary are also vulnerable to AI-empowered attacks against information systems or data poisoning, whereby the wrong data set is included on purpose to produce biased results; in these situations, the damage is potentially even greater and can cause exponentially greater harm to both individuals and groups. The deployment of AI in law enforcement and the judiciary should not be seen as a technical feasibility, but rather a political decision about the design and objectives of law enforcement and criminal justice systems; today's criminal law is based on the idea that authorities react to an offence after it has been committed, without assuming that all people are dangerous and need to be constantly monitored. The Parliament adopted the Artificial Intelligence Act in March 2024, and the Council followed with its approval in May 2024 (COM(2021)0206 – C9-0146/2021 – 2021/0106(COD)). It will be fully applicable 24 months after entry into force, but some parts will be applicable sooner:

- The ban on AI systems posing unacceptable risks will apply six months after the entry into force
- Codes of practice will apply nine months after entry into force

- Rules on general-purpose AI systems that need to comply with transparency requirements will apply 12 months after they enter into force. High-risk systems will have more time to comply with the requirements as the obligations concerning them will become applicable 36 months after the entry into force. An Artificial intelligence (AI) system is defined by Article 3(1) of the AI Act as: a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. Certain types of AI, such as machine learning, rely on vast amounts of data that will feed into decision-making algorithms. While this use of data is not a problem as such, data protection rules may be infringed when training or using AI models and systems; rights violations may occur where AI is used for commercial or political manipulation; where data subjects are not informed of how their data are being used; where decisions made about an individual cannot be explained; or where poor data quality produces biased or discriminatory results. Concerns regarding AI data needs are polarising the debate on (de)regulating AI training data (Understanding EU data protection policy, 2025). In need to notice in opinion the judge of EC Serghides in case of Ships Waste Oil Collector B.V. and others v. The Netherlands (Case ECtHR, 1.04.2025) it may be conceivable that autonomous artificial intelligence may in the future benefit from the protection of rights similar or adjacent to human rights contained in the Convention, at the same time, it is crucial that this goes hand in hand with the capacity and obligation of such artificial intelligence to respect human rights, the rule of law and the principle of democracy. If Member States decide to provide some protection for artificial intelligence, it would be better done through a new Protocol.

Finally, can artificial intelligence itself become a subject of legal relations? On 16 February 2017, the Commission on Civil Rules for Robotics prepared a Resolution of the European Parliament (European Parliament resolution, 16.02.2017), which developed recommendations for the creation of a special legal status for robots in the long term, namely that the most sophisticated autonomous robots could have the status of "electronic persons" responsible for repairing any damage they may cause, and possibly applying electronic legal personality in cases where robots make autonomous decisions or otherwise interact independently with third parties.

The possibility of recognising an artificial intelligence system as a legal entity is also being considered at the doctrinal level. It is becoming increasingly probable that legal personality will be recognized for artificial intelligence. However, legal personality can only be recognized for the so-called “strong” artificial intelligence or superintelligence, which will have self-awareness and be capable of making decisions based on personal experience. In addition, it is assumed that superintelligence will have its own subjective experiences. Giving subjectivity to artificial intelligence, robots, algorithms, and similar phenomena, in case such phenomena have certain features that allow them to participate in legal relationships, does not contradict the classical approach, according to which legal fictions exist in legal reality. The recognition of the legal personality of artificial intelligence will entail the emergence of a new subject in civilian relations. It is necessary to develop the status of such a subject, considering its specificity. According to the most popular conceptions, it is proposed to recognize the legal personality of artificial intelligence by analogy with slaves in Roman law or with legal entities. Legal recognition of artificial intelligence will include property rights and the rights to its intellectual output. In property relations, artificial intelligence could have a property. Artificial intelligence will be accountable for this property. This simplifies AI-related injury responsibility. AI can trust certain properties

until robot rights are fully resolved. In this case, a robot agent can do its owner's business. The robot owner's liability for obligations created by trust property will be limited. Artificial intelligence-created items of creativity can be recognized as “electronic personalities” with intellectual property rights. This is allowed if such works are made purely by artificial intelligence without human assistance (Nekit K. et.al., 2020, p.249).

So, advanced artificial intelligence (AI) and machine learning (ML) methodologies are used to analyze and interpret biomedical data. The group concentrates on conducting blue-sky research, encompassing Artificial Intelligence for the early identification, prediction, and diagnosis of diseases; Artificial Intelligence for individualized interventions and therapies; Artificial Intelligence for the identification of novel biomarkers and therapeutic targets; Secure, resilient, and comprehensible AI methodologies; AI methodologies that safeguard privacy. Use AI in utilising imaging and computing technology to enhance the comprehension of brain development (both in-utero and ex-utero), to refine the diagnosis and stratification of patients with dementia, stroke, and traumatic brain injury, as well as to facilitate the thorough diagnosis and management of patients with cardiovascular disease and cancer.

AI applications can be used in disease identification and diagnosis. In contrast to humans, AI does not require sleep. Machine learning models may monitor patients' vital signs in critical care and notify doctors if specific risk factors escalate. Medical instruments like heart monitors can monitor vital indicators, whereas AI can aggregate data from these devices to identify more intricate illnesses, such as sepsis. An IBM client has created a predictive AI model for preterm infants with 75% accuracy in identifying severe sepsis—also, customised illness therapy. Virtual AI aid may facilitate the advancement of precision medicine. AI models can learn and preserve preferences, enabling them to continuously deliver personalised real-time recommendations to patients. Instead of requiring patients to reiterate information to each new representative, a healthcare system may provide 24/7 access to an AI-driven virtual assistant capable of addressing enquiries based on the patient's medical history, preferences, and individual requirements. Artificial intelligence is already assuming a significant role in medical imaging. Studies have demonstrated that AI utilising artificial neural networks may match the efficacy of human radiologists in identifying indicators of breast cancer and other ailments. Besides assisting physicians in identifying early disease indicators, AI can facilitate the management of the overwhelming volume of medical photos by identifying critical aspects of a patient's history and presenting pertinent images accordingly. Significant time is devoted in clinical trials to assigning medical codes to patient outcomes and updating the pertinent datasets. AI can expedite this process by facilitating a more rapid and sophisticated search for medical codes. Two IBM Watson Health clients have discovered that using AI has enabled them to decrease their medical code searches by over 70%. The process of drug discovery frequently represents one of the most protracted and expensive phases of medication development. AI can reduce the expenses of developing new pharmaceuticals in two principal ways: by generating superior medication designs and identifying promising novel drug combinations. Artificial intelligence can potentially address numerous significant data difficulties encountered by the life sciences sector—the advantages of artificial intelligence in healthcare. Patient care is based on informed decision-making. Incorporating medical AI into clinician workflows can give providers essential context during care decision-making. A trained machine learning algorithm can reduce research time by providing doctors with relevant, evidence-based suggestions regarding treatments and procedures while the patient is present. Minimisation of errors. Evidence suggests that AI may enhance patient safety. A recent

systematic assessment of 53 peer-reviewed studies investigating the influence of AI on patient safety revealed that AI-driven decision support tools can enhance error detection and medication management. Minimising healthcare expenditures. Numerous possible methods exist for AI to decrease expenses within the healthcare sector. Prominent potential encompasses minimising prescription errors, personalised virtual health aid, fraud mitigation, and enhancing administrative and clinical operations. Enhancing doctor-patient interaction. Numerous patients contemplate enquiries after conventional business hours. Artificial intelligence can offer continuous support via chatbots that address fundamental enquiries and furnish patients with resources while their healthcare provider's office is closed. AI may also be utilised to triage enquiries and identify material for further examination, thereby assisting in notifying providers of health changes requiring more attention. Ensuring contextual significance. A significant advantage of deep learning is that AI algorithms can utilise context to differentiate between various types of information. For instance, if a clinical note contains a compilation of a patient's existing drugs alongside a newly recommended medication, a proficient AI system can employ natural language processing to discern which medications are part of the patient's medical history (What is artificial intelligence in medicine?, 2021).

Additionally, the use of AI in medicine is related to significant concerns: In healthcare, the current laws are not enough to protect an individual's health data. Clinical data collected by AI systems can be hacked and used for malicious purposes that minimize privacy and security. Also, some genetics testing and bioinformatics companies, which are not legally audited as per specific regulations or intensely monitored, could sell customer data to pharmaceutical and biotechnology companies. Consequently, the medical staff must be aware that the negative aspects of AI use might overshadow its benefits. Ethical principles of respect for human autonomy, harm prevention, fairness, explicability, and privacy were elaborated (Pop-Jordanova, 2024, p.9).

Part 5. Conclusions.

AI in medicine has the potential to revolutionize healthcare by improving diagnostic accuracy, personalized treatment plans, and patient outcomes. Additionally, AI can help streamline administrative tasks and reduce healthcare costs, making it a valuable tool for healthcare providers and patients. Furthermore, AI can also assist in predicting disease outbreaks and improving population health management through data analysis and predictive modeling. Overall, the integration of AI in medicine has the potential to significantly enhance the efficiency and effectiveness of healthcare systems worldwide. By leveraging AI technology, healthcare professionals can make more informed decisions and provide better care to patients. This ultimately leads to a more proactive and preventative approach to healthcare, benefiting both individuals and communities. Additionally, AI can help streamline administrative tasks, such as scheduling appointments and managing medical records, allowing healthcare providers to focus more on patient care. By automating routine processes, AI can free up time for healthcare professionals to spend with patients and improve overall patient satisfaction. Overall, the integration of AI in healthcare has the potential to increase efficiency and effectiveness in delivering medical services. With AI support, healthcare professionals can enhance patient outcomes and drive improvements in the healthcare industry.

The key medical AI applications are: 1) Image processing, analysis Medical image and scan processing is a popular AI application. CT and MRI scans, X-rays, medical acoustics, etc., require machine and deep learning technologies for appropriate analysis. AI classifies photographs faster

and better than humans. It improves failing images, too. AI analytics is essential for early cancer detection, pneumonia, tuberculosis, osteoporosis, Alzheimer's disease, and more. Artificial intelligence optimises surgical operations to reduce patient risk and impact.

2) Individualised care. AI algorithms enable tailored prevention and treatment. Medical records, medical history, genetic information, and lifestyle factors can be analysed to forecast illness risks and generate personalised therapy alternatives. Therapy can benefit from personalisation. Using genetic information, algorithms can help doctors choose the best chemotherapy medications for cancer patients. After analysing a patient's medical history and physical state, artificial intelligence can decide the best medicine or radiation therapy dose.

3) Machine learning and deep learning are revolutionising medical research data processing. AI helps scientists evaluate massive data sets to find patterns, connections, and viable illness study and therapy targets. Doctors can evaluate new cancer treatments using Big Data, including patient information, clinical trial outcomes, and genetic data. Medicine becomes safer and advances faster in the years to come.

4) Epidemic prediction/modeling: Epidemiologists examining potentially catastrophic viral/infectious disease outbreaks use AI models. With the correct data, generative AI can simulate disease spread in communities or globally. Such modelling identifies crucial characteristics of the rapid epidemic spread to build efficient interventions and countermeasures. Scientists developed a deep learning algorithm to predict COVID-19 dynamics 14 days before.

5) Find new medications. New medication development is another possible AI medical application. AI systems can swiftly discover disease-related proteins and drug-like compounds. This makes drug development initiatives several times faster and cheaper: the average cost of a new medicine is above $2 billion. Meanwhile, scientists have learnt to use deep learning algorithms to locate novel antibiotics. AI can reliably predict a molecule's antimicrobial activity. MIT scientists invented the first neural network-based antibiotic last year. The AI model evaluated over 100 million chemical molecules in a few days.

6) Genomic analysis. Medical revolutions are hidden in the human genome, which comprises gene sequences, functions, relationships, gene expression, etc. Genome research involves biologists, geneticists, and data scientists worldwide. This research requires processing exabytes of data, making genome studies nearly unachievable without AI models. Genomic researchers use neural networks to examine DNA strands. Artificial intelligence can analyse massive data sets to uncover genome-protein compound connections. At the very least, genetic analysis allows us to customise medication and advise patients on inherited illnesses and health concerns. Genome research will eventually treat the deadliest, incurable diseases.

7) Predictive equipment maintenance. Modern medicine uses pricey, complex equipment. A CT scanner or ventilator failure might limit a hospital's ability to save patients' lives, and maintaining and repairing such technology is expensive and limited. Set up a predictive maintenance model with AI algorithms to reduce equipment loss. The artificial learning model automatically analyses device operation data and warns of equipment breakdown.

8) Medical care AI algorithms help medical institutions forecast patient numbers and workload to maximise staff, beds, drugs, and other resources. History and present data can be analysed to control patient flow and segment patients to treat the most patients. In a pandemic or conflict, such talents are crucial. They enable medical infrastructure to adapt to any environment.

Artificial intelligence in medicine has shown great promise in improving patient care and outcomes. However, challenges such as data privacy concerns and resistance from healthcare

professionals must be addressed for successful implementation. The future of AI in medicine holds potential for transforming healthcare delivery and reducing costs, but ethical considerations and integration into clinical practice must be carefully considered moving forward.

Artificial intelligence in medicine refers to using algorithms and software to interpret complex medical data, to assist healthcare providers in making more accurate diagnoses and treatment decisions. The integration of AI in healthcare has revolutionized patient care by enabling early detection of diseases, personalized treatment plans, and improved patient outcomes.

Benefits of Artificial Intelligence in Medicine include increased efficiency in diagnosing and treating patients, reduced medical errors, and improved overall patient satisfaction. Additionally, AI in medicine can potentially lower healthcare costs by streamlining processes and optimizing resource allocation.

Some examples of AI applications in medicine include image analysis for diagnostic purposes, predictive analytics for patient outcomes, and virtual health assistants for patient care management. These technologies can potentially enhance efficiency, accuracy, and accessibility in healthcare delivery, ultimately leading to better overall patient health outcomes.

Challenges and Limitations of Artificial Intelligence in Medicine include concerns about patient privacy and data security and the potential for bias in algorithms. Additionally, integrating AI into healthcare systems may require significant investment in infrastructure and training to ensure successful implementation.

Artificial intelligence in medicine refers to applying AI technologies to improve healthcare services, enhance diagnostic accuracy, optimize treatment plans, and streamline medical workflows. AI methods such as machine learning, natural language processing, and computer vision are used to analyze large datasets, identify patterns, predict patient outcomes, and support clinical decision-making. This integration aims to increase efficiency, reduce errors, personalize patient care, and accelerate medical research. The future of Artificial Intelligence in Medicine includes the potential for AI to revolutionize personalized medicine through predictive analytics and precision treatment plans. As technology advances, AI can streamline administrative tasks and improve clinical decision-making, leading to more efficient and effective patient care.

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