

**BIOETHICAL ASPECTS OF THE USE OF NANOTECHNOLOGY
IN MEDICINE****Umirzakova Nargiza Akmalovna,**Tashkent State Medical University, PhD, associate professor
n.a.umirzakova@gmail.com +998 94 6797907<https://orcid.org/0009-0001-8741-4964>

Abstract: Nanotechnology today has the potential to revolutionize healthcare, significantly changing the delivery and accessibility of medical care. However, despite its many advantages, the use of nanotechnology also poses a number of challenges. The article analyzes bioethical aspects related to the development and application of nanotechnology in modern medicine.

Key words: medicine, nanotechnology, health, risks, bioethics, nanoscience, principles of bioethics, healthcare.

Аннотация: В наши дни нанотехнологии способны произвести настоящую революцию в сфере здравоохранения, существенно изменив способы оказания и доступность медицинской помощи. Однако, наряду с многочисленными преимуществами, использование нанотехнологий сопряжено и с рядом проблем. В статье анализируются биоэтические аспекты, связанные с развитием и применением нанотехнологий в современной медицине.

Ключевые слова: медицина, нанотехнологии, здоровье, риски, биоэтика, нанонаука, принципы биоэтики, здравоохранение.

INTRODUCTION

Nanotechnology is our present and our future. There's arguably no area of human life that it hasn't touched. When discussing the potential uses of nanotechnology, it's in the field of medicine that some of the most visionary nanotechnology projects have been proposed and are currently being implemented. The creation of molecular robotic doctors that would "live" inside the human body, repairing or preventing any damage that occurs, including genetic damage. It's also easy to imagine the advantages that nanotechnology will offer. Humanity will be freed once and for all from the dangers of blood transfusion infections (HIV, hepatitis viruses, malaria parasites, etc.), and post-transfusion reactions. Anemia associated with hereditary blood disorders will also be cured. Such nanodevices will be particularly useful in transplants as oxygen carriers. Robots can provide breathing support to newborns suffering from uterine asphyxia, trauma, and other conditions.

LITERATURE REVIEW

In researching this topic, the author turned to the Universal Declaration on Bioethics and Human Rights, developed by UNESCO in 2005 [1]. The works of T.L. Beauchamp and Childers J.F.[2], Allhoff F, Lin P., Moor J., Weckert J. [3] were also studied. The bioethical aspects of the use of nanotechnology have been studied and defined in the works of such post-Soviet scientists as Mishatkina T.V., Siluyanov I.V., Belyaeva E.V., Yudin B.G., etc.

RESEARCH METHODOLOGY

Since the issue of the application of nanotechnology is a modern one and is of an innovative nature, the philosophical and methodological analysis of this topic was carried out on the basis of the study of nanotechnology in the field of medicine and required such philosophical research methods as analysis and synthesis, induction and deduction.

ANALYSIS AND RESULTS

The development of nanotechnology opens up vast opportunities for progress in medicine, pharmacology, and bioengineering, but at the same time gives rise to a whole range of new bioethical challenges[4]. Contemporary research in this area requires philosophical and ethical analysis aimed at understanding the boundaries of permissible intervention in human nature and the environment.

First and foremost, one of the key concerns is safety for human health. Due to their microscopic size, nanoparticles have high penetrating power and can penetrate cells, tissues, and even the body's genetic structures. This creates a risk of toxic effects and mutagenic changes, the consequences of which are not fully understood [5]. The lack of long-term clinical observations increases uncertainty regarding the potential risks to human health and life.

The second important aspect concerns the responsibility of researchers and manufacturers. The rapid pace of nanotechnology's introduction into medical practice often outpaces the development of adequate ethical and legal regulatory mechanisms. The question arises: who bears moral and legal responsibility for potential negative consequences—scientists, manufacturing companies, or government agencies?

The next set of issues concerns privacy and personal autonomy. Nanotechnological devices implanted in the body for diagnostics or health monitoring can be used to collect personal data, posing a threat to privacy and the ability to control a person's behavior[6].

Furthermore, environmental and social risks should be noted. The release of nanoparticles into the environment can lead to ecosystem pollution, the consequences of which are difficult to predict. The social danger is that access to nanomedical technologies may be limited by socio-economic factors, which will deepen inequality between different population groups.

The issue of so-called human enhancement is also attracting particular attention. The use of nanotechnology to enhance cognitive and physical capabilities goes beyond traditional medical approaches, sparking debate about the limits of human nature [7] and the moral permissibility of such interventions.

Finally, one of the most pressing problems remains the lack of a clear regulatory framework. Ethical standards and legislation do not always keep pace with the pace of scientific progress, which requires the development of new international mechanisms for regulating nanotechnology research, taking into account bioethical principles: respect for individual autonomy, the principle of "do no harm," fairness, and responsibility.

Hypothetically, nanotechnology could help solve many of humanity's global problems. In 2005, the United Nations (UN) Millennium Project Task Force on Science, Technology, and Innovation concluded, nanotechnology can contribute to the achievement of the Millennium Development Goals (MDGs), in particular those aimed at reducing child mortality, improving maternal health, and combating HIV/AIDS, malaria, and other diseases. Nanotechnology has the potential to revolutionize healthcare. From the above, we can understand that the development of nanoscience in medicine can significantly change human existence, making life safer and less burdensome.

However, despite the significant benefits of nanotechnology, there are concerns. In particular, there is uncertainty regarding its potential impact on human health, the environment, and society as a whole. Meanwhile, nanotechnology could also pose a host of problems in terms of biomedical ethics[8]. For example, the question of reviving people currently cryopreserved. Currently, the press is openly declaring that, pending advances in nanotechnology, the pace of cryopreservation for terminally ill people should be stepped up. Such statements and actions raise numerous ethical concerns. In fact, even with the most advanced nanotechnology, the chances of reviving such people are practically zero[9]. Scientific research shows that when a warm-blooded object larger than sperm is frozen, a complete rupture of all cells occurs due to the conversion of cellular water into ice. From this it is clear that no nanorepair cells will be able to "reassemble" the actual human corpse, restore all the cells, restore interrupted intercellular connections, disrupted functions, etc.

Under these conditions, recommendations to develop cryonics today violate numerous principles of biomedical ethics[10], including "do no harm" and "do good." Euthanasia and iatrothanasia are deliberately encouraged, and the human right to a dignified death is violated through deception.

Numerous biomedical ethical issues are also emerging in other nanotechnologies that may be implemented in medicine in the coming decades. For example, the issue of their universal accessibility and the principle of equitable resource distribution in medicine will immediately arise. There is little doubt that, given the current state of morals in modern society[11], nanotechnology will be distributed selectively, in accordance with the service or monetary hierarchy.

The problem of regional egoism will also arise, as technologies will be available primarily in the regions where they are developed or purchased. UNESCO considers educating the public about the problems of nanotechnology a crucial task for its various bioethics committees[12]. It requires an extremely precise calculation of the problem of extending human life on earth by introducing molecular robots into the body that prevent cell aging, as well as restructuring and "refining" human tissues. If another nanotechnological challenge of artificial food synthesis is not realized, then human life extension could have the most serious consequences.

CONCLUSION / RECOMMENDATIONS

In conclusion, nanotechnology has every chance of becoming a key area of modern science in the near future. The prospects for its development appear extremely promising. In conclusion, nanotechnology has every chance of becoming a key area of modern science in the near future. The prospects for its development appear extremely promising. I would like to

believe that humanity will be able to wisely use their potential, directing their achievements for the benefit of society and progress. Thus, bioethical problems of the use of nanotechnology reflect the need for an integrated approach that combines scientific development with moral and social responsibility to humans and nature.

REFERENCES:

1. Всеобщая декларация о биоэтике и правах человека. Париж: ЮНЕСКО, 2005. https://www.mjil.ru/jour/article/view/543?locale=ru_RU
2. Beauchamp T.L., Childress J.F. Principles of Biomedical Ethics. 8-nashr. – Оксфорд: Oxford University Press, 2019.
3. Allhoff F., Lin P., Moor J., Weckert J. Nanoethics: The Ethical and Social Implications of Nanotechnology. – Hoboken: Wiley-Blackwell, 2007.
4. Royal Society & Royal Academy of Engineering. Nanoscience and Nanotechnologies: Opportunities and Uncertainties. Лондон, 2004.
5. Hodge G.A., Bowman D.M., Maynard A.D. International Handbook on Regulating Nanotechnologies. Cheltenham: Edward Elgar, 2010.
6. Умирзакова Н. А. Биоэтика как ценностная ориентация в профессиональной компетентности врачей //Гуманитарный трактат. – 2020. – №. 77. – С. 4-7.
7. Умирзакова Н. А. Репродуктивные технологии в системе здравоохранения Узбекистана в качестве социальной инновации //Наука, образование, инновации: апробация результатов исследований. – 2019. – С. 884-888.
8. Умирзакова Н. А. Аксиологическая функция биоэтики в формировании профессиональной компетентности у студентов //Academic research in educational sciences. – 2022. – Т. 3. – №. 12. – С. 115-123.
9. Умирзакова Н. А. Биоэтика как ценностная ориентация в профессиональной компетентности врачей //Гуманитарный трактат. – 2020. – №. 77. – С. 4-7.
10. Умирзакова Н. А. Востребованность биоэтики для гуманизации медицинского образования в Узбекистане //IX международного симпозиума о биоэтике здоровья, медицина та философи: стратеги виживання. – С. 15-16.
11. Умирзакова Н. А. Аксиологическая функция биоэтики в формировании профессиональной компетентности у студентов //Academic research in educational sciences. – 2022. – Т. 3. – №. 12. – С. 115-123.
12. Зикирова М. Ш. и др. Альтернативы проведения экспериментов над животными //Academic research in educational sciences. – 2022. – №. 2. – С. 181-184.
13. Tillakhujayeva D., Umirzakova N. A. Human in a medical experiment //SCHOLAR. – 2023. – Т. 1. – №. 34. – С. 37-41.
14. Umirzakova N. A. et al. Knowledge and understanding of the principles of bioethics at the department of prosthodontics //Гуманитарный трактат. – 2020. – №. 97. – С. 4-6.
15. Умирзакова Н. А. Биоэтиканинг пайдо булиши, фан сифатида шаклланиши ва урганадиган муаммоларининг фалсафий-методологик тахдили //Фалсафа ва ҳдёт.- Тошкент. – 2020. – Т. 1. – №. 8. – С. 56-69.
16. Умирзакова Н. А. Биоэтические правила проведения пластических операций //Academic research in educational sciences. – 2022. – Т. 3. – №. 12. – С. 221-226.
17. Умирзакова Н. А. Принципы биоэтики и деонтологии в детской стоматологии //Academic research in educational sciences. – 2022. – Т. 3. – №. 12. – С. 144-148.

18. Умирзакова Н. А. Актуальность и востребованность биоэтики в медицинском образовании Узбекистана //Педагогика и психология в медицине: проблемы, инновации, достижения.-М. Издательство Перо. – 2021. – С. 291-295.
19. Umirzakova N. A. The importance of studying bioethics in the formation of professional competence of medical students //Научные исследования XXI века. – 2020. – №. 5. – С. 140-144.
20. Umirzakova N. A. The attitude of society and christianity to the issue of artificial insemination //Потенциал современной науки. – 2020. – С. 330-335.
21. Умирзакова Н. А. Гуманизм как основа медицины //SCHOLAR. – 2025. – Т. 3. – №. 4. – С. 68-72.
22. Умирзакова Н. А. Биоэтические вопросы проведения имплантологических вмешательств в контексте мировых религий //SCHOLAR. – 2025. – Т. 3. – №. 4. – С. 62-67.
23. Умирзакова Н. А., Инагамова С. Д. Решение этических проблем медицины в условиях цифровизации //GOLDEN BRAIN. – 2025. – Т. 3. – №. 4. – С. 94-100.
24. Умирзакова Н. А., Исмаилов У. М. Влияние цифровых технологий на диагностику и лечение: телемедицина, приложения для мониторинга здоровья //Academic research in educational sciences. – 2025. – №. Conference 1. – С. 229-233.
25. Собритдинова Ш. С., Умирзакова Н. А. Биоэтические аспекты применения искусственного костного материала ethoss //Russian-Uzbekistan Conference. – 2024. – С. 189-192.
26. Умирзакова Н. Значение социально-гуманитарных дисциплин в формировании гуманизма у будущих врачей //Евразийский журнал академических исследований. – 2024. – Т. 4. – №. 11 Special Issue. – С. 380-383.
27. Сатарова Д. Г., Умирзакова Н. А. Развитие глобальной этики и всеобщая декларация о биоэтике и правах человека //Этика и история философии. – 2016. – С. 202-207.