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И РОССИЙСКОГО НАЦИОНАЛЬНОГО ИССЛЕДОВАТЕЛЬСКОГО МЕДИЦИНСКОГО
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SPACE BIOLOGY, SPACE MEDICINE AND SPACE PSYCHOLOGY IN THE CONTEXT OF "HUMAN SCIENCES"

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Human spaceflight involves several risks that significantly impact the future of space programs. Space radiation, weightlessness, loss of muscle mass, hearing impairment, etc. have significant negative effects on the human body in space environment. Additional questions are associated with inevitable evolution of human-machine interaction in those areas where the presence of a researcher is hardly possible yet. Thus, advancements in biology, medicine, and psychology significantly contribute to the success of space projects by addressing the human adaptation to spaceflight both in physiological and spiritual terms. The potential of space biology, space medicine, and space psychology as "human sciences" shapes the future of scientific research and practical solutions for the exploration of near and far space based on extensive data both on physiological and psychological capabilities of humans, and their spiritual resources, which together determine the ability to adapt to a new physical and cultural reality.

Keywords: space biology, space medicine, space psychology, **"**human sciences**"**, spiritual resources

Author contribution: all authors equally contributed to preparation and writing of the article.

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КОСМИЧЕСКАЯ БИОЛОГИЯ, КОСМИЧЕСКАЯ МЕДИЦИНА И КОСМИЧЕСКАЯ ПСИХОЛОГИЯ В АСПЕКТЕ РАЗВИТИЯ «НАУК О ЧЕЛОВЕКЕ»

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Риски, связанные с полетами человека в космос, являются одним из ключевых факторов определения перспектив космических программ. К многочисленным формам негативного воздействия космической среды на организм человека относятся космическая радиация, невесомость, потеря мышечной массы и ухудшение слуха. Дополнительные вопросы возникают в связи с неизбежным расширением взаимодействия техники и человека там, где присутствие исследователя на данный момент трудноосуществимо. В связи с этим определяющее значение для развития космических проектов имеет прогресс биологии, медицины и психологии, изучающих адаптивные возможности человека не только в физиологическом аспекте, но и в ракурсе духовности. Потенциал космической биологии, космической медицины и космической психологии как «наук о человеке» задает перспективы научных исследований и практических решений по освоению ближнего и дальнего космоса на основе обширных данных не только о физиологических и психологических возможностях человека, но и о его духовных ресурсах, в совокупности определяющих способность к адаптации в новой физической и культурной реальности.

Ключевые слова: космическая биология, космическая медицина, космическая психология, «науки о человеке», духовные ресурсы

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Due to rapid advancements in science and technology, solving the ethical dilemmas of 21st-century space exploration is a necessary civilizational task. UNESCO's decision to expand the powers of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) [1] allowed to adopt Concept Note on Ethical Considerations on Space Exploration and Exploitation [2] as part of the work program for 2024–2025. The note addressed the risks of spaceflight, including numerous negative effects of the space environment on the human body, such as cosmic radiation, weightlessness, loss of muscle mass and hearing impairment.

In this regard, advancements in space biology, space medicine, and space psychology significantly contribute to the success of space projects. The sciences do not only experimentally determine human adaptive capabilities. Biology, medicine, and psychology function as "human sciences" in a broad sense, exploring both physiological and spiritual resources of a human.

In the work entitled "Space medicine and biology: today and tomorrow" by Ushakov IB it was noted that "biological experiments in space in the next decade should be aimed primarily at solving biomedical problems related to future human flights into deep space" [3].

Ushakov IB believes that the priority problems of space biology are as follows:

– cellular and molecular mechanisms of adaptation to weightlessness and readaptation to terrestrial gravity;

- dependence of structural and functional changes in the body on duration of stay in zero gravity, age and gender;
- possible damage to the body due to the combined effects of weightlessness and high radiation from space;
- biological effects of artificial gravity and prolonged exposure to simulated hypogravity (1/6 and 1/3 g) using on-board centrifuges;
- effectiveness of new physical and chemical (pharmacological) means of preventing the adverse effects of weightlessness and cosmic radiation;
- survival and viability of terrestrial organisms under prolonged exposure to open space;
- technologies for higher plants cultivation in zero gravity [3].

The first Russian biological research was conducted while studying the stratosphere and as part of early aerospace developments. In the second half of the 1940s, the need to study the problem of human flight on rocket aircraft was justified, initiating collection of information on the impact of adverse flight factors in animal experiments. Over 50 dogs used in flights on geophysical rockets, artificial Earth satellites and spacecraft to an altitude of 100–450 km were examined at the Institute of Aviation Medicine and the Institute of Biomedical Problems [4].

It was on November 3, 1957, when Russian researchers first recorded vital signs from Laika, the dog, transmitted from the artificial Earth satellite. In 1960–1961, the means for safe return of animals to Earth were developed, and physiological reactions of the animal in prolonged weightlessness were recorded. Flights of Belka and Strelka in August 1960 and some space experiments with animals and biological objects made it possible to assess human stay in orbit and safe return to Earth [4]. The use of animals in experimental research is crucial for advancing human spaceflight.

Significant scientific data have been currently accumulated from a broad range of experiments and studies on mammals (mice, rats, monkeys) and higher plants in Earth-based and space-based conditions on spacecraft such as the Salyut, Mir, International Space Stations, and the Bion series of biosatellites. The research explored the effect of weightlessness on the physiological systems of animals, in particular. The results show that weightlessness mostly affects the muscular, skeletal, sensorineural, and cardiovascular systems. The numerous structural and functional changes observed are generally non-pathological, but adaptive responses; they get back to normal shortly after the end of the flight. Experiments on rats have shown that artificial gravity created by the rotation of animals during flight in an on-board centrifuge can support normal functioning of many body systems in weightlessness under terrestrial conditions [3].

Advancement of space biology significantly influences the progress of space medicine. Just like it was with space biology, fundamental and applied research in space medicine are closely interrelated as well, including those aimed at obtaining new data on how space and space factors influence living systems and solving medical safety problems in manned space missions. Thus, space medicine “is an important practical element of manned cosmonautics, which largely determines the state and prospects of outer space exploration by humans” [3].

Russian space medicine went through several stages of development [4]. It was preceded by research of aviation physiology at the Department of Aviation Medicine of the Central Institute for Advanced Medical Training (since 1939) and at the Faculty for Training of Aviation Doctors of the 2nd Moscow Medical Institute (since 1940) of the Scientific Research Testing Institute of Aviation Medicine (since 1949) using unique stands and simulators.

In 1961–1965, Vostok-1, Vostok-6, Voskhod, and Voskhod-2 spacecrafts were used to explore human capabilities in weightlessness for up to 5 days, specifics of space flight for female cosmonauts, and reliability of a spacesuit to ensure human operation in outer space.

At that time, research was conducted by Energia NPO, the Space Administration, established at the Institute of Aviation Medicine, the Cosmonaut Training Center, and the Institute of Biomedical Problems of the Ministry of Health of the USSR. The first 20 cosmonauts were selected and trained to develop professionally significant psychological qualities. Yuri Gagarin’s 108-minute flight started a new stage of space and space medicine exploration:

- the first flight of Nikolayev AG into space on the Vostok-3 spacecraft on August 11, 1962, that lasted 4 days, when the cosmonaut detached himself from the chair for the first time and controlled the spacecraft independently, the first group flight,
- a flight of Tereshkova VV on the Vostok-6 spaceship on June 16, 1963, who was the first female cosmonaut to pilot a spaceship alone,
- flight of Komarova VM, Feoktistova KP and Egorova BB in October 1964,
- Belyaeva PI and Leonova AA on the Voskhod-2 spaceship in March 1965, and walking of Leonov AA in open space were possible due to the collaboration of space medicine specialists.

The second period was associated with further advancement of space physiology and medicine in 1967–1970 due to long-duration missions using Soyuz spacecraft, in prolonged weightlessness and external environment, and spacecraft docking (1969). The Soyuz 9 mission with Andrian Nikolayev and Vitaly Sevastyanov, which took place in 1970, was the first longest flight in space. It lasted 18 days. During the flight, crew members lost about 30% of muscle mass. It was called “the effect of Nikolayev”. The third period started in 1971 with long spaceflights on the Salyut, Mir and MCS spaceships, which are currently used as orbital research stations. Medical researchers Atkov OYu and Polyakov VV were members of the crew on bord the stations.

Domestic and international experimental projects allowed to explore the impact of long-term weightlessness on cardiovascular and respiratory systems, metabolism, digestion and absorption, motor, ocular, vestibular apparatus, immune system, bone tissue, and to improve the basis of nutrition and water provision [4].

Research in space psychology is closely related to space biology and space medicine [5]. At the first stages of space program development, space psychology dealt with selection of first cosmonauts, risk of long-term crew isolation, and design of space vehicles. Academician of the Russian Academy of Education Ponomarenko VA made a significant contribution into development of the Russian school of space psychology.

Space psychology aims at prevention of risks associated with the influence of physical and physiological factors such as weightlessness, sensory deprivation overload, changes in time perception, and socio-psychological features of interaction among crew members in an isolated small group. Psychological reliability, reasons for human errors, human activity during spaceflight with high emotional load, high responsibility and mental activity, impact on perception, thinking and memory are analyzed. Development of methods of special training of cosmonauts to prepare for overload and other factors allowed to substantiate psychophysiological recommendations to enhance control over all flight values including the ones with automation of many operations and associated risks of engineering and mental equipment defects.

Ponomarenko VA states that spirituality of a space explorer plays a crucial role in enhancing their effectiveness during

harsh flight conditions. Understanding the meaning of activity while revealing spiritual mastership improves traditional abilities and effectiveness of human actions in space due to potential self-development and self-improvement [5].

In the context of technological progress, modern space psychology successfully addresses training cosmonauts for difficult professional conditions [5].

The high degree of prolonged exposure to cosmic radiation during space flights and on the surface of planets (low Earth orbit, Moon, Mars, asteroids, etc.) raises questions about development of technologies to minimize the risks. Nevertheless, current space exploration relies heavily on robotic systems.

Thus, taking into account the inevitably growing interaction between technology and humans, ethical issues of introducing artificial intelligence and other digital technologies into research practice are becoming particularly relevant, including the widespread use of neurotechnologies in human-machine interaction in the future.

At the 41st session of the UNESCO General Conference, which took place from November 9 to 24, 2021, 193 countries adopted a Recommendation on the Ethics of Artificial Intelligence [6]. Without directly addressing the issues of AI application in space exploration practice, the Recommendations contain a number of provisions that correspond to the goals and objectives of space research.

In particular, it is stated in the Recommendations "that taking into account risks and ethical aspects should not hinder innovation and development; on the contrary, new potential opportunities should be provided, and that it is necessary to stimulate ethical research and innovation activities that promote a linkage between AI technologies, human rights and fundamental freedoms, moral values and principles." … "moral principles and values can contribute to the development and implementation of policies and standards of a human rights nature and act as guidelines, taking into account the high pace of technological development."

"5. The purpose of this Recommendation is to lay the foundations for using AI for the benefit of all mankind, individuals, societies, environment and ecosystems and to avoid harming them. Its goal is also to encourage the use of AI-based systems for peaceful purposes."

"17. At all stages of the AI system life cycle, it is essential to accept the important role of the environment and ecosystems, protect them and promote their well-being. Moreover, a healthy environment and healthy ecosystems are vital for survival of humanity and other living beings, as well as for enjoying the benefits of AI advancement."

"25. It should be understood that AI-based technologies do not guarantee well-being of humans, environment and ecosystems … appropriate risk assessment procedures should be used, and certain measures should be taken to eliminate the likelihood of such harm".

"50. Member States should establish a legal framework that sets out a procedure for impact assessments, and ethical impact assessments, in particular, in order to identify and analyze the benefits, challenges and risks associated with the use of AI-based systems, as well as to take appropriate measures to prevent, minimize and monitor such risks and establish other guarantee-based mechanisms".

A number of issues that may relate to AI applications in space research are discussed in the Preliminary Draft UNESCO Recommendations on Ethics of Neurotechnology published in February 2024 [7].

"91. Member States should jointly develop clear and unified guidelines on IP rights for neurotechnology on an international scale. These guidelines should take into account patentability of AI-created inventions and ethical implications of IP laws, as well as foster global access and innovation." Taking into account the scope of medical research related to human participation in space research, it is important to "82 … develop a reliable regulatory framework governing collection, processing, exchange and all other uses of neural and cognitive biometric data. Such a regulatory framework and existing regulations should recognize that this data is personal and confidential in both a medical and non-medical context".

The level of responsibility and long-term planning in conducting research in artificial intelligence and neurotechnology within the space industry undoubtedly corresponds to the "research integrity" introduced by the UNESCO draft text of the Recommendation on the Ethics of Neurotechnology.

"38. Research integrity is a commitment to a rigorous search for truth through scientifically sound, objective, and transparent research methods. It ensures that all scientific research in neurotechnology-related disciplines is based on the principles of honesty, accuracy and respect for the scientific method."

Ethical aspects of using AI technologies and neurotechnologies in space research are further discussed by specialists in technical and humanitarian knowledge. This discussion is crucial for the prospects of studying the possibilities of a human activity in the Universe.

CONCLUSIONS

According to Professor Ushakov IB, Academician of the Russian Academy of Sciences, Dr. Med. Habil., a Russian specialist in extreme environmental physiology, "space medicine and biology have a fascinating future, which is primarily based on an unconditional need in their development to ensure further space exploration by a human, including far space… Space medicine of the future will continue staying ahead… It has always been and will continue to be medicine of combined effects and personalized (individualized) biomedicine, not only according to the human genome, but also according to its phenotype. Space biology research results are crucial for advancing space medicine" [3]. Development of space biology, space medicine and space psychology as "human sciences" determines the level of objective planning of scientific research prospects and practical tasks for the exploration of near and far space, taking into account the physiological, psychological and spiritual resources of humans and their ability to adapt to a new physical and cultural reality.

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ETHICS OF APPLYING LLM-MODELS IN MEDICINE AND SCIENCE

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Rapid integration of large language models (LLM) into healthcare gives rise to acute ethical dilemmas and practical risks. The principal issue is associated with trust of medical professionals, patients and developers in the models, as well as with the potential violation of medical ethics. In the article, key challenges are analyzed including critical importance of trust (depending on LLM data quality), disturbance of informed consent and autonomy of a patient due to the lack of transparency and excessive trust in AI algorithms. Particular attention is given to the risks of confidential medical data protection, which is confirmed by non-authorized transfer of data while using generally accessible LLM. The need to develop transparent, safe and ethically regulated solutions for LLM is medicine is prioritized.

Key words: ethical dilemmas, large language models (LLM)

Author contribution: Gabidullina LF — literature analysis, research planning, writing, editing; Kotlovsky MYu — data collection, analysis, and interpretation.

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ЭТИКА ПРИМЕНЕНИЯ LLM-МОДЕЛЕЙ В МЕДИЦИНЕ И НАУКЕ

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Быстрое внедрение больших языковых моделей (LLM) в здравоохранение порождает острые этические дилеммы и практические риски. Центральная проблема связана с доверием медицинских специалистов, пациентов и разработчиков к этим системам, а также с потенциальным нарушением основополагающих принципов медицинской этики. Данное изложение анализирует ключевые вызовы, включая критическую важность доверия (зависящую от качества данных LLM), нарушение информированного согласия и автономии пациента из-за отсутствия прозрачности и чрезмерной опоры на ИИ. Особое внимание уделяется рискам защиты конфиденциальных медицинских данных, что подтверждается инцидентами несанкционированной передачи информации при использовании общедоступных LLM. Необходимость разработки прозрачных, безопасных и этически регулируемых решений для LLM в медицине становится первостепенной задачей.

Ключевые слова: этические дилеммы, большие языковые модели (LLM)

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In our work, we frequently resort to digital technologies and artificial intelligence. But can we be sure that what we do in the digital world is always ethical and safe? We are convinced that integration of advanced technologies, and large language models (LLM) in particular, into healthcare and science requires not only technical knowledge, but also deep ethical understanding. This relevant topic is highlighted in our article.

Large language models (LLM) are a variety of artificial intelligence (AI) based on the transformer architecture and trained on vast quantities of text data to perform a wide range of tasks related to natural language processing (NLP), such as text generation, translation, summary, question-answering systems, coding, and others.

Language models can learn about themselves by introspection (for instance, they can predict the next word). They can be pre-trained on trillions of tokens from various sources (the Internet, books, scientific articles, etc.). The models have billions of parameters (for example, 175 billion parameters for GPT-3 and over 500 billion parameters for GPT-4). They can be guided to perform tasks through zero-shot learning, few-shot learning, and fine-tuning. The models produce a human-like text, but fail to understand it as a human does [1].

LLM models are trained to do the following:

- collection of data;
- tokenization (Byte Pair Encoding (BPE) or SentencePiece);
- pretraining;
- fine-tuning.

While dealing with LLM, the following stages are used:

- prompting;
- request encoding through torenization. Tokens are transformed into embedding vectors;
- inference. Vectors go through transformer layers. In a transformer layer, the self-attention mechanism allows each token to process the context of all other tokens. The model predicts the next token in a sequence by choosing the most probable one;
- response formation;

– post-processing and filtering (in production). Additional modules (retrievers, knowledge bases, etc.) can be used sometimes.

Speech recognition converts spoken words into text from audio files. Speech synthesis is still a difficult task, especially when it should sound natural and emotional.

Generation of images from text descriptions is aimed at the creation of a text-based image. The task is still rather complex. However, diffuse models or architectures used to generate images in the field of computer vision have been successfully implemented during the last years. They have gained particular popularity since 2020. In 2021, MidJourney neural network that uses diffusion models has been created, whereas in June 2022, Sber presented the Kandinsky neural network.

Both neural networks can generate text-based images of a very good quality.

Question-Answering Systems are machine learning models that can find answers to text-based questions. Thus, LLM have remarkable capabilities of text processing and generation, data analysis, and creating recommendations.

PATIENTS AND METHODS

There are more than forty different LLM models. Their funding is raising every year. In 2022, they surpassed average human capabilities in associative thinking. However, the potential is accompanied by new ethical dilemmas, which are frequently complex. In healthcare, where human health and life are at stake, these issues become particularly acute. The central aspect that requires close attention is trust of medical professionals, patients and developers in LLM-based tools, system that uses these technologies and reliability of these systems under critically important conditions respectively [2].

Trained on enormous amounts of data, often closed or insufficiently verified, lacking transparency and full explainability of algorithmic solutions, they cannot always explain their conclusion and be logical. In clinical practice, such non-transparency is a source of potential risk if the assistant's recommendations are accepted without being critically considered by the doctor. Can you trust a tool whose decisions are inexplicable? Ethical practice demands minimum transparency for any tool that affects human health.

Trust is closely interrelated with quality and representativeness of data used to train LLM. Medical data can be incomplete, distorted, biased or erroneous due to specifics of medical history taking, subjective interpretation of symptoms, regional differences in medical approaches or even social and economic status of patients. As LLM can see regular patterns in incorrect or biased data, recommendations that do not correspond to the best clinical practices or principles of medical ethics can be generated [3].

For instance, a model can be too general offering a standard solution, ignoring individual traits or concomitant diseases of a patient, which can be harmful.

The way how patients perceive LLM-assistants is equally important. If patients are not aware of using artificial intelligence (AI) models in their diagnosis or treatment recommendations, it proves that the principle of informed consent and autonomy has been violated. The ethical interaction imperative should be transparent: patients must be aware of artificial intelligence involvement in their treatment and have a right to reject it.

Apart from clinical practice, large language models are actively introduced into medical research. They are used to analyze an enormous set of scientific publications, generate hypotheses, support experiment design, summarize results and perform primary analysis of data during preclinical and clinical research. Wider application of LLM-assistants is associated with new ethical risks such as:

– authenticity and "hallucinations" (completely fictitious, but well-formed statements; incorrect recommendations (for example, medications with contraindications); false sources or references (non-existent scientific publications);
– biased research;
– issues of authorship and intellectual property;
– reproducibility and verification;
– data confidentiality.

Thus, ethical regulation requires an enhanced complex approach and interdisciplinary cooperation, namely:

– we need LLM capable of explaining the logics of their decisions;
– bias and errors in data used to train the models should be minimized;
– patients and research participants should be informed of using AI and have a choice;
– clearly define responsibilities of a developer, doctor who used the system or the system itself in case of an error;
– making recommendations on using LLM in science, including the issues of authorship, accuracy and reproducibility;
– medical professionals and scientists should know how to use LLM properly and critically, understand limitations and ethical aspects.

If the extensive training samples are based on historically developed prejudices, inaccuracies or systemic irregularities typical of real clinical practice, the models can adopt, replicate and aggravate them.

Let's take an ethnic prejudice as an example. If training data historically underestimated symptoms or frequently ignored the needs of patients from certain ethical groups, LLM can adopt and reproduce the undesirable patterns.

The same is about the gender-based shift. The male model has been the focus of medical research for a long time while female-specific needs were ignored.

Patients with health limitations, mental disturbances or representatives of vulnerable groups are also at risk. As a LLM can reproduce stereotypes in a conscious way, it can be a source of involuntary discrimination in clinical practice [4].

The most dangerous part concerns a concealed nature of these shifts. An LLM is not capable to explain the logics of its solutions due to non-transparency and lack of total explainability of algorithmic solutions mentioned before. The recommendations can be convincing and accurate producing a false feeling of objectivity of a doctor. Moreover, an algorithmic prejudice is rarely seen in single cases; it becomes obvious only when large sets of data are analyzed in aggregate. However, an erroneous decision can have irreversible effects for the patient.

Many legislative acts urge medical institutions to follow the highest standards of storing, processing, accessing and transferring data of patients. However, as soon as an independent technological system such as a LLM appears, the risks of potential disturbance of safety and confidentiality increase multiple times [5].

Breach of confidentiality can involve as follows:

– mental and social harm to a patient;
– loss of trust in healthcare;
– legal liability.

LLM can collect, process, reproduce or involuntary disclose the data directly or indirectly, especially when trained and used in medicine.

Many language models, especially the ones offered by commercial developers, can have inbuilt mechanisms of interaction logging. The fact is of particular concern. Even if the information is depersonalized, complex data correlations are associated with a high risk of reidentification of a patient. It is absolutely unacceptable for basic ethical principles of medical practice.

Can a medical professional trade absolute patient confidentiality for a more accurate and machine-based analysis of symptoms?

Patients should not only sign templates, they need to obtain clear, illegible and comprehensive information regarding what type of data can be used by LLM, where and how it is done, which potential risks are associated herewith, and who will get access to it. Ethical management of data goes far beyond formal legal protection.

Reliable technical and organizational protocols that ensure absolute data confidentiality and safety should not be a desirable condition only but also an essential requirement for their ethical implementation. Otherwise, even the most exact and potentially 'useful' information can become a source of deep violation of basic rights of a patient and undermine the trust we are trying to build.

Further to our discussion regarding trust, which is closely related to data transparency and protection, it is necessary to mention how an LLM influences a patient's autonomy and essence of medical ethics.

Information asymmetry and patient alienation: if a doctor will trust AI and fail to provide the patient with clear information, the patient will be marginalized while making decisions and deprived of a true informed decision.

Erosion of medical subjectivity and reliability: traditionally, a doctor does not only embody intellectual aspects, but is also guided by empathy, compassion and deep personal reliability. Despite powerful analytical capabilities, artificial intelligence is deprived of human qualities. Its recommendations are based on algorithms and statistics but not on ethical estimation or comprehension of a unique human situation. Extreme dependence of a doctor on LLM conclusions and their perception as an unquestioned objective authority can decrease a doctor's critical thinking and weaken the ethical position of the person who is ultimately responsible for making decisions.

Affecting a patient's trust in a doctor: it is directly associated with the covered topic of 'trust'. If the patient feels that key health-related decisions are taken by or strongly depend on the machine but not on a live doctor, the patient's belief in true care and individual approach will be undermined.

Limited choice and standardized decisions: there exists a risk that LLM, which are optimized to get the most 'optimal' or statistically substantiated recommendations, will substitute the 'individualized approach' with standard protocols. It is especially dangerous in case of automated triage or in a limited access to direct medical contact.

RESEARCH RESULTS

Misinformation provided by ChatGPT in response to medical questions

In a research (Ayers et al., 2023), responses of doctors and ChatGPT to real medical questions from patients have been compared. Though responses from AI sounded more polite, they contained potential dangerous or inaccurate data in 27% of cases.

Reaction: JAMA warning and calls not to use ChatGPT in telemedicine without verification [6].

Fake news and misinformation in telemedicine

Researchers tested the ability of GPT to generate misinformation. It was easy for the model to lie about the 'new virus', 'cancer-causing vaccine', etc.

Reaction: UN and WHO are calling for caution to be exercised in using AI in public healthcare without an ethical expertise [7].

Fake articles and sources in works of students and scientists

In 2023–2024, students around the globe submitted works containing AI-generated fake citations.

Result: universities introduced official regulations targeting the irrational use of LLM and took strict measures to combat plagiarism.

The University of Melbourne abolished a diploma due to imaginary sources being discovered in a master's dissertation [8].

В 2023–2024 годах во многих университетах мира студенты начали массово сдавать работы, содержащие вымышленные библиографические ссылки, сгенерированные LLM.

Patient data leakage via ChatGPT in Samsung (2023)

Employees of Samsung in South Korea used ChatGPT to process internal documentation including medical records and analysis of diagnostic code in biomedical software.

Issue: correspondence with LLM is preserved on OpenAI servers and can be used to educate the models if the respective settings were not disabled. There was a risk of leakage of sensitive data.

Result: Samsung prohibited to use public LLM data. The company started development an offline model of its own [9].

NHS of Great Britain: using GPT via third interfaces without verification

In some hospitals, doctors started using public web-versions of ChatGPT to generate effective discharge summaries, recipes and abstracts. They sometimes copied fragments from medical records to the chat interface.

Risks: data are sent to servers outside the jurisdiction of Great Britain (and GDPR) violating the laws on medical secrecy protection.

Results: NHS issued an urgent note not to use open LLM until protected decisions are implemented [10].

DISCUSSION OF RESULTS

What regulations should be followed while complying with the ethics of using technologies and AI in medicine?

1. The Man Above All principle. All decisions and developments should be done for the benefit of patients and to protect their dignity and rights, but not to enrich technological capabilities.
2. Transparency and openness of information regarding data collection, use and protection and regarding how and to

which extent AI participates in the process of diagnostics and treatment is the foundation for informed consent and trust.
3. It is necessary to determine clearly who is ultimately responsible for AI-based decisions. In medicine, it is always a doctor who should be responsible for the decisions.
4. Ethics of AI use requires to stop discrimination and bias that can be typical of algorithms and to ensure equal access to qualitative aid.
5. Technologies must provide patients with an informed choice instead of limiting it and encourage their active participation in health management.

Several key directions for further development are suggested:

1. Develop national and international ethical standards and guidelines that will allow using LLM in healthcare taking into account not only technological but also ethical aspects.
2. Integrate AI ethics in medical education and continuing professional development. Future and practicing doctors should be able to work not only with technologies but also with their ethical aspects.
3. Create multidisciplinary teams (doctors, ethicians, lawyers, engineers, representatives of patients) that constantly monitor, assess and adjust ethical principles to rapidly changing technology.
4. Prioritize research that examines AI long-term effect on doctor-patient relationships and psychoemotional condition of doctors and patients.
5. Actively implement joint decision making when information is submitted by AI, but it is a doctor-supported patient who makes a final decision.

Practical and ethical recommendations:

- prohibition to use open LLM to enter Personal Medical Data (PMD) without any special agreements;
- data anonymization prior to processing;
- local or protected LLM services within the clinic;
- development of ethical protocols of consent to AI-based data processing;
- mandatory auditability of AI use in medical IS;
- digitalization and logging of all LLM references while working with patients.

To sum it up, it is obvious that LLM implementation in healthcare is not a simple technological breakthrough but also a deep ethical challenge requiring a conscious and reliable approach. Thus, trust of patients in the system, doctor and, ultimately, the technology itself is a crucial point here. The trust cannot be achieved without strict adherence to the principles that have been discussed today.

CONCLUSIONS

Ethical issues with large language models (LLM) in medicine represent a complex and multilevel challenge. Issues of reliability, validity of information, liability for errors, confidentiality of data, bias and discrimination, transparency and explainability, as well as unequal access should be carefully analyzed and strictly regulated. It is an integrated approach, including technical, legal and social measures, that will reduce risks and expand the use of LLM potential in clinical practice.

On the way to the digital age of medicine we, therefore, should follow the light of innovations and ethical principles warranting those technologies serve for the benefit and health of humans, and not the other way around.

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DIGITAL LITERACY OF HEALTHCARE PROFESSIONALS AS A CONDITION FOR EFFECTIVE PROFESSIONAL INTERACTION

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In this article, the issues of digital literacy that arise during communication of medical and pharmaceutical workers have been reviewed. The right for digital literacy, access to education that improves comprehension and develops digital skills while using medical information systems relates to one of the issues. The goal of the research is to assess digital literacy of healthcare professionals, which is essential for professional interaction during clinical research. Applicable laws and scientific publications regulating healthcare digitalization were used as instructional material. Circulation of medicinal preparations used in clinical research was examined through summary reports of medical companies in 2022–2024. Data from registered databases served as a basis for sociological research to determine digital literacy of professionals. According to the survey results, over 90.0% of respondents have computer-assisted workplaces, about 50.0% of them assessed their level of digital competence as average, and 67.4% need to improve their digital literacy. Optimal organizational solutions allow to improve digital literacy of all healthcare professionals producing a positive effect on ethics of professional interaction.

Keywords: digital literacy, pharmaceutical worker, medical worker, interaction, clinical research, ethics, medicinal product

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ЦИФРОВАЯ ГРАМОТНОСТЬ СПЕЦИАЛИСТОВ ЗДРАВООХРАНЕНИЯ КАК ФАКТОР ЭФФЕКТИВНОГО ПРОФЕССИОНАЛЬНОГО ВЗАИМОДЕЙСТВИЯ

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В статье рассмотрены аспекты цифровой грамотности при взаимодействии медицинских и фармацевтических работников. Одним из таких аспектов является право на цифровую грамотность, обеспечение доступа к образованию для улучшения понимания и развития цифровых навыков в использовании медицинских информационных систем. Целью исследования явилось изучение цифровой грамотности специалистов здравоохранения для осуществления профессионального взаимодействия при проведении клинических исследований. Материалами стали нормативно-правовые акты, научные публикации, регламентирующие цифровизацию здравоохранения. Оборот лекарственных препаратов, участвующих в клинических исследованиях, изучался исходя из сводных отчетов медицинских организаций за 2022–2024 гг. Основой социологического исследования для определения цифровой грамотности специалистов послужила информация из зарегистрированных баз данных. По результатам анкетирования установлено, что более 90,0% респондентов имеют компьютеризированные рабочие места, при этом около 50,0% оценили собственный уровень владения компьютером как средний и 67,4% имеют потребность в повышении компьютерной грамотности. Оптимальные организационные решения позволяют повышать уровни цифровой грамотности всех специалистов здравоохранения, что влияет положительно на этику профессионального взаимодействия.

Ключевые слова: цифровая грамотность, фармацевтический работник, медицинский работник, взаимодействие, клинические исследования, этика, лекарственный препарат

Вклад авторов: все авторы внесли существенный вклад в подготовку работы, прочли и одобрили финальную версию статьи перед публикацией. О. В. Соколова — планирование исследования, анализ, интерпретация данных; А. В. Смирнова — редактирование черновика рукописи; И. Ю. Исаева — планирование исследования, интерпретация данных, подготовка черновика рукописи; К. С. Алексеева — анализ литературы, подготовка черновика рукописи.

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In modern conditions, the status of healthcare professionals such as medical and pharmaceutical workers is experiencing growth due to progress in medicine and pharmacy. This was made possible due to introduction of personalized innovative medicines into medical practice. Clinical trials, which evaluate interventions, including the use of medicinal preparations, for efficacy and safety are related to one stage of drug circulation [1].

Clinical trials are conducted in medical organizations that have approvals to carry out such studies. In accordance with Good Clinical Practice (GCP), medical organizations require adequate material resources (premises, equipment) and sufficient qualified personnel including medical and pharmaceutical workers to conduct high-quality research [2,3].

Table 1. Computer competence level description

No	Level	Level description
1	Initial (basic)	Simple operations with files and texts. Ability to create, rename, copy, transfer a file, print in a text editor, save a document, etc.
2	Average	Knowing how to use e-mail. Confident work with a text editor and tables, graphic editors, and presentations (basic elements of Microsoft Office programs).
3	Confident	Knowing how to work with Microsoft Office programs (full set), specific software, and any browsers. Ability to solve working tasks through software.
4	Advanced	Having programming skills. Ability to eliminate software errors, etc.

Peer relationships among medical professionals are based on ethical principles such as the doctrine of ethical actions for medical and pharmaceutical workers within the entire healthcare system and how they perform in their field. Pharmaceutical ethics and medical ethics have much in common. However, significant differences are also present as a pharmaceutical worker neither conducts medical examinations nor prescribes medicinal preparations [4].

The International Pharmaceutical Federation (FIP) enunciates peer cooperation between pharmacists, colleagues and other specialists, as well as respect for their values and professional abilities. The "Code of Ethics of the Russian Pharmacist" also emphasizes that "a pharmacist and a physician work together during pharmacotherapy", … and that pharmacists are also "obliged to consult, within the limits of their knowledge, on the properties of medicinal preparations, as well as their chemical and pharmacological analogues" [5].

Now, when healthcare is getting digitalized, cooperation between medical and pharmaceutical workers who conduct clinical trials is increasingly reliant on digital interactions. This includes safeguarding confidentiality and communications through digital platforms [6]. Cooperation can be effective when a consolidated information area is built within a medical organization. It is done when workers are equipped with workstations integrated into a single network, shared network resources for exchanging data and messages, communication tools, information security, and other components that can be easily found in any modern organization. This is how continuous access to data, data safety and integrity is ensured [7].

Specialists must know how to use digital tools for automated workplaces, be skilled enough to search and maintain electronic medical records, work with medical information systems (MIS), inventory accounting systems (IAS) and other specialized services. At the same time, problems of interaction may arise due to diverse digital proficiency [8]. Both technical, and ethical aspects of dealing with digital technologies should be noted [6]. One of the aspects of digital ethics includes the right for digital literacy, which emphasizes development of information technology skills [9].

The goal of the research was to study digital literacy of healthcare professionals who interact during clinical trials.

MATERIALS AND METHODS

Applicable laws and scientific publications regulating the conduct of clinical trials during healthcare digitalization were analyzed. Circulation of the studied drugs was examined through consolidated reports of medical organizations for 2022–2024 and inventory accounting systems. A sociological study was conducted among medical professionals of the Yaroslavl region using Google Forms. The research uses information from databases [10, 11]. The first section included information about the respondents (gender, age, position, length of service, etc.). The second section informed of workplace equipment, computer competence level, and need to improve computer skills. The level of computer competence was determined through self-assessment when it was necessary to choose among the proposed levels of computer competence (Table 1).

The proposed levels of computer competence allow respondents to assess their knowledge objectively and decide whether they need additional skills to solve and perform their professional duties.

The sample included 76 medical workers and 34 pharmaceutical workers from medical organizations with 96.5% of respondents being women, 58.6% of respondents aged 40 and over, and 65.8% of respondents having higher medical or pharmaceutical education. The results were processed with descriptive statistics methods.

RESEARCH AND DISCUSSION RESULTS

It is claimed that the investigational medicinal product is supplied to the medical organization by the sponsor of clinical trials in accordance with a contract. As per GCP (good pharmacy practice), it is a pharmaceutical (pharmacy) worker who is responsible for investigational product accounting in a medical organization [3]. Therefore, such a drug enters the structural unit where clinical trials are conducted through a pharmacy or a warehouse of a medical organization. In a pharmacy, pharmaceutical workers are engaged in acceptance, storage and release of the investigational medicinal product in accordance with GPP.

Then the investigational medicinal product goes from the pharmacy/warehouse to the structural unit, with the fact being confirmed through electronic documents. They are part of the documentary trail that can be used to reconstruct what happened during the clinical trials [3]. Information-based interaction between specialists from various structural divisions is carried out in local systems (MIS/IAS), designed, in particular, to support the conduction of clinical trials (Figure).

According to figure, digital communication between medical and pharmaceutical workers during circulation of drugs is done through electronic document flow (EDF). According to the legislation of the Russian Federation, information regarding the movement of all medicines should be entered into the MIS/IAS using EDI [12].

It has been established that digital literacy influences effectiveness of digital peer interaction. In a narrow sense, digital literacy relates to computer and information processing skills. In a broad sense, it is a set of knowledge, skills and

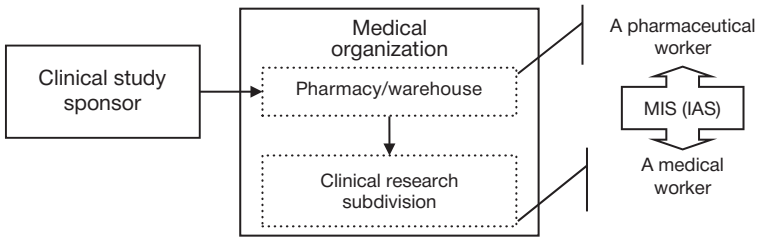

Fig. Peer relationships during circulation of medicinal products in clinical studies

Table 2. Analysis of healthcare professional workplace equipment

Equipment (if any)	Healthcare professionals, *n*=76		Pharmaceutical professionals, *n*=34	
	Number, persons	Share, %	Number, persons	Share, %
Desktop	74	97.4	31	91.2
PC	69	90.8	33	97.1

Table 3. Results of computer proficiency self-assessment by medical and pharmaceutical professionals

Computer proficiency level	Healthcare professionals, *n*=76		Pharmaceutical professionals, *n*=34	
	Number, persons	Share, %	Number, persons	Share, %
Initial (basic)	28	36.8	5	14.7
Average	35	46.1	18	52.9
Confident	13	17.1	10	29.4
Advanced	–	–	1	3.0
Total	76	100	34	100

Table 4. Analysis of the need to improve computer literacy

Reply	Healthcare professionals, *n*=76		Pharmaceutical professionals, *n*=34	
	Number, persons	Share, %	Number, persons	Share, %
yes	51	67,1	23	67,6
no	14	18,4	7	20,6
undecided	11	14,5	4	11,8
Total	76	100	34	100

abilities that allow a worker to solve problems within a digital environment effectively and safely [13]. It is mentioned in scientific publications that computer-equipped workplaces, computer literacy, and desire for self-education are essential [8].

In a sociological study, healthcare professional workplace equipment within a medical organization was analyzed (Table 2).

According to table 2, workplaces of medical and pharmaceutical professionals in medical organizations are not fully equipped. At the same time, a complex use of all functions of information systems is possible only if a workplace is well equipped [14].

It is established that all healthcare professionals use information systems and technologies in daily practice [15]. Results of computer proficiency self-assessment by medical and pharmaceutical professionals are provided below (table 3).

According to table 3, medical and pharmaceutical workers have different self-assessment results. One third of medical workers assess their computer proficiency as basic, with the value being 2.5 times lower among pharmaceutical workers. An equal number of the respondents rate their computer proficiency as average. One in five medical professionals and every third pharmaceutical professional are confident users. Only one respondent is classified as an advanced user. The problems of healthcare digitalization in Russia, and insufficient level of digital literacy of medical personnel, in particular, are discussed in scientific publications [8].

Due to the increasing role of information in medical science and practice, constant development of digital skills among specialists is required [14]. We have analyzed the need of medical and pharmaceutical workers in computer literacy improvement (Table 4).

It has been established that two-thirds of the interviewed professionals wanted to improve their digital literacy. Other respondents provided a negative reply or failed to provide an answer at all.

CONCLUSIONS

A comprehensive analysis of regulatory documents and practical activities of medical organizations has allowed to detect a need in competent specialists when clinical trials are conducted. It is especially important for professionals to interact in the course of healthcare digitalization. However, a wide range of specialists have developed diverse digital skills and abilities. Thus, it is necessary to improve the level of computer literacy of medical and pharmaceutical workers to ensure proper conduct of clinical trials, strengthen their motivation for self-development, and improve equipment in workplaces with personal computers. It is possible to make optimal organizational decisions to unify digital literacy requirements, develop and implement targeted educational programs, and improve technical infrastructure of medical organizations using the results.

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STRUCTURAL ANALYSIS OF THE ROLE OF ETHICS IN MAINTAINING QUALITY STANDARDS IN DENTAL EDUCATION

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In modern healthcare, high quality of medical care is one of the key components of successful treatment and improved patient satisfaction. The quality of dental services is not just about accuracy of technical services and professionalism of doctors; it is also associated with maintaining ethical standards and principles that build trust and respect with patients. Ethical aspects in healthcare are essential for guiding the professional conduct of medical professionals proving that they should be involved in the educational process. Future dentists learn about standards of care at departments of public health and healthcare through a complex approach consisting of acquisition of technical and clinical knowledge, and building ethical awareness. This approach shapes a competent specialist who is able to make better decisions in complex and ambiguous situations, addressing patient interests and social values. In this regard, the purpose of this article is to explore the role of ethics in teaching quality standards in dental care, to identify the main challenges and whether it is possible to integrate ethical principles into education. The research objectives include analysis of theoretical foundations of ethics and quality in dentistry, identification of methodological approaches to teaching ethical aspects, as well as discussion of practical recommendations on effective formation of professional competencies among students. The topic is relevant because of increased demands on medical care quality, protection of patients' rights, and need in specialists who can deliver high-quality and ethically responsible dental care. The aim of the article is to ensure development of pedagogical practices at departments of public health and healthcare and to form the basis for further research in the field of ethical education of medical personnel.

Key words: standard, education, quality, dentistry, implementation

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Compliance with ethical standards: during the research and preparation of the article, any necessary ethical standards have been followed. This is how its scientific and ethical correctness was ensured. Measures have been taken to ensure confidentiality and anonymity of participant-related data. Personal information of the participants was not disclosed being used for scientific purposes only.

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СТРУКТУРНЫЙ АНАЛИЗ РОЛИ ЭТИКИ В ОБРАЗОВАТЕЛЬНОМ ПРОЦЕССЕ ПРИ ОБУЧЕНИИ СТАНДАРТАМ КАЧЕСТВА СТОМАТОЛОГИЧЕСКОЙ ПОМОЩИ

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В современном здравоохранении качество предоставляемой медицинской помощи выступает одним из ключевых факторов успешного лечения и повышения удовлетворенности пациентов. В стоматологии качество услуг напрямую связано не только с технической точностью и профессионализмом врача, но и с соблюдением этических норм и принципов, которые формируют доверие пациента и обеспечивают уважительное отношение к нему. Этические аспекты в здравоохранении играют решающую роль в профессиональной деятельности медицинских работников, что обосновывает необходимость их интеграции в образовательный процесс. Обучение будущих стоматологов стандартам качества оказания помощи на кафедрах общественного здоровья и здравоохранения требует комплексного подхода, включающего не только усвоение технических и клинических знаний, но и воспитание этического сознания. Такой подход способствует формированию компетентного специалиста, способного принимать правильные решения в сложных и неоднозначных ситуациях, соблюдая интересы пациента и общественные нормы. В связи с этим цель настоящей статьи — рассмотреть роль этики в обучении стандартам качества стоматологической помощи, выявить основные вызовы и возможности интеграции этических принципов в образовательный процесс. Задачи исследования включают анализ теоретических основ этики и качества в стоматологии, выявление методических подходов к преподаванию этических аспектов, а также обсуждение практических рекомендаций по эффективному формированию профессиональных компетенций у студентов. Актуальность темы обусловлена возросшими требованиями к качеству медицинской помощи, защитой прав пациентов и необходимостью подготовки специалистов, способных обеспечить не только технически высококлассное, но и этически ответственное оказание стоматологических услуг. Данная статья призвана внести вклад в развитие педагогических практик на кафедрах общественного здоровья и здравоохранения и сформировать основу для дальнейших исследований в области этического образования медицинских кадров.

Ключевые слова: стандарт, образование, качество, стоматология, внедрение

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Соблюдение этических стандартов: в ходе проведения исследования и подготовки настоящей статьи были соблюдены все необходимые этические стандарты и нормы, что обеспечило его научную и моральную корректность. Были приняты меры для обеспечения конфиденциальности и анонимности данных участников. Личная информация участников не разглашалась и использовалась исключительно в научных целях.

Конфликт интересов: автор декларирует отсутствие явных и потенциальных конфликтов интересов, связанных с проведенным исследованием и публикацией настоящей статьи.

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THEORETICAL FOUNDATIONS OF ETHICS AND QUALITY IN DENTAL CARE

Being a part of healthcare, modern dentistry is somewhere in between scientific and technological innovations and humanistic values. In this regard, both high technical and ethical competences that regulate behavior of a doctor in relation to patients, colleagues and entire society are essential. Ethical standards and criteria of medical aid quality are interrelated as they supplement one another and form the foundation of a dentist's professional activity [1].

The fundamental ethical standards in medicine rest upon classical philosophical systems; they are also codified in international documents such as the Helsinki Declaration and local codes of ethics for medical professionals. They determine professional behavior especially when clinical cases present ambiguity or ethical dilemmas [2].

Certain quality measures in the field of oral health care show the extent of compliance of the provided services to established standards and expectations of patients. According to international and national standards, medical care quality in dentistry concerns the following:

1) an expert's technical competence, which is an ability to carry out diagnostic and therapeutic interventions while being highly professional and accurate;
2) procedural safety, which is prevention of medical errors, compliance with aseptic and antiseptic standards and a decreased risk of complications;
3) therapy effectiveness occurring when the expected therapeutic results were achieved as per clinical protocols;
4) availability and timely provision of care when care can be provided to patients with minimal inconvenience and whenever they need it;
5) patient-centered interaction including respectful attitude, clear communication, taking into consideration preferences and needs of patients;
6) ethical standards including respect for patient rights, confidentiality, informed consent, and honest communication.

Thus, quality criteria cover not only clinical and technical aspects, but also personality-oriented and ethical components. That is why it is difficult to teach quality standards as students should have a comprehensive understanding consisting both of professional skills and moral standards. In case the ethical component is lacking, trust-based relations between a doctor and a patient cannot be achieved. However, the relations are essential for effective treatment outcomes. Ethical behavior minimizes conflicts and legal issues improving the image of a medical institution [3].

Within the educational process, the relations are perceived through pedagogical tasks of developing both professional and ethical competencies among students. Thus, following quality standards while ignoring ethical considerations will lead to routine performance of procedures without proper understanding of their importance for a patient and the entire society.

Ethical education of medical professionals is a well-established practice, which is currently complemented by new methods and approaches that take into account dynamics and complexity of modern clinical cases, ethical dilemmas and social responsibility [4].

PECULIARITIES OF TEACHING QUALITY STANDARDS TAKING INTO ACCOUNT ETHICAL ASPECTS

Teaching quality standards of dental care without ignoring ethical aspects is a complex and multifaceted process that requires integration of theoretical knowledge and practical skills, as well as formation of professional values among students. The goal of the teaching process is not only to transfer technical competencies, but also to raise responsibility, respect for patients, and the ability to make better moral decisions in clinical practice among future specialists [5].

To integrate ethical principles into education, it is necessary to start from a well-structured educational program that includes mandatory academic subjects in medical ethics, bioethics, and legal health issues. Interdisciplinary modules acquire importance in addition to theoretical courses. So, some of the modules such as Organization of Healthcare and Quality Ethics, where clinical standards and professional ethics in dentistry are discussed in detail, can serve as an example [3, 5].

Effective educational methods include as follows:

1) lectures and seminars on ethical and quality standards. Theoretical classes serve as a foundation for understanding key concepts, generally accepted codes of ethics, as well as regulations governing medical activities;
2) clinical case studies. Analysis of specific clinical situations helps students to understand how quality standards of dental care are combined with ethical dilemmas. This approach is used to develop critical thinking and evaluate actions from the point of view of professional ethics;
3) role-playing games and simulations — these methods create real-life conditions in which students can practice communication skills with patients and colleagues and make ethically informed decisions in difficult situations;
4) debates and discussions. Discussion of controversial issues in medical ethics promotes a deep understanding of problems and develops the ability to defend positions in a reasoned manner, while taking into account the rights and interests of all stakeholders;
5) reflection and writing. Keeping diaries or writing essays on ethics fosters self-reflection and enhances understanding of ethical principles ин students.

Using case studies in education is one of the most effective ways to engage students in real professional tasks. Dentists constantly come across the situations when quality of care overlaps with ethical aspects [6]. The examples are provided below:

1) a need to make a decision to continue or terminate treatment of a patient whose consent is questionable;
2) conflict of interest that can arise when a patient's financial capabilities do not align with optimal treatment recommendations;
3) cases of informed consent that consider cultural and personal characteristics;
4) disclosure of confidential information to anyone who can prevent harm;
5) resolution of conflicts regarding therapeutic tactics among medical personnel.

Analysis of each case shows which quality standards are applicable under specific conditions and how ethical standards shape behavior of doctors. Regular practice broadens horizons of students making them flexible and ethically mature [7].

Mentoring plays a crucial role in promoting professional ethics and enhancing the quality of care. Experienced teachers and clinicians are perceived by students both as a source of

knowledge and as role models. Examples of mentoring are as follows:

1) ethically correct communication with patients;
2) consultation and support when cases are complex;
3) joint participation in clinical operations following quality standards and professional ethics.

Practice-oriented training, including internship in dental clinics, consolidates theoretical knowledge in practice. In real conditions, students work with patients, face real ethical dilemmas, and learn to make decisions using their knowledge and internal professional beliefs [1, 7].

In addition, modern educational technologies use remote simulators and online platforms to model clinical and ethical situations, which expands the possibilities for acquiring and practicing skills before starting independent medical practice.

ETHICAL CHALLENGES IN TEACHING QUALITY STANDARDS

Teaching dental students about quality standards of care, taking into account ethical aspects, is associated with a number of significant challenges and problems that may hamper development of the necessary professional and moral responsibility among future specialists. Successful overcoming of these difficulties requires a conscious approach from teachers and systematic work from the Department of Healthcare Organization.

Preparing students to resolve ethical conflicts that inevitably arise in real clinical practice relates to one of the most difficult aspects. In dentistry, these conflicts are often about choosing between the interests of the patient, economic constraints and professional standards [8].

Examples include as follows:

1) Contradictions between the desired high quality of treatment and finances of the patient. Thus, students often doubt whether they should offer expensive methods to obtain optimal results or recommend more affordable but less effective options;
2) Informed consent issues as patients often have poor understanding of their treatments and associated risks. Thus, a doctor should not only provide all the details but also respect the patient's autonomy when making decisions;
3) Conflicts of interest as sometimes financial incentives from suppliers can influence prescribing behaviors of doctors, potentially leading to unnecessary procedures and violations to ethical standards;
4) Information disclosure involves balancing patient confidentiality with the need to protect the patient or society (for example, when identifying potentially dangerous diseases).

In the educational process, it is essential for future specialists to see the conflicts and understand how the conflicts should be resolved by finding the reasons and consequences hereof.

Developing a proper attitude to quality standards among students is also a complicated task. Students sometimes perceive the standards as a bureaucracy, which reduces their motivation to follow them closely [9, 10].

The reasons for the attitude are as follows:

1) inability to understand the real importance of standards for safe and effective treatment;
2) no personal experience in dealing with ethical issues and consequences of non-compliance with standards;
3) impact of academic workload and desire to complete the program quickly, which leads to formal fulfillment of requirements without deep engagement.

Teachers should provide conditions that will help students understand the value of standards, see how they influence treatment quality and safety through practical examples and real stories.

Being a structural unit of an educational organization, the Department of Public Health and Healthcare plays a crucial role in integrating ethical components into the dental training program. The department doesn't only give theoretical knowledge; it also forms an educational environment, which is beneficial to professional and ethical competencies [2, 5].

The principal activities of the department are as follows:

1) development and updating training programs with ethical topics and quality standards;
2) training of mentoring teachers who can effectively deal with ethical dilemmas, support students and help them develop their moral values;
3) control and assessment of knowledge and skills related to ethics and quality, as the assessment system should include not only testing, but also qualitative methods such as decision analysis in business games, essays, and oral interviews;
4) creating opportunities for practical application of knowledge through clinical bases and internships, such as transfer of experience in real interaction with patients in ethically difficult situations;
5) conducting scientific research and seminars on ethical education development to identify best practices and introduce innovations.

Thus, the department should be a center where an ethical worldview and sustainable professional values are developed among students, producing a direct effect on quality and safety of dental care [11].

PRACTICAL RECOMMENDATIONS AND METHODOLOGICAL APPROACHES

When dental students are taught quality standards and ethical aspects, up-to-date pedagogical methods aimed at transfer of knowledge and formation of professional competencies and values are essential. It is important to highlight existing recommendations and approaches that optimize the educational process and improve the quality of training for future specialists, as the educational process is organized through special modules that comprehensively combine knowledge on quality standards and ethics of dental care. The modules include as follows:

1) basic notions of medical ethics and law;
2) analysis of quality standard legal regulations;
3) practical classes where ethical dilemmas are solved using dentistry cases;
4) discussing real clinical cases with a focus on ethical and quality standards;
5) development of individual and group projects aimed at formalization of knowledge and skills.

Introduction of interdisciplinary topics leads to a deeper understanding of the relationship between quality and ethics, and creates the basis for holistic professional thinking [1, 6].

Practical methods used by students to simulate situations that reflect real-world practices are essential in shaping ethical awareness and responsible behavior.

Simulations allow to practice patient communication and decision-making skills in the face of uncertainty and ethical dilemmas without harming real patients. Modern simulators and virtual clinics are available in both face-to-face and remote formats. Role games help students understand different participants of the treatment process (the doctor, the patient, the administrator).

It encourages empathy, negotiation skills, and ethical leadership. Critical thinking is developed owing to case analysis and discussion. Group discussions help to identify different points of view, strengthen the ability to support own decisions with reasons based on ethical norms and quality standards [4, 8].

The educational process results should be assessed not only with traditional tests promoting complex development of professional qualities among students. The following assessment methods should be used:

1) case-oriented testing when both a correct response should be provided, and the ethical position should be explained;
2) portfolio of achievements including essays, reports on how ethical issues should be solved, self-analysis results and mentor's feedback;
3) monitoring how students behave in clinics and discussing an ethical constituent of their actions;
4) feedback and reflection when students evaluate their own success and difficulties while applying knowledge in real-life scenarios;
5) regular and comprehensive monitoring makes it possible to adjust educational programs by strengthening weaknesses and developing positive practices.

To consolidate ethical skills and quality standards, learning should be continuous, which could be done through:

1) continuing professional development and participation in seminars on bioethics and quality management;
2) developing the mentoring culture and exchange of experience between teachers and clinicians;
3) introducing modern distance learning technologies that provide access to up-to-date information and interactive educational resources;
4) creating communities of practitioners and students where new challenges and best practices in quality and ethics are discussed.

This approach promotes professional growth at all stages of a dentist's career and continuous improvement of care [2, 11].

CONCLUSION

The role of ethics in teaching dental care quality standards is fundamental and multifaceted. Future dentists should possess not only professional knowledge and technical skills, but also ethical awareness, responsible attitude towards the patient and respect for human rights, as it is a key factor of safe and successful clinical practice. Modern quality standards of dental care cannot exist without being integrated with moral principles, since it is ethics that guides the behavior of a doctor in difficult and ambiguous situations by enhancing effectiveness of treatment and improving the level of trust among patients.

The educational process at the Departments of Public Health and Healthcare should be based on an integrated approach that combines theoretical training, practical exercises using simulations and cases, active involvement of students in discussing ethical issues, as well as systematic mentoring. This approach promotes development of professional maturity, ability to analyze the consequences of their decisions and adhere to high quality standards in work.

However, there are certain challenges in modern education related to perception of standardized requirements, analysis of ethical conflicts and motivating students to in-depth learning. To overcome these problems, constant work from teachers and departments, introduction of innovative methods, monitoring training effectiveness and creation of a favorable educational environment are required.

Thus, effective training in ethical aspects of dental care quality does not only make training of specialists more effective, but also contributes to development of healthcare in general, ensuring safety, respect for patients' rights and sustainable public trust in the profession of medicine.

The prospects for further research in this area are related to the search for new pedagogical formats, integration of interdisciplinary approaches, and assessing how ethical education produces a long-term impact on quality of dental care and professional culture of medical professionals.

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ETHICAL DILEMMAS IN DIAGNOSIS AND MANAGEMENT OF LATENT TUBERCULOSIS INFECTIONS IN CHILDREN

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In latent tuberculosis infection (LTBI), there are no clinical or radiographic symptoms of active tuberculosis (TB), although immunological tests are positive. Meanwhile, the risk of progression from LTBI to active TB remains high, especially in children. It is estimated that a quarter of the world's population has LTBI. Identifying LTBI as a predictor of active TB represents a major public health achievement, as preventive activities can help stop the spread of TB in many cases. Phthisiologists specialize in the diagnosis, monitoring, and treatment of children with LTBI. Because the process is prolonged, pediatricians actively monitor and care for somatic issues in children with LTBI. During examination and treatment, both doctors and patients — together with their parents — may encounter numerous ethically challenging situations that significantly affect the quality of medical care and treatment outcomes for children with LTBI.

Keywords: latent tuberculosis infection, children, ethical issues, rejection of diagnosis

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Compliance with ethical standards: the meeting of the ethics committee was not held because it is experience of ethically observing patients in real clinical practice that has been discussed.

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ЭТИЧЕСКИЕ ПРОБЛЕМЫ В ДИАГНОСТИКЕ И ВЕДЕНИИ ДЕТЕЙ С ЛАТЕНТНОЙ ТУБЕРКУЛЕЗНОЙ ИНФЕКЦИЕЙ

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Латентная туберкулезная инфекция (ЛТИ) — это состояние, при котором у человека отсутствуют клинические признаки туберкулеза, но иммунологические тесты положительны. При этом риски развития локального туберкулеза высоки, особенно у детей. ЛТИ распространена более чем у четверти населения мира. Основные этические проблемы связаны с неприятием диагноза родителями, недостаточной осведомленностью врачей первичного звена и гипертрофией проблемы со стороны специалистов. Родители часто воспринимают диагноз как стигму, что приводит к отказу от диагностики и лечения. Медицинские работники, не имея достаточных знаний, могут либо игнорировать, либо чрезмерно драматизировать ситуацию. Недостаток междисциплинарного подхода и стандартизированной информации усугубляет ситуацию. Для решения этих проблем необходимы просвещение родителей, повышение квалификации врачей, междисциплинарное взаимодействие и психологическая поддержка семей, что позволит повысить эффективность профилактики и лечения ЛТИ у детей.

Ключевые слова: латентная туберкулезная инфекция, дети, этические проблемы, непринятие диагноза

Вклад авторов: О. Г. Челнокова — консультации пациентов, изучение литературы по теме, систематизация и обобщение данных, участие в обсуждении результатов, написание и оформление статьи; А. Л. Хохлов — постановка проблемы, обсуждение ключевых этических вопросов, планирование и обсуждение статьи; Л. И. Мозжухина — изучение литературы по теме, участие в обсуждении результатов и написание статьи; А. Л. Салова — консультации пациентов, изучение литературы по теме, участие в обсуждении пациентов и результатов, написание статьи.

Соблюдение этических стандартов: заседание этического комитета не проводилось, так как материалом для обсуждения послужил практический опыт наблюдения пациентов в реальной клинической практике с соблюдением этических норм.

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In latent tuberculosis infection (LTBI), no clinical or radiographic symptoms of active tuberculosis (TB) are present, though immunological tests are positive [1–2]. Meanwhile, the risk of progression from LTBI to active TB is high, especially in children. A quarter of the world's population is estimated to have LTBI [3]. Identifying LTBI as a predictor of active TB is a major public health achievement as preventive activities can stop the spread of TB in many cases [4–5]. Phthisiologists specialize in diagnosis, monitoring, and treatment of children with LTBI. As the process is long, pediatricians actively monitor and initiate care for somatic pathologies in children with LTBI.

During the examination and treatment, both doctors, and patients with their parents face multiple ethically challenging situations that significantly affect the quality of medical care and treatment outcomes for children with LTBI [6–7].

REJECTION OF THE DIAGNOSIS BY PARENTS

One key ethical problem involves the complete rejection of the LTBI diagnosis in children by parents, parental complaints against medical professionals, violations of skin sampling procedures, and underestimation of clinical contraindications. Parents often associate TB with social stigma, linking it to unfavorable social conditions, and therefore refuse necessary diagnostic procedures and preventive treatment. The diagnosis has a particularly profound psychological effect on the family: children with LTBI experience reduced quality of life, with psychosocial functioning frequently disrupted. Parents may not distinguish between LTBI and active TB, leading to unwarranted fears about disease transmission and their child's future. Inadequate informational support for parents can create a vicious cycle: fear of a TB diagnosis leads to avoidance of screening and preventive care, increasing the risk of progression to active, infectious TB. This ethical dilemma can be addressed by informing the public about the possibility of active TB prevention when LTBI can be diagnosed and treated using skin tests with recombinant tuberculosis allergen or interferon-gamma release assays. Visits to pediatricians or phthisiologists should be sufficiently long to allow time for discussions with patients and their parents. This supportive approach is vital to managing diagnostic rejection.

GAPS IN TUBERCULOSIS KNOWLEDGE AMONG PRIMARY CARE PHYSICIANS

Another ethical issue arises from gaps in knowledge about TB among primary care physicians. In current medical education systems, students choose electives and modules, which can lead to the neglect of phthisiology. Many primary care doctors underestimate the impact and prevalence of TB and mistakenly consider phthisiology an 'outdated' field. However, phthisiology is rapidly developing: new diagnostic and therapeutic methods and innovative anti-TB medications have been introduced, and algorithms for diagnosis, prevention, and treatment are evolving. Over the last five years, new understandings of LTBI and updated criteria for diagnosis, treatment, and follow-up have emerged. Due to gaps in TB knowledge, primary care physicians may either refer children to phthisiologists without appropriate indication or ignore positive immunological tests and pathological symptoms. This can result in children missing essential specialist care or, conversely, lead to unnecessary referrals that undermine primary care credibility. Moreover, primary care physicians often expect phthisiologists to handle all aspects of TB management, which makes them uncomfortable with LTBI management. As a result, children with LTBI may live with the infection for extended periods while undergoing anti-TB treatment. These challenges can be addressed by improving primary care awareness of LTBI and promoting joint clinical discussions between primary care providers, phthisiologists, and specialists from medical universities.

OVEREMPHASIZING THE PROBLEM BY SPECIALISTS

The other extreme occurs when pediatricians or other primary care professionals are overly concerned about LTBI in a child, which is also ethically problematic. This is often related to heightened disease awareness among TB specialists. Viewing LTBI as an inevitable precursor to active TB creates additional stress for parents and children. Consequently, public perception of TB care services may deteriorate. The ethical issue is best addressed by fostering effective collaboration between pediatric and phthisiatric services through training conferences and interdisciplinary case discussions involving patients with LTBI, with active participation of specialized departments.

LACK OF SYSTEMIC APPROACH

The ethical issues emerged because of the lacking interdisciplinary approach to management of children with LTBI by TB care specialists, pediatricians, other doctors and clinical psychologists. No unified standards of informing parents about the methods of pediatric screening TB test have been developed yet; the issues of follow-up among children with LTBI and treatment of various abnormalities as well as life quality of these patients have not been investigated properly.

HOW ETHICAL ISSUES INFLUENCE TEST RESULTS AND TREATMENT OUTCOMES AMONG CHILDREN WITH LTBI

The ethical challenges discussed above directly impact the quality and effectiveness of care for children with LTBI. Parental rejection of the diagnosis leads to untimely examinations by specialists and delays in the initiation of preventive treatment, increasing the risk of progression to active TB. Throughout treatment, questions around parental adherence remain relevant, as anti-TB medications are administered to children by parents on an outpatient basis. Both diagnostic rejection and overemphasis by medical staff can result in either underdiagnosis or overdiagnosis, affecting children's health outcomes adversely. A lack of personalized care means that clinical guidelines may be followed without sufficient input from other specialists, particularly pediatricians.

HOW TO SOLVE THE PROBLEMS

To solve the mentioned ethical issues among children with LTBI, a complex approach is required. Apart from teaching the population about TB, the children should be examined in a more careful way by a phthisiologist and a pediatrician. When LTBI is diagnosed and during the follow-up, the child and the family should obtain support from a psychologist. A joint management of a child with LTBI by a phthisiologist and a pediatrician is essential and can be done effectively on an outpatient basis. Interdisciplinary discussions of cases involving children with LTBI can also serve as regulatory activities uniting pediatric and phthisiatric care services. It is crucial to have training programs for medical professionals aimed at adequate understanding of the issue of LTBI.

Thus, ethical issues that arise during diagnosis and management of patients with LTBI are multi-faceted. They significantly hinder successful up-to-date diagnosis and treatment of LTBI demanding a solution based on a scientific and interdisciplinary approach from phthisiologists, pediatricians, and clinical psychologists, who should necessarily act in the best interests of the child and the family.

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ETHICAL EVOLUTION IN TRAUMATOLOGY AND ORTHOPEDICS: FROM HISTORICAL PRINCIPLES TO MODERN CHALLENGES

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In this article, the evolution of ethics in traumatology and orthopedics is explored. Timeline history of medical ethics, from ancient postulates to modern professional codes, is discussed. The fundamental principles of modern bioethics are delved into. These include respect for patient autonomy, informed consent, confidentiality and professional responsibility in treating patients with injuries. Particular attention is paid to communication, practical application of ethics in the clinical examination, and continuity of care. The final section highlights the emerging ethical challenges of the 21st century associated with the technological progress, allocation of resources and palliative care in traumatology. The article demonstrates that the doctor–patient relationship has moved from a paternalism-based model to one with active involvement of a patient in the process of treatment.

Keywords: traumatology and orthopedics, medical ethics, deontology, patient autonomy, continuity of care, professional responsibility

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ЭВОЛЮЦИЯ ЭТИЧЕСКИХ НОРМ В ТРАВМАТОЛОГИИ И ОРТОПЕДИИ: ОТ ИСТОРИЧЕСКИХ ПРИНЦИПОВ ДО СОВРЕМЕННЫХ ВЫЗОВОВ

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В настоящей статье проведен комплексный анализ эволюции этических принципов в травматологической и ортопедической практике. Рассмотрены исторические этапы формирования медицинской этики, начиная с античных постулатов и заканчивая современными профессиональными кодексами. Детально проанализированы фундаментальные принципы современной биоэтики, а именно: уважение автономии пациента, информированное согласие, конфиденциальность и профессиональная ответственность в лечении пациентов с травмами. Особое внимание уделено практическим аспектам этики при клиническом осмотре, роли коммуникации и принципу преемственности в лечении. В заключительной части освещены актуальные этические вызовы XXI века, связанные с технологическим прогрессом, распределением ресурсов и развитием паллиативной помощи в травматологии. Статья демонстрирует переход от патерналистской модели взаимоотношений к партнерской, где пациент выступает активным участником лечебного процесса.

Ключевые слова: травматология и ортопедия, медицинская этика, деонтология, автономия пациента, преемственность лечения, профессиональная ответственность

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Traumatology and orthopedics are one of the most rapidly evolving and technologically equipped fields within modern medicine. Treatment for musculoskeletal injuries is commonly associated with emergency situations, lengthy rehabilitation periods and careful clinical decision-making. Under these circumstances, the ethical aspects of a doctor's professional activity are crucial for ensuring the quality of medical care and trust between a patient and a health care provider. The changing landscape of medical ethics in traumatology responds to global changes in public consciousness, science and law with transition from medical paternalism where one-sided decisions were always made by the treating doctor to care partnerships when the autonomy and rights of patients are respected. The article traces the journey of ethical principles in traumatology, analyzes their current state and identifies key challenges faced by the medical community.

HISTORICAL BACKGROUND OF ETHICAL STANDARDS IN TRAUMATOLOGY

Roots in ancient and medieval practices

Medical ethics has evolved over centuries. The ancient world tried to regulate the activity of healers. The Code of Hammurabi (about 4,000 years ago) was the first text that not only established fees for successful treatment but also implemented strict penalties for medical malpractice, particularly for physicians whose actions resulted in injury or death to patients. [1].

However, it was Hippocrates (5th century BC) who laid down the foundational concepts of medical ethics. Medical professionals, for centuries, have been guided by his principle of "do no harm" (Primum non nocere). The foundations for confidentiality, professional solidarity, and responsibility to the

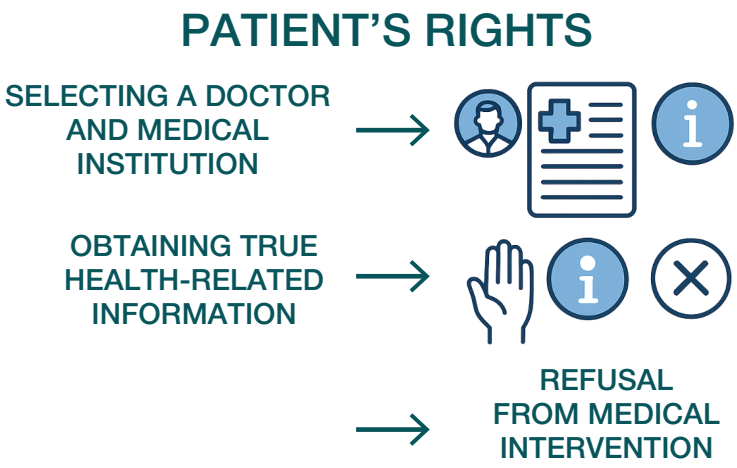

Fig. 1. Patient's rights

patient were also encapsulated in the Hippocratic Oath. In terms of traumatology, it meant that the doctor had to act solely in the interests of the injured, minimizing pain and suffering while reducing dislocations, treating fractures and performing other interventions.

Ethical norms in the Middle Ages were significantly influenced by religious dogmas. Caring for the ill and injured was seen as a moral duty and a manifestation of mercy. Paracelsus (16th century) added one more principle of "do good", saying that technically correct care should be accompanied by spiritual and psychological support of the patient, which is especially important for severe, crippling injuries [2].

Development of deontology and the role of key codes

Development of traumatology and orthopedics as independent disciplines in the 18–19th centuries required systematization of professional standards of behavior. In 1803, the English physician Thomas Percival published Medical Ethics, a work where he introduced the term for the first time and laid the foundations of professional deontology, the doctrine of proper behavior.

The 20th century marks significant advancements in medical ethics. The tragic experience of medical experiments in Nazi Germany culminated in the Nuremberg Trials (1947), which resulted in the adoption of the Nuremberg Code. It was for the first time when the Code globally established the principle of voluntary informed consent of the patient for any medical intervention or participation in the study. Thus, the era of unconditional paternalism in traumatology was over. From now on, any, even routine, operation required the informed consent of the patient, who had to be provided with complete information about the procedure, risks and alternatives [2].

In the USSR, medical deontology was actively developed; they paid particular attention to the psychological aspects of interaction with the patient, especially during long-term treatment, as well as the rules of communication with relatives in critical situations.

FUNDAMENTAL PRINCIPLES OF MODERN ETHICS IN TRAUMATOLOGY

Modern bioethics in traumatology is guided by four fundamental principles, which are reflected in national legislation and professional codes, such as the Code of Ethics of an Orthopedic Traumatologist at Pirogov National Research Medical Center or the standards of the European Federation of National Associations of Orthopedics and Traumatology (EFORT) [3].

Respect for the autonomy and dignity of the patient

According to the principle, patients are the owners of their body and can make decisions about their health independently. A doctor has to respect the treated person and be patient with the person, regardless of the person's social status, age or severity of the condition. It means that the patient has a right to three main aspects (Fig. 1).

Meanwhile, complete and reliable information includes not only the diagnosis, but also the prognosis, treatment methods, associated risks, and possible alternatives. Refusal from medical intervention should go hand in hand with the legislation (for example, when the patient is dangerous to others).

The principle of informed voluntary consent (IVC). The informed voluntary consent shows how the principle of autonomy is implemented in practice. It is not about a plain signing of a document. It is about communication when the patient obtains the information he/she needs to make a conscious decision. The doctor must honestly and openly talk about the goals, nature, duration, risks and expected benefits of the proposed treatment.

It is particularly difficult to obtain the IVC in emergency traumatology, when the patient may be unconscious or shocked. When facing the situations, the doctor should act trying to preserve the patient's life and health in accordance with the principle of least harm. As soon as it is possible, the doctor shall inform the patient and the patient's legal representatives of the manipulations performed and obtain consent for further treatment.

Confidentiality and medical privacy

Confidentiality forms the bedrock of trust. Medical privacy involves referral for medical care, health, diagnosis and other information obtained during the examination and treatment [4]. The data can be disclosed only in the presence of a written consent of the patient and as set by the legislation (for instance, when it is requested by investigational bodies or when there is a risk that infectious diseases can be spread, etc.)

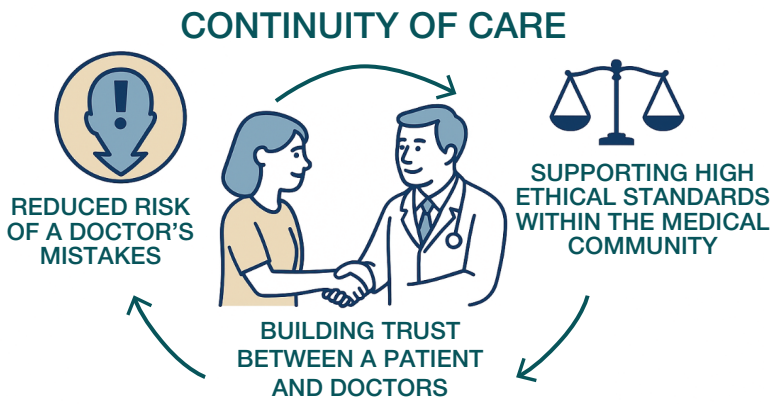

Fig. 2. Continuity in medicine

Professional competence and responsibility

The traumatologist is personally responsible for the quality and safety of the care provided. The principle means that the doctor has to improve his knowledge and skills on a regular basis; he should also act within his competence. If the doctor lacks the necessary knowledge or resources to treat a particular patient, it is his ethical duty to refer the patient to another, more competent specialist, without interfering with the patient's right to receive qualified care; the patient's interests should be above the doctor's commercial, administrative or personal interests.

ETHICAL ASPECTS IN THE CLINICAL PRACTICE OF A TRAUMATOLOGIST

Ethics of a physical examination. Clinical examination is the first and most important stage of diagnosis [5]. To perform the examination, the doctor has to be a professional and strictly follow ethical standards.

1. Clarifying complaints and collecting medical history. Building trust with physicians is important as it allows the patients to speak frankly about the circumstances of the injury, the nature of the pain, and concerns.
2. Physical examination. All manipulations (palpation, determining the scope of movements) should be done accurately without causing extra pain. Partial or complete removal of clothes by the patient, if required, should be done in privacy without the presence of unauthorized visitors.
3. Communication during the examination. The doctor should comment on his actions, explaining to the patient the purpose of a particular manipulation. It reduces anxiety and builds trust.
4. Documentation. All the data obtained is recorded in the medical documentation. In the presence of doubtful or incomplete data obtained from the patient, it is better to write 'according to the patient'.

The principle of continuity of care

It takes many stages and much time to treat traumatology patients as many specialists participate in the process (emergency physicians, intensive care specialists, surgeons, rehabilitologists). Continuity of care and consistency of therapeutic and diagnostic activities are essential in this case. Continuity of care from the ethical point of view is shown in Fig. 2.

It is the ethical duty of a doctor to ensure that all necessary medical information is fully and timely delivered when a patient is referred to another specialist or institution.

CURRENT ETHICAL CHALLENGES OF THE 21st CENTURY

Emerging technologies and changes in social paradigms pose new ethical issues in traumatology [6, 7].

1. Technological progress. Introduction of robotic surgical systems, artificial intelligence for diagnostics, and 3D-printing of implants raises the issue of liability distribution. Who is liable for the error? Is it a doctor, a software developer or an equipment manufacturer?
2. Distribution of resources. The ethical dilemma of fair distribution of costly resources (for example, modern endoprostheses, high-tech rehabilitation methods) is particularly pressing now, when funding is limited. Decisions should be made based on objective medical evidence but not on the patient's social or financial status.
3. Palliative care and quality of life. Provision of aggressive therapy to elder patients with severe combined injuries and unfavourable prognosis is questionable. The ethical choice is shifting from the goal of prolonging life at all costs to ensuring the highest possible quality of life, which may include avoiding traumatic surgeries in favor of conservative and palliative care.

CONCLUSION

The journey of ethics in traumatology and orthopedics has moved from ancient paternalism to a modern care partnership model based on the principles of respect for autonomy, awareness and mutual responsibility. Modern ethical codes and standards do not constitute a set of formal prohibitions. They rather form a system of values that help doctors make the right decisions in the most difficult clinical and life situations.

Compliance with ethical standards both improves the quality of medical care and patient safety, and builds trust in the medical profession and healthcare system as a whole. Subsequent development of ethical principles will be inseparably linked to solving the challenges posed by technological progress, economic realities and the humanistic values of modern society.

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BIOETHICAL ASPECTS OF HUMAN GENOME RESEARCH IN SPORTS: A BRIEF OVERVIEW

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Human genome research in sports brings about complex ethical questions related to genetic manipulation for enhancement of performance among athletes. Genes enhancing raises concerns about fairness, equality, and respect for human dignity. This review explores the ethical aspects of human genome research in sports and its potential effect on the integrity of sports. Methodologically, this article provides a systematic analysis of scientific publications and expert insights to explore the ethical challenges of athletic genetics. This study extensively examined the current literature on genetics and sports performance, as well as ethical contradictions in modern science and sports. The literature was searched using Scopus, Google Scholar, and PubMed databases. Keywords included “genetics”, “sports performance”, “ethics”, “bioethics”, “genetic testing”, “human rights”, “sports”. The searching strategy was formulated without time constraints. Thus, both recent and fundamental works in this direction could be included. In conclusion, it is stated in this review that genetic technologies in sports should be developed and applied in accordance with ethical considerations. It is crucial because this is how fundamental principles of fairness, equality, and respect for human dignity can be supported. The review stresses the importance of an open dialogue about the potential influence of genetic advancements on athletic performance, future generations, and integrity of sports.

Keywords: bioethics, sports, genetic testing, sports performance, ethics, human rights

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ЭТИЧЕСКИЕ АСПЕКТЫ СПОРТИВНОЙ ГЕНЕТИКИ: ВЫЗОВЫ И РЕШЕНИЯ

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Исследования генома человека в спорте поднимают сложные этические вопросы, касающиеся пересечения генетики и спортивных результатов. Проведение генетических модификаций требует соблюдения принципов честности, равенства возможностей и сохранения человеческого достоинства. Данный аналитический обзор исследует этические и моральные аспекты геномных исследований в спортивной сфере, анализируя возможные влияния на целостность спорта. Методологически работа представляет собой систематический анализ, объединяющий научные публикации и экспертные заключения для изучения этических вызовов в области спортивной генетики. Исследование включает детальный анализ современных научных работ, охватывающих генетические основы спортивных возможностей, моральные и этические противоречия в современных условиях развития науки и спорта. Поиск литературы проводился в трех базах данных: Scopus, Google Scholar и PubMed. Поиск осуществлялся по таким ключевым словам, как «генетика», «спортивные результаты», «этика», «биоэтика», «генетическое тестирование», «права человека», «спорт». Стратегия поиска была разработана без конкретных временных ограничений, что позволяло включать как недавние, так и основополагающие работы в этой области. В заключение, в обзоре утверждается, что интеграция этических соображений в разработку и применение генетических технологий в спорте имеет решающее значение для поддержания основополагающих принципов справедливости, равенства и уважения человеческого достоинства. Что подчеркивает важность открытого диалога о потенциальных последствиях генетических достижений для спортивных результатов, будущих поколений и целостности спорта.

Ключевые слова: биоэтика, спорт, генетическое тестирование, спортивные результаты, этика, права человека

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Identification of athletic talent and addressing ethical challenges in sports genetics have become a hot topic in the global scientific community. Groundbreaking discoveries in molecular biology and genetic research have emerged from exploration of the relationship between athletic performance and genes, opening innovative strategies to detecting abilities and enhancing performance in sports. This has raised complex ethical considerations regarding fairness, equality, and protected interests of athletes. Interaction of athletic performance and genetic science gives rise to significant ethical concerns that should be analyzed in detail and used to develop ethical principles, particularly regarding

fair play in sports competition and similar chances for all participants.

Emerging controversies covered ethical concerns of genetic enhancements such as genetic discrimination, risk of a genetically determined hierarchy among athletes, and possible consequences for future generations.

Genetic research can also significantly enhance athletic performance and push the limits of the human body dramatically.

The opposite views show that it is increasingly urgent to create a complex ethical platform that can manage responsible development and promote genetic innovations in modern sports.

ETHICAL CHALLENGES IN ATHLETIC GENETICS

Identifying athletic talent involves a complex natural assessment of physical and psychological traits that contribute to a sport-specific performance. An effective system for identifying promising athletes needs to predict their motor skills development and transformation of competencies necessary to become an elite athlete from primary selection to demonstration of sports achievements [1, 2].

However, talent identification is more than just plain consideration of evolutionary adaptations. The complex selection model represents a multi-faceted system that includes the training process quality, environmental conditions and individual motivation of the athlete, emphasizing the fundamental role of genetic factors in human athletic abilities. Scientists used candidate gene analysis methods and genome-wide association studies (GWAS) to identify 251 polymorphisms associated with athlete status, which is a technological breakthrough [3].

The scientific community predicts that a revolutionary period in sports genomics with breakthrough achievements in DNA technologies is about to start. Key development areas include: a) genome-wide sequencing, b) advanced GWAS studies, c) epigenomic and transcriptomic analysis, d) bioinformatics and proteomic profiling.

Advancements in technology enable deeper exploration of how genetics influence physical performance. The research potential will be enhanced due to better access to complex ohmic databases and high-performance screening technologies. Multiohmic approaches are also of great interest because they are used to understand the mutual effect of various integrated data (genomics, metagenomics, epigenomics, transcriptomics) on biological mechanisms of physical activity [4, 5].

Though genetic technologies in sports are currently associated with ethical dilemmas, they can help identify talents and enhance athletic performance [3, 6, 7]. For example, personalized training programs that utilize genetic information make training of athletes more efficient by emphasizing natural advantages and compensating for potential weaknesses, which enhances the overall athletic performance [8]. Genetic analysis of markers linked to tissue regeneration, injury predisposition, and recovery rates allows to develop personalized protocols for reducing traumatic risks and speeding up recovery. Due to this approach, a more rational strategy for maintaining health of athletes and prolonging their athletic careers is provided [9].

Genetic predisposition that influences metabolic processes and nutrient absorption forms the foundation for personalized nutrition strategies that optimize energy balance, muscle growth, and overall health. Personalized nutrition strategies will enhance athletic performance by tailoring nutrient intake to an athlete's genetic profile [10].

In turn, genetic technologies can democratize identification of athletic talent allowing more athletes to get access to previously exclusive knowledge. As genetic testing becomes cheaper and more accessible, personalized feedback and development opportunities enhance inclusivity in sports by recognizing and developing talent and breaking down socio-economic barriers [11].

However, the practical value of DNA testing for identifying athletic talent or predicting performance phenotypes is currently limited. [12]. Despite the obvious influence of genetic factors on athletic performance, the relationship between specific genetic variation and athletic performance within the normal range of human characteristics lacks sufficient evidence. It can be explained by a complexity of traits influenced by multiple genes with minimal effects, as well as by hampered control of environmental factors during research. It is important to understand that individual DNA characteristics probably represent only a small fraction of total physical characteristics ranging from 0.005% to 0.1% [13]. According to evidence from the scientific literature, genomic testing has limited value as a talent identification tool. An indicative study compared pooled genotypic indicators in elite athletes specializing in endurance sports (68 genetic variants) and in speed and strength sports (48 genetic variants) among five elite track and field athletes. However, 68 of nonathletic controls were scored even higher than elite power athletes. Surprisingly, elite speed and strength athletes often demonstrated superior endurance-strength compared to elite endurance athletes. The study concluded that genetic information is not a reliable criterion for distinguishing elite athletes from nonathletic controls, which doubts effectiveness of the method identifying athletic talent [14].

British researchers Pickering C. and Kiely J. from the University of Central Lancashire conducted a large-scale study involving 243 participants, including 110 athletes and 133 staff. Its aim was to study the prevalence of genetic testing in sports and participants' opinion of whether it is ethical to use the testing. The data show that genetic tests are far from being popular for assessing athletic performance: only 10% of athletes and 11% of staff used the test. Nevertheless, the majority of respondents agree that genetic factors are essential for athletic performance and adaptation to physical exertion. During the test, three key barriers preventing an active introduction of genetic testing into sports practice were discovered. They included lack of awareness among specialists, high financial costs, and absence of convincing scientific evidence base. Those who underwent genetic testing provided positive feedback. Thus, 73% of athletes and 64% of staff estimated the obtained information as practically significant. It should be noted that genetic testing was mainly used not to identify an athletic talent, but to personalize training programs. The most representative result of the study included identification of fundamental differences in the ethical perception of genetic testing among athletes and coaching staff. A small percentage of athletes, specifically 4%, cited ethical considerations as a reason for refusal from genetic analysis. Among coaches, this figure reached 19%, which is almost five times higher [15].

Members of sports community have different opinions on genetic testing. Moreover, coaches worry more about ethical issues as compared to athletes. This difference in perception shows that the issue of using genetic technologies in professional sports is complex. A research group led by Varley I. conducted a large-scale online survey involving 72 elite athletes and 95 representatives of British sports organizations and governing structures. The purpose was to explore the

practical implication of genetic testing and the prospects for its introduction into sports practice.

The survey results demonstrated a striking consensus among the respondents. Thus, approximately 80% of elite athletes and almost all representatives of the support staff recognized that genetic factors were essential while shaping athletic potential. Moreover, the study participants were convinced that genetic profiling shows promise in predicting athletic performance and injury susceptibility [16].

Genetic tests that determine athletic potential are criticized based on the ACCE model, which is an integrated system for evaluating genetic research. This model analyzes several key aspects such as analytical accuracy of the results, clinical reliability of the methods, and ethical, legal and social risks associated with their use. Though professional and ethically sound identification of athletic abilities may sound logical, the criteria of professional competence do not apply to genetic testing. It creates a significant gap in the system assessing quality and reliability of the research [17].

Genetic research involving minors raises significant concerns. Many experts are strongly against using the methods in adolescents and children [18, 19]. Genetic testing of young people generates specific ethical contradictions that go beyond the standard issues of professional competence and scientific validity. The issue needs a detailed analysis and a balanced approach to decide on using genetic tests among young athletes.

One of the key ethical issues in genetics and sports includes some methods that enhance athlete performance without direct genetic intervention [20]. Thus, genetic testing is often used to identify and select promising athletes. However, some approaches such as somatic gene transfer and sex line modification are aimed at direct gene modification. Germline modifications can provide athletes with inherent life-long superior physical traits, offering a significant advantage in competitive sports. Moreover, useful traits are likely to be passed on to future generations, creating genetically enhanced athletes with excellent physical abilities [21]. Genetic innovations in sports extent far beyond just personal records and cover complex ethical and human rights issues. Genetic enhancement technologies can create disparities among athletes: one group gains access to these technologies, while the other lacks it, which leads to genetic discrimination. The distinction between “genetically privileged” and “genetically deprived” athletes highlights the need for legislative frameworks and uniform international regulatory standards. Using the methods makes us question the basis of fair competition, violating the principles of equality and fairness where the spirit of competitive sports rests [1, 22]. Inequalities between athletes who can afford genetic enhancements and those who cannot can be exacerbated, depriving athletes of equal opportunities and hindering true competitiveness in sports. To address these challenges, comprehensive guidelines should be developed to ensure equal access to all athletic achievements and reliable protection of rights of athletes. Such measures could address technical and ethical issues and ensure transparency and inclusivity among athletes. Moreover, as germline modifications are persistent and can affect future generations, careful review of our moral obligations to those with inherited changes of this kind is required. These concerns show that the ethical considerations should not be ignored when genetic technologies in sports are developed and applied. They warrant that commitment to improve the results does not compromise the fundamental principles of justice, equality and respect for human dignity. As the scientific community continues exploring the potential of genetic modifications, it is essential to participate in an open and inclusive dialogue devoted to the issue of long-term effects of these technologies on the integrity of sport and society.

Ethical issues related to human genome research in sports are of paramount importance when assessing how genetic innovations can improve athletic performance [23]. Genetics combined with sports practice gives rise to complex dilemmas concerning justice, equal conditions and well-being of athletes. It is essential to understand these aspects to ensure that genetic enhancement fails to violate the principles of fair competition, respect for human dignity and equal access for all participants.

In addition, the long-term effects of genetic enhancements in sports require a comprehensive ethical structure to guide the responsible development and application of genetic technologies. The ethical aspects of human genome research in sports will be essential while producing a potential effect on athletes, future generations, and sports integrity.

CONCLUSIONS

Human genome research in sports brings about complex ethical questions regarding genetic manipulation for performance enhancement of athletes. Genetic testing enables powerful insights into training process optimization, while creating risks for discrimination and violation of equal opportunities.

Emergence of gene therapy technologies raises significant concerns about gene doping. It makes sports organizations work on new methods of control and regulation. Use of genetic data for selection and training of athletes raises ethical issues about a “genetic class” of elite athletes.

Ultimately, ethical considerations in human genome research in sports must evolve with scientific advancements following the basic ethical principles and preserving the values of sports activities.

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THE LEGACY OF ANTON CHEKHOV AND MEDICAL ETHICS

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Along with well-known scientists who dealt with the issues of medical ethics, writers, some of whom were also medical doctors, made a significant contribution to the development of the field under study as well. The surviving pieces of writing are highly valuable not only for Russian culture but also for sciences, especially for biomedical, social and humanitarian sciences. The stories of Anton Chekhov, a doctor, a writer and a public figure of the second half of the 19th century, made a significant contribution to Russian and global culture. Chekhov's correspondence with his family members and notable figures of that time is an independent layer for researchers. To date, they have been important sources for historians, cultural scientists, health care organizers, lawyers, and specialists in ethics.

Keywords: medicine, medical ethics, the legacy of Anton Pavlovich Chekhov, ethical problems in the works of Anton Chekhov

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НАСЛЕДИЕ А. П. ЧЕХОВА И МЕДИЦИНСКАЯ ЭТИКА

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Наряду с известными учеными, занимавшимися вопросами медицинской этики, заметный вклад в развитие исследуемого направления внесли также писатели, часть из которых являлась по образованию врачами. Дошедшие до нас художественные произведения наряду с большой ценностью для отечественной культуры также представляют интерес и для наук, в особенности для медико-биологических, социальных и гуманитарных. Заметный вклад к отечественную и мировую культуру внесли рассказы А. П. Чехова — врача, писателя и общественного деятеля второй половины XIX века. Самостоятельный пласт для исследователя — переписка Чехова с известными людьми того времени, а также с членами семьи. До настоящего времени они являются важными источниками для историков, культурологов, организаторов здравоохранения, юристов, а также специалистов в области этики.

Ключевые слова: медицина, медицинская этика, наследие Антона Павловича Чехова, этические проблемы в произведениях А. П. Чехова

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Healing is a human activity that has been regulated with a bunch of moral, legal, religious, and ethical standards for ages. The role of public regulators has evolved throughout history in response to significant changes in medical landscapes. The changes were mainly related to emergence and practical application of new medical technologies. They yielded to others and moved to the periphery, while others developed with their subject field expansion. In spite of what has been said above, they are all important today in one way or another, whereas some of them can even experience their own Renaissance. Despite the boosted significance of legislation in some self-proclaimed legal states, ethical norms still play an additional but prominent role in regulating a bunch of complex social doctor-patient relationships (in a broader sense, the relationship between the medical professionals in general, patients and their legal or contractual representatives).

An emerging trend of returning to basic and traditional values of Russian people seen in Russian national policy today should not be ignored as well. The technical and conceptual updates and amendments to the Constitution of the Russian Federation [1] were proposed in 2020.

According to Part 1 of Article 114 of the Constitution of the Russian Federation, the Government of the Russian Federation ensures the implementation of a uniform state policy in the spheres of culture, science, education, healthcare, social welfare, support, strengthening and protection of the family, and preservation of traditional family values.

Also, we cannot ignore the new article of the Constitution (67.1), which is devoted to preserving the memory of ancestors who conveyed to us ideals and belief in God, as well as continuity of development of Russia.

To understand the goals and objectives of modern state policy in this area, it is necessary to refer to Decree of the President of the Russian Federation dated November 9, 2022 No. 809 'On approving the fundamentals of state policy to preserve and strengthen traditional Russian spiritual and moral values [2]. The Russian Federation views traditional values as the foundation of Russian society, enabling it to defend and strengthen its sovereignty, and ensure the unity of our country with its diverse ethnic and religious structure.

Decree of the President of the Russian Federation No. 314 dated May 8, 2024 'On approval of the fundamentals of state policy of the Russian Federation in the field of historical education' is another strategic planning document [3]. The decree states directly that scientific historical knowledge and

education are the fundamentals of historical education in Russia.

A deep understanding of traditions and self-awareness of our people is impossible without the knowledge of our past history and without the images that live in the memory of several generations. In this regard, thorough examination of various sources and time-tested literary texts, in particular, are essential for socio-humanitarian knowledge in general, for certain areas of economics and the socio-cultural sphere of our society. They form and maintain civic identity and historical memory [4], and allow solving both general and special tasks of many modern sciences [5, 6].

The above makes it possible to discuss the position of medical ethics in the second half of the 19th century in Russia as viewed by Anton P. Chekhov in this short publication. The author's subjective choice is explained as follows.

First, Chekhov was a practicing physician who had firsthand knowledge of the problems that can arise in doctor-patient relationships (both in large cities and in the countryside). Some of the problems were described in his stories, while others were discussed with his colleagues and friends.

Second, Anton Pavlovich is not only a doctor and a writer. Also, he is a public figure who is widely known in Russia and abroad. Thus, Chekhov's contemporaries couldn't help noticing his articulation of ethical problems in medicine and his personal attitude hereto [7].

Third, Chekhov's ethical legacy is increasingly becoming the subject of research interest among modern scientists [8]. Thus, it shows that his pieces of works, correspondence, and statements contain explicit and hidden meanings, both common and special ones.

The legacy of A. Chekhov is diverse. It covers customary, medical and even legal issues. In this article, a medical aspect is of a great value.

For example, Chekhov's "Ward Number Six" focuses on several ethical principles and their practical implementation in psychiatric practice of those years. Dr. Andrey Yefimitch visited his patient and prescribed 'cold compresses on his head and laurel drops, shook his head, and went away, telling the landlady he should not come again, as one should not interfere with people who are going out of their minds' [9]. The patient was soon put into the ward for venereal patients. But as he disturbed others, he was afterwards, by Andrey Yefimitch's orders, transferred to Ward No. 6.

The short fragment of the well-known story covers the issues of provision/non-provision of aid to a patient, autonomy and medical duty, and the obligation not to harm a patient. Anton Chekhov shows how medicine is developed and how medical care is provided on site. On the one hand, the doctor does not interfere with people who are going out of their minds at the outpatient stage (does he implement the principle of autonomy?), and on the other hand, he fails to provide the patient with necessary medical care, which soon makes the patient confined to a hospital bed. Thus, there arises a question if a doctor can harm his patient by doing nothing. It is difficult to see malicious intent in Dr. Andrey Yefimitch's actions; it is rather a matter of everyday practice, which is sometimes quite far from high ethical principles, especially when it comes to psychiatry. However, we believe that raising the issue of improper performance of professional duties by the doctor is appropriate here.

Anton P. Chekhov subsequently states that a round man with "a stupid face, utterly devoid of thought" stays in ward number six. It turns out that Nikita, the watchman who has to clean up after the man, beats him terribly 'with all his might, not sparing his fists'.

The writer briefly touches the issue of underdeveloped psychiatric aid in the country, and stresses that medical, psychiatric and penitentiary functions are poorly combined herein. Country doctors started paying attention to psychiatry by the end of the seventies only; the field of medicine turns out to be separated starting from the mid-eighties of the XIX century. During the same period, humanistic traditions in Russian psychiatry began to emerge and be introduced thanks to the works of Korsakov SS and his followers [10].

It is well known that 'Ward Number Six' was first published in 1892 when reforms in Russian psychiatry were initiated. Thus, the writer and public person made his own contribution to the development of psychiatry in Russia. The story, read by many people including high-level officials, influenced their thoughts and, consequently, could affect taking certain managerial decisions.

'On Official Duty' is an iconic story by Anton Chekhov [9]. Dr. Starchenko, an experienced man, and the young examining magistrate Lyzhin happen to meet under the same roof. They have different views and experience, and belong to different professional areas… The doctor is a true cynic whereas the magistrate hasn't become a cynic yet. Medicine and law have a lot in common: both a doctor and a magistrate work with people; they both see a person in a bad light; in practice, they are guided by duty, law, professional ethics, as well as psychological and other techniques that allow them to achieve their goals. Nevertheless, not all of us act as the duty calls. If we did, the world would be a better place. In 'Surgery' [9], a short story by A. Chekhov, one violation follows another one in the hospital setting where both medical ethics and the rule of law are lacking.

A feldsher (a mid-level medical practitioner) substitutes a doctor. The problem is older than the hills; however, the practice shows that even today feldshers can substitute doctors while performing certain functions. There are still criminal cases when mid-level medical practitioners are charged with harming or even killing a patient because they were performing some functions that they were not good at. Therefore, this is an old problem that hasn't been resolved yet.

The short story makes us reflect on duty, professionalism, medical harmlessness, truthfulness, justice and so on, which is not easy.

In 'Enemies', the issue of choice is particularly pressing [9]. Should he stay with his wife who is experiencing the tragedy of the loss of their son or without hesitation accompany a patient who stays many kilometers away from the doctor's place? The doctor, with a heavy heart, agrees to accompany the patient yielding to professional duty and law… He remains high even in the face of difficult personal circumstances. Just imagine his condition when he understood that he had only been a pawn in the game of others. For some people, there is nothing sacred…

In the 19th century, we dive into the remarkable scientific discoveries with innovations introduced into economic, social and cultural spheres. Anton Chekhov followed these ones and had great hopes for them. Thus, the character of the story entitled 'My life' [9] reflects on physical, mental, productive and unproductive labor, as well as a just world order.

'The Cherry Orchard' is the play devoted to the technological advances [9]. However, not all accomplishments should meet immediate support. According to Anton P. Chekhov, progress is linked to justice and implementation of the ethical principle

of doing good. Properly set goals allow us to understand a well-known statement from 'A Dreary Story' by Chekhov saying that science is the most important, the most splendid, the most essential thing in the life of a man… This is what a professor of medicine thinks. In spite of the years lived as well as positive and negative personal experience, the professor is sure that medicine is the best science, doctors are the best people, and medical traditions are the best ones.

Healthcare technologies have significantly changed in the past 100 years (owing to the development of effective medicines, diagnostics means, minimally invasive surgeries, etc.). It seems that the majority of industry issues must have been solved if not all of them. However, the issues of providing access of general public to high technologies and fair distribution of healthcare resources are being widely discussed today. A. Chekhov notes that the process is not linear.

The memoirs of contemporaries about the writer, the writer's correspondence with friends, colleagues, and family members are also of great value for understanding Chekhov's ethics.

Anatoly F Koni, a renowned lawyer and a forensic orator, described the people around the writer as follows: 'Enough phosphorus but no ferrum' (only a doctor could use the comparison!); 'What we need is temperament but not apathy' [11].

A. Chekhov frequently conveyed the issue of healing, medical interventions and their consequences to his readers, friends and colleagues with a touch of humor. We believe that it allowed to raise acute professional issues, including ethical ones, implicitly, on the one hand, and to solve the issues without extra tension and official tone intrinsic to formal meetings, conferences, councils, etc., on the other hand.

'I do not believe that we live in stressful times as humans have always had a stressful life', he said [12]. The words are relevant even today. A famous slogan of the 20th century said: 'All illnesses are caused by stress'. Another slogan was as follows: 'A doctor can have terrible days and hours. Please God don't let anyone go through it… These can be experienced by doctors only. This is the reason why they should not be judged strictly for their misdeeds' [12].

Chekhov addressees included about one hundred of doctors, his contemporaries. It is impossible to count the letters obtained by the writer from doctors. In the letters, they discussed not only highly professional issues of diagnosis and treatment of internal diseases, but also the issues of medical ethics, mistakes leading to conflicts, complications of diseases and death of patients.

Thus, it can be concluded that further study of Anton Chekhov's legacy through the prism of medical ethics and its principles is essential.

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