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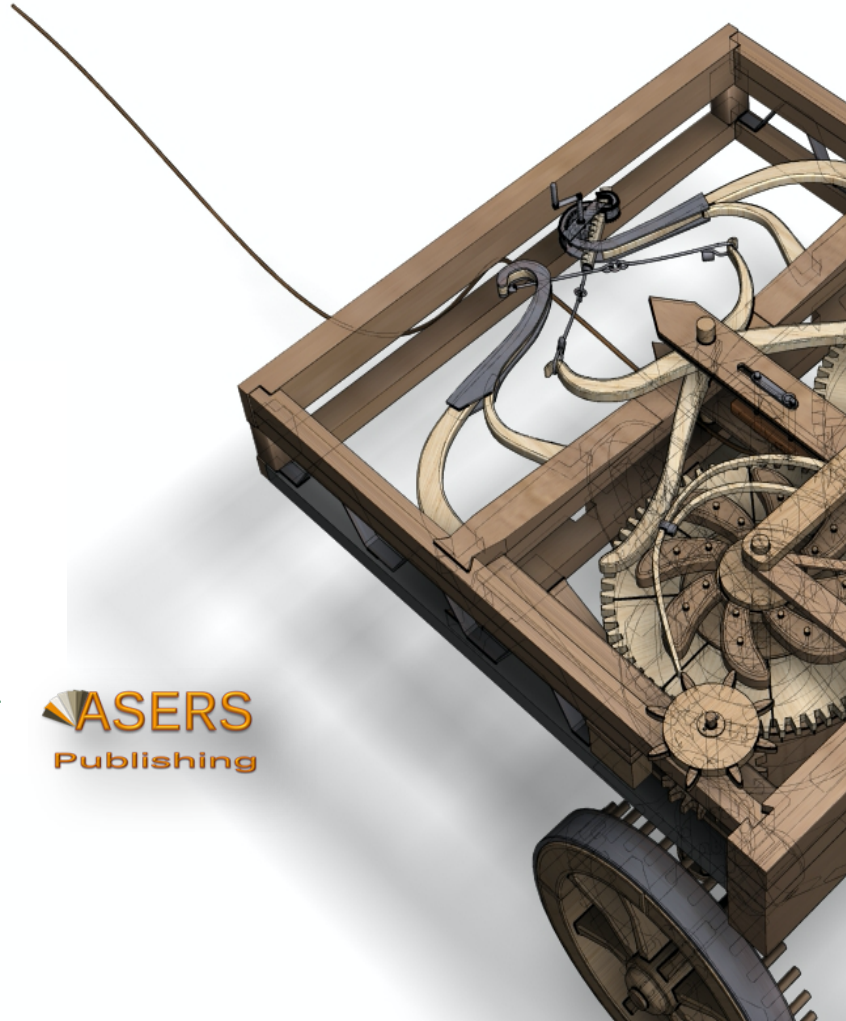
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# Call for Papers Fall Issues 2023 Journal of Environmental Management and Tourism

**Journal of Environmental Management and Tourism** is an interdisciplinary research journal, aimed to publish articles and original research papers that should contribute to the development of both experimental and theoretical nature in the field of Environmental Management and Tourism Sciences.

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## Exploring of the Pharmacy Industry of Kazakhstan: Theory, Implementations and Model of Waste Management

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### Abstract:

The purpose of this research is to study the level of development of the pharmaceutical industry, to develop recommendations to household disposal of pharmaceuticals and to propose a waste management model to climate change. The goal was achieved solution of the following objectives: analysis of the pharmaceutical industry in Kazakhstan, including within the framework of the EAEU; study of the problem of waste management and approaches to its solution; development of proposals for the management of medical waste processing. In our study we are using the following methodological algorithm of scientific research provision: analytical review of the current situation, conducting a sociological survey, building a management model in the form of a "flowchart" based on the use of a systematic approach. In the result of the provided research, it was proved that the volume of pharmaceutical drugs production is constantly growing and almost does not decrease. At the same time, the development of the pharmaceutical industry has increased the growth of waste. Therewith, the strategy of management must be focused on prevention and reduction of such effect, at finding opportunities for managing, but at the same time so as not have a negative influence on the environment. Because the environment is one of the most important aspects of human life.

**Keywords:** pharmaceutical industry, waste management, drug waste, circular economy, environmental economics.

**JEL Classification:** Q53; I18; L65; O13.



## Introduction

Demographic world situation and uttermost spread of different disease, especially considering recent events, related to coronavirus COVID-19, has led to the increasing demand for pharmaceuticals and emergence of new drug products. More than that, the demand in many of the most frequent medicines has increased not only in connection with epidemiological situation, but due to lifestyle change of a person and climate change as well. Thus, the shift to the distance format can result in the spread of sedentary life followed by deterioration of health of people, which is also affected by environmental pollution.

Over the last years there has increased the usage and consumption of medical drugs for prophylactic purposes. The increase in the consumptions of medical drugs generates the problem of the utilization of both used and expired medical products (Gerbut *et al.* 2020; Chernets *et al.* 2008; Saduakassova, Korlan and Gulnara Svyatova 2022). In developed countries as Germany and France they are tough about the elimination of waste problems. Notwithstanding, during pandemic some rules on waste management were softened. When in Eurasian Economic Union (EAEU) including Kazakhstan the development of recommendations on introduction of a sensible approach to waste classification has just begun. Nevertheless, most of the waste is being sorted by hand. Herewith the amount of waste is increasing and there are no clear recommendations on solid waste management, especially medical products (Paton *et al.* 2005).

The activity of pharmaceutical industry brings evident advantage from the perspective of health preservation and economic benefits, however its waste has increasingly bad effect on the environment (Gwenzi, Simbanegavi and Rzymiski 2023), as unused medical products are, oftentimes thrown away or utilized improperly (Benítez-Rico *et al.* 2023; Zhou *et al.* 2023; Paton *et al.* 2005). Medical products are cumulated mainly in surface waters, soil, organic fertilizers and even in drinking water (Rzymiski, Drewek and Klimaszuk 2017; Bhuyan and Ahmaruzzaman 2023). To assess in full the effect of a range of factors is quite complicated. Issues related to medicine utilization are not new, however they are little touched upon the solution of medical waste processing (Edderkaoui, *et al.* 2019; Barai, and Bhanvase 2023). Consequently, scientific research can be important for further solution of the problem in all contexts including environmental (Alsayadi and Arora 2023; Inarmal and Moodley 2023).

In this fashion, the research question of the impact of pharmaceutical products on the environment remains the subject of scholarly discussions all over the world. Moreover, for manufacturers of not only pharmaceutical products, but all types of manufacturers the main problem is elimination and disposal of expired products (Abil'dinova, Kuleshov and Svyatova 2003). The goal was obtained through solution of following tasks: study of the problem of waste management and approaches to the problem solution; recommendations development on medical waste processing management.

Current scientific research makes a contribution to science in more ways than one. Section 2 addresses the empirical literature about medical waste's impact on the environment with a focus on differences in methodology, data sources and sample periods. In Section 3 there are proposed standout features of data set used for empirical study. In Section 4 there are suggested recommendations and proposals on management of energy-efficient processing of medical waste.

## 1. Literature Review

Pharmaceutical drugs form a group of substances which have a great significance for the society, as a tool for healthcare. Pharmaceutical drugs are widely spread, and worldwide there is a steady growth in the usage of potent pharmaceutical drugs, driven by drug design, population ageing in Western governments and efforts in health gaining in developing countries. Because of this use, there appears corresponding increase in the pharmaceutical waste generation (Sharma, *et al.* 2023; Tyliczszak and Pielichowski 2013). It is obvious that ever growing application of pharmaceutical drugs in clinical and veterinary medicine practice can have adverse impact on the environment (Zhou, *et al.* 2023; Ali *et al.* 2017; Bulegenova, *et al.* 2018). Utilization of pharmaceutical drugs has become an issue for the society and healthcare and poses risks to the environment. This is proved through the following global issue, such as the issue of pharmaceutical waste management. Throughout the world given problems are considered as primary one, which quickly and fundamentally has influence of the air, water, and soil, moreover on ecology.

Pharmaceutical waste includes expired, unused, spilled, spoilt and out of production pharmaceutical products, drugs, vaccines, and serums, which are no longer needed and must be utilized properly. This category also includes thrown away objects used in the handling of pharmaceuticals such as bottles, boxes with remains, gloves, masks, connecting tubes and medicine vials. This waste is toxic and can pollute the environment and cannot have the same end use as normal waste. Specifically, in the view of major research project there were

considered all together 123 761 cases of measured concentrations of pharmaceutical drugs in the environment worldwide (Gwenzi, Simbanegavi and Rzymiski 2023). Thus, in some studies it is noted that in Asian countries waste is dumped into soil, which is not particularly good from the perspective of the future. Even though some pharmaceuticals are present in small amounts in domestic household waste, their cumulative effect must be considered (Helwig, *et al.* 2023; Toichuev, *et al.* 2018). Besides, the waste has an inherent environmental risk potential, which is spread to micro-absorbent material, which can have widespread repercussions on ecology. This raises fears about conceivably adverse ecological impact of this pollution.

The routine of pharmaceutical products waste usage and disposal endangers safety of the environment, also puts forward grave risk for the health benefits as they it can cumulate and remain active over a long period of time in the aquatic environment (Hossein, *et al.* 2023; Abzhaliyeva, *et al.* 2018; Biyashev, *et al.* 2016). In this relation, the research on the analysis of pharmaceutical drugs usage is focused on water-based systems, where waste waters are considered to be the primary source of environmental emissions because of pharmaceutical drugs discharge in the natural form or as metabolites. According to most of the scientific research in the field of pharmaceutical waste management the largest number of pharmaceuticals remains can be found in the surface, ground and drinking water tanks (Khan, *et al.* 2023; Gryshchenko, Danchenko and Musiyshuk 2019). Most commonly, wastewater treatment units dispose pharmaceuticals not in full due to the lack of a proper construction (Zhou *et al.* 2023).

## 2. Methodology

Most of the works considered the attempts assay the impact of medical waste on the environment. The researchers used different approaches, which were different in the subjects of the study (pharmaceutical enterprise, country), data sources (primary, secondary), the sample size and period, methods used (quantitative, qualitative, mixed (Lee and Choi 2015; Oreskovich and Gittins 2016)). Notwithstanding, such research has not been provided in Kazakhstan until present. In this connection the scientific-methodological substantiation for the development of recommendations on problem solution of sustainable development, related to disposal of pharmaceuticals acquires major importance.

The information base of the research is providing both primary and secondary data. Secondary data is a statistical data of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, the Eurasian Economic Commission for the period from 2014 to 2019 in the field of production and waste in the pharmaceutical industry. A wide range of studies on controlling principals of questionnaire design can be summarized, mentioning the existence of the set of general question-writing principles, which must be used to avoid common mistakes when writing questionnaire questions (Gwenzi, Simbanegavi and Rzymiski 2023). A structured questionnaire for the assessment of medical workers and patients' attitude towards the utilization of the remaining medicine was developed. The respondents were explained the aim of the research and their anonymity was ensured. For the analysis of socioeconomic status there was collected information about age, gender, education, and profession. The respondents were asked if they ever had any kinds of medicine, also when and how they utilized them. The survey was provided in electronic format.

The authors used the following algorithm of scientific research provision:

Step 1: analysis of pharmaceutical industry of Kazakhstan and within of the EAEU framework through economics and statistics analysis of various indicators: assessment of pharmaceutical industry marketability, analysis of pharmaceuticals production dynamics and emission and waste rate into the environment.

Step 2: provision of sociological survey for the analysis of current situation in Kazakhstan among medical workers and patients, focused on the definition of awareness and participants attitude to the medical waste utilization.

Step 3: composition of the management model in the form of a "flow-chart" based on the usage of systematic approach, due to which any subject of modeling is regarded as the system interrelated with other subjects of the research. The main feature of the management model is the structure namely is determinate order of assembly of elements, which make up an integrated model. The characteristics of current model, lies in the fact that, its composition is based on the systematic approach, which is the main methodic modeling principle.

The process offered by the authors is distinct in its approachability and simplicity of calculation, also allows developing directions of collecting and destroying drugs from the point of view of environmental protection.

## 3. Results and Discussion

In much of the world creation of profitable and acceptable government collection and recycling systems and utilization is needed. For its functioning, it is proposed to comply with specific norms and strict rules. Thuswise,

accurate and correct utilization of medicals can help to reduce the effect of medical drugs on the environment (Barai and Bhanvase 2023; Tyliczszak, *et al.* 2017). The issue was also framed through the lens of the culture of collaboration across health care and environmental policy which is certainly essential in maintaining and solving the environmental problem with joint efforts. Meanwhile it is necessary to notice that the cost of drug disposal is higher than production. For instance, the cost of pharmaceutical waste utilization through high temperature incineration costs the USA 4.4 to 8.2 million USD. In India, the cost of such utilization makes up from 0.5% to 2% of total sales (Barai and Bhanvase 2023). In the meantime, one of the important side effects as environmental hazards is the reason for approximately 25% of total disease burden all over the world, and almost 35% in such regions as Sub-Saharan Africa (Inarmal and Moodley 2023).

Regarding the study of factors, which can affect the efficiency of pharmacies in collection and utilization of medical waste of the population, has given positive results. In this vein the distribution of medical drugs from households and their utilization is of great concern for the lack of monitoring and control of the process (Benítez-Rico, *et al.* 2023). Then, management of waste based on medical drugs, which is home-based generated, is in the very beginning and efficient way of medicinal products waste collection (Sisdyani, *et al.* 2020). Therefore, it is important to analyze the distribution of pharmaceutical drugs from household and the impact of emission performance of the environment. There are studies about when and how unfinished pharmaceutical drugs are utilized to develop the conceptual assessment model of ways human pharmaceutical drugs get into the environment (Barai and Bhanvase 2023; Mustafayeva, *et al.* 2011). Proper consultations of patients about safe utilization of drugs at home can have considerable importance for public health and the environment, which has been proved in some studies (Alsayadi, and Arora 2023; Bielov, *et al.* 2021). It is advisable to provide continuous education at all levels for awareness rising about dangers associated with nonselective utilization of unused or expired pharmaceutical drugs of arising environmental issue.

Thuswise, there are scientific studies which show that pharmaceutical drugs are increasingly produced and used. This increase comes with anxiety about further situation and the effect of these compounds in the environment. There arise some prerequisites of optimized usage of medicinal products by consumers. First, in the hope that the volume of drugs with an approximately close expiration date will decrease, in other words everything will be used. Therefore, entrepreneurs will have heavy expenses for annual disposal of thousands of tons of medical drugs. While the population makes nothing of it. Secondly, there is still a question to solve about environmentally safe procedure of expired medical drugs disposal from this perspective we are determined to propose the way of expired medical drugs disposal in pharmaceutical industry or to legally remove liability in this regard. Our research is focused on the attempt to show the importance of utilization of unused medicinal products at all levels, including households.

Due to the constant production increase and deterioration of the environment the problem of disease development and its effective treatment is growing more urgent. Dynamic development of pharmaceutical market and its vital importance, as humanity is always in the need of drugs and medical devices to maintain a healthy standard of living from the very beginning. Pharmaceutical market is an important sector of economy of any country and is defined as an indicator of the level of well-being, economic and social development of the population of the country.

Over the last years there is observed a considerable increase in drug manufacturing which is involved with creation of common market for medicine between the countries of the EAEU. The situation somewhat became complicated since the transition of Kazakhstan to the floating exchange rate from the 30th of August 2015. This has led to the growth of prices on local and foreign medicals, as shown in the diagram there was an increase expressed in money terms. In the Table 1 there is provided the level of competitiveness of index value of EAEU countries including Kazakhstan.

In compliance with the provided analysis for the period 2014-2022 it is seen that different countries react in different ways to the level of pharmaceutical industry development. It should be noted that in 2022 there is the tendency of the situation improvement in Russia and Kazakhstan compared with 2014. According to the index of competitiveness of pharmaceutical industry the first place is taken by Russia (0.992), In the second place – Kazakhstan (0.912), In the third Kyrgyzstan (0.793). At the same time the lowest indicator was recorded in Belarus (0.453). Moreover, based on the research results competitiveness of pharmaceutical industry in Kyrgyzstan during the period 2014-2022 worsened. Meanwhile in other member states of EAEU, index of competitiveness in Armenia has moderate growth. This is even though Armenia is one of the most import dependent countries in medical drugs. The share of imported medical drugs in 2022 was 99.9%.



Table 1. Competitiveness indexes of the pharmaceutical industry in the EAEU countries

Country	2014	2015	2016	2017	2018	2019	2020	2021	2022
Armenia	0.284	0.507	0.635	0.589	0.412	0.545	0.610	0.590	0.623
Belarus	0.081	0.333	0.332	0.666	0.715	0.337	0.378	0.399	0.453
Kazakhstan	0.283	0.169	0.489	0.909	0.614	0.775	0.790	0.852	0.912
Kyrgyzstan	0.827	0.704	0.099	0.696	0.477	0.592	0.638	0.736	0.793
Russia	0.180	0.400	0.807	0.830	0.637	0.820	0.889	0.956	0.992

Note: 1) Index of competitiveness is a collection of factors which have influence of the productivity and economy development dynamics; 2) calculated by the authors based on data from the Eurasian Economic Union.

As of late pharmaceutical industry of Kazakhstan is one of the leading countries of CIS area. Kazakhstan has stable and unchanged indicators of pharmaceutical drugs production in EAEU. Thus, in the Table 2 there are given quantitative indicators in terms of volume of production of pharmaceutical products in Kazakhstan and its share in the EAEU for 2014-2022.

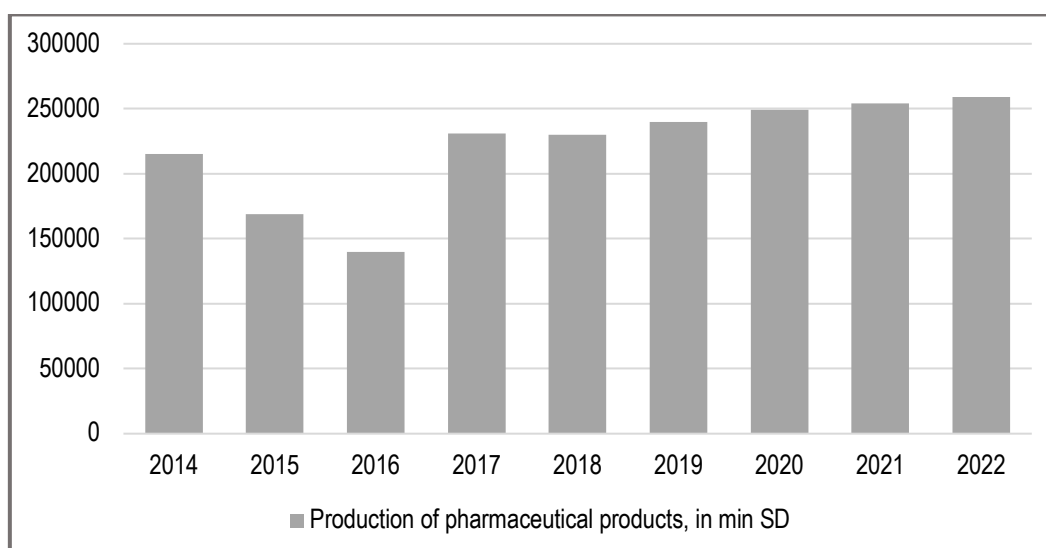
Table 2. Pharmaceutical production indicators in Kazakhstan during the period 2014-2022, USD million

Indicator	2014	2015	2016	2017	2018	2019	2020	2021	2022
The volume of pharmaceutical production in the EAEU, USD million	6805.9	5372.3	6209.3	9415.7	9784.1	10846.2	11106.1	11937.5	12138.5
The volume of production of pharmaceutical products in Kazakhstan, USD million	161.9	143	124	222.2	227.8	240.5	251.3	267.1	269.1
EAEU Share	2.38	2.66	2.0	2.36	2.33	2.22	2.34	2.39	2.42

Source: compiled by the authors based on data from the Eurasian Economic Union.

Based on the provided data between 2014-2022 it is clear that the lowest production volume indicator of pharmaceutical industry is noted in 2016 due to national currency devaluation which was mentioned by us earlier (Figure 1).

Figure 1. Dynamics of pharmaceutical products production in Kazakhstan between 2014-2022, in mln. USD



Source: compiled by the authors based on data from the Eurasian Economic Union.

However, the share of the influence of Kazakhstan in EAEU has not decreased in monetary terms. In 2022 the volume of pharmaceutical production in Kazakhstan is almost for 1.97% more than the figures for the last year. In Kazakhstan there are more than 120 pharmaceutical manufacturers. The volume of pharmaceutical production is constantly increasing. Especially in recent years there is increase in the production of antibiotics, antitussives, antiseptic and expectorants. Consequently, it can be acknowledged that pharmaceutical market of

Kazakhstan is developing in accordance with the main world trends.

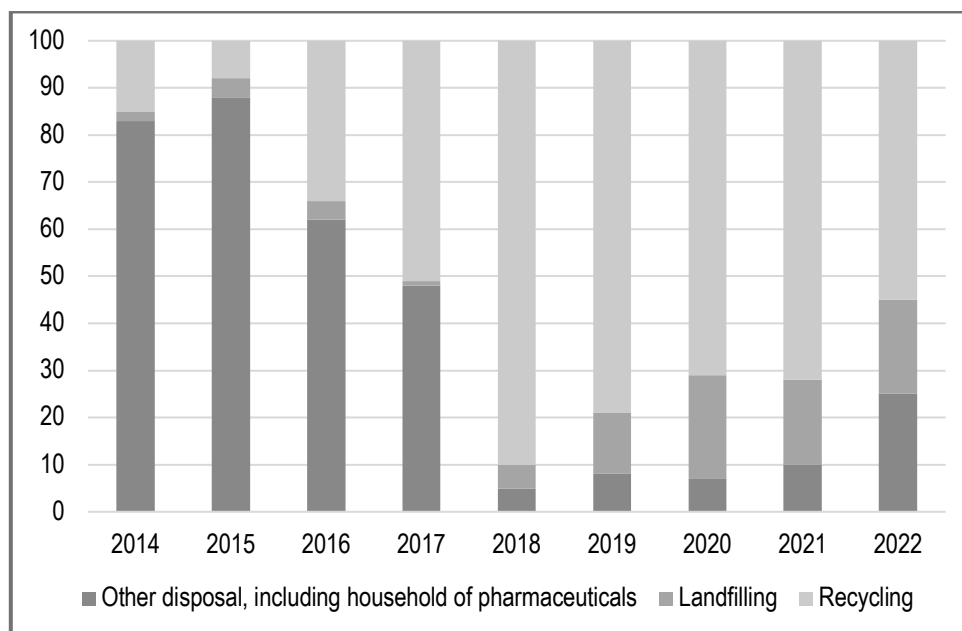
Provided data for the period between 2014-2022 shows, that there is annual growth rate of minimum 8%-12% in the production of pharmaceutical drugs in Kazakhstan. At the same time in 2016 in Kazakhstan there is decrease in the level of pharmaceutical drugs production and made up about 138.40 million US dollars. This is associated with national currency devaluation in 2015, which had an impact of the level of the production. Nevertheless, production of pharmaceutical drugs is increasing, and in 2022 it almost made up 259.01 million US dollars. This is almost 2 times more in comparison with 2016.

It should be noted that with the increase of medical drugs production there is an increase in the consumption medicals. To greater extent exerts an effect on wildlife, as unused medical drugs frequently wasted or utilized improperly (Shtrimaitis, Kukhtenko, Sadovnyk and Kukhtenko 2023; Garibli, *et al.* 2021). On the whole, indicators of waste generation have an impact on the level of economic activity, which is reflected in the structures of production and consumption formed in society. This first of all is associated with effective management of medical drugs remnants, as chemicals but of a better quality, which mainly unhealthy. The problem of medical waste management is regarded worldwide as the primary one, as this type of waste quickly and fundamentally negatively affects air, water and soil, and the environment.

In the period from 2014 to 2022 among EAEU countries the number of emissions, including pharmaceutical waste were done by Russia, Kazakhstan, Armenia, Kyrgyzstan, and Belarus. The volume of emissions is not decreasing but is constant. Thus, 85.9% of emissions were produced by Russia, 10.8% by Kazakhstan, and only 2.2% by Belarus. Also, it should be noted that noted that in terms of per capita emissions among the EAEU countries, Kazakhstan is in the leading position. In terms of air pollution emission from stationary sources per unit area the first place is taken by Armenia in the view of small area territory among compared countries.

Annually, in Kazakhstan there is generated 4.5-5 million tons of domestic solid waste. *Solid domestic waste* is sorted and processed at factories in the cities Astana, Shymkent and Zhanaozen, also in organizations, mostly small and medium business. At present, 15% of waste processing has been achieved by the government. The country has accumulated about 31.6 billion tons of industrial waste. Below in the Figure 2 there is annual volume of processed and disposed waste in Kazakhstan, including pharmaceutical drugs waste for the period 2014-2022.

Figure 2. The percentage processed and disposed of waste from 2014 to 2022



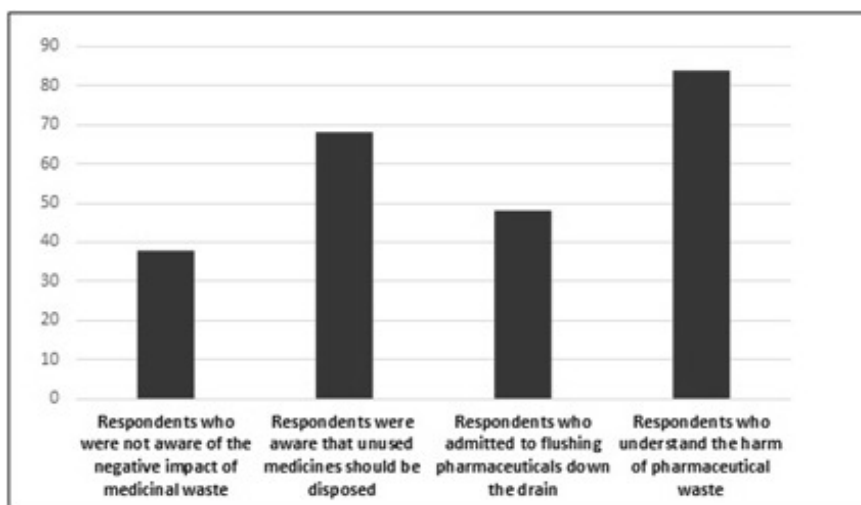
According to the provided data, it is seen that in 2022 recycled solid waste decreased sharply and amounted to 21%. In comparison in 2017 this indicator made up 47.65%. Then, in 2018 the total volume of the share of hazardous waste reduced by almost 6 times. Nevertheless, the share of other disposal, including household of pharmaceuticals increased dramatically during the period 2018-2022. Then, for precise understanding of the level of dependence correlation fields were built, allowing to assess visually the degree of dependency on the studied features. The results obtained show that emission levels into the environment is

constantly increasing. Based on the regression line (trend) construction there is shown a steady growth between 2014-2022. According to the available data, this reduction in the range of processed and wasted hazardous waste between 2015-2016 was only a slight decline. In general, the dynamics of emission increase into the environment per unit area ( $y$ ) in Kazakhstan to a high precision ( $R^2=0.9804$ ) is described by an exponential trend over a year of observation. At the same time, the growth dynamics of processed and wasted hazardous waste ( $y$ ) in Kazakhstan to a high precision ( $R^2=0.9151$ ) is described by an exponential trend over a year of observation. However, since 2017, with the beginning of the acceptance of solid waste for processing and disposal, the indicators began to improve sharply, reaching a peak of 18.47%. In 2022 despite the successful implementation of state program, the processing and disposal of solid waste decreased for 6.16%. This supports the necessity in extra power for solid waste processing and disposal, as the production overall, including production of pharmaceutical products in Kazakhstan is constantly growing.

Consequently, provided data in the sections 4.1 and 4.2 prove that production volume of pharmaceutical drugs is constantly growing and almost does not decrease. At the same time the development of pharmaceutical industry has increased the waste growth. This is why strategies of waste management are important, which will be directed at reduction of its negative impact on the environment. Moreover, the management strategy must be aimed at prevention or reduction of the impact, on finding of opportunities to manage it without affecting the efficiency and availability of drugs and the affordable cost. Although, the results independently are not the evidence of nonconforming use of medical drugs, pharmaceutical drugs production is not always involved with medical necessity.

As part of the survey, 300 questionnaires were distributed, of which 258 were returned with answers for all indicators. The survey involved 68% of women and 32% of men. The average age of the respondents was 28-30 years old. The survey showed that the most distributed medicals, which are usually kept at home are aspirin, analgin, paracetamol, cough syrups, antihistamines, antidiabetic drugs, etc. In Figure 3 an analysis of the level of awareness of drug disposal is shown.

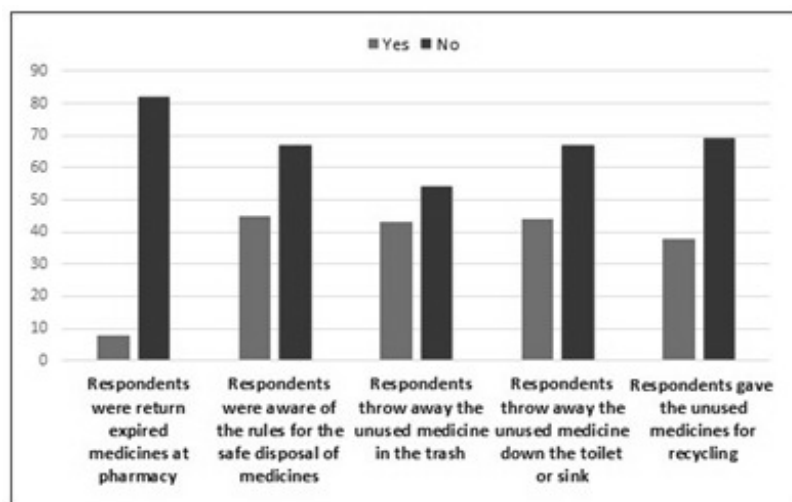
Figure 3. Assessment of the level of awareness of the harm of pharmaceutical waste



The survey findings demonstrate that respondents are quite aware of the harm of medical drugs (85%), about the necessity of medical drugs utilization (68%) and about ongoing processes of healthcare digitalization (60%). However, 38% of surveyed respondents admitted that they dumped pharmaceutical drugs into wastewater disposal and 48% never thought of medical waste hazardous impact. As in any sociological survey the results quality depends on the respondents and the veracity of their answers. In the result many medical workers and patients clearly understand that the presence of pharmaceutical drugs has harmful impact on the environment.

Further, we decided to analyze the attitude of respondents to medical waste utilization. It must also be mentioned that respondents embarrassment about the way they utilize medicals was also taken into account. In general, unfavorable for the environment methods of utilization are throwing out into the street, draining into the wastewaters, throwing into the rubbish bin. In this context the present study was conducted to provide evaluation of the knowledge and attitude of respondents regarding safe utilization of medicals. In Figure 4 there is presented the analysis of the level attitude of respondents to the disposal of drugs.

Figure 4. Assessment analysis of the level of attitude towards the disposal of medical drugs



Survey findings made it clear that respondents agree with the necessity of careful handling with unused medical drugs and know the rules referring to the utilization of medicals. Accordingly, about 67% of questioned respondents are aware of safe rules of medical waste utilization and 38% of participants delivered unused medical drugs to the processing. However, many respondents never thought of the possibility to return unused medicals to the pharmacies (82%), throw unused medicals into the rubbish bin (43%), throw unused medicals into the toilet sink (44%). The survey results show that participants have a good awareness about medical waste utilization importance and are aware of the safe rules for their processing. Nevertheless, many of them still throw away unused medicals into the rubbish bin and wastewater disposal.

This way, the survey results have proved the importance of the significance and necessity of pharmaceutical waste utilization. In this regard current research is an attempt to solve the problem of waste and unused medicals management. The problem of utilization management has not been studied deeply yet, since the government has not yet worked on this side of the issue. It is necessary to show and to educate the public on drugs safe disposal. Correct utilization of medicals can have a significant impact on the health of the public and the environment. Awareness about the ways unused medical drugs utilization is as important as the knowledge about medical drugs consumption.

The strategy of response to environmental issues, resulting from health care practices, in most cases did not lead to the development of effective solutions due to the fact that their implementation requires cooperation of both sectors - health and environmental science which usually have incompatible priorities and conditioned work practices (Aktaeva, Mirzakhmetova and Padaiga 2020). Acknowledgement that established work practices can sometimes create specific barriers, as well as finding ways to establish cooperation and communication between sectors- these factors can create opportunities for innovation development and achievement of real progress.

From the perspective of pharmaceutical management, there are two main categories of pharmaceutical waste, they are: pharmaceutical waste which include expired or unused drugs, which consist of syringes and vials, disposed by households and health care facilities, also pharmaceutical waste generated in hospitals, medical and research institutions. Ideally pharmaceutical drugs are wasted and processed through high temperature incineration (*i.e.*, above 1200 °C). The equipment used in this high temperature incineration disposal method, combined with enough emission control, is mainly found in developed countries (Low, *et al.* 2023).

Kazakhstan as well as many countries of EAEU doesn't have such experience. According to the events schedule on the implementation of the Concep for the transition of the Republic of Kazakhstan to "green economy" between 2013-2020 the government provided for the implementation of the project, in terms of which there is expected collection of solid domestic waste with further processing. This would have ensured the provision of the project to modernize solid domestic waste management sector. However, it was not properly developed.

Therefore, we tried to solve and suggest mechanisms for this problem solution. The important part of which is the issues of environment, economy and sociology. Taking into account the above mention and above presented model, we suggest, that there must be created "a centralized base" of the state level, which will complete the drugs with remaining date of expiry from 6 months till the last date. There must be allocated a competent authority and created a commission at the state level, which will be controlling the work of the

centralized base. Implementation of effective environmentally safe approaches to the programs of intersectoral collaboration and cooperation at all levels.

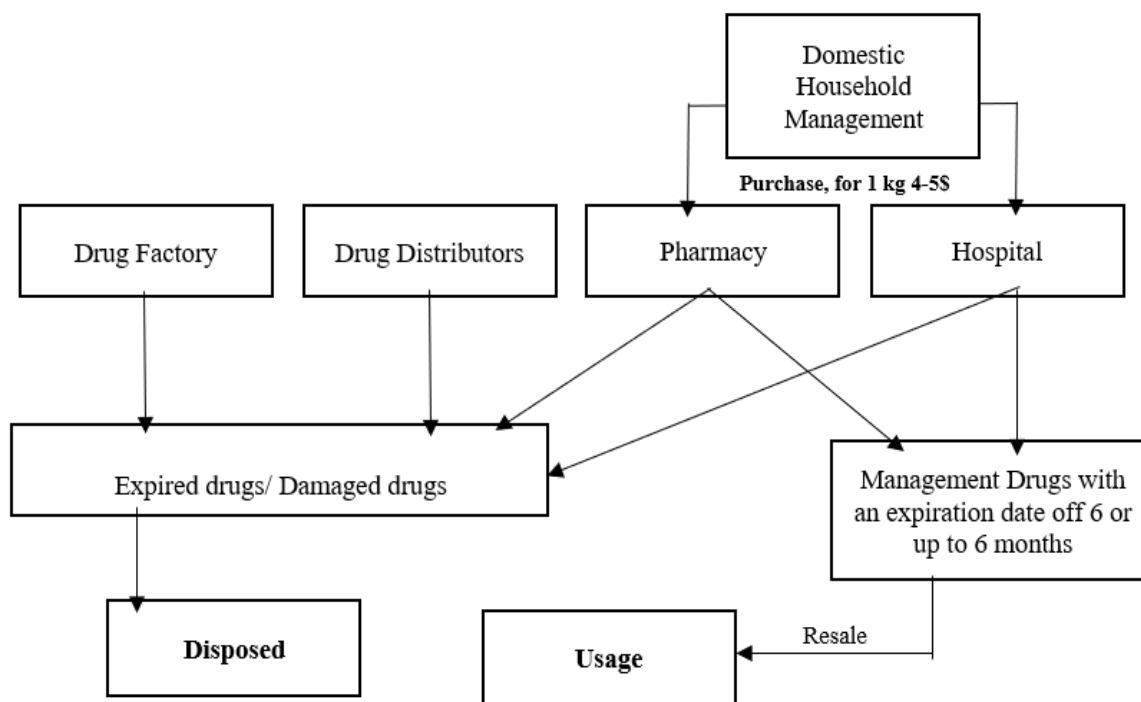
Current division (organization) as shown in the suggested model will be designated for collection and sorting of drugs for further processing, such as:

- previously purchased expired drugs;
- spoiled medicines, under the influence of external factors, such as temperature, moisture, improper storage, and transportation, etc.
- previously purchased drugs which expiration date that has not yet expired, but there is little time left;
- previously purchased drugs which are not used in personal consumption regardless of the expiration date (allergies, individual side effects were found, intolerance was found, etc., and the patient recovered or died).

Other organizations, as evident from the model, as factories and drug distribution companies, which deal with medicinal products also have in their rotation expired or spoilt medicals which must be disposed of. Now they can also sell drug withdrawal to collection points for correct and legal disposal, without wasting time and a lot of money.

In Figure 5 there are directions of collecting and destroying drugs from the point of view of environmental protection. The proposed model is focused on the solution of economic, environmental, and social management problems.

Figure 5. Household pharmaceuticals management from the point of view of environmental protection



According to this model data collection will be implemented through following channels all over the country, where every listed organization will be obliged to accept them from Domestic household Management:

- pharmacies of all types;
- multidisciplinary local polyclinics;
- hospitals of all levels;
- specialized collection centers, where everyone can pass pharmaceutical drugs, they are factories, retailers of pharmaceutical drugs, pharmacies, hospitals, polyclinics, and general population.

Onward, in accordance with the sorting each drug will be redistributed for further procedure of solution of ecological and social issues of the population in the following way:

- 1) spoilt and expired drugs will be utilized in accordance with ecological and legal requirements, which we propose in this research;
- 2) drugs which expiration date is yet to come, and the time is running out, in particular Management of Drug with an expiration date of 6 or up to 6 months, also drugs which are not being used regardless of the expiry date in personal consumption, a digital database will be developed for those in need for their further release.



Regarding the creation of the digital database for resale, an economic and social management decision is pending. For the start, as it is in developed countries, it is suggested to provide an opportunity for voluntary registration of people, holding citizenship of Kazakhstan. This will provide native users, depending on who was the first to book the drug from the database, could take the opportunity to purchase the needed drug. The drug will be available only by prescription from a doctor and with at a fixed discount at half price or even free. This is good, if the drug is very expensive or rare, for example drugs for oncology patients which cost starts from 1000 USD. It is apparent that getting of expensive drugs at discounted prices would have been indispensable solution for the poor, especially during pandemic regime. This experience is widely used in developed countries which eases the search for rare and expensive drugs.

We consider the need to develop regulatory legislation and ratify the order of the protocol of drugs disposal and licensing of this activity equally important. This will allow excluding distribution of legal and environmental damage through drugs disposal. At present in Kazakhstan, unfortunately, there is still no such legislation, and participants of pharmaceutical industry each in their own way dispose remaining expired medical drugs. Internationally it has been established that such measures are implemented, and the drugs are destroyed in special compressed thermal installations with rigid requirements to the disposal of medical drugs. Therein it is necessary to license this activity at the legislative level.

The above-mentioned measures will allow establishing individual disposal of medicals and will allow preserving the environment in a stable condition. On the other hand, we consider that optimal utilization of medical drugs will reduce the burden on public procurement provided to the population through Compulsory Social Health Insurance, whereas private business will get rid of additional expenses.

## Conclusions

Based on the literature review there was defined the existence of scientific studies showing the presence of unrest about pharmaceutical products exposure on the environment. The following findings were obtained.

Firstly, during 2014-2015 in the pharmaceutical production in Kazakhstan and Russia there were observed the lowest indexes of competitiveness. Incidentally, the financial crisis had a great influence by slowing the development of many markets, among which is pharmaceutical industry, For the period 2017-2022 Kazakhstan and Russia show the best indicators in terms of competitiveness. This is associated with the production index advance with the better ratio of exports to imports and the decrease in consumer price index for medical products. The valid reason for the increase is that Kazakhstan entered the EAEU and appropriate good manufacturing practice requirements, which it was to embody in the production of medical products and to which it was not ready.

Secondly, in capturing and neutralizing of emissions Russia took the first place with a share of 58.8%, and Kazakhstan follows it with 38.2%, which together amounts to 97%. Following the dynamics, it can be regarded as if Kazakhstan is good at dealing with emissions of air pollutants from stationary sources, but this is only no more than 14.7% of all waste. Thus, 85.9% of emissions is produced by Russia, 10.8% by Kazakhstan and only 2.2, emissions are produced by Belarus. We also need to mention, that Kazakhstan is taking the leading place in per capita emissions among the EAEU countries.

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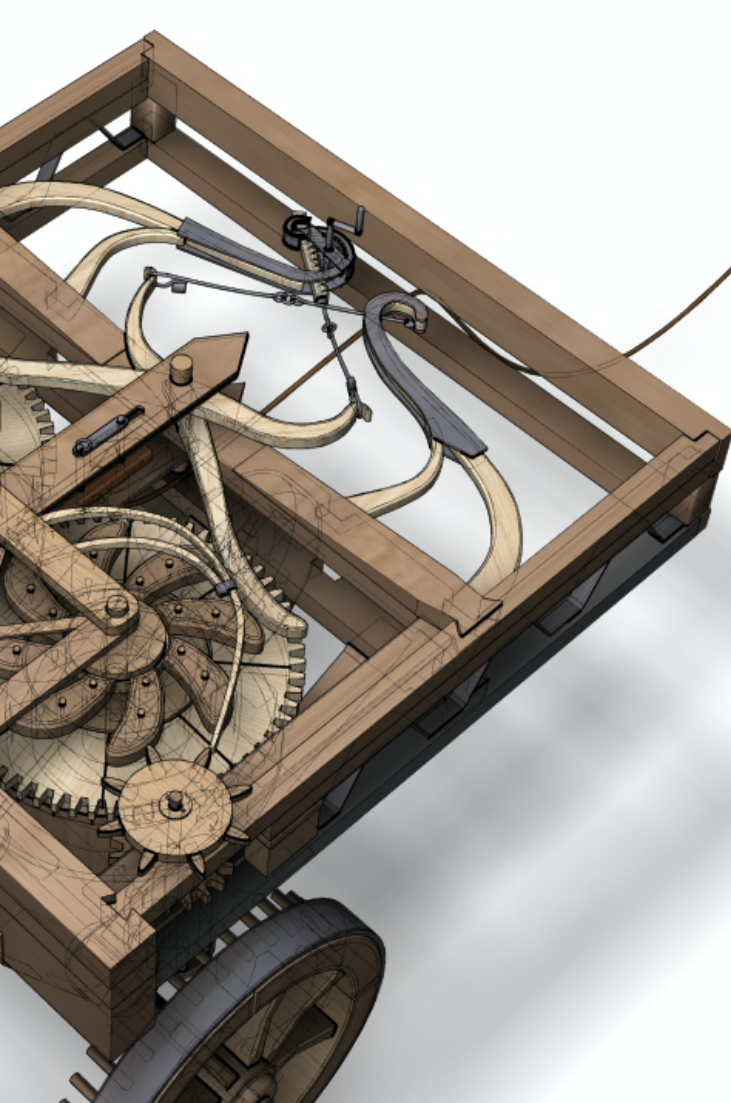
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