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Sanitary-Hygienic Research to Ensure State Sanitary-Epidemiological Surveillance in the Republic of Kazakhstan

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Abstract

Objective: There are numerous factors that impact human health. Sanitary and hygienic conditions in the workplace and living environments, the state of the environment, and nutrition levels play a significant role in determining environmental quality. An integral part is also the organization of effective treatment and preventive health care services for the population. The purpose of this study is to analyze the sanitary and hygienic situation in the Republic of Kazakhstan.

Methods: The methodological framework employed general theoretical methods, statistical analysis, and techniques for systematizing information.

Results: During the study, it was determined that in several cities, high levels of respiratory and skin morbidity are recorded, linked to elevated concentrations of dust, ammonia, hydrogen fluoride, and nitrogen dioxide. As a consequence of chemical contamination of drinking water sources, there is an escalation in the incidence of nephritis and hepatitis, an upsurge in the number of toxicosis cases among pregnant women, and congenital anomalies. The sanitary condition of settlements greatly impacts the development of satisfactory living conditions.

Conclusions: Therefore, this research holds significant practical relevance, and the findings can be utilized by specialists in relevant fields to analyze and address the identified problems, as safeguarding public health, development, and improvement of its protection system is currently becoming one of the paramount tasks.

The most important factor contributing to ensuring the sanitary and epidemiological welfare of the population is the analysis of objective information about environmental factors, which was obtained as a result of laboratory and instrumental studies, as well as properly organized laboratory control in this matter. Data analysis is the main element in evaluating the sanitary and epidemiological situation in the region, explains the causal relationships in the change of health state under the influence of adverse factors that connect with the environment, and finally, is the main evidence in practice that prevents and stops the violation of sanitary legislation. Each region deserves special consideration from an ecological point of view because it is a territory with certain natural conditions and a specific type of economic development. Regional sanitary and epidemiological analysis is in the fact that its results are of great practical importance.

According to a 2019 meta-analysis that included 184 publications from 62 countries and a total of 47 880 different samples, Kazakhstan had an excess of air pollution from waste from large enterprises of 79.5%.[1] The main sources of emissions into the atmosphere are large enterprises such as chemical, metallurgical, and energy industries. Ferroalloy plants daily emit into the atmosphere coarse dust, chromium oxides, sulfur dioxide, nitrogen dioxide, carbon oxides. Chromium compound plants emit inorganic dust containing aerosols of 3- and 6-valent chromium, sulfur dioxide, carbon monoxide, and hydrogen sulphide. Atmospheric air in residential areas is mainly polluted with 6-valent chromium and emissions from thermal power plants, chemical plants, and factories.[1] In cities, noise pollution has local nature and is mainly due to modes of transport: urban, rail, and air. Particularly harmful are cars whose technical parameters do not meet the requirements and are not within the limits of air quality standards. Exhaust gases of automobile exhaust gases release lead into the atmosphere, tire wear emits zinc, and diesel engines produce cadmium. Or heavy metals are known to be strong toxicants. In 2021,

25.2% did not meet the requirements for maximum permissible indicators, and 28.4% for sanitary and chemical indicators. More than 10% of samples indicated a real danger.[2]

Currently, the diet is most often deficient in protein, especially of animal origin with a tendency to increase the deficiency degree. Just as studies have shown, there is a problem of a lack of most vitamins and macro- and microelements: calcium, iron, phosphorus, selenium, zinc, and dietary fiber. Therefore, the analysis of regional features of the actual nutrition of the population and the study of its impact on health status, plays an important role. In 2019, an analysis was conducted of 10 clinical trials that studied the connection between vitamins and essential nutrient levels and immunity. In summary, it was concluded that deficiency is a propensity factor, with a decrease in the body's supporting ability to various diseases. 60 000 000 people live in conditions of constant excess of permissible concentrations of substances in the air, which is harmful to their health.[3] Almost half of the residents use drinking water that does not meet hygienic standards.

As of 2022, about 26 000 000 tons of municipal solid waste was formed in cities and settlements, and in 2015, this figure was 16 000 000 tons, which, in the absence of industrial methods for their processing, is a significant factor determining environmental pollution.[4] Bacterial contamination of tap water has repeatedly led to outbreaks of acute intestinal disease. Another study was conducted connected with sanitary and epidemiological indicators, "The Prevalence of Intestinal Infections Connected With Drinking Water in Kazakhstan," with the selection of 833 water samples at different sites in 2019 in the Republic of Kazakhstan, which revealed intestinal bacteria in 673 samples out of 833.

Analysis and statistics of the demographic situation show a negative balance of natural population growth. An important role in creating an unfavorable sanitary and epidemiological situation in the country was played by the fact that before the law on the sanitary and epidemiological welfare of the population was adopted, the service could not fully use the rights that were granted to the state sanitary and epidemiological service. There were cases of building housing, industrial, and other facilities without the consent of the State Sanitary and Epidemiological Service, expanding the possibilities of chemical, metallurgical, forestry, and woodworking enterprises without sanitary protection zones and without taking into account the possibility of structure cleaning. The service was dependent on the health authorities and local authorities, which will resolve many issues that negatively affected the development of the environmental, sanitary, and epidemiological situation. There is no legal basis for the service activity. This determined the need to provide the service with a different status and new priority areas.

The purpose of this study is to analyze the sanitary and hygienic situation in Kazakhstan and to determine the measures necessary to improve the system of sanitary and epidemiological supervision in order to protect public health. To achieve the goal the following tasks were set:

1. To assess the current state of environmental pollution (air, water, soil) and its impact on public health in Kazakhstan.
2. To assess the safety conditions at the workplace, and occupational diseases and their contribution to the overall morbidity rate.
3. To study the prevalence of infectious diseases, the level of vaccination, and the need to improve preventive measures.
4. To analyze nutritional deficiencies and their impact on public health.
5. To examine the effects of radiation exposure from sources such as Chornobyl and nuclear test sites.
6. To identify the shortcomings of the current laboratory control system and the need to modernize it.
7. To recommend specific actions to improve environmental monitoring, labor safety, infectious disease control, and general sanitation.

Materials and Methods

The work provides the materials for an in-depth study of the state of the sanitary and epidemiological situation and the health of the country population, issues of reforming and developing the state sanitary and epidemiological service, organization, and activities to implement the Law of the Republic of Kazakhstan "On sanitary and epidemiological welfare of the population."[5] The population's health status was assessed using statistical data on indicators such as fertility, mortality, overall morbidity, temporary disability, occupational diseases, infectious diseases, and disability rates.

During processing materials characterizing the health and quality of the environment, methods of variation statistics, multivariate correlation analysis, territories ranking, and the sanitary and epidemiological situation forecasting were used. Mathematical methods were used in the structure and model development of the federal and municipal sanitary and epidemiological service. For the study period from 2000 to 2022, 27 648 samples were analyzed for bacteriological factors, 37 469 for sanitary and chemical indicators, 35 678 for radiological factors, and 56 738 for other physical factors.[6]

The methodological foundations of social-hygienic and epidemiological monitoring of public health were studied to analyze the interaction with the environment and human living conditions, the impact evaluation on health, and a set of preventive measures for individuals and population groups. Highly sensitive methods for monitoring chemical, physical, and biological environmental factors were used. The analysis method considered measures to prevent the growth of infectious morbidity and mortality, the threat of epidemics against the background of a decrease in immune status, increased migration processes, and environmental deterioration. The methodology for evaluating the efficiency of sanitary, hygienic, and anti-epidemic measures and economic justifications for the sanitary and epidemiological state of the population were used.

The literature on the sanitary and epidemiological situation was reviewed, focusing on sanitary, hygienic, and anti–epidemic measures. The primary goal of these measures is to ensure public health and sanitation, particularly through disease prevention for both adults and children. Additionally, sanitary and epidemiological assessments, along with regulatory and technical documentation, were examined. The role of the supervision service in protecting consumer rights, specifically by enforcing hygiene-related legislative requirements, was also considered to ensure the population's sanitary and epidemiological welfare.[7] Statistically, an analysis was made of the maintenance monitoring of the sanitary and epidemiological state of the population at the federal level, infection accounting, and occupational diseases due to the harmful effects of environmental factors.[8]

Information on supervision in the radioactive contamination area, which carries out state control over compliance with the mandatory requirements of legislation in the area of population health protection in contaminated territories, was considered

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similarly. By the method of statistical analysis, observations were made in the areas of mass noncommunicable diseases (poisoning), occupational diseases due to the harmful effects of environmental factors, control of the sanitary and epidemiological situation of the population at the federal level, and state registration of infections.

Results

In the area of the main tasks of strengthening the protection and the health of the population, issues of improving the prevention of diseases connected with the influence of dangerous and harmful environmental factors on the body are becoming increasingly important. The disadvantages of economic development had a negative impact on the state of the environment. Public health is negatively impacted by the poor sanitary, epidemiological, and environmental conditions. These issues are largely due to the concentrated growth of industrial production, including environmentally harmful industries, without adequate environmental safeguards. Additionally, rapid urbanization and the use of outdated technologies have further exacerbated these challenges. In recent years, the situation has been aggravated by the deterioration of the economy, the decline in discipline, the increase in population migration, and the decline in its living standard. The risk of importing infectious diseases into the country, including low-quality food products, has increased.[9] Taking into account the current situation, priority areas were identified, on the solution of which it is necessary to focus the efforts of the State Sanitary and Epidemiological Service and ensure coordination of the activities of all interested departments. The quality of its samples from the centralized water supply sources that do not meet the requirements of the standards does not have positive dynamics.

In 2017, 11.2% did not meet the requirements for bacteriological indicators, and 20.4% for sanitary and chemical indicators. More than 4% of samples indicated a real epidemic danger because the level of bacterial contamination exceeded the established standard by 10 or more times. Despite the large reserves of groundwater, in many regions of the country, surface sources with a high degree of chemical and bacterial contamination are used to supply the population. In 2018, 27.2 cubic meters of contaminated wastewater were discharged into water bodies. As a result, 30% of the studied samples of surface water bodies do not meet hygienic standards in terms of sanitary and chemical indicators, and more than 25% in terms of bacterial indicators. The danger of this situation due to the water factor in infection transmission is evidenced by the number of annually increasing epidemic outbreaks of acute intestinal diseases. In 2019, 3 such outbreaks were registered with the number of 17 victims, in 2020—8 and 24 people, and over 5 years—7 and 25 people.[10]

Air pollution problems are not decreasing despite the significant decline in industrial production. According to regular observations and data that have been collected, in 173 cities, the average annual concentrations of ammonia, nitrogen dioxide, soot, dust, and hydrogen fluoride exceed the maximum permissible concentrations—formaldehyde and benzapyrene, as well as carbon disulfide, by 2 to 3 times. The total emission of harmful substances from vehicles in 615 cities is more than 15 600 000 tons per year. The contribution of road transport to the total emission of the considered harmful substances is about 47%, and in the capital, it accounts for up to 70% of the total air pollution in general. Within the limits of hygienic standards, with the level of air pollution, Only 15% of urban residents live within air quality levels that meet hygienic standards. The most unfavorable situation in terms of emissions of harmful substances into the atmosphere is noted in the centers of ferrous and non-ferrous metallurgy, pulp and paper, microbiological industries, chemical, and oil refineries.[11]

The necessary measures to improve the situation are

- introduction and development of environmentally friendly vehicles and technologies;
- methods development for highly efficient purification of emissions from transport and industry;
- development of the state system of environmental monitoring;
- transfer of motor fuel to unleaded gasoline, replacement of liquid motor fuel with compressed, and reduced gas;
- expansion of scientific studies on this issue with the development of rigid hygienic requirements and recommendations.

The sanitary condition of settlements has a significant impact on the development of satisfactory living conditions. Currently, up to 75 000 000 tons of waste is generated annually in cities and settlements, 28% of which are recyclable. Heavy metals such as aluminium, cadmium, chromium, copper, zinc, lead, tin, and mercury quickly accumulate in the soil. This contributes to the secondary pollution of atmospheric air and groundwater. The problem of neutralization and burial of toxic industrial wastes and their disposal is aggravating, approximately 3 billion tons of which have accumulated in inappropriate places and about 1 billion tons are in equipped storage facilities. Only a small number of industrial enterprises have landfills for waste disposal, and these often lack proper infrastructure. Only 3 waste incineration plants and 1 waste processing plant have been built and operated in the country, which provide processing of only 4.5% of the total amount of household waste. As a result of the accident at the Chornobyl nuclear power plant, 15 territories of the country with a population of 10 00 000 people suffered radioactive contamination.[12]

To solve this issue, the following is necessary:

- revision and development of medical and hygienic requirements and standards on this issue;
- recommendations development on the general layout of accommodation facilities and waste disposal;
- control over the waste inventory that is generated and accumulated in tanks and storages;
- increasing the requirements for compliance with sanitary legislation by industrial, agricultural, and social facilities.

From 2010 to 2020, the incidence of malignant neoplasms in the population increased from 151 to 195 cases per 90 000 people. In the period from 2010 to 2020, the incidence of peptic ulcer disease increased by 3 times; chronic nonspecific diseases of the bronchopulmonary system increased by 3.4 times. The incidence of hypertension and ischemic diseases increased by 5 times over the same period. The general mortality level of the population has increased. It was established that the pathological incidence of blood diseases per 1000 surveyed inhabitants exposed to radiation at a dose of more than 100 Sv is 332, and up to 35 Sv is 9.3. Since 2020, among 17 000 registered persons, the incidence of leukemia has increased by 19%; an increase in overall mortality has been registered (9-15% higher compared to non-irradiated residents of the same administrative districts).[13] Mortality rates from congenital anomalies in the exposed population are 2 times higher than in the comparison group. In general, in the territory subjected to radioactive contamination, there is a tendency for an increase in the incidence of the population with the main classes of diseases. For the period from 2016 to 2021, there was an increase in the incidence in the neoplasms class by 10%, the circulatory system diseases by 19%, the

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digestive system diseases by 22.6%, and congenital anomalies by 11.3%. The incidence of chronic bronchitis increased by 10.6%, and bronchial asthma increased by 30.3%.[14]

In addition to the influence of technogenic radiation sources, natural and medical sources, which create about 90% of the total dose, contribute to the radiation dose of the population. These doses are formed due to the use of materials with a high content of natural radioactive substances in housing and civil construction, the location of settlements near previously existing and currently existing uranium mines in areas with a low occurrence of radon-emitting materials, and a high content of natural radionuclides in water. Approximately 4 300 000 people, or 15% of the workforce, work in environments that do not meet labor protection standards. More than 337 000 people are involved in heavy physical labor. At the enterprises, 60-80% of the operated, worn-out, and outdated equipment and 70% of the manufactured equipment do not meet hygienic and sanitary standards. According to laboratory studies, 67.2% of all industrial facilities exceeded the limits of permissible concentration of harmful substances; 25.3% of air samples for dust and aerosols of hazard classes 1 and 2 exceeded the maximum permissible concentrations. The situation is similar with harmful physical factors.[15] In 2020, 25.6% of the total number does not meet hygiene standards in terms of noise pollution, 26.8% in terms of vibration, and 15.1%in terms of microclimate parameters.

A significant part of the country's population lives in the territories exposed to radioactive contamination and requires appropriate social and medical rehabilitation. In accordance with this, it is necessary to approve the "Concept for the protection of the population and economic activity in territories subjected to radioactive contamination, improvement and implementation in all territories for monitoring exposure doses and radiation conditions"[16]; implementation of the activities of the State Program "On Radiation Rehabilitation"; and improvement of the regulatory and methodological framework for ensuring radiation safety. In practically all areas of the national economy, the working conditions of women do not meet the requirements of the existing standards and rules. Insufficient attention to women's health care leads to violations of the reproductive system in childbearing age. By the time of adulthood, 38.4% of girls already have chronic diseases, and the presence of chronic pathology in a mother increases the incidence of newborns by 1.5 to 4.5 times.[16]

The results of scientific studies indicate that work in a polluted air environment, noise exposure, vibration, and lifting and moving heavy loads adversely affect the course of pregnancy and childbirth, and the condition of the fetus and newborn. Therefore, antenatal mortinatality, the frequency of labor complications due to late toxicosis and perinatal mortality, have increased. About 12 000 newly diagnosed occupational diseases and poisonings are registered annually, which is 5 times more than in the mid-1990s.[17]

Therefore, the following measures should be taken:

- improving the regulatory and legal framework for breast hygiene;
- strengthening the role of the State Sanitary and Epidemiological Service in stopping the industries' operation with imperfect technology that create unfavorable working conditions. In the future, it is necessary to develop enterprises with non-waste technology that guarantees safe working conditions;
- development of occupational pathology centers in the regions focused on timely diagnosis, taking into account modern scientific studies, which will allow timely implementation of the entire range of preventive measures;
- strengthening the role of hygienic science, why it is necessary to provide the development of hygienic centers in different directions, taking into account scientific research institutions.

The incidence rates per 10 000 employees in various industries are as follows: coal industry enterprises (17.8), light industry (10.6), automotive and agricultural engineering (7.1), and energy (6.9). Respiratory diseases occupy the leading position among occupational diseases, accounting for 37.16%, with dust bronchitis at 11.96% and silicosis at 9.99%. These are followed by vibration disease (24.71%), musculoskeletal disorders (12.6%), and hearing disorders (12.61%). In large industrial areas with developed oil refining, machine-building, and chemical industries, the rate of newborns is 108–152 per 10 000 people, compared to 39–54 per 10,000 in rural areas. Special studies in the last decade have registered changes in the health status of the population living in an environment with a high level of air pollution, and also revealed a decrease in the body's nonspecific resistance and its vulnerability to development of infectious and other diseases. Thus, in unfavorable areas, the incidence of tracheobronchitis in children is 2.9 times, pneumonia is 6.1 times, and chronic bronchitis is 7.7 times higher than in ecologically safe areas. In total, the duration of respiratory diseases in children living in contaminated areas is 2–2.5 times longer.

In territories with a developed chemical, oil refining, gas processing, or metallurgical industry, there is an increased incidence and mortality from pneumonia. Thus, the incidence of chronic pneumonia is 15.9 per 1000 children. From 2010 to 2020, there has been a tendency toward an increase in the manageable group of infections, tuberculosis, venereal diseases, and HIV infection.[18] A difficult situation is with infections for the fight against which there are effective means of specific prevention. The incidence of measles in 2015 increased by 2 times, and whooping cough increased by 52%; diphtheria increased by 4 times. Among patients with diphtheria, 62% are adults. Thus, the vaccination coverage rate of children under 2 years in different years did not exceed 70-80%. According to selective studies, more than 60% of the adult population do not have antibodies to the causative agent of diphtheria.[19]

An increase in severe clinical forms is noted. The incidence of intestinal infections remains high. In 2016, 200 000 people got ill with dysentery, typhoid fever, and salmonellosis. At the same time, the number of patients with dysentery increased by 24.4%, with typhoid fever increasing by 26.9%. Based on the results of the structure of actual nutrition study in various regions of the country, conducted by the Scientific Research Institute of Nutrition of the Russian Academy of Medical Sciences, it was concluded that on average the deficiency of complete proteins exceeded 15%, vitamin C deficiency was detected in 60–70% of the examined, and 30% had an insufficient supply of B vitamins, PP refers to Vitamin PP, which is another name for niacin (Vitam in B3), and folic acid. In many cases, multivitamin deficiency combines with iron deficiency to cause widespread iron-deficiency anaemia, especially in children and pregnant women. Due to the measures taken by the Sanitary and Epidemiological Service, in 2019 the number of food samples that do not meet biomedical and hygienic standards has slightly decreased.[20]

However, up to 15% of samples of dairy products and up to 10% of meat products did not meet sanitary standards in terms of bacteriological indicators. Antibiotics were found in 15-26% of livestock product samples.[21] The reasons for this are not only the weak material and technical base of processing enterprises, but also the low level of sanitary culture, a decrease in production discipline,

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and gross violations of the rules for storing and trading food products.

Necessary measures to improve the situation are as follows:

- development of a state social and hygienic surveillance system;
- development and approval by the Government of the "Regulations on social and hygienic monitoring";[21]
- organization of subdivisions of state sanitary and epidemiological surveillance centers, for the study and identification of cause-and-effect relationships between the health state and adverse environmental factors;
- development of an organized information association, and information exchange between interested ministries and federal executive agencies;
- development of methodological approaches and hygienic criteria for evaluating the impact of environmental factors on human health based on modern scientific studies in this area;
- integration of state social-hygienic monitoring into the European monitoring system;
- prevention of infectious and parasitic diseases.

Another factor aggravating the sanitary and epidemiological situation is the growing volume of the population migration, the development of a significant population layer of socially unsettled people living in unsatisfactory conditions. A certain role is played by the border's openness, along which the population masses and many low-quality goods pass. An important impact on health is the ongoing economic decline, which contributes to the emergence of stress, addiction to alcohol, smoking, and low social responsibility.

The study reveals significant problems in the sanitary-epidemiological situation in the Republic of Kazakhstan, finding occupational health standards exceeded and a surge in infectious diseases. Respiratory diseases, vibration sickness, musculoskeletal disorders, and hearing impairment dominate occupational health concerns, while infectious diseases such as measles, whooping cough, and diphtheria have witnessed an alarming increase over the past decade, particularly affecting adults due to inadequate vaccination coverage. In addition, the study highlights the impact of environmental factors on public health: deficiencies in essential nutrients and a marked increase in neoplasms, circulatory and digestive disorders, congenital anomalies, and chronic respiratory diseases. These data emphasize the urgent need for comprehensive reforms in the sanitary-epidemiological service to effectively preserve public health.

Discussion

The main reasons for the current situation are the imperfection of water treatment technology, insufficient capacity or lack of water supply facilities, reduction in assignments for non-repair and restoration work, construction of new and reconstruction of existing water supply systems, and lack of necessary coagulants and disinfectants. The solution requires the development of centralized water supply systems, reconstructing existing water treatment plants, providing the national economy and the population with local and individual water treatment plants, and ensuring state control and supervision over the quality of drinking water. The proportion of atmospheric air pollution by road transport, which practically does not meet hygienic requirements, is significantly increasing. In addition, untimely repairs, a low technical level of service, and an increase in the number of foreign cars with a high degree of wear and tear make this problem especially acute.

The use of leaded gasoline continues in most territories. And against this unfavorable background, there are very few means to control the content of harmful substances in exhaust gases. In 2019 and 2020, a scientific study was conducted by JAPAN Company, according to which an analysis of air pollution indicators from car and factory waste was conducted. According to the observations and data that have been collected, in 195 cities, the average annual concentrations of ammonia, nitrogen dioxide, soot, dust, and hydrogen fluoride exceed the maximum permissible concentrations—and formaldehyde and benzapyrene, as well as carbon disulphide, by 5-6 times. The total emission of harmful substances from vehicles in 615 cities is more than 30 600 000 tons/year. The same indicators were collected in 2010-2011, when the average annual concentrations were 2-3 times higher, and the total emission was 12 600 000 tons/year. All this is connected with a significant city's industrialization, an increase in transport, and the construction of new factories.[22]

One of the most important factors is radioactive contamination of the environment as a result of the Chornobyl disaster, accidents, and nuclear explosions. In 2020, the researchers of the scientific base conducted an analysis according to which, in the western regions, the doses of the total exposure of the population ranged from 3 to 14 rem.[23] Until now, the scale of radioactive contamination of territories and the impact on human health in places where nuclear explosions are carried out for "experimental purposes", as well as the radiation exposure levels to the population of individual regions due to the activities of nuclear testing sites, are not known and require study. According to the joint leadership of China Company, measurements of radioactive contamination of territories where nuclear exercises were previously conducted were carried out. According to them, the exposure dose to the population that lived in areas bordering the data ranged from 5 to 10 rem.[24] An evaluation of the health status of children in connection with environmental factors, conducted by the Institute of Hygiene in 2020, showed that the accumulation of internal exposure as a result of nuclear explosions at testing sites has an increased content in environmental objects. Heavy metals and chemicals increase the percentage of development cases of neoplasms in children (leukaemia) and manifestations of genetic effects. The disease percentage in these children is 40% higher than in children who lived in relatively favorable areas.[25]

Unfavorable working conditions also have a detrimental effect on health. The effect is developed starting from the period of intrauterine development, the course of which depends on a woman's health. A direct consequence of unsatisfactory working conditions is occupational morbidity, which has doubled in recent years and is causing social and economic damage to the national economy of the country. Earlier in 2018, scientists conducted a study of the occupational diseases of workers in chemical and petrochemical enterprises and the population living in industrial cities. The results showed that allergic diseases are widespread (dermatitis [27%], asthmatic bronchitis [37%], bronchial asthma [57%]).[26] A study of the health status of children in cities with unfavorable environmental conditions revealed functional deviations in the haematopoiesis systems, intracellular enzymes and immunity, and violation of compensatory-adaptive mechanisms in the environment. The current situation in the country requires the development of the monitoring system of the environment and public health state, which should focus on indicators and factors that are really significant for sanitary and epidemiological service, conduct their dynamic comprehensive analysis, and predict the effect of their change.

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The adoption of comprehensive measures to prevent infectious diseases in the country will make it possible to achieve a steady decrease in some nosological entities. However, for most infections, the situation remains unstable and varies greatly in different regions. The main reason for the epidemiological trouble with these infections is the low coverage of children with preventive vaccinations and, connected with it, the insufficient level of immunity in older age groups. In Japan, in 2019, work was conducted to study the impact of preventive vaccinations on the spread of main infectious diseases, such as measles, whooping cough, diphtheria, and influenza. In this study, children between the ages of 6 and 17 were considered. According to the results, the percentage of children who had already been previously vaccinated against these diseases was 15%, and the percentage of children who did not receive more than one dose of the vaccine was 69%, which shows the practical significance of vaccinations for the prevention of infectious diseases.[27]

This situation has developed as a result of unreasonably wide medical contraindications to immunization, the poor health of children, the low level of explanatory work among the population on the efficiency of specific means of preventing infectious diseases, the insufficient qualification of doctors in vaccine prevention in a number of cases, and the campaign launched in the mass media to discredit vaccinations. Another factor aggravating the sanitary and epidemiological situation is the growing volume of population migration and the development of a significant layer among the population of socially unsettled people living in unsatisfactory conditions. A certain role is played by the border's openness, along which the population masses and many low-quality goods pass. The ongoing economic decline, which contributes to the emergence of stress, addiction to alcohol, and tobacco smoking, has an important impact on health. The democratization process of society goes with a large lag in the law's development, followed by a moral's deterioration, moral principles, and discipline. This situation significantly complicates the sanitary and epidemiological situation, especially because the promotion of a healthy lifestyle is extremely unsatisfactory.

In recent years, measures have been taken to strengthen the material and technical laboratories base, to equip them with modern technology and equipment. There has been a change in the structure of physical and chemical study methods connected with the widespread introduction of complex modern methods into the laboratories practice, such as atomic absorption spectrometry, gas and high-performance liquid chromatography, and chromatography-mass spectrometry. A gas chromatography system with a ShimadzuGCMS-QP2010 Ultra mass-selective detector; gas chromatograph with electron-capture and nitrogen-phosphorus detector "Agilent7890B"; tensile machine "SEM-3-M-1"; extractor with circulation bath "V-811"; ultrasonic bath "PSB-Gals"; viscometric analyser "Somatos-V.K.", image (toxicity) analyser "AT-05" in the Industrial Dewar flask "SDP-25" set; and mini-centrifuge vortex "Microspin FV-2400", HPLC chromatograph "RotorGene-6000" with real-time results detection were purchased. Laboratory control is conducted on a wide range of objects: household purpose products, industrial group products, children's toys, products, food raw materials, and products in contact with food, perfumes and cosmetics, natural and industrial environments (soil, water, air).

For the period from 2019 to 2021, 124 907 samples of water, atmospheric air, indoor air, working air, and soil were analyzed, and 388 748 studies were conducted on them. Moreover, the volume of both samples and studies shows a significant decreasing trend. In 2019, there were 28,657 samples and 114,791 studies. In 2020, the figures were 57,970 samples ("PSB-Gals") and 155,995 studies, followed by a further reduction to 38,280 samples ("PSB-Gals") and 117,962 studies later in the year. The sample decrease was due to quarantine measures due to the COVID-19 pandemic in 2021. The radiation situation on the territory is evaluated by taking environmental samples and analyzing the content of Cs-137, Sr-90, and other natural and artificial radionuclides. Samples were taken of soil, atmospheric precipitation, atmospheric air, drinking water, water from open reservoirs, and food products, the results of which make it possible to evaluate the radiation situation. There are no inconsistent samples or measurements. Sanitary and bacteriological studies account for the largest share among surveillance studies. Over the past 3 years, the volume of water and food studies has increased by 1.2 times in the region. In the dynamics of the years, there is a decrease in the average regional indicators, which indicates the efficiency of the monitoring conducted.

Health development occurs under the influence of a factor's combination, considering that the main factors are medical and biological factors, environmental pollution, and social-economic conditions of life. Ensuring control and monitoring of the health state of the population and the human environment based on the programs for collecting, unified methods, transmission, and processing of information developed by scientific institutions will allow us to identify and evaluate the observed changes in the health state under the influence of adverse factors of the natural, industrial, and social environment and establish the causes and conditions for the spread of mass diseases in the population.

Conclusions

An evaluation was made of the infection's prevalence among the population and compliance with normal conditions at enterprises. There is a significant excess of standards regarding occupational health. The leading place is occupied by respiratory system diseases (37.16%), followed by vibration disease (24.71%), musculoskeletal system diseases (12.6%), and hearing organ diseases (12%). The disease percentage in children already previously vaccinated against these diseases was 15%, and in children who did not receive more than one dose of the vaccine, it was 69%. The rates of infectious diseases, both in children and adults, have increased. The incidence of measles increased by 2 times, whooping cough increased by 52%, and diphtheria increased by 4 times. Among patients with diphtheria, 62% are adults. More than 60% of the adult population does not have antibodies to the causative agent of diphtheria. An increase in severe clinical forms is noted. The incidence of intestinal infections remains high. In 2020, 2000 people got ill with dysentery, typhoid fever, and salmonellosis. At the same time, the number of patients with dysentery increased by 24.4%, and the number of patients and the number of patients with typhoid fever increased by 26.9%. An increase in the incidence in the neoplasms class is 10%; circulatory system diseases are 19%; digestive system diseases are 22.6%; and congenital anomalies are 11.3%. The incidence of chronic bronchitis increased by 10.6%, and that of bronchial asthma increased by 30.3%. Vitamin C deficiency was detected in 60-70% of the examined; 30% had an insufficient supply of B vitamins, PP, and folic acid.

These results are directly connected with the crisis in the social-economic conditions of society. The progressive deterioration of the quality of the quality of the environment, the decline in the public health level, and the depression of demographic processes determine the urgent need for urgent reform of the sanitary and epidemiological service to activate it. The primary task is to improve the organization and management of sanitary and epidemiological surveillance on a scientific basis and to create more effective forms of its activity.

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References

1. **Rakhmanin YuA**, **Novikov SM**, **Avaliani SL**, et al. Modern problems of risk assessment of the impact of environmental factors on public health and ways to improve it. *Analiz Riska Zdorovyu*. 2019;**2**:4–11.
2. **Kumar MV**, **Babu AV**, **Reddy ChR**, et al. Investigation of the combustion of exhaust gas recirculation in diesel engines with a particulate filter and selective catalytic reactor technologies for environmental gas reduction. *Case Stud Therm Eng*. 2022;**40**:102557.
3. **Belyayev AA**, **Savenko TS**, **Gapanovich NK**. Sanitary and hygienic research is a source of necessary objective information for assessing the quality and safety of the environment. November 15, 2019. Accessed August 10, 2023. https://rspch.by/Docs/sbornik_2019.pdf
4. **History of the Development of the Sanitary and Epidemiological Service of the Republic of Kazakhstan**. October 25, 2022. Accessed August 10, 2023. https://www.rk-ncph.kz/ru/o-tsentre/istoriya
5. **Law of the Republic of Kazakhstan** "On Sanitary and Epidemiological Welfare of the Population." December 4, 2002. Accessed August 10, 2023. https://online.zakon.kz/Document/?doc_id=1034904
6. **Bayzhunusov EA**. Stages of health care development in Kazakhstan. *J Health Dev*. 2018;**1**(26):12–16.
7. **Bimuratova GA**, **Reznik VL**, **Kasymov OT**. Formation and development of the laboratory support system for sanitary and epidemiological surveillance in the Republic of Kazakhstan. *West Kazakhstan Med J*. 2018; **80**(4):7–12.
8. **Kamaliyev MA**, **Pruglo GY**, **Kozhekenova ZA**. *Organization and Management of the Sanitary and Epidemiological Service in the Republic of Kazakhstan*. K. Dosmukhamedov School of Public Health; 2019.
9. **Bekshin ZM**. *State Report "Sanitary and Epidemiological Situation in the Republic of Kazakhstan for 2021."* RGKP "NPTSSEEiM"; 2022.
10. **Zacharias N**, **Essert SM**, **Brunsch AF**, et al. Performance of retention soil filters for the reduction of hygienically-relevant microorganisms in combined sewage overflow and treated wastewater. *Water Sci Tech*. 2020; **81**(3):535–543.
11. **Stanley IL**, **Wilcke BW**, **Downes FP**, et al. Comprehensive laboratory services survey of state public health laboratories. *J Pub Health Manag Pract*. 2019;**12**(6):514–521.
12. **Lypska AI**, **Nikolaev VI**, **Shytiuk VA**, et al. Radioecological studies on the drained bed areas of the Chornobyl nuclear power plant cooling pond. *Nucl Phys Atom Energy*. 2022;**23**(4):263–270.
13. **Federal Law** "On the Federal Budget for 2020 and for the Planning Period of 2021 and 2022." December 2, 2019. Accessed August 13, 2023. http://www.consultant.ru/document/cons_doc_LAW_339305/
14. **Kuiper HA**, **Kok EJ**, **Engel KN**. Exploitation of molecular profiling techniques, for GM food safety assessment. *Cur Opin Biotech*. 2019;**14**(2):238–243.
15. **Korrick SA**. Polychlorinated biphenyls, organochlorine pesticides and neurodevelopment. *Cur Opin Biotech*. 2020;**20**(2):198–204.
16. **Morris NS**. The effect of urease inhibitors on the encrustation of urethral catheters. *Urolog Res*. 2018;**26**(4):275–279.
17. **Mohammad-Ghasemi M**, **Dehghani-Bidgoli S**, **Ahmadi T**, et al. Investigating the effect of workplace noise exposure on cardiovascular disease risk factors in a power plant industry: a case-control study. *Work*. 2023;**76**(4): 1429–1440.
18. **Wilcke Jr BW**, **Inhorn SL**, **Astles JR**, et al. Laboratory services in support of public health: a status report. *Publ Health Rep*. 2020;**125**(2):40–46.
19. **Hassall L**, **Rigsby P**, **Stickings P.** Collaborative study for the calibration of a replacement International Standard for Diphtheria Antitoxin Equine. *Biologicals*. 2023;**82**:101682.
20. **Healthy Connecting Environment – Healthy People**. September 8, 2018. Accessed August 11, 2023. https://www.euro.who.int/__data/assets/pdf_file/0007/367189/eceh-rus.pdf
21. **Traven L**, **Zaja R**, **Loncar J**, et al. CYP1A induction potential and the concentration of priority pollutants in marine sediment samples – *In vitro* evaluation using the PLHC-1 fish hepatoma cell line. *Toxicol In Vitro*. 2008; **22**(6):1648–1656.
22. **Van den Berg H.** Global status of DDT and its alternatives for use in vector control to prevent disease. *Env Health Persp*. 2009;**117**(11):1656–1663.
23. **Pareniuk O**, **Yasuda N.** Chornobyl exclusion zone: current status and challenges. *Annals of the ICRP*. 2021;**50**(1):201–208.
24. **Guo Q.** Research progress on environmental radionuclides by the Radiation Protection Research Group, Peking University. *Chinese Sci Bull*. 2023;**68**(9): 1104–1111.
25. **Pruss-Ustun A**, **Vickers C**, **Haefliger P.** Knowns and unknowns on burden of disease due to chemicals: a systematic review. *Env Health*. 2019;**21**(10): 319–325.
26. **Zhou Yu**. Analysis on the characteristics of new occupational diseases in Changzhou City from 2006 to 2018. *Chinese J Indust Hygi Occup Dis*. 2019; **37**(12):946–948.
27. **Exner M.** *Microbial Colonization of Pipes, Tubes, and Catheters*. Bonn: University of Bonn; 2019.