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Legal and economic issues of improving the medical waste management system

Currently, the unfavorable environmental situation with medical waste in the Republic of Kazakhstan is one of the acute problems. In addition, nature and the population of Kazakhstan and neighboring countries are in a worse situation. In this article, the legal analysis of the improvement of the medical waste management system in the Republic of Kazakhstan is carried out, the legal foundations of the provision are considered. The analysis of the current state of medical waste management in a number of regions of the Republic of Kazakhstan has been carried out, the prerequisites for the application of an integrated approach to the disposal and neutralization of this type of waste within the framework of regional environmental policy have been studied. Based on the analysis of law enforcement practice, gaps in the legal regulation of the medical waste management system have been identified. A methodological approach is proposed, which is a feature of the legal and financial justification of the territorial schemes of medical waste management used in the regions. The methodological tools of the study include statistical methods of processing data on the disposal and disinfection of medical waste. The Republic of Kazakhstan is distinguished by increased attention to the methods of handling medical waste, the desire to ensure environmental safety and the prevention of violations of legislation in the disposal of medical waste. On the other hand, low satisfaction of the authorities was revealed with the pace of solving the problems of disposal of healthcare institutions not included in the process of medical activity, including medical waste requiring disinfection and recycling. The result of the study is proposals on the need for interregional cooperation in the field of placement and construction of complexes for the processing, disposal and neutralization of medical waste of various hazard classes. The authors propose as a promising direction of scientific and technological development to create a complex of high-tech equipment for the disposal of various types of medical waste with the production of secondary raw materials, as well as the neutralization of medical waste of increased and increased danger.

Keywords: medical waste, environmental safety, recycling, high-tech equipment for the disposal of medical waste, medical waste management system, incineration.

Introduction

The safe and efficient management of medical waste is one of the key issues in ensuring healthcare and environmental sustainability today. The particular danger of waste generated by medical institutions is directly related to the presence of infectious diseases, chemical, and biological hazardous substances. Therefore, improper management of such waste can harm both the environment and human health.

Currently, the issue of regulating the management of medical waste is one of the most critical challenges, as it is considered a fundamental element of state policies at both international and national levels within the framework of environmental and public health protection. It must be acknowledged that existing management systems are insufficiently developed [1].

Every year, millions of tons of waste are generated by medical institutions, including hazardous types. The need for proper management of this waste has led to economic and legal responsibility issues for both the government and the private sector. While many countries have developed legal frameworks and regulatory mechanisms to effectively organize medical waste management systems, there are still aspects that require further improvement.

The issue of handling medical waste is considered a crucial component of public epidemiological and environmental safety. Medical waste requires special attention as it poses risks to both humans and the environment due to the presence of infectious disease agents, toxic substances, and radioactive materials.

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According to the World Health Organization (WHO), legal regulation is a key element in ensuring the safe and efficient management of medical waste. WHO believes that a comprehensive legal approach is necessary to improve medical waste management systems. This involves not only adopting regulatory acts but also ensuring their effective implementation, monitoring, and public awareness. Such legal measures contribute to the protection of human health, environmental safety, and the sustainable development of society. As per WHO recommendations, governments should allocate funds to establish and maintain safe medical waste management systems. Additionally, they should engage funding organizations, partners, and other resources to ensure adequate contributions to waste management.

Furthermore, governments should implement and monitor safe medical waste management systems, support capacity-building initiatives, and contribute to ensuring the health and safety of both medical personnel and the general public.

The effective management of medical waste should be a strategic goal for any country. This issue is one of the pressing topics in our country. In the studies conducted by Nukusheva A.A., Baysalova G.T., and Beisenbayeva M.T., cases of illegal storage and disposal of medical waste in private areas, as well as the unauthorized placement of medical waste in household waste landfills, have been reported [2].

According to Article 351 of the Environmental Code of the Republic of Kazakhstan, medical waste belongs to the category of waste that is prohibited from being disposed of in landfills.

Thus, strict compliance with legislative norms and requirements regarding the effective management and neutralization of medical waste is necessary. The illegal storage of medical waste and its disposal in household waste landfills in our country pose significant environmental and public health risks. Therefore, strengthening state control, enforcing legal requirements for responsible individuals, and increasing public awareness and responsibility regarding this issue are crucial to ensuring the proper management, safe disposal, and recycling of medical waste.

Additionally, for the effective management of medical waste, sufficient funding must be allocated for the collection, utilization, neutralization, transportation, storage, and disposal of waste generated in the operations of medical institutions. In regional medical institutions, the process of handling medical waste is carried out based on its hazard classification [3].

To improve the efficiency of the medical waste management system, it is necessary to propose comprehensive solutions through an analysis of its legal and economic aspects.

Studying national legislation in the field of medical waste management, identifying gaps in the existing legal framework, comparing it with international practices, and developing recommendations for improving legal regulation form the basis for addressing legal issues.

Key issues in studying economic efficiency include analyzing the economic costs of medical waste collection, transportation, storage, and recycling; exploring opportunities to enhance economic cooperation between the public and private sectors; and proposing ways to optimize costs through the introduction of innovative technologies and green economy principles.

In improving the management system in medical institutions, it is crucial to study best practices in medical waste management, implement training programs for staff, and raise awareness about proper waste handling.

In foreign countries, medical waste is strictly classified as hazardous waste. These countries place significant governmental attention on the collection, recycling, and disposal of medical waste. Such an approach has enabled the proper organization of processes, effective neutralization of waste, and its safe disposal [4].

According to the World Health Organization’s recommendations on medical waste management, urgent technical guidelines are required for officials to implement measures from waste storage to the disposal of incinerator residues. During the storage stage, waste bags should not be allowed to overfill, and waste collection personnel should ensure that bags of the same color are combined and sent to the appropriate disposal location. This approach helps prevent the negative impact of waste management on the environment, staff, and nearby communities.

According to Aripin, as cited in the works of Nursamsi, Thamrin, and Deni Evison, medical waste must be either incinerated or buried with lime and removed on the same day. The management, treatment, and disposal of hospital waste must ensure that it does not harm the environment or public health [5].

According to Russian researchers Kulikova O.V. and Sorokina Y.V., a study of foreign legal regulations in medical waste management has identified three main approaches to improving legislation in this field. The first approach involves issuing a specialized (independent) act specifically regulating medical

waste. India serves as a clear example of this method. The second approach regulates all types of waste under a single act, with each section dedicated to the legal regulation of a specific waste type. This approach has been implemented in the United Kingdom. The third approach regulates medical waste within the framework of legislation on public health protection and sanitary-epidemiological safety [6].

Currently, the Republic of Kazakhstan follows the third approach; however, its implementation remains underdeveloped compared to other countries. This approach is characterized by significant gaps in legal regulation and the delineation of responsibilities, requiring substantial improvements to the legislative framework. Such improvements should be carried out considering accumulated international experience and current national standards. Therefore, in the future, government authorities and representatives of the scientific community must pay increased attention to the legal regulation of medical waste management. Through joint efforts, it is essential to systematize this field and achieve the highest level of legal efficiency in its regulation.

According to Shamshurina N.G., Prisyazhnaya N.V., Pavlova Yu.V., and Shulyatyev S.V., medical waste requires special attention, as it significantly differs from other industrial and consumer waste. Medical waste may contain pathogens of dangerous diseases, toxic and radioactive substances, as well as non-degradable polymeric materials. This highlights the necessity of organizing specialized services for the processing and disposal of medical waste [7].

Sidorova M.A. notes that the existing legislative framework for handling medical waste includes several potential problems. These issues can only be resolved by enhancing legal regulation in areas related to medical production processes, medical services, and everyday human activities [8].

According to Ponomarev M.V. and Comartova F.V., the absence of licensing requirements for certain types of medical waste management services is a separate concern. Given the potential risks to human health, habitats, and the environment resulting from non-compliance with environmental and sanitary-epidemiological standards, it is necessary to introduce specific restrictions on granting permissions to business entities for engaging in such activities [9].

The analysis of foreign medical waste management systems, the development of recommendations for implementing effective methods adapted to local conditions, and the improvement of the legal and economic foundations of medical waste management are crucial for protecting public health, ensuring environmental safety, and reducing economic costs.

Enhancing the legal and economic foundations of the medical waste management system will contribute to preserving public health, ensuring ecological safety, and minimizing financial expenses.

If safety requirements for the disposal of potentially hazardous medical waste are not met, it can negatively impact the environment. Additionally, direct or indirect contact with contaminated waste, water, and soil may lead to the spread of infectious and non-infectious diseases among the population [10].

In this regard, one of the key applied tasks in solving the medical waste issue is the establishment of a medical waste management system and the improvement of its legal and financial-economic support. Research conducted under the leadership of Academician N.V. Rusakov has reliably demonstrated the necessity of enhancing the legislative framework regulating procedures for handling hazardous medical waste, as well as improving organizational-instructional [11] and methodological documents. Additionally, the study highlights the importance of using the most effective sterilization devices for medical waste. The objective of this research is to analyze the legal and economic aspects of medical waste management and to identify ways to improve the medical waste management system.

Methods and materials

In the process of writing this article, general scientific methods were used in legal science and related environmental sciences were applied as the methodological foundation of the study. These included comprehensive methods specific to environmental law, as well as comparative analysis, normative-logical methods, synthesis, and systematic legal analysis. An analysis was conducted on the existing laws, decrees, and regulatory acts governing medical waste disposal in Kazakhstan.

The study describes ways to improve the economic methods of managing environmental legal order, optimize the use of economic tools, and develop new mechanisms that contribute to more effective environmental legal regulation.

During the research, regulatory legal acts issued by the Government of the Republic of Kazakhstan and the Ministry of Health, regional programs and concepts, applied studies on this issue, electronic resources,

publications from scientific conferences, and other materials related to the development of the medical waste management system in Kazakhstan were utilized.

Results

The undeniable relevance of improving the risk management system in medical waste disposal highlights several economic and legal issues. To prevent harmful effects on human health and the environment, the general legal framework for waste management is ensured by Article 100 of the Code on Public Health and the Healthcare System (Code of the Republic of Kazakhstan No. 360-VI dated July 7, 2020) [12]. At the same time, the only existing document regulating the procedure for handling medical waste is the "Rules for Providing Information on Medical Waste" [13]. Specifically, the issues related to medical waste management are outlined in the "Sanitary Rules for Health Care Facilities", which establish sanitary-epidemiological requirements. However, these regulations remain inadequately structured and require further refinement [14].

The relevance and social diversity of the medical waste management problem are evident in the experience of developed countries and the dynamics of its research. This should also be taken into account in domestic practice, considering local characteristics and capabilities. For example, the United States provides a notable case, where discussions on medical waste issues peaked in the late 1980s and early 1990s. During that period, materials on problems in this field were widely published in specialized and periodical publications, actively drawing public attention and significantly stimulating government action.

This situation led to the development and adoption of legislative acts regulating medical waste management rules in each state. Until the late 1980s, such acts existed only in a few states. Alongside legislative activities, the U.S. Environmental Protection Agency (EPA) developed a document titled "Medical and Medical Industry Waste Control", which acquired the status of a legislative act applicable to all states.

Additionally, medical waste management has a distinct hygienic, epidemiological, environmental, and social character due to its pronounced polymorphism, as well as potential but very real risk factors such as infection, toxicity, and radioactivity. Therefore, organizing a medical waste management system— particularly in transportation and disposal — requires compliance not only with sanitary requirements but also with environmental legislation [15].

Polish legislation provides for the neutralization of medical waste while prohibiting the recycling of certain categories of such waste. These include:

Waste generated from medical diagnostics, treatment, and preventive procedures.

1. Human body parts and organs, as well as containers for blood and its preservative solutions.
2. Live pathogenic microorganisms, their toxins, or other forms capable of transmitting genetic material that are known or strongly suspected to cause diseases in humans and animals.
3. Hazardous chemical substances, including chemical reagents.
4. Cytostatic and cytotoxic pharmaceutical substances.
5. Residual dental amalgam waste.
6. Used biologically active therapeutic baths with infectious properties.
7. Food waste from infectious disease departments.

The epidemiological risks associated with medical waste can be mitigated through incineration. This method significantly reduces the volume and quantity of waste. However, incineration produces toxic gas emissions, including dibenzodioxins, dibenzofurans, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, carbon, cadmium and lead oxides, as well as lead, arsenic, hydrochloric acid, hydrogen cyanide, and nitrogen oxides. To minimize these emissions, expensive filtration and gas treatment systems must be used.

The use of closed incineration chambers equipped with sorbents, emission analysis devices, and appropriate filters helps reduce harmful gas emissions to minimal levels. However, these measures increase operational costs. Additionally, the management of residual ash, airborne particulate matter from filters, saturated sorbents, and technical waste from incineration must also be addressed. A further drawback of incineration is that the resulting ash, while free of pathogenic microorganisms, still contains hazardous substances.

Managing waste left after hospital incineration remains a major issue in waste processing. Specific regulatory guidelines for incineration are outlined in the European Parliament and Council Directive [16]. Medical waste management is a complex ecological and economic issue. While incineration plays an

essential role in waste neutralization, its efficiency and environmental safety require expensive technologies and strict adherence to waste management regulations.

Discussion

The lack of clear legislative regulations creates several legal challenges in the medical waste management sector. For instance, the issue of licensing for medical waste management remains unresolved in legal practice, making it difficult to hold organizations accountable for the collection, transportation, and disposal of medical waste.

In Kazakhstan, the licensing of medical waste management activities has not been fully regulated and involves several critical aspects.

The primary requirements for medical waste management are outlined in the Environmental Code of the Republic of Kazakhstan and the Code on Public Health and the Healthcare System. However, these documents do not specifically address licensing procedures. Currently, the licensing issue is indirectly regulated through environmental and sanitary rules, but a clear and independent licensing mechanism is not in place.

Since medical waste falls under the category of hazardous waste, organizations handling it should be subject to strict regulatory requirements. However, the current legal framework lacks clear licensing mechanisms for such requirements. This creates difficulties in registering and monitoring organizations involved in waste management. Specialized technical equipment and trained personnel are essential for handling medical waste safely. However, without licensing requirements, there is no guarantee that these standards will be met.

Currently, Kazakhstan has not fully implemented a licensing system for medical waste management. Addressing this issue requires improvements to the legislative framework. Doing so would not only enhance environmental and sanitary safety but also improve the efficiency of the sector.

For example, an incident in Lenger, Turkistan Region, highlights the urgency of this problem. In this region, amputated body parts, used syringes, and containers with blood residues were found discarded in plastic bottles. The company responsible for disposing of hazardous medical waste was fined. However, it was revealed that this type of business does not require a special license or designated landfills. The conclusion drawn from this case is that any company with transport, storage facilities, and incinerators or shredding equipment could engage in this type of business without strict oversight. This situation underscores the need for immediate regulatory measures to address the issues mentioned above and establish proper control mechanisms [17].

Thus, the question remains open as to whether the practices of unlicensed enterprises comply with regulatory requirements. Currently, a moratorium on scheduled inspections of medical and sanitary safety enterprises is currently active in Kazakhstan. However, according to First Deputy Prime Minister R. Sklyar, after the moratorium is lifted, plans are in place to strengthen oversight of enterprises providing medical waste disposal services [18].

One of the key issues in improving the situation and addressing the consequences of the organizational-methodological gap in Kazakhstan is solving the problem of licensing medical waste management services. Additionally, developing unified tender documentation for the procurement of services related to the collection, transportation, and disposal of medical waste is crucial. At this stage, the ongoing political and legal measures are not sufficient to ensure the effective management of medical waste. The proposed measures require additional investments, as well as technical and expert support.

Moreover, there is a lack of a reliable national assessment of the impact of medical waste and its potential risks to the environment and human health. Given the existing political and legal initiatives in the country, increased interaction with NGOs and the implementation of expert-technical support measures should be prioritized. Further research should focus on analyzing the effectiveness of these measures, evaluating legislative changes, and assessing their societal impact.

If the above-mentioned legal and economic issues are not addressed in a timely manner, citizens' rights to a favorable environment may not be realized. This issue must be resolved through measures aimed at eliminating the negative impact of an unfavorable environment on human health.

Proper supervision of medical waste management is a crucial element in environmental protection, epidemiology, and occupational safety. For effective management, the primary importance lies in correctly categorizing waste at the point and time of its generation [19]. This approach ensures the most efficient conditions for waste neutralization.

According to sorting procedures adopted in healthcare institutions, if household waste is mixed with infectious waste, all collected waste is subsequently classified as biologically hazardous [20]. Therefore, it is essential to implement proper standards for collection, labeling, and transportation. The rational management of infectious medical waste in healthcare facilities must ensure occupational safety, public health, and environmental protection.

Conclusions

The disposal of medical waste remains a significant issue worldwide, and addressing this challenge in Kazakhstan is no easy task. To effectively manage the process from the initial generation of medical waste to its disposal or recycling, a systematic approach must be developed and implemented based on modern scientific and practical advancements. Additionally, it is crucial to establish and enforce legal mechanisms to minimize the harmful effects of medical waste on human health and the environment.

Improving the medical waste management system is a critical issue in ensuring environmental safety and protecting public health. A balanced approach to addressing legal and economic aspects can help eliminate shortcomings in this sector, organize the system efficiently, and optimize resource utilization.

Based on the study of foreign practices and domestic conditions, this article highlights the need to improve the legal framework for medical waste management in accordance with international standards, strengthen government oversight, and introduce economic incentive mechanisms. Furthermore, the implementation of innovative technologies for safe waste processing and disposal, raising ecological awareness in society, and ensuring effective collaboration among all stakeholders are of great importance.

In Kazakhstan, the legal and regulatory framework for medical waste management still requires further improvement. The absence of a licensing system, insufficient oversight, and the lack of unified standards for medical waste management pose serious challenges. These shortcomings not only harm the environment but also threaten public health.

Studies of international experience indicate that systematic legal regulation and economic incentives are necessary for the efficient management of medical waste. The adoption of innovative technologies, increased funding, and employee training are essential steps toward improving this sector.

Enhancing legal regulations and interdepartmental cooperation in medical waste management can elevate waste disposal to a new level, ensuring epidemiological and environmental safety.

To improve the situation in Kazakhstan, it is necessary to adopt specific laws and regulatory documents on medical waste management, introduce a licensing system, and strengthen oversight. Moreover, optimizing economic costs through the principles of a green economy and the development of public-private partnerships is essential. Raising awareness about the dangers of medical waste, promoting a culture of compliance with sanitary and epidemiological standards, and developing the necessary infrastructure using modern collection, transportation, and sterilization methods should also be prioritized.

By enhancing medical waste management, we can protect public health, ensure environmental safety, and reduce economic costs. Achieving these goals requires coordinated efforts from the government, scientific community, and private sector.

These measures will help systematize the medical waste management system, improve ecological sustainability, and enhance the quality of life.

In conclusion, eliminating the environmental impact of medical waste requires a multifaceted approach, including technological innovations, legal reforms, stakeholder collaboration, and continuous monitoring. By implementing the recommendations outlined above, we can move toward a future where medical waste is managed in a way that protects both the environment and public well-being.

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Р.А. Сеилкасымова, Д. Нұрмұханқызы

Медициналық қалдықтарды басқару жүйесін жетілдірудің құқықтық және экономикалық мәселелері

Қазіргі уақытта Қазақстан Республикасындағы медициналық қалдықтардың қолайсыз экологиялық жағдайы өткір мәселелердің бірі. Сондай-ақ, Қазақстан мен көршілес елдердің табиғаты мен халқының жағдайы нашар. Мақалада Қазақстан Республикасындағы медициналық қалдықтарды

басқару жүйесін жетілдіруге құқықтық талдау жасалып, оны қамтамасыз етудің құқықтық негіздері қарастырылған. Еліміздің бірқатар өңірлеріндегі медициналық қалдықтармен жұмыс істеудің қазіргі жағдайына ерекше назар аударылған, өңірлік экологиялық саясат шеңберінде қалдықтардың осы түрін кәдеге жарату мен залалсыздандыру бойынша кешенді тәсілін қолданудың алғышарттары зерделенген. Құқық қолдану тәжірибесін талдау негізінде медициналық қалдықтарды басқару жүйесін құқықтық реттеудегі олқылықтар анықталды. Өңірлерде қолданылатын медициналық қалдықтармен жұмыс істеудің аумақтық схемаларын құқықтық және қаржылық негіздеудің ерекшелігі болып табылатын әдістемелік тәсіл ұсынылды. Зерттеудің әдістемелік тәсілдері медициналық қалдықтарды кәдеге жарату және зарарсыздандыру туралы деректерді өңдеудің статистикалық әдістерін қамтиды. Қазақстан Республикасы медициналық қалдықтармен жұмыс істеу әдістеріне аса көңіл бөлуімен, экологиялық қауіпсіздікті қамтамасыз етуге ұмтылуымен және медициналық қалдықтарды кәдеге жарату мәселелерінде заң бұзушылықтардың алдын алумен ерекшеленеді. Алайда, билік органдарының денсаулық сақтау мекемелерінің медициналық қызмет процесіне енгізілмеген кәдеге жарату мәселесін, оның ішінде зарарсыздандыру мен өңдеуді қажет ететін медициналық қалдықтарды шешу қарқынымен қанағаттанушылығының төмендігі анықталды. Зерттеу нәтижесі әртүрлі қауіптілік класындағы медициналық қалдықтарды өңдеу, кәдеге жарату және залалсыздандыру кешендерін орналастыру және салу саласындағы өңіраралық ынтымақтастық қажеттілігі туралы ұсыныстар. Авторлар ғылыми-технологиялық дамудың перспективалық бағыты ретінде қайталама шикізат ала отырып, медициналық қалдықтардың әртүрлі түрлерін кәдеге жарату, сондай-ақ қауіптілігі жоғары медициналық қалдықтарды залалсыздандыру үшін жоғары технологиялық жабдықтар кешенін құруды ұсынады.

Кілт сөздер: медициналық қалдықтар, экологиялық қауіпсіздік, кәдеге жарату, медициналық қалдықтарды залалсыздандыру үшін жоғары технологиялық жабдықтар, медициналық қалдықтарды басқару жүйесі, инсенерация.

Р.А. Сеилкасымова, Д. Нұрмұханқызы

Правовые и экономические вопросы совершенствования системы управления медицинскими отходами

В настоящее время неблагоприятная экологическая ситуация с медицинскими отходами в Республике Казахстан является одной из острых проблем. Кроме того, в худшем положении находятся природа и население Казахстана и соседних стран. В данной статье проведен правовой анализ совершенствования системы управления медицинскими отходами в Республике Казахстан, рассмотрены правовые основы обеспечения. Особое внимание уделено современному состоянию обращения с медицинскими отходами в ряде регионов Республики Казахстан, изучены предпосылки применения комплексного подхода к утилизации и обезвреживанию данного вида отходов в рамках региональной экологической политики. На основе анализа правоприменительной практики выявлены пробелы в правовом регулировании системы управления медицинскими отходами. Предложен методический подход, который является особенностью правового и финансового обоснования применяемых в регионах территориальных схем обращения с медицинскими отходами. Методологический инструментарий исследования включает статистические методы обработки данных об утилизации и обеззараживании медицинских отходов. Республика Казахстан отличается повышенным вниманием к методам обращения с медицинскими отходами, стремлением обеспечить экологическую безопасность и предупреждением нарушений законодательства в вопросах утилизации медицинских отходов. Однако, была выявлена низкая удовлетворенность органов власти темпами решения проблем утилизации учреждений здравоохранения, не включенных в процесс медицинской деятельности, в том числе медицинских отходов, требующих обеззараживания и переработки. Результатом исследования являются предложения о необходимости межрегионального сотрудничества в области размещения и строительства комплексов по переработке, утилизации и обезвреживанию медицинских отходов различного класса опасности. Авторы предлагают в качестве перспективного направления научно-технологического развития создать комплекс высокотехнологичного оборудования для утилизации различных видов медицинских отходов с получением вторичного сырья, а также обезвреживания медицинских отходов повышенной опасности.

Ключевые слова: медицинские отходы, экологическая безопасность, утилизация, высокотехнологичное оборудование для обезвреживания медицинских отходов, система управления медицинскими отходами, инсенерация.

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