

Federal Service for Supervision of Consumer Rights Protection and Human Well-Being
Federal Scientific Center for Medical and Preventive Health Risk Management Technologies
of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being
Department of the Federal Service for Supervision of Consumer Rights Protection
and Human Well-Being in the Perm Territory
Department of Medical Sciences of the Russian Academy of Sciences
Perm State Medical University named after Academician E.A. Wagner of the Ministry
of Health of the Russian Federation

HEALTH RISK ANALYSIS – 2024

Dedicated to the Decade of Science and Technology in Russia

Proceedings of the
XIV All-Russian Scientific and Practical Conference
with International Participation

(Perm, May 15–16, 2024)

*Edited by Professor A.Yu. Popova,
Academician of the Russian Academy of Sciences N.V. Zaitseva*

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Proceedings of the XIV All-Russian Scientific and Practical Conference with International Participation “Health Risk Analysis – 2024” cover fundamental and applied issues of methodology of human health risk analysis to ensure sanitary and epidemiological well-being of the population of the Russian Federation and other countries. The conference is held under the auspices of the Decade of Science and Technology in Russia.

Conference materials reveal sanitary and epidemiological and medical-demographic problems of the regions at the present stage, acquaint with Russian and international experience of development of scientific and methodological approaches to the organization of situation monitoring and control and supervisory measures within the framework of risk-oriented model. Risk factors of external environment, labor, educational process, lifestyle, socio-economic conditions that negatively affect the health of the population are covered in depth. The authors analyze modern methods of diagnostics, correction and prevention technologies of health disorders associated with the leading hazard factors.

The works of foreign and domestic scientists and practitioners summarize the experience of health risk assessment in hygienic and epidemiological studies. A number of articles present the best practices of the national projects “Ecology”, “Demography”, “Housing and Urban Environment”, “Clean Air” and “General Cleaning”. The works emphasize the importance of the projects in improving the quality and increasing the life expectancy of the Russian population.

A separate section is devoted to fundamental research of the negative impact of environmental factors on health using cellular, subcellular, molecular-genetic methods of diagnostics, mathematical modeling; prospects of implementation in practice.

The authors present the results of research and methodological developments relevant to the practical activities of the service in carrying out hygienic analysis, investigations, studies, examinations.

The materials are intended for specialists of agencies and institutions of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being, research institutions, educational institutions of higher education in the medical and preventive field, students, postgraduates, physicians and specialists working in related fields of science and practice.

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**Welcome address by Anna Yurievna Popova, Head of the Federal Service
for Supervision of Consumer Rights Protection and Human Well-Being
to the organizers and participants of the
XIV All-Russian Scientific and Practical Conference
with International Participation
HEALTH RISK ANALYSIS – 2024
May 15-16, 2024, Perm**

Dear Colleagues!

On behalf of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being let me greet the organizers and participants of the XIV All-Russian Scientific and Practical Conference with International Participation “HEALTH RISK ANALYSIS – 2024”!

The role of science in the socio-economic development of our country has grown significantly. Particularly today, when Russia confidently faces to the challenges emerging in the world, when the issue of achieving technological sovereignty and self-reliance is becoming more acute, and all this requires a noticeable increase in the depth and scope of research work.

In the Decade of Science and Technology, the conference participants will focus on the discussion of innovative fundamental and applied scientific and practical achievements in the field of hygiene, epidemiology and preventive medicine, which are relevant for ensuring sanitary and epidemiological well-being of the country.

In the context of external challenges, the strategic directions of the activities of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being remain in the field of the development of science-intensive methods and criteria for analyzing and forecasting the sanitary and epidemiological situation, improvement of social and hygienic monitoring and risk-oriented supervision. New methods of assessment, forecasting and risk management in the field of consumer protection, mitigation of risks due to the negative impact of chemical, physical and biological factors remain highly relevant.

Special attention is paid to the implementation of national and federal projects aimed at improving the quality of life of the population of the Russian Federation and increasing healthy life expectancy.

Nowadays, all conditions have been created for conducting fundamental and applied research and developing critically important technologies.

Your intellectual labor is essential to the development of the Service. Today, our talented young people, start their way in science, and achieve breakthrough results, supporting the scientific potential of the epidemiologists and hygiene experts of the Service.

I am confident that the conference will become the place for the in-depth consideration of a wide range of topics and constructive exchange of opinions of scientists and practitioners.

I wish the conference success, and its organizers and participants – fruitful cooperation, active discussions and new creative achievements.

Head of the Federal Service
for Supervision of Consumer Rights
Protection and Human Well-Being,

Chief State Sanitary Doctor of the Russian Federation,
Doctor of Medical Sciences, Professor



A.Yu. Popova

May 15, 2024

Section I

**Analysis of the sanitary-
epidemiologic situation:
methodology, forecasting
and management technologies,
risk assessment, main results**

INTEGRATED HYGIENIC ASSESSMENT OF ATMOSPHERIC AIR POLLUTION IN VIEW OF ODOR EMISSION RISK

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This study considers methodological approaches to the hygienic assessment of atmospheric air pollution by odorous substances, taking into account the existing criteria for quantitative sanitary-hygienic assessment of the quality of habitat and public health, foreign practice of odor management in the environment, as well as our own experience in the areas of location of enterprises – sources of odor.

Based on the results of analysis and field studies in the areas of location of more than 10 enterprises of different industries – sources of odors, we propose an algorithm of complex hygienic assessment of atmospheric air pollution by complex mixtures of odorous substances. This assessment includes a preliminary assessment of the state of the environment, health and quality of life of the population with the establishment of circumstances indicating the adverse effects of odor (the presence of "intrusive" odor) in the atmospheric air; assessment of the impact of atmospheric air pollution by odorous substances on the health and quality of life of the population with justification of hygienic standards; development of management decisions to reduce the impact of atmospheric air pollution on public health in areas where enterprises-sources of irritating (intrusive) industrial odors are located (justification of maximum permissible emissions, methods of control and cleaning of emissions).

The study has established that in order to improve the quality and reliability of the assessment of atmospheric air pollution, taking into account the risk of odor in areas where enterprises and other facilities are located, it is advisable to use all available empirical and forecasting methods in combination with interviews with residents and other ways of assessing the health of the population.

Keywords: odor; ambient air; pollution; olfactory; odorous emissions; enterprises.

EVALUATION OF THE LEVEL AND STRUCTURE OF LIFE EXPECTANCY LOSSES (ON THE EXAMPLE OF A REGION OF THE RUSSIAN FEDERATION)

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Assessment and monitoring of the medical and demographic situation in the territories of the constituent entities of the Russian Federation is an urgent task in the light of the implementation of national and federal projects. To assess the actually realized medical and demographic potential, the

indicator “years of life lost” is used, as well as the indicator of life expectancy calculated on the basis of summary mortality tables.

The assessment of available capacity is based on preventable deaths. We found that the indicator of life expectancy from 2010 to 2019 increased on the territory of the Perm Territory and the Volga Federal District by 7.14 % and 6.64 %, respectively. The indicator “years of life lost” decreased from 18,936 to 13,082 person-years per 100,000 population in the Perm Territory and from 16,148 to 11,397 person-years per 100,000 population in the Volga Federal District. The highest values of the difference in the levels of life years lost in 2019 between the Perm Territory and the Volga Federal District are characteristic of the average working age (25–39 years). It is shown that in 2019, the leading causes of death that contribute the most to the loss of life expectancy are diseases of the circulatory system (30.8 %), external causes (22.3 %), and neoplasms (14.0 %).

We observed an increase in the importance of such causes as diseases of the nervous system, some infectious and parasitic diseases, diseases of the endocrine system. It is calculated that due to the elimination of preventable causes of death, the indicator of life expectancy in the Perm Territory can increase by 9.34 % (up to 29.04 years) relative to the level of 2019.

Keywords: life expectancy; life expectancy; years of life lost; projected life expectancy; mortality; causes of death; Perm Territory.

ANALYSIS OF THE DYNAMICS AND STRUCTURE OF MALIGNANT NEOPLASMS OF THE POPULATION OF THE REPUBLIC OF BASHKORTOSTAN IN 2019–2023

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The article analyzes the data of state medical statistics according to the form No. 7 "Information on malignant neoplasms". The study used the data of Bashkortostan statistical authority on the distribution of deaths from malignant neoplasms by sex and age (Form No. 5, Table C51) and the average annual population of municipalities of the Republic of Bashkortostan for 2019–2023. The researchers conducted hygienic assessment of data and indicators of socio-hygienic monitoring.

Keywords: malignant neoplasms; morbidity; mortality; socio-hygienic monitoring; prevention.

ASSESSMENT OF CHEMICAL CONCENTRATIONS BASED ON LAND USE INDICATORS

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Application of modern modeling programs and technical means of monitoring to a greater or lesser extent allows solving the problems of calculation of atmospheric air pollution of residential areas. However, when describing the pollution of large cities and industrial centers, significant difficulties arise due to the significant contribution to the overall pollution of local sources (vehicles, quarries, etc.). This leads to a strong heterogeneity of atmospheric air pollution, which requires special methods for assessing air pollution. The importance of solving this problem is also related to the need to reduce the cost of monitoring atmospheric air quality, which can be achieved by reducing observation points.

With the development of GIS and geostatistical methods, a wide range of spatial interpolation methods has become available. This article discusses the use of land use regression method (LUR), which consists in statistical modeling of surface pollution based on certain measurements at monitoring sites.

We outline a method for deriving a regression relationship based on land use indicators and show its application to the calculation of concentrations.

This work has resulted in the creation of a regression model based on land use indicators to estimate nitrogen dioxide concentrations in the northern administrative districts of Moscow. The determination coefficient R^2 obtained in the model was 0.556. The model is currently being refined to bring it to a working state and tested on real tasks.

Keywords: air pollution; exposure assessment; regression model; LUR method; buffer zones.

TOPICAL PROBLEMS OF ESTABLISHING THE SEVENTH SUBZONE OF THE AIRFIELD AREA

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During the period of effect of the Federal Law No. 135-FZ dated 01.07.2017 and other by-laws (Resolution of the Government of the Russian Federation No. 1460 dated 02.12.2017, No. 635 dated 31.05.2018), the "Methodology for establishing the seventh subzone of airfield area, calculation and assessment of risks to human health" was prepared (approved by the Order of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being dated 07.12.2022 No. 664), designed to clarify the procedure for the development, establishment and use of the seventh subzone of the airfield area. The implemented methodology applies exclusively to civil aviation airfields, which limits the scope of its application.

Since the introduction of the "Methodology for establishing the seventh subzone of the airfield area, calculating and assessing risks to human health", numerous questions have arisen on its implementation, obtaining and using data, modeling methods and verifying results, as well as the subsequent use of the territory of the seventh subzone of the airfield area.

One of the most important tasks of the development of the territory of the seventh subzone of the airfield area is the possibility of using land for civil engineering tasks, in particular housing and social and cultural facilities, normalized by noise factor, taking into account the implementation of compensatory measures and ensuring the possibility of full-fledged land use (according to Federal Law No. 191-FZ of 11.06.2021) according to the criteria of public health risk, taking into account typical population scenarios.

The prospect of research in the field of harmful effects of aviation noise on public health is to estimate the potential number and predicted health risk of the population living under the influence of noise, as well as the assessment of realized cases of diseases associated with environmental noise, based on medical statistics.

In terms of urban planning policy, the prospect of using the boundaries of the seventh subzone of the airfield area is to combine the established zones with special conditions of territory use with the general rules of land use and development of municipalities.

Keywords: aviation noise; seventh subzone; airfield area; noise risk assessment; noise zoning.

QUALITY OF LIFE OF WORKERS IN THE NORTHERN REGION IN THE PRESENCE OF MODIFIABLE AND UNMODIFIABLE RISK FACTORS FOR CARDIOVASCULAR PATHOLOGY

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The study examined the health-related quality of life (QOL) of male workers in the northern region, depending on the presence of modifiable and non-modifiable risk factors for cardiovascular pathology. Group 1 included respondents with a low risk of developing diseases of the cardiovascular system ($n = 38$); Group 2 ($n = 32$) consisted of men with several risk factors for developing cardiovascular pathology. The findings suggest that in the lacking comfort conditions of the northern region, the differences associated with the presence of risk factors are evident in the self-assessment of QOL. In men with a high level of risk, QOL was most reduced according to scales characterizing the restriction of daily physical activity and work performance by health problems. In low-risk individuals, QOL was diminished largely according to psychological criteria than according to the physical component. QOL of the examined group No. 1 appeared higher according to all criteria of the physical component ($p = 0.00004$ – 0.00007) and according to two scales of the psychological component (VT, $p = 0.007$ and RE, $p = 0.004$).

Keywords: risk factors; cardiovascular pathology; quality of life; north.

USE OF TOBACCO PRODUCTS AND ALCOHOLIC BEVERAGES AS A RISK FACTOR FOR THE DEVELOPMENT OF CHRONIC NON-INFECTIOUS DISEASES AMONG THE ADULT POPULATION OF THE NIZHNY NOVGOROD REGION

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The article presents the materials of the study conducted by the method of epidemiologic monitoring among the adult population living in rural areas of the Nizhny Novgorod region. The use of tobacco products and alcoholic beverages was studied by means of a sociological survey in terms of gender and education level of the respondents. The obtained results served as a basis for clarifying the structure of work on hygienic education of the Center for Hygiene and Epidemiology in the Nizhny Novgorod Region and the Nizhny Novgorod Regional Center for Public Health and Disease Prevention. This work was conducted within the framework of the research work of the Department of the Research Institute of Hygiene and Occupational Pathology “Study of the criterion significance of medico-social and sanitary-hygienic risk factors for the assessment and prognosis of chronic non-infectious diseases among the population of Nizhny Novgorod region” (initiative topic, no state registration).

Keywords: alcoholic beverages; tobacco products; epidemiologic monitoring.

RISKS TO THE HEALTH OF THE POPULATION OF THE ARCTIC AND NEAR-ARCTIC TERRITORIES: POLLUTION OF THE REGION'S ATMOSPHERE

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The article deals with the problem of sufficiency and adequacy of measures aimed at preventing the risks of escalation of environmental pollution in the Arctic and near-Arctic territories, including those related to the prospects for economic growth and an increase in CO₂ emissions. According to statistical data, the growth of carbon dioxide emissions per capita in Russia and, in particular, in the

Arctic and Arctic zone, remains stable, and the rather weak positive effect of decoupling determines the continued threat to the health of the population of the Arctic and Arctic territories of the country. Both trends – increasing rates of environmental tension and indicators of socio-economic development of these territories – today form the vectors of research search and prompt discussion of their intersection areas not only in scientific but also in public discourse. Given the current situation, the forecast of environmental stress in the short term remains uncertain, and the turbulent nature of socio-economic changes is one of the factors of uncertainty in forecasts in the long term. In addition, the coherence of these trends determines the need to find new approaches to strategic planning for the development of the Arctic and Arctic territories, taking into account the existing threats to the health of the population of the territories and the recorded dependence of the economic growth of the Arctic and Arctic regions on the involvement of a large number of natural resources.

Keywords: Arctic and near-Arctic territories; atmospheric pollution; decoupling; population growth.

SEDENTARY LIFESTYLE PATTERNS

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Nowadays, hypodynamia is widespread due to the urban lifestyle of the population, as well as the nature of modern professional and recreational activities. Prolonged sedentary lifestyle can contribute to or cause the development of various pathological conditions, the risk of which increases with age. There are several methods for determining the level of physical activity of a person, but each of them can have drawbacks.

In this article, we review the application of proteomic measurements by mass spectrometry to identify potential biomarkers of sedentary lifestyles and associated physiological conditions.

Keywords: health risk; safety; risk analysis methodology; diagnostics; proteomics.

FEATURES OF THE DISTRIBUTION OF SULFONAMIDES IN WATER RESERVOIRS

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The widespread use of antibacterial drugs in medicine, agriculture, and aquaculture has led to their presence in various environmental media, especially aquatic ones. The presence of trace amounts of antibacterial drugs in water reservoirs (wastewater, surface water bodies,

groundwater, tap water), even in low concentrations, poses a high risk to human health due to the increasing resistance of bacteria to antibacterial compounds. To date, one of the most effective and most commonly used antibacterial drugs in the treatment of humans and animals are sulfonamides. The work includes a review of scientific foreign and domestic literature devoted to research on the stability and distribution of sulfonamides and their metabolites in water reservoirs.

Keywords: sulfonamides; acetyl-sulfonamides; water reservoirs; high-performance liquid chromatography; mass spectrometry.

HEALTH RISK ASSESSMENT IN CASE OF INSUFFICIENT CALCIUM AND MAGNESIUM CONTENT IN DRINKING WATER

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The article presents the results of health risk assessment in case of deficiency of the main elements (calcium, magnesium) in drinking water. The work included population health risk calculation conducted in two districts of the Brest region (territories with low levels of mineralization and hardness of drinking water), two districts of the Vitebsk region (territories with high levels of mineralization and hardness of drinking water) and one of the districts of the Minsk region (territories with an average level of mineralization and hardness of drinking water). The data obtained correlate with the results of morbidity analysis for the 10-year period with higher levels of cardiovascular and genitourinary diseases.

Keywords: drinking water; calcium; magnesium; water hardness; risk assessment.

SELECTION OF TOOLS FOR GROUPING POPULATION MORBIDITY DATA ARRAYS WHEN VISUALIZING THEM USING GEOGRAPHIC INFORMATION SYSTEMS

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Domestic and foreign experience shows the effectiveness of using geographic information systems (GIS) to assess the sanitary and epidemiological well-being of the population across large territories.

When analyzing non-standardized indicators (population morbidity, medical and demographic indicators, integral indicator of drinking water quality, etc.), it is critically important to choose the appropriate algorithm of analysis and grouping of data necessary for their classification and identification of areas of disadvantage by a set of characteristics.

Modern domestic and foreign GIS possess a set of methods for manual or automatic grouping of data based on mathematical models for estimating the distribution of values of the studied attributes. However, there are currently no scientifically grounded standard criteria for selecting appropriate tools, which leads to incorrect results when assessing the spatial distribution of indicators.

The aim of the study was to justify the choice of optimal tools for grouping spatially linked morbidity data to analyze their distribution using geographic information systems.

The study revealed differences in the results of automatic grouping of spatially referenced data in ArcMap depending on the normality of the distribution in individual samples and the scatter of indicator values, which is visually represented on the map. The values of sample characteristics directly affect the features of data grouping, which is important to take into account when working to correctly select the appropriate tool.

Keywords: morbidity; methods of spatial analysis; grouping of spatially referenced data.

ASSESSMENT OF THE RISK TO THE HEALTH OF THE POPULATION OF PERM CITY IN CONDITIONS OF COMBINED INFLUENCE OF HEAT WAVES AND CHEMICAL POLLUTION OF ATMOSPHERIC AIR

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We have assessed the health risk for the population of Perm due to circulatory diseases under the combined effect of the 2020 heat wave and chemical pollution of atmospheric air by carbon monoxide. The risk levels due to the development of diseases in the groups of nosological forms “ischemic heart disease” and “cerebrovascular diseases” for the adult population of working age were $1.12 \cdot 10^{-5}$ and $1.53 \cdot 10^{-5}$, respectively. For the population older than working age, the risk level for the nosologic form “other cardiac rhythm disorders” was $1.04 \cdot 10^{-5}$. The calculated risk levels are categorized as acceptable (tolerable). The contribution of meteorological factor (heat waves) to the formed risk levels ranged from 76.2 to 92.4 %, chemical factor (carbon monoxide) ranged from 7.6 to 23.8 %.

Keywords: meteorological factors; public health risk assessment; heat wave; carbon monoxide; circulatory system diseases.

COMPARATIVE ANALYSIS OF INDICATORS OF SANITARY AND EPIDEMIOLOGICAL WELL-BEING OF THE POPULATION IN VARIOUS DISTRICTS OF METROPOLIS TO JUSTIFY MANAGEMENT DECISIONS

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The study targets objective and subjective indicators of sanitary and epidemiological well-being of the population of the Moscow city districts, exposed to excessive aircraft noise of aircrafts of the Vnukovo International Airport in comparison with similar indicators of the districts not exposed to this negative impact factor.

The purpose of the study was to establish an evidence base for the existence of an actual threat to the life and health of the population of Moscow districts exposed to excessive noise of aircrafts of the Vnukovo International Airport in order for the authorized federal executive authorities (Federal Air Transport Agency), the Moscow City Government, and the owner of the airport (Vnukovo International Airport PJSC) to make decisions aimed at ensuring hygienic standards of noise levels in the impact of aircrafts on residential buildings and adjacent territory.

Keywords: Moscow; aircrafts; aviation noise; noise measurements; health risk assessment; air approach strips of aerodromes; near-airfield territory; complaints of citizens; Department of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being in Moscow.

THE EFFECT OF AN ASYMMETRIC PHOTOPERIOD ON THE STATE OF SYSTEMS THAT DETERMINE THE DEVELOPMENT OF A STRESS REACTION, IN FEMALE STUDENTS OF THE NORTHERN REGION AS A HEALTH RISK FACTOR

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The study observed the influence of daylight duration on the components of stress-limiting and stress-implementing systems in female students of the northern region ($n = 25$). The concentration of 6-sulfatoxymelatonin in the morning urine was determined by enzyme immunoassay, the

level of situational and personal anxiety was established according to the questionnaire of Charles D. Spielberger (adapted by Yu.L. Khanin). The parameters of spectral analysis of heart rate variability in conditions of short (December 2022) and long (May 2023) daylight hours were studied. The data are represented by the median (*Me*) and the interquartile range ($Q_{25} - Q_{75}$). The criterion for dependent samples of the Sign Test was applied. The differences were considered significant at $p < 0.05$. The study found that with a long light day, there was a decrease in melatonin secretion and parasympathetic effects, that is, the activity of stress-limiting mechanisms decreased and the risk of desynchronosis increased, which reflected negative trends in health. Changes in the psychological state of the female students were favorable from the position of stress limitation in the spring season – a decrease in the level of situational and personal anxiety, which corresponded to a decrease in the activity of stress-realizing mechanisms.

The study revealed the influence of daylight hours on the activity of systems realizing and limiting the development of stress reaction in female students of a northern university. In general, functional changes in conditions of long daylight compared with "biological twilight" demonstrate negative trends in the body functioning of the female students, reflecting the state of health, with the exception of psychological status.

Keywords: risk factors; north; students; stress; melatonin.

Section II

Sanitary and epidemiological problems of the regions: best practices of hygienic assessment and analysis of health risks in solving urgent problems and implementation of national projects "Ecology", "Demography", "Housing and Urban Environment", "General Cleaning"

RESULTS OF ATMOSPHERIC AIR MONITORING AND ASSESSMENT OF AEROGENIC RISK TO PUBLIC HEALTH IN VOLGOGRAD CITY

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This study explores the dynamics of non-carcinogenic risk to public health from chemicals contained in the atmospheric air of a large industrial city (on the example of Volgograd). It provides the list of leading stationary sources of atmospheric air pollution, dynamics, and structure of pollutant emissions into the atmosphere, dynamics of the share of studies of chemical substances with exceeding hygienic standards. We conducted a quantitative calculation of non-carcinogenic risks to public health from chemicals contained in atmospheric air. Based on the results of the calculations, we determined the priority organs and systems of the human body, which are most exposed to the risk of damage. The study offers suggestions to minimize the health risk to the population from the identified priority pollutants in the atmosphere of Volgograd.

Keywords: social and hygienic monitoring; public health risk; clean air; urban air pollution; health damage.

PREDICTIVE ASSESSMENT OF THE EFFECTIVENESS OF AIR PROTECTION MEASURES AT THE FACILITIES OF THE THERMAL POWER COMPLEX

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The study is devoted to the predictive assessment of the effectiveness of planned measures of the Integrated Plan (2018) at thermal power facilities according to hygienic criteria (MPC), criteria for public health risk and indicators of additional associated morbidity in the study area by 2024.

A comprehensive plan of air protection measures to reduce emissions of pollutants into the atmosphere of the city participating in the federal project "Clean Air" was analyzed; calculations of the dispersion of pollutants were carried out; concentrations of substances were estimated according to the MPC criteria, risk indicators and associated morbidity were calculated for the current situation and the future as a result of the implementation of air protection measures.

The study found that the implementation of air protection measures and a reduction in gross emissions only at thermal power facilities by 18.1 thousand tons for 20 pollutants would

not provide a significant improvement in the living conditions of the population of the analyzed territory. The hygienic standards in the residential area will remain exceed by up to 6.25 MPC one-time, 7.0 MPC yearly average; the level of carcinogenic risk will be CR_T up to $3.30 \cdot 10^{-4}$; high levels of acute and chronic non-carcinogenic risk will locally remain at the level of up to 25.5 HIac and 22.6 HIch; the number of additional cases of diseases associated with atmospheric air quality in the entire population will decrease by 18.8 % and amount to 70.9 thousand cases.

In the current situation, it is advisable to use a differentiated approach to the selection of optimal areas of regulation in relation to all sources of atmospheric air pollution, taking into account their share contribution, which will make it possible to prioritize air protection measures and fine-tune the Integrated Plans.

Keywords: atmospheric air quality; federal project "Clean Air"; comprehensive plan of air protection measures; risk; associated morbidity.

DYNAMICS OF CHANGES IN INHALATION HEALTH RISK TO THE POPULATION OF NORILSK IN THE COURSE OF IMPLEMENTATION OF THE FEDERAL PROJECT "CLEAN AIR"

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Norilsk is one of the 12 cities participating in the federal "Clean Air" project, one of the five northernmost cities in the world with a population of over 100,000 people. The Russian Federal Service for Hydrometeorology and Environmental Monitoring included Norilsk in the list of Russian cities with the highest level of atmospheric pollution, taking into account significant sulphur dioxide emissions and the results of observations of the chemical composition of precipitation.

The study resulted in the assessment of inhalation risk to the population of Norilsk in dynamics for 2019–2023. Chemical factors that contribute to the risk have been identified. The analysis was based on the data of instrumental measurements of the content of chemical substances in the atmospheric air, performed within the framework of social and hygienic monitoring programs. The analysis showed that the leading risk factors for the development of non-carcinogenic health effects in long-term (chronic) inhalation exposure to pollutants (HQ more than 3.0) continue to be copper and nickel compounds, the hazard ratios of which increased 1.3–1.9 times during the study period. Risk indicators for the development of non-carcinogenic respiratory effects, both for acute and chronic exposure to pollutants, still remain at a consistently high level.

Keywords: atmospheric air; inhalation risk; risk factors; federal project "Clean Air"; participating city.

CHANGES IN THE LEVELS OF HEALTH RISK TO THE POPULATION. OF KRASNOYARSK DURING THE IMPLEMENTATION OF MEASURES TO REDUCE EMISSIONS OF POLLUTANTS INTO THE ATMOSPHERIC AIR

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Increased anthropogenic air pollution in large industrial cities was the reason for the launch of the federal "Clean Air" project. Improvement of atmospheric air quality is planned through the implementation of comprehensive measures to reduce emissions at industrial enterprises, municipal and transport infrastructure facilities. The study was based on the data of instrumental measurements of the content of chemicals in the atmospheric air, carried out within the framework of social and hygienic monitoring programs. Analysis of the results of the Krasnoyarsk public health risk assessment during the implementation of the federal Clean Air project (2019–2023) demonstrated that the leading risk factors for the health of the Krasnoyarsk population were: benzene, formaldehyde, nitrogen dioxide, suspended particles PM_{2,5} and PM₁₀, benz(a)pyrene, suspended solids, prop-2-enitrile, nitrogen (II) oxide. We noted decrease in the total carcinogenic risk index from "alarming" to "acceptable" level. Decrease in the development of non-carcinogenic effects with respect to disorders of developmental processes, blood system, immune system, central nervous system, nervous system was noted within the acceptable level of acute risk. With regard to the respiratory organs, there was a transition from "acceptable" to "alarming" level in acute and chronic exposure. The study established decrease in chronic non-carcinogenic effects in relation to the blood system from "high" to "alarming" levels.

Keywords: measures to reduce emissions; atmospheric air; health risk; priority health risk factors; federal project "Clean Air".

CARCINOGENIC RISKS TO THE HEALTH OF THE POPULATION OF OMSK CITY IN CASE OF MULTI-MEDIA EXPOSURE TO CHEMICALS ENTERING THE HUMAN BODY BY INHALATION

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The aim of the study was to assess the carcinogenic risks to the health of the population of the city of Omsk when exposed to chemical substances coming by inhalation from different habitat objects: atmospheric air, soil, drinking water, water of open reservoirs.

We used the materials of socio-hygienic and environmental monitoring for 22 carcinogenic substances for the period 2017–2022. Risk assessment was conducted in accordance with Guidelines R 2.1.10.3968-23. To calculate lifetime average daily doses, standard parameters in three age groups were used; mean values of concentrations (arithmetic mean and medians) and upper limits of confidence intervals of mean values (95 %) or 90th percentile (P90) were used for risk calculations; the malignancy severity factor (*g*) was considered.

The study obtained values of total long-term carcinogenic risks to public health in different age groups under multimedia inhalation exposure under different scenarios; the risks were evaluated as alarming. The data on the contribution to the total carcinogenic risks by media, polluting chemicals and localizations/target organs of carcinogenic effects were obtained; priorities were established.

The main contribution to the total carcinogenic risk in the inhalation route of exposure is made by organochlorine compounds (halogens) when using drinking water for bathing / washing – 88.9 %; in the structure of localizations of malignant neoplasms, the greatest risk fell on malignant neoplasms of the gastrointestinal tract (51.0 %) and on the risk of cancer of the urinary tract (41.4 %). The highest risk was characteristic of the age group of children – aged 6 to 18 years.

Keywords: carcinogenic chemicals; multi-mediated health risks.

PRACTICAL APPLICATION OF THE RESULTS OF THE SURVEY OF SCHOOLCHILDREN IN TERMS OF IMPROVING NUTRITION CONDITIONS WITHIN THE FRAMEWORK OF THE NATIONAL PROJECT "DEMOGRAPHY" (ON THE EXAMPLE OF THE AMUR REGION)

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During the period of three full academic years (2020/2023), a study was conducted to assess the nutrition of school children in the Amur Region. The survey covered three groups of respondents: heads of educational institutions ($n = 162$), catering operators ($n = 27$), students of educational institutions and their parents ($n = 6341$). The research was conducted in accordance with the methodological recommendations of the Guideline MR 2.3.0237-21 "Preparation and monitoring of the nutritional status of students in general education institutions" and Guideline MR 2.3.0274-22 "Preparation and monitoring of nutrition of students in general education institutions".

The results of the study were communicated to the executive and legislative authorities of the Amur region, a number of management decisions were made to improve the organization of children's nutrition taking into account the principles of healthy eating in the family and school, the regional program "Creation of school cafes in general educational institutions of the Amur region" was approved (Order of the Ministry of Education and Science of the Amur region № 1167 dated 03.10.2022).

The analysis covered changes in the perception of the organization of school meals by the students in comparison between 2020/2021 and 2022/2023 academic years.

Keywords: health; nutrition; national project "Demography"; school cafe; Amur region.

METHODS AND RESULTS OF ASSESSING PUBLIC SATISFACTION WITH THE QUALITY OF DRINKING WATER

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The quality of drinking water from centralized water supply systems makes a significant contribution to the health of the population of modern cities.

The everyday health behavior of the population, including those aimed at preventing diseases associated with chemical and biological contamination of drinking water, depends not only on its objective characteristics, but also on the subjective satisfaction of the population with its quality.

The article presents the results of approbation of the methodology for assessing public satisfaction with drinking water quality on the example of the city of Perm (online survey, $n = 317$). It is shown that the level of satisfaction of the majority of respondents is average or low, which requires the implementation of urgent sanitary and epidemiological and/or informational measures.

Keywords: satisfaction; drinking water quality; subjective well-being; satisfaction indicators.

EXPERIENCE OF APPLICATION OF METHODOLOGICAL APPROACHES TO THE ASSESSMENT OF FACILITIES OF ACCUMULATED ENVIRONMENTAL DAMAGE ACCORDING TO THE CRITERIA OF RISK TO PUBLIC HEALTH

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Federal project “General Cleaning” includes an assessment of the health risk to citizens and their life expectancy.

The study found that the long-term existence of high-risk facilities for public health was characterized by similar features: location within the boundaries of large settlements, including near residential development areas.

The facilities were the sources of contamination of soil, natural and drinking water, atmospheric air with a complex of toxic organic and inorganic substances. In the zones of influence of such facilities of accumulated damage, population morbidity levels were registered that were reliably higher than in the region or in the municipality as a whole.

Assignment of the facility to the “high risk” category allowed considering it as a priority and mandatory for priority inclusion in the list of facilities to be eliminated.

Keywords: environment; facilities of accumulated damage; health risk; federal project “General Cleaning”.

ON THE PROGRESS AND INTERIM RESULTS OF THE FEDERAL PROJECT “CLEAN AIR” IN THE CITY OF BRATSK

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The city of Bratsk is included in the list of the first 12 territories with high levels of atmospheric air pollution, where the federal project “Clean Air” is being implemented.

As a result of inhalation risk assessment for the population of the city of Bratsk, it was found that in the dynamics for 2019–2023, the total lifetime individual carcinogenic risk was formed at the level classified as “alarming”. It was mainly caused by the benzene content in the atmospheric air. The risk levels for non-carcinogenic effects in acute inhalation exposure to pollutants in relation to the blood system, immune system and developmental disorders formed by the presence of elevated concentrations of benzene in the atmospheric air of Bratsk remained stably “high”.

The hazard indices for the development of non-carcinogenic effects during chronic inhalation exposure to pollutants on the respiratory organs have decreased from “high” to “alarming” levels and still remained “high” with respect to the blood system.

The identified risk levels were mainly due to the presence of benzene, sulfuric acid and suspended solids in the atmospheric air.

Keywords: atmospheric air; health risk assessment; classification of risk levels; federal project “Clean Air”.

ASSESSMENT OF THE DYNAMICS OF INHALATION HEALTH RISK TO THE POPULATION OF CHITA DURING THE IMPLEMENTATION OF THE FEDERAL PROJECT “CLEAN AIR”

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The city of Chita is one of 12 cities included by the Decree of the President of the Russian Federation in the federal project “Clean Air” of the national project “Ecology” on the atmospheric air pollution.

The study resulted in the assessment of inhalation risk to the population of Chita city in dynamics for 2019–2023. We identified chemical factors that contribute to the risk. The analysis was based on the data of instrumental measurements of the content of chemical substances in the atmospheric air, performed within the framework of social and hygienic monitoring programs.

The risk assessment revealed that the leading health risk factors for the population of Chita were dihydrosulfide, benzene, suspended solids, benz(a)pyrene and nitrogen oxides, whose hazard coefficients exceeded the “permissible” level. We detected an increase in the hazard index of non-carcinogenic effects (from “target” to “high” level) during acute exposure of respiratory organs to pollutants. Risk indicators for the development of non-carcinogenic effects in chronic exposure to pollutants on the cardiovascular system, central nervous system, kidneys and liver decreased from “high” to “target” levels. The risks of pathology development on the part of respiratory organs and blood system remain at a stable “high” level in case of chronic non-carcinogenic exposure, and the risks of developmental disorders remain at a “alarming” level.

Keywords: atmospheric air; inhalation risk; federal project “Clean Air”; participating city; priority factors.

THE INFLUENCE OF ENVIRONMENTAL FACTORS ON CIRCULATORY DISEASES IN THE ADULT POPULATION IN THE ARCTIC REGION

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According to the World Health Organization (WHO), 37% of premature deaths from coronary heart disease and stroke are associated with air pollution. The average annual concentrations of formaldehyde, benzene, chromium, copper, benz(a)pyrene, ozone and suspended fine particles in Arkhangelsk in 2011–2022 exceeded the maximum permissible concentrations at the 90th percentile

level. The purpose of the study was to assess the risk and damage to the health of the adult population from exposure to atmospheric air pollutants in the city of Arkhangelsk.

The primary morbidity of circulatory system diseases (CSD) was studied using the data of record form No. 12. The analysis included the main headings corresponding to ICD-10 codes: I10-I13, I20-I25, I60-I69, I80-I89, and 10 nosologic forms. We calculated hazard quotients (HQ) for chronic inhalation exposure for 23 pollutants and hazard indices (HI) for cardiovascular, number of attributable outcomes associated with exposure to PM_{10} and $PM_{2.5}$. Hazard quotients exceeded the acceptable level (1.0) for formaldehyde ($HQ = 2.3$), copper ($HQ = 1.8$), and $PM_{2.5}$ ($HQ = 1.7$). For the cardiovascular system, the risk of developing general toxic effects was identified as high ($HI = 6.6$). The main contributors to risk were copper, $PM_{2.5}$, ozone and PM_{10} . The additional number of circulatory disease cases attributable to exposure to $PM_{2.5}$ was 10.69 %, PM_{10} was 2.96 %. The damage associated with mortality from circulatory disease and associated with $PM_{2.5}$ and PM_{10} was 2.28 and 3.21 %, respectively.

Keywords: circulatory system diseases; risk assessment; damage; pollutants; atmospheric air.

PRACTICE OF HYGIENIC ASSESSMENT AND HEALTH RISK ANALYSIS IN SOLVING ACTUAL TASKS AND IMPLEMENTATION OF THE FEDERAL PROJECT “GENERAL CLEANING” IN THE REPUBLIC OF BASHKORTOSTAN

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The article considers the experience of express risk assessment of public health and life expectancy under the impact of facilities of accumulated environmental damage in the Republic of Bashkortostan in 2022–2023, as part of the implementation of the federal project “General cleaning”.

To conduct express assessment of the risk to public health and life expectancy under the impact of facilities of accumulated environmental damage, we collected, processed and analyzed a set of data, obtained calculated comparative characteristics of facilities of different types, capacity, duration of existence and degree of impact on the environment and public health. We also ranked the facilities of accumulated environmental damage by the degree of potential impact on the health of citizens and their life expectancy to determine the facilities to be eliminated in priority order.

Then we performed a comparative analysis of the data obtained as a result of survey and assessment of facilities of accumulated environmental damage in 2022 and 2023.

As a result of the express assessment of the facilities in the Republic of Bashkortostan in 2022, ten facilities were assigned to the medium category of cumulative impact in terms of risk to health and life expectancy, and one facility was assigned to the high category of cumulative impact in terms of risk.

In 2023, based on the express assessment of the facilities of the Republic of Bashkortostan, we identified twenty facilities with a medium category of cumulative impact in terms of risk to health and life expectancy and two facilities with a moderate category of cumulative impact in terms of risk.

Keywords: federal project “General Cleaning”; health risk assessment; express risk assessment; facility of accumulated environmental damage; waste; environment.

RANKING OF UNDERGROUND SOURCES ACCORDING TO THE DEGREE OF DANGER OF DRINKING WATER IN THE MOSCOW REGION

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The purpose of the work was to analyze the state of underground sources of centralized household and drinking water supply to the population of the Moscow region according to sanitary and epidemiological water monitoring data and to rank territories according to the degree of danger of drinking water to health.

The water of underground sources of centralized domestic drinking water supply and drinking water from the distribution network of 55 municipalities of the Moscow region were selected as the object of study.

The methods and scope of the study included a systematic analysis of the results of social and hygienic monitoring of sanitary and chemical indicators of the state of sources of centralized drinking water supply and drinking water in urban areas of the Moscow region for 2018–2022.

The study established that the priority chemicals contained in the water of underground water supply sources and drinking water of centralized water supply systems of the Moscow region included iron, fluorine, manganese and its compounds, fluorides, strontium, silicon, lithium, boron, chloroform, carbon tetrachloride, tetrachloroethylene, and ammonia.

The analysis of sanitary, chemical and microbiological indicators indicated the absence of underground water supply sources with a stable composition of drinking water in the Moscow region.

The proposed principles of ranking underground sources of drinking water supply according to the degree of danger to human health are based on the deviation of drinking water quality indicators from the requirements of hygienic standards, frequency of control, and complexity of the analysis.

Results of a comprehensive ranking of the quality of drinking water from underground sources in the Moscow region revealed the most disadvantaged areas in terms of the danger of exposure to chemical and microbiological factors on public health.

Keywords: sources of household drinking water supply; drinking water; chemical; microbiological indicators; ranking; criteria; Moscow region.

EXPERIENCE IN THE IMPLEMENTATION OF THE FEDERAL PROJECT "GENERAL CLEANING" IN THE REPUBLIC OF BURYATIA

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The problem of waste management of production and consumption is of particular relevance for the Republic of Buryatia due to the significant number of unauthorized locations of production and consumption waste on its territory. The article presents the main results of the implementation of the Federal project "General Cleaning" in the republic in 2023.

Keywords: federal project "General cleaning"; the object of negative environmental impact; waste; risk; atmospheric air; soil.

Section III

**Leading risk factors for the health
of children and adolescents:
assessment and ways of mitigation**

PATHOGENETIC FEATURES OF ALLERGIC RHINITIS DEVELOPMENT IN CHILDREN UNDER THE COMBINED INFLUENCE OF ENVIRONMENTAL FACTORS, MODERN EDUCATIONAL PROCESS, NUTRITION AND LIFESTYLE

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The steady increase in the incidence of allergic rhinitis (AR) demonstrates the need for detailed studies able to establish the direction and mechanism of action of risk factors for the development of measures for the early prevention of AR. In order to establish the pathogenetic features of AR development in schoolchildren associated with the combined influence of environmental, educational process, nutrition and lifestyle factors, the results of hematological, biochemical, immunological, chemical-analytical studies, the study included the analysis of the results of surveys and nutrition diaries of 238 children with allergic diseases studying in innovative schools and 201 students of traditional schools. Identification of pathogenetic features of AR development in schoolchildren was based on the analysis of proven causal relationships risk factor→change in laboratory index → AR development.

The probability of AR development increased 4.2 times in innovative schools under conditions of disordered educational activity arrangement, high digital and low physical activity, deficient nutrition, contamination of biomedica with metals and hydrocarbons. Pathogenetic features of the development of risk-associated AR have been established: strengthening of adaptive immune response, inflammatory reaction, oxidative processes, sensitization, reduction of antioxidant protection, development of general adaptation syndrome, changes in neuro-endocrine regulation. We identified a list of laboratory indicators of risk-associated allergic rhinitis: CD3+-lymphocytes, cortisol, lymphocytes, MDA, AOA, and total IgE.

The obtained data provide a scientific basis for determining the directions of preventive measures aimed at reducing the risk and actual development of AR.

Keywords: risk-associated allergic rhinitis; pathogenetic features; educational process; nutrition; lifestyle; chemical compounds.

FEATURES OF POSTURE DISORDERS AND CONNECTIVE TISSUE DYSPLASIA IN ADOLESCENTS WITH WEIGHT DEFICIENCY

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Recent years mark a progressive deterioration in the health of children and adolescents. It is characterized, among other things, by a high prevalence of pathology of the musculoskeletal

system and metabolic disorders. The aim of the study was to study the features of the development of posture disorders and connective tissue dysplasia in adolescents with weight deficiency. The study included 36 adolescents with weight deficiency (study group) and 92 adolescents with normal body weight (control group). All adolescents were examined by specialized doctors. They also underwent computerized diagnosis of spinal deformities, flat feet, ultrasound examination of the gallbladder, and study of the state of phosphorus-calcium metabolism. According to the results of the study, 94.5 % of adolescents with low body weight had a pathology of posture, manifested in almost 3/4 by deformity of the spine in the frontal plane, including 19–30.5 % of cases developed structural scoliosis and scoliotic posture. The study revealed that the probability of spinal deformities in the frontal plane, especially scoliosis, in adolescents with weight deficiency was 2.4 times higher. The study observed that decreased body mass index in adolescents contributed to the development of thoracic deformities. Small anomalies of heart development were found in 22.2 % of adolescents with weight deficiency, gallbladder anomalies in 38.2 % of cases, while visceral signs of connective tissue dysplasia were combined with structural scoliosis in every second adolescent in the observation group, and flat feet in every third adolescent.

Keywords: adolescents; posture disorders; weight deficit; connective tissue dysplasia; computer-aided optical topography.

COMPARATIVE ASSESSMENT OF IODINE AND ZINC PROVISION FOR STUDENTS OF SECONDARY AND CORRECTIONAL SCHOOLS IN IRKUTSK

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The full development of a child is contingent upon the provision of micronutrients, which determine the possibility of achieving final growth, optimal cognitive development, and the adaptive capabilities of the organism under the influence of unfavorable environmental factors.

The study established a high incidence of iodine deficiency among the child population when assessing the provision of micronutrients to students of correctional and general education schools: 46.67 ± 9.1 % of students of general education schools and 76.67 ± 7.72 % of correctional schools; at the same time, zinc deficiency was detected only in 2.72 ± 1.55 % of children with special health care needs, which indicates optimal zinc provision.

The identified deficiency determines the need to implement medical monitoring and nutrition optimization programs, both in general education and correctional schools of the Irkutsk region, using iodine-enriched products, as well as iodine preparations, especially for children with special health care needs, in order to effectively correct micronutrient deficiency.

Keywords: students; correctional school; secondary school; iodine; zinc.

COMPARATIVE CHARACTERISTICS OF SOCIO-ECONOMIC AND LIFESTYLE FACTORS OF STUDENTS OF SECONDARY SCHOOLS OF THE REGIONAL CENTER WITH DIFFERENT TYPES OF EDUCATIONAL PROGRAMS

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The lifestyle of modern schoolchildren studying in institutions with different types of educational programs may vary. In addition to the specifics of the educational environment, students are affected by other socio-economic living conditions, which can act as both health risk factors and anti-risk factors, as they affect the intellectual development, emotional and social well-being, and the formation of physical health of a child. The purpose of this study was to perform a comparative analysis of the socio-economic portrait of families, lifestyle and intensity of use of information and communication technologies by students with higher academic workload (gymnasium) and lower study load (regular secondary school).

The study conducted by a handout survey ($n = 307$) found that the families of children studying at the gymnasium, compared with the families of children from a regular school, had a higher level of material support and education of parents, as well as focus on the quality and multidirectionality of the child's basic and additional education, organization of sufficient physical activity and sports. Gymnasium students demonstrate greater activity in the educational process and in the use of modern electronic devices, longer time devoted to sports, earlier start of smartphone use (before the age of 6). The intensive rhythm of life of gymnasium students, on the one hand, provides additional opportunities for the realization of their potential, but, on the other hand, early and active use of electronic devices can be regarded as a risk factor for the formation of school-related pathology, and increased academic workload is regarded as a risk factor for nervous system disorders.

The study of socio-economic and lifestyle factors of students requires an interdisciplinary approach and can be used for regional programs aimed at improving the health of the child population.

Keywords: health risk; risk factors; lifestyle; students; academic workload; modern electronic devices.

IMPLEMENTATION OF MEASURES AIMED AT THE PREVENTION OF DISEASES RELATED TO THE NUTRITION OF CHILDREN AND ADOLESCENTS

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Currently, there is a common commitment in the world to accelerate progress towards the elimination of malnutrition, primarily among children and adolescents. This necessitates constant monitoring of the situation, taking measures to prevent diseases related to nutrition.

Purpose: to analyze the effectiveness of measures for healthy nutrition of children and adolescents in educational institutions.

The study used the official data of the Medical Information and Analytical Center, the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being, the report of the Novosibirsk Research Institute of Hygiene "On the results of the survey assessing the actual nutrition of children, carried out as part of the implementation of the Federal Project "Strengthening Public Health" of the National Project "Demography" (2022–2023 school year) The work summarizes and systematizes the data on the implemented regional preventive programs and educational activities.

The level of primary morbidity of obesity among children appeared 2.7 times lower than the national average, in the Ural Federal District – 3.4 times lower; among adolescents – does not exceed the national average and the level in the Ural Federal District. There have been significant improvements in the situation in the region to reduce the incidence of goiter in children. The total incidence of anemia among adolescents in the region is 1.9 and 1.8 times higher than the average Russian level and the level for the Urals Federal District, respectively. The highest prevalence rates of obesity and BMI were observed in students of the second and third grades. When choosing dishes and supplementary food products on their own, the students mostly chose pastries and confectionery products.

Keywords: monitoring; prevention; children and adolescents; obesity; healthy nutrition; information and educational work.

NUTRITION OF CHILDREN WITH BRONCHIAL ASTHMA IN URBAN AREAS

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The study presents the results of hygienic evaluation of the actual dietary intake of children with a history of bronchial asthma. The study used the “Food Frequency Analysis” method. The study sample comprised 37 children in the study group and 46 children aged 11–12 years in the reference group. We found that nutrition of children in urban areas with bronchial asthma was not optimal, deficient in nutrients and unbalanced due to the predominance of the fat component. The frequency of consumption of certain food groups does not provide the body with the required nutrients, which may increase the risk of an unfavorable course of the existing disease.

Keywords: actual nutrition; nutrition of children; bronchial asthma; health risk; environmental factors.

PECULIARITIES OF SPECIFIC IMMUNITY TO MEASLES IN SCHOOLCHILDREN DEPENDING ON NUTRITIONAL STATUS

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The study evaluated the state of specific immunity against measles in school-age children with different nutritional status according to body mass index. The aim was to evaluate the influence of nutritional status on the state of post vaccination immunity against measles in school-aged children.

Groups of children with body weight deficit (study group No. 1), overweight (study group No. 2), and obese (study group No. 3) were formed for the set tasks. The reference group consisted of children with normal BMI. Body weight was assessed using the standard deviation scale (SDS).

We compared the group averages of antibody content and frequency of disorders relative to the protective level. The results of specific immunity were interpreted according to the attached regulations for the test systems.

We found that 14.9–26.9 % of schoolchildren did not have protective antibody levels, with 1.6 times more antibodies in study group No. 3 than in the reference group ($p = 0.05$). Mean concentrations of anti-chicken antibodies were 1.3 times lower in study group No. 2 ($p = 0.09$) and 1.6 times lower in study group No. 3 ($p = 0.000$) relative to the reference group. The study demonstrated peculiarities of immune response and metabolic status in obese children.

The insufficient immune response to a measles vaccine antigen in obese schoolchildren suggested that they were at increased risk of measles infection and required additional measures to improve the effectiveness of immuno-prophylaxis.

Keywords: post vaccination immunity; measles; schoolchildren; nutritional status.

FEATURES OF OXIDATIVE STRESS DEVELOPMENT IN CHILDREN IN COMBINED EXPOSURE OF HERPETIC INFECTION AND MAN-MADE CHEMICALS

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Oxidative stress is known to play an important role in the pathogenesis of many diseases. The study aimed to investigate the features of oxidative stress development in children under the conditions of combined exposure to herpetic infection and anthropogenic chemical factors.

We conducted a comprehensive clinical examination of 171 children aged 5–14 years living in the conditions of chronic aerogenic pollution with anthropogenic chemical compounds (study group) and in conditions of sanitary and hygienic well-being (reference group). 30–91.6 % of children in the study group demonstrated elevated blood concentrations of benzene, toluene, manganese, and chromium 1.5–3.9 times higher than the level of the reference groups. In the study group, $\frac{3}{4}$ of the children had Epstein-Barr virus, cytomegalovirus markers, 49.4 % had herpes simplex virus type 1,2, and 33.7 % had herpes virus type 6.

In conditions of combined exposure to herpetic infection and anthropogenic chemical factors, chronic lymphoproliferative pathology of the nasopharynx was registered in 52.8 % of children of the observation group, and chronic rhinitis was registered in 23.7 %, the probability of formation of which was 2.6–3.3 times higher.

Reduction of antioxidant defense in 15.6 % of cases was manifested by suppression of superoxide dismutase activity. A polymorphism of the antioxidant system gene SOD2 (C14510A) was detected in 20.3 % of children in the observation group, and the presence of the variant allele A may form the risk of antioxidant defense disorder mediated by the enzyme superoxide dismutase.

Keywords: children; oxidative stress; aromatic hydrocarbons; metals; herpetic infection.

STRUCTURE OF MORBIDITY OF STUDENTS OF SECONDARY GENERAL EDUCATION SCHOOLS ACCORDING TO THE RESULTS OF COMPREHENSIVE MEDICAL EXAMINATIONS

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Official statistics on the morbidity of children and adolescents do not allow the identification of priority pathology in different age groups, which limits the possibility of developing and implementing targeted preventive measures for students at different stages of school education. The study included 498 children, study group No. 1 – 132 primary school students, study group No. 2 – 257 middle school students, and study group No. 3 – 109 high school students. The assessment of the educational process organization revealed a deficit of space in an educational organization per student, lack of breaks between the shifts and optional classes, inefficient arrangement of short and long breaks, increased classroom workload of students, as well as inefficiently planned timetable with absence of periods of workload increase or decrease. Diseases of the musculoskeletal system and connective tissue (17.1–19.9 %), diseases of the endocrine system (15.7–17.4 %) and diseases of the digestive system (15.1–18.5 %) occupied the leading positions in the structure of morbidity in all three groups of students.

The dynamics of the educational process revealed a significant increase in diseases of the musculoskeletal system from primary to middle school, from middle to high and from primary to high school – by 1.2 times; eye system disorders – from primary to middle school and from primary to high school – by 1.6–1.7 times; diseases of the nervous system – from primary to high school – by 1.2 times; diseases of the circulatory system – from primary to middle school – by 1.2 times.

Keywords: primary middle and high school students; educational process; morbidity structure.

THE INFLUENCE OF DIETARY REGIMEN ON THE FATIGUE OF MIDDLE AND HIGH SCHOOL STUDENTS

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Exploring the role of nutrition as a factor in the development of fatigue in children remains an urgent problem in today's world. The study reviews the role of nutrition in the development of fatigue in middle and high school students.

The aim of the study was to investigate the nutritional characteristics of students aged 11–17 years and to identify the influence of nutrition on the development of fatigue. The study involved 214 people, 84 boys and 130 girls. We conducted a survey of schoolchildren to assess their nutritional status and dietary patterns. The level of fatigue of schoolchildren was determined using the Multidimensional Fatigue Inventory (MFI-20). The study revealed that the development of asthenic syndrome can be influenced by the frequency and the time interval between meals. In addition, the development of asthenia and, as a consequence, asthenic syndrome can be influenced by the presence in the dietary regime of a late dinner (eating at night), the absence of breakfasts and warm lunches, as well as the lack of fresh vegetables, greens, fruits in the daily regimen.

The results obtained are necessary for the development of hygienic recommendations aimed at preventing fatigue among schoolchildren.

Keywords: dietary regimen; fatigue; middle school; high school; asthenia; asthenic syndrome.

INFLUENCE OF EXOGENOUS CHEMICAL ENVIRONMENTAL FACTORS ON THE IMMUNE REGULATION OF MIDDLE SCHOOL CHILDREN (USING FORMALDEHYDE AS AN EXAMPLE)

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The study included 194 children (study group) and 150 children of middle school age (control group). The exposure marker used was the level of chemical haptens (formaldehyde) in biological media that enter the child's body from atmospheric air. We used the immune profile indicators (CD3+CD8+, CD19+, serum immunoglobulins of class G, indicators of general and specific sensitization, IL6, TNF, TPO antibodies) quantitatively characterizing immunological changes in the body in response to excessive contamination by bio-mediated exogenous chemical factors (formaldehyde) as markers of effects. As a result of testing the content of contaminants in the blood of the examined children, the average group concentration of formaldehyde in the blood of middle school students of the study group ($0.0350 \pm 0.0054 \text{ mg/dm}^3$) was significantly higher than the regional background level ($0.0050\text{--}0.0014 \text{ mg/dm}^3$). Immunological analysis revealed in the examined children hyper activation of humoral (growth of serum IgG, increased sensitization) and imbalance of cellular immunity (deficiency of T-killers and expression of B-lymphocytes), as well as hyper production of anti-TPO together with inversion of pro-inflammatory cytokines (activation of IL6 and TNF deficiency). The established changes are characterized by the presence of a significant risk of metabolic disorders, intoxication, immune dysregulation with the formation of autoimmune reactions of the body to formaldehyde ($OR = 2.34$; $95\% \text{ CI} = 1.49\text{--}3.68$; $RR = 1.69$) and violations of controlling the development of tumor-associated processes.

Keywords: environmental factors; school age; formaldehyde; formaldehyde-specific IgE; immune regulation.

RESPIRATORY FUNCTION STATUS IN COVID-19 UNVACCINATED CHILDREN AND ADOLESCENTS WITH THE PRESENCE OF CLASS G IMMUNOGLOBULINS TO SARS-CoV-2

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The issue of studying the impact of the novel coronavirus infection (COVID-19) on the health of the child population and the presence of delayed post-infectious consequences remains a pertinent and ongoing concern.

The aim of the study was to establish the features of respiratory function in children and adolescents unvaccinated against COVID-19 with the presence of class G immunoglobulins to SARS-CoV-2.

A total of 300 children and adolescents aged 7–17 years were examined. The study group included 167 children and adolescents with the presence of class G immunoglobulins to SARS-CoV-2 at the time of examination, the control group included 133 children and adolescents without class G immunoglobulins to SARS-CoV-2. The examination included assessment of external respiratory function by spirometry and statistical analysis of the results.

In the study group, statistically significantly lower values of the medians of the volume of the relative value of forced expiratory volume for the first second (FEV1, %), the modified Tiffno index (forced expiratory volume/vital capacity (FEV1/FVC, %) and the peak rate of forced exhalation (PEF, %) ($p < 0.001$ – 0.028) were established against the background of more significantly frequent registration reduced values of the modified Tiffno index and PEF.

The observed alterations in spirometry indicators suggest a potential association between obstructive respiratory dysfunction and acquired active specific immunity to SARS-CoV-2 in schoolchildren.

Keywords: children; adolescents; spirometry; pulmonary function; IgG antibodies to SARS-CoV-2; COVID-19.

FEATURES OF CHRONIC EXPOSURE TO AROMATIC HYDROCARBONS AND ALDEHYDES OF INDUSTRIAL ORIGIN ON THE UPPER RESPIRATORY TRACT OF CHILDREN LIVING IN THE VICINITY OF PRODUCTION FACILITIES

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The study has established, for the first time, the relationship between blood concentrations of chemical compounds and laboratory-instrumental indicators in children with upper respiratory tract pathology living in the territory with excessive levels of phenol, formaldehyde, and acrolein.

The total nasal airflow in the study group was 10–15 % lower than in the reference group and was in inverse relationship with the blood concentration of acrolein, o-xylene, phenol, formaldehyde, as well as with the content of IgG specific to phenol, myeloperoxidase, total number of lymphocytes, CD3+CD25+ and CD3+CD95+ subpopulations, integral proliferation index and the frequency of cells with apoptotic bodies and circular notches of the nucleus.

The characteristic features of the upper respiratory tract pathology associated with increased blood content of acrolein, o-xylene, phenol and formaldehyde are a decrease in the nasal airflow amid specific immune-dependent and nonspecific inflammation processes.

Reducing the incidence of upper respiratory tract diseases in children requires the development of programs that include measures aimed at improving the quality of environment, together with therapeutic and preventive measures to increase adaptive capacity.

Keywords: nasal breathing; upper respiratory tract pathology; aromatic hydrocarbons; aldehydes.

ANALYZING THE CONTRIBUTION OF NUTRITIONAL FACTORS TO THE DEVELOPMENT OF OBESITY IN SCHOOLCHILDREN USING ARTIFICIAL INTELLIGENCE METHODS

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The prevalence of obesity in children has been growing over the past decade, leading to adverse health responses in adulthood. It increases the likelihood of cardiovascular, endocrine, and digestive diseases and thereby reduces the life expectancy of the population. Modern approaches to the study of nosology development require a comprehensive assessment of the influence of nutritional factors, taking into account the peculiarities of each individual organism.

The use of neural network modeling allowed us to account for the synergistic effects of alimentary factors on the likelihood of obesity.

The source data were surveys containing information on the nutrition of students of general education institutions, obtained as a result of a large-scale sociological study conducted in various regions of the Russian Federation. With the help of modeling conducted using artificial intelligence techniques, we produced a model with a high degree of confidence. In order to assess the impact of all possible combinations of factors using the constructed model, we made a simulation matrix containing 300 thousand scenarios reflecting different combinations of values of school feeding factors based on the Monte Carlo method.

Analysis of the obtained neural network model made it possible to establish the most optimal levels of exposure to alimentary factors for seven different groups of school-age children. The greatest negative contribution to the emergence of nosology was made by daily consumption of potatoes, cakes and pastries, juices, getting high-calorie food products in a vending machine and/or buffet, avoiding purchasing salads and vegetable dishes. The worst combination of factors increased the probability of developing obesity to 0.98 in all groups under study.

Keywords: obesity; nutrition; neural networks; artificial intelligence; health.

Section IV

**Ensuring the quality and safety
of food products according to the
criteria of risks to public health**

APPLICATION OF MULTIPLEX PCR FOR DETECTION OF *METORCHIS USSURIENSIS* TREMATODES IN FISH PRODUCTS

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The researchers developed and tested primers for multiplex PCR, which allow to assess the quality and biological safety of fish products, and selected the conditions of the reaction. Diagnosticians detected DNA of the *Metorchis ussuriensis* trematode. The DNA of the second intermediate hosts of these parasites, fish of the Cyprinidae family, serves as a reference. In addition, primers complementary to host DNA can be used to assess the quality of products made from marine invertebrates in order to identify unregulated meat additives in both river and marine fish.

Keywords: parasitic infestations; biological safety; fish products; quality control.

QUALITY AND SAFETY ASPECTS OF FOOD PRODUCTS FOR INFANT NUTRITION

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The article provides a justification for the increased requirements for the ingredient and chemical composition of food products for infant nutrition and their safety indicators. The article also presents a system of hygienic requirements ensuring the safety of food products for infant nutrition. It reviews the aspects of production practice of food products for infant nutrition, as well as the modern legislative framework in the field of quality and safety of food for young children, preschool and school age children.

Keywords: food products for infant nutrition; quality and safety.

STABLE STRONTIUM IN THE ENVIRONMENT AND FOOD PRODUCTS: TOXICITY, ASSESSMENT OF EXPOSURE AND POTENTIAL RISKS

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Strontium (Sr) is a toxic trace element commonly found in the lithosphere, surface and groundwater, and in a variety of food products. The primary target of the harmful effects of Sr on the body (critical organ) is bone tissue. The toxic effects of Sr are mediated by its competitive interactions with calcium during absorption, transport, biodistribution and accumulation in bones. There is evidence of the ability of Sr to block the synthesis of the active form of vitamin D ($1,25(\text{OH})_2\text{D}_3$) in the kidneys. Stable Sr compounds are not carcinogens according to IARC. Clinical observations on the relationship of Sr levels in the body or its actual intake to the development of rickets, osteomalacia and some other types of human pathology have a relatively low level of evidence at present. The RfD value of safe intake of Sr with food and water into the human body is 0.6 mg/kg bw/day, which, taking into account the existing estimates of its actual intake, indicates a low (acceptable) level of non-carcinogenic risk. There are, however, uncertainties in the estimates due to both the large variability of Sr content in environmental media and food products and the lack of data on the effects of its low doses at the post-genomic level of research. It seems relevant to control the content of Sr in drinking water, certain types of food products, as well as to assess the load of Sr on various populations using the level of this element in hair.

Keywords: stable strontium; toxicity; bone tissue; rickets; vitamin D; risk assessment.

ASSESSMENT OF THE PUBLIC HEALTH RISK CAUSED BY CONTAMINATION OF FOOD PRODUCTS WITH POLYAROMATIC HYDROCARBONS AND JUSTIFICATION OF MEASURES TO REDUCE IT

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One of the main routes of entry of polyaromatic hydrocarbons (PAHs) into the human body is with food. The purpose of the study was to assess the risk to public health caused by contamination of food products (fat-and-oil, dairy and alcoholic, cocoa products, smoked meat and fish products, smoked cheeses, bakery products, coffee and eggs) with individual PAHs (benz(a)pyrene (BP), benz(a)anthracene (BA), benzene(b)fluoranthene (BbF), chrysene) to determine measures to reduce it. The most realistic scenario, taking into account the median of PAH contamination and consumption, is characterized by acceptable (minimum) levels of individual and total risks, which range from $2.13 \cdot 10^{-08}$ for chrysene to $1.39 \cdot 10^{-06}$ for BA, $3.50 \cdot 10^{-06}$ for 4 PAHs. With an aggregated assessment, the individual risk for BaA ($2.76 \cdot 10^{-05}$), BbF ($2.01 \cdot 10^{-05}$), BP ($6.80 \cdot 10^{-05}$) is low, and the total for 4 PAHs ($1.16 \cdot 10^{-04}$) is average. The population risk indicators for the adult population range from 4 for BbF under realistic exposure conditions of 18 to 791 additional to background

cases of diseases for the amount of PAHs in conditions of high levels of contamination and consumption. The results obtained indicate the health risk associated with the intake of PAHs with a diet ranging from minimal to average, and the relevance of implementing specific measures to reduce it, which consist in choosing technological methods for manufacturing food products and reducing consumption of certain types of smoked products.

Keywords: polyaromatic hydrocarbons; benz(a)pyrene; risk assessment; measures to reduce health risk.

METHODOLOGY FOR MEASURING MASS CONCENTRATIONS OF TOXIC AND ESSENTIAL ELEMENTS IN DIETARY SUPPLEMENTS BASED ON PURE SUBSTANCES BY ATOMIC SPECTROMETRY

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The purpose of this work was to develop, on the basis of atomic spectrometry, a methodology for measuring the mass concentrations of toxic arsenic (As), lead (Pb), cadmium (Cd) and essential elements calcium (Ca), magnesium (Mg), potassium (K), sodium (Na) in biologically active dietary supplements (hereinafter – dietary supplements) based on pure substances. The work justified the choice of the optimal method of sample preparation and the method of atomic spectrometry for dietary supplements based on pure substances for elemental analysis. The studies were carried out using atomic emission spectrometry with inductively coupled plasma (hereinafter – AES-ICP). For all the studied elements, the repeatability limit of the test results was from 4.31 to 27.10 %, the intermediate precision limit was from 7.97 to 29.90 %, the relative extended uncertainty was from 14.30 to 31.40 %.

Keywords: toxic and essential elements; dietary supplements based on pure substances; AES-ICP; measurement methods.

ALGORITHM FOR DETECTION OF PATHOGENS IN OBJECTS OF TECHNOLOGICAL ENVIRONMENT OF FOOD PRODUCTION BASED ON MOLECULAR-GENETIC AND CULTURE METHODS

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The study included laboratory experiments to determine the influence of various factors on the detection of pathogenic microorganisms of *Listeria monocytogenes* species and *Salmonella*

genus by conducting washes from the surface of environmental objects of the technological environment of food production facilities.

We determined the methodological requirements for sampling (swabs from equipment, technological tools, equipment surfaces, etc.) taking into account the peculiarities of PCR-diagnostics and culture methods. The study included the development of an algorithm for the detection of pathogenic microorganisms by conducting washes from the surface of the objects of the technological environment of food production facilities.

Keywords: emergent microorganisms; microbial profile; film formation.

RESULTS OF MONITORING OF FUSARIOTOXIN CONTAMINATION OF FOOD GRAINS OF 2017–2022 HARVESTS

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The present study presents data on the contamination of food grain of wheat, corn, barley, oats, and rye with regulated fusariotoxins, the producers of which are *Fusarium* fungi. The content of toxins in 996 samples of grain from the 2017–2022 harvests obtained from nine Federal Districts of the Russian Federation was studied using high-performance liquid chromatography combined with tandem mass spectrometric detection (HPLC-MS/MS). The most frequent contaminants for food grain were deoxynivalenol and T-2 toxin, for maize – fumonisins B1 and B2. Zearalenone was also detected. Deoxynivalenol contamination of maize, wheat, barley and oats was found not only in grain from the Far Eastern, Southern and North Caucasus Federal Districts, but also from the Central and North-Western Federal Districts. Simultaneous contamination with two or more mycotoxins was revealed. Estimated total intake of deoxynivalenol per person on average in Russia differed by year and ranged from 0.10 (in 2020) to 0.63 µg/kg body weight per day (in 2017), but in all cases remained below the accepted conditional tolerable daily intake – 1 µg/kg body weight. In the areas of grain fusariosis (North Caucasian and Southern Federal Districts), the estimated total deoxynivalenol intake in 2017 was 109–119 %.

Keywords: fusariotoxins; deoxynivalenol; T-2 toxin; fumonisins; contamination; food grain.

TOWARDS THE FEASIBILITY OF PUBLIC HEALTH RISK ASSESSMENT OF NON-REGULATED N-NITROSAMINES IN FOOD PRODUCTS, ON THE EXAMPLE OF SMOKED SAUSAGES

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The purpose of the study was to consider the feasibility of assessing the risk to public health in relation to N-nitrosamines in food products on the example of smoked sausages. The object of the study was raw smoked sausages of “servelat” varieties. Sampling took place in the retail chains as part of a search study. We collected 12 samples in total.

The content of N-nitrosamines was estimated by gas chromatographic analysis with mass spectrometric detection.

The assessment of the health risk associated with the content of NDMA and NDEA in smoked sausages was carried out in accordance with the principles of the health risk assessment system in the States of the Eurasian Economic Union and the Guidelines for Assessing the Risk to Public Health from Exposure to Chemicals Polluting the Environment. The assessment of the risk to public health was carried out on the basis of research data conducted on the basis of the Federal Research Center for Medical and Preventive Health Risk Management Technologies of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being, to study the concentrations of N-nitrosamines in smoked sausages.

The established levels of carcinogenic and non-carcinogenic risk to the health of the adult population associated with the consumption of smoked sausages sold in Russia are characterized as acceptable. Despite the acceptability of the risk, it is advisable to conduct further studies on the group of N-nitrosamines due to their potential carcinogenic and non-carcinogenic danger to humans, as well as the largest contribution to the total risk of N-nitroso compounds for which food content standards have not been developed.

Keywords: risk assessment; consumer health; N-nitrosamines; smoked sausages; food safety.

EVERYDAY DIETARY PRACTICES AS A RISK FACTOR FOR THE HEALTH OF THE URBAN POPULATION

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This study reveals the subjective meanings of healthy eating characteristic of modern city dwellers based on the results of a sociological research conducted in the qualitative tradition. It

describes everyday eating practices, demonstrates health-preserving and risky elements of these practices. The paper discusses the impact of the COVID-19 pandemic on the transformation of everyday eating practices.

Keywords: nutrition; healthy eating; nutrition practices; daily practices; in-depth interview.

FOOD AND VEGETARIAN PRODUCT RISK ASSESSMENT FOR PUBLIC HEALTH IN HANOI CITY IN 2022–2023

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The study focused on the assessment of microbial and chemical contamination of 480 samples of food raw materials and vegetables collected in Hanoi during 2022–2023. The study methodology involved systematic sampling including both unprocessed components and ready-to-eat food products from vegetarian food production. After collection, the samples were analyzed to assess the levels of microbial and chemical contamination using standard methods including methods approved by the Association of Analytical Chemists (AOAC), Vietnam National Standards (TCVN) and internationally recognized ISO/IEC 17025: 2017 laboratory methods.

The resulting dataset was analyzed in detail using Microsoft Excel and the findings were evaluated against current food safety standards. The study found that exceeding the permissible levels of microbial contamination was found in 2.5 % of mushrooms and finished products made from them, in 50 % of samples of cereals and finished products made from them, in 11.6 % of samples of food additives and spices and in 6.67 % of samples purchased from online stores. Furthermore, heavy metals (Pb, Cd, As, Al, Ni) were detected in most of the samples tested, and 2.50–3.30 % of the mushroom food products did not meet the safety standards for Pb and Cd content.

The results of the study provide sufficient scientific justification for the development of threshold values of safety criteria for vegetarian food products.

Keywords: contaminants; vegetarian diet; risk assessment.

NITROSAMINES IN THE ASPECT OF FOOD SAFETY AND THEIR IMPACT ON PUBLIC HEALTH (SCIENTIFIC LITERATURE REVIEW)

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The age of neo-industrialization places increased demands on the health of the working population, as well as on the overall health of the nation. In conditions of intensification of human technogenic activity, highly toxic compounds with carcinogenic and mutagenic properties, such as aliphatic and some cyclic N-nitrosamines (NA) accumulate in the environment. The ease of formation, high reactivity and resistance of nitrosamines determine their undesirable effects on humans. The non-occupational sources of exogenous substances are tobacco, tobacco smoke, household chemicals, atmospheric air, food products, and beer. The sources of occupational risk are the products of the rubber and tire industry.

Amid the introduction of new technological processes in food production, the use of various chemical compounds and food additives, the relevance of the problem of food safety increases every year, which necessitates the creation of international food legislation that tightens the requirements for food safety.

Codex Alimentarius, which is a set of legislative acts on the composition, properties and quality of food products, is currently in force in the developed countries of the West. To ensure guaranteed food safety, a hazard analysis system based on critical control points has been created and operates at processing enterprises in industrialized countries. It ensures quality control system for the production of food products according to the level of risk criteria.

In the Russian Federation, the hygienic safety of products is among the priorities of the state policy in the field of healthy nutrition and is a necessary condition for ensuring the sanitary and epidemiological well-being of the population.

Purpose of the study: analytical review of scientific literature of domestic and foreign scientists on the current understanding of the impact of nitrosamines on public health.

Analysis of the literary data was based on the resources of the scientific electronic library "CyberLeninka", the scientific electronic library eLibrary.RU, the National Medical Library of the USA, the Central Scientific Medical Library, the Electronic Medical Library, the National Digital Resource Rucont.

Keywords: nitrosamines; food products; safety; health.

NITROSAMINES – ANALYTICAL METHODS AND RISK ASSESSMENT OF FOOD PRODUCTS IN VIETNAM

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Nitrosamines are a group of substances that are formed in foods as a result of chemical interactions, most often during the processing of food raw materials. Many substances in this group have been assigned class 2A and 2B by the International Agency for Research on Cancer as potentially carcinogenic to humans. They are a factor that can cause cancer of various localizations (e.g., stomach, esophagus, pancreas, and lungs).

Currently, only standards establishing maximum permissible levels of nitrosamines in drinking water have been developed, but their levels in foodstuffs are not regulated in any way in global practice. Therefore, risk assessment of nitrosamines is an urgent need. Risk assessment is the most important component of risk analysis and the scientific basis for risk management and risk communication. To support the decision-making process with the appropriate analytical data and framework, the assessment should begin with an analysis of nitrosamine exposure in food products. The analysis should include an examination of the amount of consumption of particular foods, making it possible to calculate exposure levels through the consumption of major food products, and then to estimate the associated health risk according to these levels.

The National Institute for Food Control has been conducting research on food risk assessment of nitrosamines since 2018, including the development of analytical methods to assess levels of these substances in the most popular foods in Vietnam (meat, poultry, seafood, eggs, dried foods, fermented foods, and other ready-to-eat food products).

The study also includes research on the consumption of major food products in Hanoi and surrounding areas, with further expansion to the whole territory of Vietnam to create a database to help regulatory authorities safely and effectively control and monitor food products and inform consumers about health risks in a timely manner.

Keywords: N-nitrosamines; gas chromatography-mass spectrometry/mass spectrometry; prepared food; risk assessment; food safety.

SOME RESULTS OF MONITORING THE MICROBIOLOGICAL SAFETY OF CULINARY PRODUCTS

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Ensuring food quality and safety is one of the priority components of national security.

The purpose of the study was to analyze the results of monitoring the microbiological safety of culinary products, to identify indicator parameters and to optimize the programs of laboratory tests of the products.

The results of the study showed that when forming programs for monitoring the microbiological safety of culinary products, priority should be given to the types of products that are not heat-treated (e.g., salads, sushi, rolls). Priority indicators for inclusion in the plan of laboratory tests of culinary products are: coliform bacteria, mesophyll aerobic and optional-anaerobic microorganisms (QMA&OAMO), *S. aureus*, *E.coli*. The increased content of coliform bacteria, QMA&OAMO in culinary products, relative to the norm, does not always indicate the presence of pathogenic strains of microorganisms in the products, with a higher frequency of detection of opportunistic flora.

Further research should aim to examine the results of monitoring a wider range of culinary products by prioritizing the components of culinary products such as meat, fish et al, as well as examining the contamination of semi-finished and raw food products to identify their characteristics.

It remains a priority to study the occurrence of cases of harm to health when consuming contaminated food products and to determine the conditions contributing to the occurrence of health risks.

Keywords: monitoring; food products; microbiological safety; culinary products; violations of mandatory requirements.

ASSESSMENT OF ALIMENTARY EXPOSURE BY INDIVIDUAL ORGANIC SUBSTANCES ASSOCIATED WITH THE USE OF LIGNIN-CONTAINING POLYLACTIDE MATERIALS FOR CONTACT WITH FOOD PRODUCTS

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We assessed exposure by selected priority chemicals associated with the use of materials based on polylactide modified with lignin, intended for contact with food products. Their theoretical maximum daily intake has been calculated, taking into account the maximum migration levels determined analytically in model environments and "standardized" consumption. These findings were evaluated relative to toxicologically established safe exposure levels for alimentary intake. As a result, we found that the calculated values of daily intake did not exceed the specified permissible values and amounted to less than 0.5 % for formaldehyde, acetaldehyde and acetone, less than 0.1 % for methanol.

Keywords: materials in contact with food products; packaging; safety; polymer materials; polylactides; lignin.

MYCOTOXINS IN DOMESTICALLY PRODUCED FOOD GRAINS OF THE 2023 HARVEST

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The study obtained data on contamination of 249 samples of food grain harvested in 2023 with a wide range of mycotoxins produced by *Fusarium*, *Alternaria*, *Aspergillus*, *Penicillium* mold fungi. The most common toxins in wheat and barley grain were the fusariotoxins deoxynivalenol, enniatin B, and alternatoxin tentoxin; in corn – fumonisins. Oat grain samples were characterized by contamination with deoxynivalenol, zearalenone, T-2 and toxins of fungi of the *Alternaria* genus. Rye samples turned out to be the least contaminated. Exceedance of MRL of deoxynivalenol was detected in wheat samples from the Far Eastern, North Caucasus, Southern, and Central Federal Districts; T-2 toxin – in wheat from the Southern Federal District, barley – from the Far Eastern Federal District, OTA – from the North Caucasus Federal District. The study found accumulation of several mycotoxins produced by different species of mold fungi in one sample of food grain. The number of cases of combined contamination in corn samples was 8 %, rye – 30 %, wheat – 46 %, oats – 47 %, barley – 59 %.

Keywords: mycotoxins; contamination; food grain; fusariotoxins; alternatoxins; ochratoxin A.

TO THE ISSUE OF CHANGING THE AMINO ACID COMPOSITION OF THE DIET WHEN INTRODUCING NEW TYPES OF FOOD PRODUCTS

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Research on alternative food sources (“new food”) to provide protein and essential amino acids is currently under active investigation. Insect protein (entomoprotein) is of particular interest, namely the domestic cricket (*Acheta domestica*).

The flour produced from it was registered in the European Union in January 2023. However, when using insects as a source of protein, the possible change in the biological significance of the protein component of the diet, which may pose a potential health hazard to consumers, should be taken into account.

The aim of the study was to characterize the change in the biological value of protein of a simulated diet when using protein obtained from domestic cricket.

We conducted a comparative analysis of an actual diet containing protein from traditional food products and a diet with a probable substitution of beef, pork and poultry for a product containing entomoprotein.

The amount of actual consumption of traditional food products was calculated based on the results of estimation of sample survey of household budgets. Amino acid score was calculated to evaluate the biological value of protein.

We found that the complete replacement of meat products with a product containing entomoprotein preserved the necessary intake of essential amino acids. Meanwhile, the protein component of the diet including entomoprotein was more complete compared to the protein component of the “traditional” diet.

Despite the high biological value of entomoprotein, it is reasonable to determine the sufficiency of micro- and macronutrients and vitamins in food products that contain insect biomass to meet the demands of the human organism.

Keywords: new food; entomoprotein; *Acheta domestica*; safety; biological value.

HYGIENIC ASSESSMENT OF CADMIUM CONTAMINATION OF FOOD PRODUCTS – A RETROSPECTIVE STUDY

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Food safety is one of the priorities of government agencies in the field of ensuring the sanitary and epidemiological well-being of the population of the member States of the Eurasian Economic Union (EAEU) and the Eurasian Economic Commission. Among the chemical contaminants, cadmium is one of the most important due to its wide distribution in the environment, a significant range of negative non-carcinogenic and carcinogenic effects on health and the ability to accumulate in the body.

This determines the relevance of the hygienic characteristics of cadmium contamination of food products, including on the basis of retrospective data. Thus, the analysis of data for 2002–2006 indicates an increase in the frequency of cadmium detection in certain types of food products by almost 2 times (up to 12.8%). Statistically significant increase in the number of samples with cadmium detection in 2002–2006. It is established in the group of dairy products, bakery and flour-grain products, which are diet-forming.

The totality of the above determines the need to update the maximum permissible levels of cadmium content in food products, based on an assessment of public health risks, taking into account regional nutritional characteristics and the legislation of the EAEU.

Keywords: cadmium; contamination; food safety; health risk; hygienic standardization.

SELECTIVE LABORATORY CONTROL OF GMO CONTENT IN FOOD PRODUCTS (ON THE EXAMPLE OF CONFECTIONERY PRODUCTS)

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The study identified the presence of specific genetic insertions in 29 samples of food products of the confectionery category, indicating the genetic modifications made, with the determination of specific genetically modified GM plant lines by the PCR method. We found that the samples were characterized by the presence of plant DNA and GM insertions with different frequency of occurrence: soy, corn, rice, beetroot, peas, alfalfa, wheat, *cp4 EPSPS*, *nptII*, *tE9*, *35s CaMV*, *35s FMV*, *NOS*. We discovered genetically modified soybean line GST40-3-2.

It is recommended that, as part of monitoring and selective quality control of food products, namely confectionery (sweets), for the presence of genetically modified insertions, to use the following genetic markers as the most pathognomonic: *cp4 EPSPS*, *nptII*, *tE9*, *35S CaMV*, *35s FMV*, *NOS*.

Keywords: GMO; GM modifications; GM lines; promoters; terminators; GST40-3-2.

Section V

**Scientific foundations and
practice of risk assessment due
to occupational diseases or related
to working conditions**

PECULIARITIES OF ENDOTHELIAL DYSFUNCTION DEVELOPMENT IN WORKERS OF POTASH FERTILIZER PRODUCTION ENTERPRISE

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Potash fertilizer production workers have a high risk of developing work-related pathology. The purpose of the study was to identify morphofunctional features of arteries in employees of a potash fertilizer company. The study examined 160 workers engaged in the production of potash fertilizers and engaged in work under harmful working conditions (study group). The control group included 82 people who were not exposed to harmful factors of production in the course of their work. The study included analysis of working conditions, and assessed the air quality in the work area for the content of hexane, heptane and formaldehyde, as well as determined chemical compounds in biological media (blood, urine). The study also evaluated endothelium-dependent vasodilation of the brachial artery (ultrasound) and arterial wall stiffness (sphygmomanometry). In workers working under harmful working conditions, the content of formaldehyde in the blood, heptane and hexane in the urine exceeded the indicators of the comparison group by 1.2–1.5 times. Two thirds of all workers in the study group exhibited a decrease in vascular wall extensibility, and the risk of developing these changes in them was 1.5 times higher than in the control group. 29.8 % of cases in the study group demonstrated signs of endothelial dysfunction. The study found that the risk of developing endothelial dysfunction in workers in harmful working conditions was 2.3 times higher.

The revealed violations indicate the presence of additional risk factors for cardiovascular diseases.

Keywords: production of potash fertilizers; working conditions; formaldehyde; hexane; heptane; endothelial dysfunction.

UPDATE OF THE MONITORING OF HEALTH DISORDERS OF THE WORKING POPULATION BASED ON THE REGIONAL REGISTER OF PERSONS WITH OCCUPATIONAL DISEASES

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In order to improve the sanitary and hygienic monitoring of the health status of the working population, a computer program "Regional Register of Persons with Occupational Diseases" was

developed and put into practice at the Clinic of General and Occupational Pathology of the Saratov Institute of Hygiene of the Federal Scientific Center for Medical and Preventive Health Risk Management Technologies.

The developed medical information system, which corresponds to modern international principles of construction and quality criteria of digital patient registers, made it possible to update and unify statistical accounting and comprehensive analysis of occupational morbidity in the region, to increase the objectivity of forecasts of occupational health risks in the context of economic activities and professional affiliation of those employed in harmful working conditions.

The methodological techniques used in the development of the computer program "Regional Register of Persons with Occupational Diseases" are universal and can be used in the formation of digital databases and registers of occupational and work-related diseases of the working population.

Keywords: working population; working conditions; occupational morbidity; occupational disease registers.

SERUM CATESTATIN IN WORKING POPULATION, ITS RELATIONSWITH SOME MORPHOLOGICAL, FUNCTIONAL AND BIOCHEMICAL PARAMETERS

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The aim of the study was to assess the level of catestatin in the blood serum of working population and establish its relations with morphological, functional and biochemical indicators of the risk of developing cardiovascular pathology. 73 men aged 29 to 62 years (average age 41.6 ± 9.3 years) working in metallurgical production were under observation. The concentration of catestatin (CST) in blood serum was determined by enzyme immunoassay using reagent kits "Human/Mouse/Rat Catestatin Enzyme Immunoassay Kit" by Ray Biotech, Inc. CST was detected in all the examined individuals. Its concentration ranged from 4.04 to 27.1 ng/ml. A decrease in CST concentration was observed with increasing age. With the highest frequency, high blood pressure, overweight, obesity, heart rate over 75 beats per minute, elevated glucose levels were observed at low CST concentrations. With an increase in the concentration of CST, the number of people with metabolic changes on the ECG increased. The association of CST with risk markers of cardiovascular pathology has been revealed. According to the conducted studies, preliminary conclusions can be drawn about the significant role of CST in assessing the state of the sympathetic nervous system in working population and its relationship with markers of cardiovascular risk.

Keywords: catestatin; sympathetic nervous system; working population; functional and biochemical parameters; cardiovascular diseases.

CRITERIA FOR THE FORMATION OF RISK GROUPS FOR THE DEVELOPMENT OF PRODUCTION-RELATED CARDIOVASCULAR PATHOLOGY IN TITANIUM-MAGNESIUM PRODUCTION WORKERS EXPOSED TO HAZARDOUS PRODUCTION FACTORS

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The loss of qualified personnel due to the presence of medical contraindications to the performance of work is an urgent problem of occupational medicine. The study established the main diagnostic criteria for the formation of risk groups for the development of production-related cardiovascular pathology in titanium-magnesium production workers exposed to hazardous production factors. The formation of risk groups in this category of workers contributes to the early diagnosis of cardiovascular pathology, the development and implementation of medical and preventive technologies aimed at preserving and improving the health of workers, as well as increasing professional ability to work.

Keywords: risk group; production-related pathology; cardiovascular diseases; titanium-magnesium production; production factor.

FEATURES OF ULTRASONIC PARAMETERS OF THE STRUCTURE OF BRACHIOCEPHALIC ARTERIES IN METALLURGICAL INDUSTRY WORKERS

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Signs of atherosclerosis can often be detected in young people. Therefore, a targeted search for asymptomatic vascular lesions should be conducted in persons of working age exposed to harmful industrial factors. Brachiocephalic ultrasound is the simplest method used for screening examination of patients. The study group consisted of workers exposed to harmful production factors of metallurgical production (average age – 47 years, average length of service – 17 years). The control group included workers without exposure to harmful production factors (average age – 52 years, average length of service – 14 years). In workers exposed to harmful production factors, the dependence of the increase in the mean values of intima-media complex thickness on the length of service was observed (0.66 ± 0.05 mm – with less than 5 years of work experience, 0.78 ± 0.06 mm –

with 15 years of work experience in the study groups and 0.66 ± 0.04 mm – in the control group, regardless of the length of service ($p = 0.02$). With increasing length of service, the percentage of stenosis in the arteries increased (in trained workers in the study groups – 37.93 ± 9.4 %, in the control group – 23.22 ± 2.9 %, $p = 0.05$).

Keywords: metallurgical production; harmful production factors; atherosclerosis of brachiocephalic arteries.

SCIENTIFIC SUBSTANTIATION OF A COMPLEX OF MEDICAL AND PREVENTIVE MEASURES TO PRESERVE THE HEALTH OF WORKERS IN A HEATING MICROCLIMATE

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One of the leading harmful production factors is the heating microclimate. In order to develop and implement comprehensive measures to prevent health disorders of the working population, a set of preventive measures has been developed. To prevent heat exhaustion of workers, physiological monitoring is recommended, including monitoring of internal body temperature, heart rate, as well as measuring the specific gravity of urine before and after a shift. It is essential to measure indicators of thermal state, moisture loss, HR, heat sensation. It is also necessary to perform infrared thermometry, telemetric system of physiological monitoring.

Keywords: heating microclimate; medical and preventive measures; workers' health.

MODEL OF EMPLOYEE HEALTH SAVING ON THE EXAMPLE OF THE CONCEPT OF FORMING RISK GROUPS FOR OCCUPATIONAL DISEASES DEVELOPMENT

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One of the goals of the demographic policy of the Russian Federation is to improve the quality of life, to increase the life expectancy of citizens to 75 years by 2025 by reducing the mortality rate of the working-age population and increasing the duration of active life. One of the ways to achieve this goal is the development and implementation of effective measures to detect early signs of exposure to harmful production factors, monitoring and control of significant risk factors in order to minimize the risk of occupational diseases.

The article considers a modern approach to the assessment of occupational risk based on the concept of forming a risk group for the development of occupational diseases according to eight criteria that take into account hygienic and biomedical indicators. The proposed concept was tested within the framework of a pilot project on the prevention of occupational diseases of workers in certain types of economic activity¹. We defined the risk groups of occupational diseases for 2,547 workers employed in various branches of economy by three main nosological forms: sensorineural hearing loss, vibration disease, radiculopathy. The degree of influence of criteria on the risk group was established, the main influence is exerted by the presence of early signs of occupational diseases (correlation coefficient 0.45) and work experience in harmful working conditions (coefficient 0.41). We identified the values of the indicators of individual occupational risk and total occupational risk, the dynamics of which allowed us to assess the effectiveness of preventive measures for each employee and for the organization as a whole. In the development of sensorineural hearing loss, the effectiveness of preventive measures in terms of individual risk was 19 %, in the development of radiculopathy – 64 %. For the organization as a whole, the effectiveness of preventive measures on the total risk indicator ranged from 1.5 to 6.3 %, depending on the nosology.

Keywords: occupational disease; risk group; health saving; individual occupational risk index; total occupational risk index.

FEATURES OF BONE MINERAL METABOLISM IN OCCUPATIONAL LUNG DISEASES

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Due to the high prevalence of osteoporosis, according to the results of epidemiological studies, we conducted a study of bone mineral metabolism in patients exposed to aerosols of predominantly fibrogenic action. Survey results for 80 men aged 50 to 69 years with occupational lung diseases, revealed high incidence of mineral metabolism disorders (68 %), which was significantly higher compared to the reference group (44.6 %). Based on the data obtained, it is recommended to allocate people with occupational lung diseases to a group with increased risk of osteoporosis development.

The aim of the study was to assess the state of bone mineral metabolism in patients with occupational lung diseases.

Materials and methods. 80 men aged 50 to 69 years with at least 5 years of work experience who did not take systemic and/or inhaled glucocorticosteroids were examined in the clinic of the institute of occupational medicine. All the surveyed were divided into three groups.

The first group consisted of 28 patients with dusty lung diseases (11 people diagnosed with occupational COPD (J44.8 according to ICD-10), 9 people diagnosed with pneumoconiosis (J62.4 according to ICD-10), 8 people diagnosed with occupational chronic bronchitis (J41.0 according to ICD-10)). The average age was 58.5 ± 5.4 years, the average work experience under the influence

¹ On the implementation of a pilot project on the prevention of occupational diseases of workers in certain types of economic activity: Resolution of the Government of the Russian Federation from 01.02.2023g. № 134 [Electronic resource] // Garant. – URL: <https://www.garant.ru/products/ipo/prime/doc/406191371/> (date of access: 13.02.2024).

of aerosols of predominantly fibrogenic action (strongly fibrogenic aerosols) above the maximum permissible concentrations (MPC) was 31.2 ± 5.2 g. The main occupations were: miner of the mine face, sinker, stumper, crusher, molder, machinist, repairman, electrician.

The second group included 29 patients with no clinical signs of bronchopulmonary pathology, exposed to aerosols of predominantly fibrogenic action during work (19 patients diagnosed with vibration disease from local vibration (T75.2 according to ICD-10), 5 patients diagnosed with upper limb polyneuropathy (G62.8 according to ICD-10), 4 patients with diagnosed with dorsopathy (G54.8 according to ICD-10), 1 patient with a diagnosis of shoulder lesion (M75.1 according to ICD-10)). The average age was 56.5 ± 5.7 years, the average work experience under the influence of strongly fibrogenic aerosols was 27.2 ± 6.5 years. The main occupations were: cutter, underground miner, fastener, drilling rig driver, vibration loading machine driver, underground electric locomotive driver, bulldozer driver, loading and delivery machine driver.

The third (reference) group included 22 men who were not exposed to strongly fibrogenic aerosols in the workplace (class 2 of working conditions (acceptable)), with the main diagnosis of hypertension (I11.9 according to ICD-10). The average age was 57.8 ± 5.4 years, the average work experience was 29.1 ± 8.5 years. Professional staff: foreman, repairman, mechanic, shift supervisor.

The groups were comparable in age, work experience and body mass index (BMI). The study was approved by the local ethics committee, and all patients signed an informed consent before conducting the study.

All patients underwent analysis of medical documentation, physical examination, assessment of an individual 10-year probability of pathological fracture using the FRAX algorithm (fracture risk assessment tool), laboratory diagnostic studies (general clinical blood examination, biochemical blood analysis, protein fractions), instrumental studies (bioenergetic X-ray absorptiometry (DXA) of the lumbar spine and proximal femoral bone on the GE Prodigy Advance densitometer, spirometry). Statistical data was processed using Microsoft Office programs.

Keywords: dust pathology; pneumoconiosis; chronic bronchitis; COPD; osteoporosis.

RISK-BASED APPROACH TO THE FORMATION OF CORPORATE PROGRAMS AIMED AT REDUCING OCCUPATIONAL HEALTH RISKS

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The primary obstacles impeding the expansion of the country's economic potential and extending the lifespan of the Russian population are the morbidity and mortality rates among the working-age population. Despite the positive developments, the production process in the leading industries remains potentially dangerous due to the complex of existing harmful production factors, which creates an occupational risk to the health of employees. One of the leading trends in overcoming the problem is the development and implementation of comprehensive corporate programs, the purpose of which is not only to ensure safe working conditions, but also to improve the quality

of health of workers. From the modern standpoint, it is extremely important to determine the contribution of each group and individual factors (occupational and non-occupational) to the risk of negative trends in the health of workers at the first stage of the corporate program development, which will make it possible to focus on a particular aspect of the program. A comprehensive risk assessment should be the basis for the development of corporate programs. In addition to a priori risk assessment, it is advisable to conduct a posteriori risk assessment in order to plan effective medical and preventive measures based on the assessment of current and prognostic occupational risk, which will allow not only to identify priority risk factors, but also types of occupational diseases and illnesses associated with working conditions that cause this risk. The use of modern approaches to risk assessment makes it possible to reliably identify the level of risk and its structure at the current moment and in the future, both by professional and production-related pathology, form target groups, route the implementation of medical and preventive programs by location and form of their implementation, and determine their content.

Keywords: corporate programs; risk-based approach; a priori and a posteriori risk assessment.

SUBJECTIVE ASSESSMENT OF OCCUPATIONAL HEALTH RISK FACTORS OF INDOOR VEGETABLE GROWERS

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A single-stage (cross-sectional) sociological study was conducted using a continuous individual handout questionnaire in a group of female indoor vegetable growers ($n = 235$). The study found that vegetable growers indicated unfavorable microclimatic conditions and physical overload as the main occupational factors harmful to health. As the professional length of service and age of workers increased, the share of respondents who assessed occupational factors as harmful to their health statistically significantly increased. A positive statistically significant correlation was established between the manifestation of subjective signs of fatigue in the dynamics of the work shift and the assessment by vegetable growers of microclimatic conditions in the workplace and physical activity ($r = 0.84$ and $r = 0.58$, respectively) as the causes of their occurrence. The respondents associated pain in the upper extremities with an uncomfortable working position ($r = 0.38$) and the number of similar hand movements ($r = 0.42$), in the lumbar region – with lifting and moving loads manually ($r = 0.44$) and an uncomfortable working position ($r = 0.39$), in the back and lower extremities – with physical overloads ($r = 0.37$ and $r = 0.42$, respectively). The study established direct correlation of very high strength ($r = 0.92$) between the subjective assessment of the state of health as "bad" and the opinion of employees that it worsened due to professional activity. Thus, subjective assessment of working conditions and signs of fatigue in the process of labor activity represents an informative method for identifying occupational risk factors in the development of preventive measures for the health disorders of indoor vegetable growers.

Keywords: indoor vegetable growers; working conditions; subjective assessment; occupational health risk factors.

CONTEMPORARY HEALTH PRESERVATION TECHNOLOGIES TAKING INTO ACCOUNT RISK FACTORS IN HIGH-TECH ENGINEERING ENTERPRISES

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The working-age population is the main element of the economic system, making a significant contribution to the development of the country. Working conditions represent significant factors determining the health status of workers. The study examines the working conditions and health status of employees of technological engineering enterprises.

It identifies the main risk factors, priority diseases, and health preservation principles for maintaining health in the workplace based on the results obtained. The work determines the main predictors of the effectiveness of the introduction of modern health preservation methods.

Keywords: high-tech engineering; industrial enterprises; working population; production factors; health preservation.

DIGITAL TECHNOLOGIES FOR STORING AND SYSTEMATIZING BASIC REQUIREMENTS OF SANITARY LEGISLATION IN THE PREVENTION OF INFECTIOUS DISEASES IN THE WORKING POPULATION

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In order to meet the challenges of digital transformation, the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being must address two key issues: the implementation of digital storage technologies and the systematization of the basic requirements of sanitary legislation, including the prevention of infectious diseases in the working population. Digital "Directory of technologies and tools for preventing the spread of infectious diseases, taking into account the specifics of the organization of the labor process in enterprises of various industries of the economy" (hereinafter – the Directory) has been developed. Users of the Directory have access to address, coordinated with the All-Russian Classifier of Economic Activities, binding legal documents (sanitary rules and norms (SanPiN), sanitary rules (SP), federal

laws, resolutions of the Government of the Russian Federation, orders of the Ministry of Health of Russia, decisions of the Customs Union Commission, technical regulations of the Customs Union, in pursuance of which SanPiN and SP were developed, as well as to an individually customized package of technologies and tools for preventing the spread of infectious diseases based on methodological materials recommended by Federal Service for Supervision of Consumer Rights Protection and Human Well-Being (manuals, methodological guidelines, methodological recommendations, methodological guidelines on control methods, temporary procedures, information letters). The directory is implemented on the DRUPAL platform – it is a content management system (CMS) used as a framework for web applications (CMF), written in PHP and using a relational database as a data warehouse (MySQL, PostgreSQL, etc. are supported). In total, 1,292 files with technologies and tools were uploaded, 11,556 articles and clauses of regulatory documents, 2,568 articles and clauses of preventive technology documents (total 2.7 GB of data) were included. The directory is available on the Web portal "Advisory and expert support and information support for ensuring sanitary and epidemiological well-being in organizations and enterprises" at: <http://82.179.117.189>.

Keywords: directory; digital technologies of storage and systematization; prevention of the spread of infectious diseases; Sanitary Rules and Norms (SanPiN); methodological recommendations.

ORGANIZATIONAL ASPECTS AND WORK EXPERIENCE OF THE PERM REGIONAL CENTER OF OCCUPATIONAL PATHOLOGY

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The study considers the issues of organizing the work of the Perm Regional Center of Occupational Pathology. It presents statistical data characterizing the structure of occupational morbidity by nosology, length of service, age and gender composition, and area of manifestation. The functions of the Perm Regional Center of Occupational Pathology are: primary diagnosis of occupational disease; examination of the stage of occupational disease; consideration of particularly difficult cases of examination of occupational pathology; scientific and methodological support and coordination of activities of all centers of occupational pathology in the Perm Territory; development and implementation of measures to prevent and reduce occupational morbidity, implementation of corporate programs. Work experience has proved that only a multidisciplinary service combining the structures of diagnosis, treatment, and prevention is able to identify and control the risks of health disorders under the influence of professional and industrial factors, solving complex issues of preventing the development and progression of diseases.

Keywords: occupational pathology; expertise; risks of health disorders; working conditions.

CORPORATE HEALTH AND WELLNESS PROGRAMS. COMPREHENSIVE APPROACH

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Today, one of the priority areas of society's development is to take care of the health of the able-bodied population. From corporate initiatives to government programs, health promotion is becoming a key aspect. Understanding the importance of health as a key element of success and prosperity in both personal and professional life is becoming increasingly widespread. Many businesses and companies are implementing employee health promotion programs, realizing that this not only helps to increase productivity and reduce health care costs, but also contributes to enhancing the company's image and attracting highly qualified staff. However, maximizing health promotion requires a comprehensive approach that takes into account the various aspects of employee health and well-being.

Keywords: corporate health programs; health risk factors; able-bodied population; health preservation.

ISSUES OF PHYSIOLOGICAL ASSESSMENT OF LABOR TENSION OF BOOKING CLERKS AT KAZAN STATION WORKING WITH VIDEO TERMINALS

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The article presents research related to the assessment of labor tension of Kazan station checkout clerks working with video terminals. The study used methods of assessment of the central nervous system, cardiovascular system, visual analyzer and neurovascular system of hands. The results of the conducted researches revealed that the 12-hour shift-working schedule of the booking clerks with the use of video terminals has an adverse effect on the majority of the main physiological systems of booking clerks' organism and requires the improvement of recommendations on optimization of booking clerk working conditions and schedule.

Keywords: work safety; work tension; booking clerk's work with video terminals; optimization of booking clerk's working conditions.

OCCUPATIONAL HEALTH RISK CRITERIA FOR WORKERS OF HAZARDOUS INDUSTRIES

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In order to study the state of health and assess the effectiveness of a person's professional activity, it is necessary to analyze the factors that have a detrimental effect on the workers together with an analysis of the level of risk. A survey of 4,876 employees was conducted to determine the health risk criteria for workers in hazardous industries. For each enterprise, we developed a research program, taking into account the impact of production factors. The article highlights the results of cross-departmental interaction between the clinical, mathematical, and health risk analysis divisions, using a study at a chemical plant as an example. The results of the analysis of general morbidity showed that the respiratory diseases occupied the first position in the study group. The criteria of health risk of workers with a high probability of its occurrence in conditions of exposure to chemicals are: work experience in conditions of exposure to chemicals for 10 years and more; the age of 35 years and over; respiratory diseases, nervous system dysfunction and metabolic disorders. This requires the development of preventive measures taking into account the identified risk factors.

Keywords: workers of hazardous industries; interdepartmental interaction; risk criteria.

ASSESSMENT OF ADAPTATION POTENTIAL AND FUNCTIONAL STATE OF CARDIOVASCULAR SYSTEM IN WORKERS OF NOISE-VIBRATION OCCUPATIONS

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Assessment of adaptive reserves of the cardiovascular system is an effective strategy for personalized prevention of cardiovascular diseases.

The aim of the study was to assess the level of adaptive potential and the functional state of the cardiovascular system in workers exposed to noise and vibration.

We examined 500 workers exposed to combined effects of noise and vibration (250 people – group 1) and noise (250 people – group 2). The reference group included 70 workers who had no contact with noise and vibration. The compared groups were comparable in terms of age and length of service. We conducted 24-hour ECG monitoring and assessed temporal heart rate variability (HRV), central hemodynamic parameters and the level of adaptive potential (AP).

The analysis of HRV indicators, the intensity index (IN) of regulatory systems revealed significantly large deviations in workers of the 1st group exposed to noise and vibration, compared to the workers of the 2nd group and reference group ($p < 0.05$), indicating the predominance of the tone of the sympathetic nervous system in heart rhythm regulation. The study revealed a significant increase in the

average values of central hemodynamics as the length of service of employees of both compared groups increased. Among the interns, the adaptive potential in group 2 was assessed as a state of functional stress (AP = 2.9), in group 1 – the level of adaptive capabilities was unsatisfactory (AP = 3.15).

Analysis of the obtained data revealed stress of adaptive regulatory systems, deviation of which under the influence of environmental factors can be considered as indicators of the risk of developing cardiovascular diseases.

Keywords: cardiovascular system; functional condition; adaptive potential; central hemodynamics; heart rate variability; noise; vibration.

ASSESSMENT OF THE BIOLOGICAL AGE OF REFINERY WORKERS

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The assessment of biological age in hygienic studies is promising enough to identify groups of people at risk of developing diseases associated with exposure to adverse industrial and non-industrial factors.

The purpose of the work is to study the biological age of oil refinery workers. The study included 331 male employees of the Saratov oil refinery. The determination of biological age was conducted by the method of integrative assessment according to V.P. Voitenko. The results of the study were statistically processed using the Statistica 10 program.

The study revealed an accelerated rate of aging in workers of mature age I, correspondence of biological age to passport age in low-skilled workers and workers of mature age II, and a slower rate of aging in trainee workers and elderly workers.

Keywords: biological age; refinery workers; harmful working conditions.

ANALYSIS OF WELDER'S WORKING CONDITIONS AT VARIOUS WORKPLACE LOCATIONS

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The study included hygienic assessment of working conditions of an electric and gas welder at different workplace locations according to the results of special assessment of working conditions at 32 workplaces. The content of harmful chemicals in the air of the work area and

the level of ultraviolet radiation were assessed. Depending on the workplace location (at a stationary welding station or at a temporary location in an open area), the welders were divided into 2 groups. Welding production is characterized by harmful working conditions, which differ slightly in different work areas in terms of the level of excess of production factors. In accordance with the Work Conditions Classification 3.2, the occupational risk category is medium (significant) occupational risk.

Keywords: welding operations; working conditions; UV radiation; welding aerosols; working area air.

ASSESSMENT OF OCCUPATIONAL MORBIDITY OF WORKERS IN THE RYAZAN REGION IN 2017–2023

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This article is devoted to the analysis of the occupational morbidity of workers in the Ryazan region for 2017–2023. The obtained analysis results of the state of occupational morbidity of workers in industrial enterprises, institutions and organizations indicate that the number of people with newly diagnosed occupational diseases increased in 2023 compared to 2022.

Keywords: occupational diseases; work area air; physical factors; preventive measures.

OCCUPATIONAL RISK ASSESSMENT OF TRACK WORKERS

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The article presents the results of research into the factors of working environment and labor process of track maintenance workers. Based on the assessment of occupational risk from the impact of these factors, the forecast of probability of reduction and/or loss of professional working capacity of track maintenance workers was formed, taking into account changes in the length of service and working conditions. The proposed integrated approach to the assessment of occupational risk of health disorders of track maintenance workers due to the impact of factors of industrial environment is intended both for predicting the consequences of exposure and for

determining measures aimed at improving the efficiency and reliability of professional activity of track maintenance workers.

Keywords: track maintenance workers; unfavorable production factors; occupational risk; risk assessment; risk management.

IMPACT OF THE MAIN PHYSICAL FACTORS OF PRODUCTION ENVIRONMENT ON WORKERS IN THE MINING INDUSTRY OF THE ARCTIC ZONE

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Due to the ongoing registration of a significant number of occupational diseases at mining enterprises in the Krasnoyarsk Territory due to the impact of the vibroacoustic factor of the production environment, we conducted assessment of noise and vibration exposure to workers in the mining industry of the Arctic zone according to occupational risk criteria.

For the purpose of a priori risk assessment, we used the results of a hygienic assessment of vibroacoustic factors, according to the data of specialized assessment of working conditions verified by instrumental studies. We conducted a posteriori quantitative assessment on the basis of data on occupational morbidity of employees over the past ten years, taking into account the number of employees.

Unacceptable levels of a priori occupational risk, formed as a result of exposure to noise, were noted among all analyzed occupations. At the same time, according to instrumental studies, miners of the treatment face and drivers of loading and delivery vehicles revealed higher risk levels, in contrast to the results of the specialized assessment of working conditions. According to the specialized assessment of working conditions, unacceptable levels of a priori occupational risk associated with exposure to vibration were noted only for loading and delivery vehicles operators, and according to additional instrumental studies – for loading and delivery vehicles operators and borehole drillers. During the quantitative assessment of occupational risk, it was found that unacceptable (above $1 \cdot 10^{-3}$) levels of occupational risk, formed as a result of the development of vibration disease and sensorineural hearing loss, were recorded among all analyzed occupational groups.

Keywords: occupational risk; mining industry workers; Arctic zone.

OCCUPATIONAL RISK ASSESSMENT OF RAILWAY FITTERS

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The article with the assessment of occupational risks of railway transport workers – track fitters with subsequent conclusions.

The purpose of the study was to calculate occupational risks for railway transport workers – track fitters with subsequent conclusions.

Materials and methods. This study was based on the materials for assessing working conditions of track fitters at an Experimental Track Machine Station in the Moscow region during October – November 2023. Based on the materials received, in accordance with established methods, the class of working conditions of the above-mentioned employees was determined. We evaluated and analyzed occupational risks of track fitters using the Fine & Kinney method, which allowed us to determine the presence of occupational risk levels.

Keywords: occupational risk assessment; path fitters.

STUDY OF SAMPLES OF ANTIBACTERIAL SPRAY FOR HYGIENIC HAND TREATMENT OF RAILWAY TRANSPORT WORKERS

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The article presents the research data showing the effectiveness of antibacterial action of the product “AirFit Antibacterial Spray” in the treatment of human hands in the conditions of passenger railway transportation. The article materials can be used for the purpose of conducting activities to reduce the epidemic risk for citizens during the epidemic season of the year.

Keywords: antibacterial agent; prevention of the spread of diseases; bacterial-viral infection; transportation; epidemic season.

Section VI

Fundamental research of the negative impact of environmental factors on health using cellular, subcellular, molecular-genetic diagnostic methods, mathematical modeling. Prospects of practical implementation

PECULIARITIES OF CELL DIFFERENTIATION CLUSTERS IN CHILDREN LIVING IN THE TERRITORY LOCATED IN THE AREA AFFECTED BY EMISSIONS FROM THE ALUMINA PRODUCTION PLANT

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The article examines the effects of living conditions in the emission area of an alumina production plant on the parameters of regulation of the cellular immune system in children aged 7 to 13 years. Immune profile parameters were studied by flow cytometry and allergy-sorbent testing. The results of the study revealed that there was a significant increase in the content of cellular phenotypes – CD277 receptor (butyrophilin), toll-like CD284 receptor and specific IgG to aluminum in children of the study group. The study of causal relationships showed the presence of a significant dependence of immunoregulatory effects on the level of contamination of the biological medium with the formation of an increased relative risk ($RR = 2.1-2.4$) of the development of cellular stress according to the criterion CD277^{+rel.} and specific sensitivity to aluminum (IgG to aluminum). Thus, the increase in the relative amount of cellular immunity indicators suggests the development of autoimmune inflammation due to long-term aluminum exposure in children.

Keywords: markers of cellular response; IgG to aluminum; aluminum; children.

EFFECT OF LOW DOSES OF IRON AND COPPER IN DRINKING WATER ON THE INTENSITY OF LIPID PEROXIDATION IN EXPERIMENT

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Drinking water is the most important factor of human health. Almost all its sources are exposed to anthropogenic and man-made impacts of varying intensity. Iron (Fe) and copper (Cu) are the priority metals identified in the drinking water of certain districts of the Orenburg region. These essential trace elements can accumulate in the body and lead to increased oxidative stress in various tissues, which can lead to pathological conditions. Therefore, an urgent

problem is to study the effect of prolonged intake of small doses of copper and iron with drinking water separately and in combination on the intensity of lipoperoxidation processes in the experiment.

The object of the study was 40 male Wistar rats. The duration of the experiment was 20 weeks, at the end of which the activity of antioxidant enzymes (SOD, catalase) in red blood cells and the content of malondialdehyde in liver tissues were determined. According to the results of the experiment, it was found that the chronic intake of iron and copper into the animal body in isolation and together lead to a decrease in the activity of antioxidant enzymes in red blood cells. The study found a significant accumulation of malonic dialdehyde in hepatic tissue, with a positive synergistic effect in the form of increased intensity of free-radical oxidation processes at the combined intake of metals of variable valence with drinking water.

Keywords: drinking water; oxidative stress; essential trace elements; model experiment; iron; copper.

ASSESSMENT OF INSULIN RESISTANCE PARAMETERS IN CHRONIC COMBINED EXPOSURE TO ORGANOCHLORINE COMPOUNDS IN THE EXPERIMENT

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Man-made pollution of the environment is a major public health concern, with maintaining high quality of drinking water being a top priority. Organochlorine compounds contained in drinking water can lead to various pathological processes in the human body. An important issue at present is the evaluation of the combined health effects of subthreshold doses of a mixture of chemicals in drinking water.

We have performed a comparative assessment of the effect of chloroform and 2,4-DA in doses equivalent to 0.5 and 1 MAC, administered orally with drinking water in isolation and in combination on the formation of insulin resistance in a model experiment. The obtained data reflect the positive synergistic effect of combined administration of chloroform and 2,4-DA mixture in doses corresponding to 0.5 and 1 MAC on the development of glucose tolerance in experimental animals.

The study revealed that in the experimental group of animals that consumed water containing two toxicants at a dose equivalent to 1 MAC simultaneously, the changes in the glycemic profile and the development of insulin resistance were the most pronounced.

Keywords: experimental animals; organochlorine compounds; endocrine disruptors; insulin resistance; chloroform; 2,4-DA.

FEATURES OF IMMUNE AND NEUROENDOCRINE PARAMETERS IN PRESCHOOL CHILDREN UNDER CONDITIONS OF EXCESSIVE CONTAMINATION OF BIOLOGICAL MEDIA WITH ALDEHYDES

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The immune system, along with the nervous and endocrine system, performs the function of maintaining homeostasis, participates in the processes of adaptation to changing environmental conditions. It is apparent that immune status is one of the main targets of the impact of environmental pollution components on children's health. The results of the conducted research on the health of children living in conditions of industrial air pollution and excessive contamination of biological media with aldehydes indicate functional shifts in regulatory systems. The revealed disorders affect both cellular and humoral immunity, which manifests itself in inhibition of phagocytosis ($p < 0.05$) and a decrease in IgG and IgM ($p < 0.05$). At the same time, the content of free thyroxine and serotonin in the blood is increased, which indicates the activation of the neuroendocrine regulation circuit.

Keywords: immune and neuroendocrine systems; preschool children; formaldehyde; acetaldehyde.

DEVELOPMENT AND SUBSTANTIATION OF GENETIC MARKERS OF IMMUNE AND NERVOUS REGULATION DISORDERS ASSOCIATED WITH EXPOSURE TO CHEMICAL AND BIOLOGICAL EXOGENOUS FACTORS

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Pollution of the environment by chemical exogenous factors such as heavy metals, including aluminum, lead, manganese, nickel, as well as organic toxicants (benz(a)pyrene) depletes the adaptive capabilities of the human organism, forms material and functional accumulation of the exogenous factor in the organism and quite early leads to decompensation of weak genetically inherited compartments of organs and systems of the organism, including the nervous system. At the same time, the impact of the global pandemic caused by the SARS-CoV-2 virus involves a high risk of developing post-COVID complications, which are often polysystemic in nature, affecting, among other things, the functions of many systems, but it is the "cytokine storm" and post-COVID-19 asthenia that remain prominent among the possible molecular mechanisms associated with COVID-19 outcomes.

The study included two groups of children living in the residential area and attending pre-school institutions located in the zone of influence of emission sources, identical in terms of age, social and ethnic criteria, differing in the presence and absence of pathology (nervous system). Blood (buccal epithelium) was sampled for genotyping polymorphism of candidate genes, e.g., *MMP9 Q279R*, *DRD2 C2137T (rs1800497)*, *MTRR A2756G Asp919Gly* by real-time PCR on a CFX96 amplifier. Relative scaled expression of transcripts (e.g. VEGFA hs00900055_m1; TP53 hs1034249_m1) was studied in whole blood in an in vitro experiment with 24-h incubation modified with SARS-CoV-2 vaccine antigens (recombinant adenovirus particles of serotypes 26 and 5 containing the S protein S gene of SARS-CoV-2 virus at experimentally selected concentration) by reverse transcription PCR on CFX96 (BioRAD, USA).

The results of our studies allowed us to state that in the examined patients the observed pathology (e.g., asthenic syndrome) associated with contamination of biomedica by a chemical or biological factor manifested pathognomonic diagnostic features of key laboratory tests for health disorders (e.g., CD304+ - VEGF receptor) and was significantly associated with either a typical or rare allele (multiplicative model) or with homo- or heterozygous genotypes of candidate genes. The conditions of modeling SARS-CoV-2-virus load in vitro led to the formation of VEGFA gene overexpression, which is associated with the scenarios of "cytokine storm", platelet aggregation, vascular-interstitial inflammatory phenomena and asthenia. The combination of benz(a)pyrene + SARS-CoV-2 leads to overexpression of the transcription factor p53 in the case of the heterozygous CG variant of the TP53 rs1042522 gene, simultaneously in the case of its rare homozygous GG variant – to suppression of the expression of the onco-suppressor TP53 rs1042522 (marker hs1034249_m1).

Thus, the search and proof of the association of key alleles and genotypes with the pathology under study and the risk parameters for its realization under the given genetic scenario, the analysis (hypothesis) of the probable mechanism of pathology realization in the areas of competence of each polymorphism of the candidate gene, as well as the subsequent logistics of the formation of postgenome response modification features under these conditions represent a methodological basis for the development and substantiation of genetic markers of sensitivity of immune and nervous regulation disorders associated with exposure to chemical and biological exogenous factors.

Keywords: genomic transcriptomic technologies; immune and neural dysregulation; susceptibility markers; SARS; metals; benz(a)pyrene.

ASSESSMENT OF INDICATORS CONTROLLING APOPTOSIS IN THE ADULT POPULATION UNDER CONDITIONS OF EXCESSIVE ALUMINUM CONTENT IN BLOOD

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Disruption of the apoptosis control process caused by exposure to components of gas-dust emissions from the aluminum industry leads to shifts in homeostasis and is one of many factors contributing to the development of immune regulation imbalance.

The purpose of the work was to assess the features of cell death in the adult population of residential areas in the zone of influence of the components of emissions of an aluminum production enterprise.

The study group consisted of 47 people living in the zone of aerogenic exposure to emission sources of aluminum industry; the reference group consisted of 22 people living in a relatively clean area outside the zone of exposure to emission sources of industrial enterprises. The study included the use of chemical-analytical, and cytofluorimetric research methods.

We found that the aluminum content in blood of the subjects (study group) was 1.8 times higher than that of the reference group ($p < 0.05$). Cytofluorimetric analysis of membrane markers showed that in the observation group, CD95 receptor expression on lymphocytes was 2.5 times reduced and the number of Annexin V-FITC⁺7AAD cells was 3.4 times reduced relative to the values obtained in the adult population living outside the zone of exposure to the aluminum production enterprise ($p < 0.05$). Assessment of the odds ratio of changes in immunological tests with an increase in aluminum concentration in biological media allowed us to establish a significant decrease in CD95⁺ reception with an increase in aluminum concentration in urine ($R^2 = 0.23, p < 0.05$).

Thus, the results obtained indicate a violation of the perception of the apoptotic signal by an immunocompetent cell and a decrease in the realization of cell death by the mechanism of apoptosis in conditions of excessive aluminum content in biological media.

Keywords: gas and dust emissions from the aluminum industry; aluminum; immunoregulation; apoptosis; CD95 receptor.

EXPERIMENTAL PROKARYOTIC AND EUKARYOTIC MODELS FOR HYGIENIC REGULATION OF HUMAN ENVIRONMENTAL FACTORS

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The authors substantiate methodological and methodical approaches for the development and application in practice of experimental prokaryotic and eukaryotic models for hygienic regulation of environmental factors of human habitat, directions for the use of innovative test models in preventive medicine.

The study substantiated a set of short-term tests for *in vitro* evaluation of mutagenic and carcinogenic effects of chemical substances taking into account their genotoxic and non-genotoxic mechanisms of action.

The study also provided a rationale for eligibility criteria, comparative evaluation of predictive efficacy, sensitivity and specificity of tests to study carcinogenic activity of chemicals. It evaluated and defined *in vitro* testing strategies in the study of carcinogenicity of chemicals, and proposes biomarkers and criterion apparatus in tests for neoplastic cell transformation.

Keywords: prokaryotic and eukaryotic models; experimental modeling; “omics” concept.

RISK-BASED ASSESSMENT OF THE COMBINED ACTION OF CHEMICAL SUBSTANCES ON EXPOSURE MARKERS AND ADVERSE EFFECTS ASSOCIATION CRITERIA

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The assessment of the type of combined action of chemicals is a complex and urgent problem of hygiene and preventive medicine.

The purpose of this study is to expand methodological approaches to assessing the combined effect of chemicals based on the analysis of cause-effect relationships of exposure markers and adverse effects, taking into account the quantitative assessment of additional health risk. The methodological approach was tested for conditions of real chronic aerogenic exposure to benz(a)pyrene, significantly exceeding the reference concentrations (15.4 *Rfc*), aluminum oxide and hydrofluoride at the level of reference values (0.2–0.8 *Rfc*). We used the results of causal modeling based on previously conducted (in 2021–2022) medical examinations of 454 exposed and unexposed 4–7 year old children, as biomarkers of exposure and adverse effects. Depending on the binary combination of three chemicals and the choice of a biomarker of adverse effects (8 indicators), the study identified multiple variations of combined action (a total of 24 variations). An increase in the adverse effects was revealed for 10 of them. Synergetic character of action appeared predominant, causing additional to isolated risk of development of adverse effects from the immune, bone and nervous systems, exceeding the acceptable level up to 56.8 times.

Hygienic assessment practice should take into account the additional risk of adverse effects in more complex types of combined action (synergism, antagonism) than simple summation, which will improve the impartiality of hygienic assessment of the health risk of the exposed population.

Keywords: combined action; health risk; exposure markers; markers of adverse effects; aerogenic exposure.

OPTICAL METHODS AND HARDWARE-SOFTWARE TOOLS FOR COMPLEX *IN VIVO* MONITORING OF DANIO RERIO (ZEBRAFISH) ORGANISM

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Danio rerio (Zebrafish) are a valuable animal model for the research of the cardiovascular and muscular systems and the development of innovative methods for the treatment of disorders.

D. rerio have a two-chamber heart, and their blood vessels in structure and function significantly resemble those of humans. In the early stages of development, *D. rerio* embryos are optically transparent, which allows using optical methods to observe organogenesis, including the complex processes of heart and blood vessel formation and muscle development. Recording changes in the intensity of light passing through the sample allows for a quantitative assessment of hemodynamic characteristics and accurate mapping of blood vessels throughout the body, and monitoring the state of light polarization provides visualization of muscles and several other organs. In this study, we present an installation based on a microscope and a Polarsens sensor with a 4-directional integrated polarizer. It provides a combination of these two approaches and the possibility of conducting photoplethysmographic, videocapillaroscopic and cross-polarization studies at the same time. Successful testing of such a system on *D. rerio* larvae has proved its effectiveness for quantifying pathological reactions *in vivo* to various stressors in the cardiovascular system and skeletal muscle system.

Keywords: noninvasive diagnostics; optical methods; cardiovascular system; muscular system; visualization; zebrafish.

COMPARATIVE ASSESSMENT OF INDICATORS OF THE T-CELL IMMUNE PROFILE AND SPECIFIC HAPTENIC SENSITIZATION IN CHILDREN LIVING UNDER CONDITIONS OF EXTERNAL ENVIRONMENTAL EXPOSURE TO BENZ(A)PYRENE IN THE ARCTIC REGION AND IN THE MID-LATITUDE AREA

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The article includes a comparative assessment of the features of the T-cell immune profile and specific haptenic sensitization in children living under conditions of aerogenic exposure to benz(a)pyrene in the Arctic region and in the mid-latitude area. The level of blood contamination with benz(a)pyrene in children living under conditions of aerogenic exposure to benz(a)pyrene at an average daily dose of $7.11 \cdot 10^{-3}$ micrograms/(kg·day) in an urbanized area in the Arctic exceeds its value in children in the relatively clean territory of this region ($p < 0.05$) and is comparable with the value revealed in children living under the conditions of external environmental exposure to benz(a)pyrene at an average daily dose of $87.62 \cdot 10^{-3}$ micrograms/(kg·day) in the mid-latitude area. The immune profile of the child population of industrial centers in the Arctic and in the mid-latitude area is characterized by a decrease in the content of T-lymphocytes (CD3⁺) and T-helper cells (CD3⁺CD4⁺) against the background of IgG hyper production to benz(a)pyrene ($OR = 1.57-4.87$, $p < 0.05$), which indicates signs of oppression T-cell immune response and the formation of specific haptenic hypersensitivity under conditions of aerogenic exposure to benz(a)pyrene. The revealed changes in the immune profile (decrease in CD3⁺ and CD3⁺CD4⁺, increase in IgG to benz(a)pyrene) in children under conditions of aerogenic exposure to benz(a)pyrene at an average

daily dose of $7.11 \cdot 10^{-3}$ mcg/(kg·day) against the background of subarctic climatic conditions and altered photoperiodic regime in the Arctic are comparable with the values of these indicators in children under conditions of aerogenic exposure to benz(a)pyrene at an average daily dose of $87.62 \cdot 10^{-3}$ mcg/(kg·day) against the background of continental climatic conditions and circadian photoperiodicity in the territory of the middle latitude, confirming the hypothesis of modulating the immunotoxic effect of benz(a)pyrene by special climatic and photoperiodic conditions of the circumpolar territories.

Keywords: benz(a)pyrene; children; immune profile; specific sensitization; subarctic climate; photoperiodic asymmetry.

FEATURES OF ARTERIAL STIFFNESS IN YOUNG WOMEN UNDER THE CONDITIONS OF AEROGENIC INFLUENCE OF CHEMICAL FACTORS

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The aim of the study was to study the structural and functional characteristics of the carotid arteries in women living in the Far North under the influence of metals and suspended solids.

The study group consisted of 78 women living in the Far North in the zone of influence of metallurgical enterprises; the control group consisted of 20 women living in similar climatic conditions. The intima-media complex (IMC), elastic modules of Peterson (Ep) and Young (Ym) were evaluated by duplex scanning of brachiocephalic arteries. The researchers investigated cause-and-effect relationships of vascular disorders with the concentration of nickel, copper and chromium in the blood.

The thickness of the IMC in the study group was higher than in the control group (0.55 (95 % CI: 0.49–0.62) mm versus 0.46 (95 % CI: 0.45–0.5) mm; $p < 0.0001$). In the study group, Ep exceeded the indicators of the control group by 1.84 times, Ym – by 1.52 times. The relative risk of an increase in IMC reached 2.1 (95 % CI: 1.1–4.3). An increase in the probability of IMC thickening was revealed with an increase in the concentration of chromium in the blood ($R^2 = 0.10$; $p = 0.003$), an increase in the Ep values for copper ($R^2 = 0.15$; $p = 0.002$) and chromium ($R^2 = 0.19$; $p = 0.0002$), Ym values for copper ($R^2 = 0.39$; $p < 0.0001$).

In young women living under conditions of inhalation exposure to nickel, chromium, copper and suspended solids, an intensification of atherosclerotic and arteriosclerotic processes is observed, manifested by an increase in IMC, appearance of atherosclerotic plaques, and an increase in the stiffness of the common carotid artery. A causal relationship has been established between the concentration of copper and chromium in the blood and the probability of an increase in IMC, Ep and Ym. The revealed changes in the common carotid artery make it possible to classify young women living in the territory of environmental disadvantage to a higher category of cardiovascular risk.

Keywords: arterial stiffness; aerogenic pollutants; duplex scanning; common carotid artery; nickel; copper; chromium; suspended solids; cardiovascular risk.

THE RELATIONSHIP BETWEEN ANTHROPOMETRIC AND ULTRASOUND CHARACTERISTICS OF ADIPOSE TISSUE AND THE PREDICTED RISK OF CARDIOVASCULAR EVENTS IN YOUNG WOMEN

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The problem of assessing the effect of fat metabolism disorders on cardiovascular risk remains relevant.

The aim of the study was to investigate the association of abdominal adipose tissue characteristics with cardiovascular risk in young women.

Materials and methods. The study included 204 young women (36.4 ± 5.4 years). Body mass index (BMI), waist circumference (WC), as well as ultrasound criteria for adipose tissue thickness (thickness of subcutaneous adipose and preperitoneal adipose tissue, preperitoneal circumference) were evaluated, and cardiovascular risk was calculated.

Results. The assessment of the relationship between the criteria for assessing adipose tissue and lifelong cardiovascular risk showed statistical significance for all criteria with a coefficient of determination from 0.122 (for the thickness of preperitoneal adipose tissue) to 0.266 (for BMI). All criteria for the assessment of adipose tissue showed a comparable average quality of models for determining the upper quartile of cardiovascular risk.

Conclusion. All the studied anthropometric and ultrasonographic characteristics of adipose tissue in young women have a comparable effect on the estimated lifetime cardiovascular risk.

Keywords: obesity; ultrasound diagnostics; cardiovascular risk.

FEATURES OF THE IMMUNE STATUS OF WOMEN WITH EXCESS BODY WEIGHT UNDER CONDITIONS OF ALUMINUM CONTAMINATION IN BIOLOGICAL MEDIA

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The study presents the results of studying the characteristics of the immune status of women with excess body weight living in a large industrial center (study group) in relation to those living in a relatively clean area (reference group). The study found that overweight women (the study group) had an increased level of contamination of the biological media with aluminum, lower levels of phagocytic activity, CD subpopulations of immunocompetent cells CD16+56+ and CD19+, combined with multidirectional changes in the concentration of serum immunoglobulins – a decrease

in the expression of immunoglobulin G (IgG) and activation of the production of immunoglobulin A (IgA), an increase in the level of cytokine-producing activity according to the IL-6 criterion, as well as an increase in the content of fetal CEA protein (carcinoembryonic antigen).

Keywords: excess body weight; aluminum; immune status; phagocytic activity.

PROTEOMIC PROFILING OF RAT BLOOD PLASMA DURING COMBINED INHALATION EXPOSURE TO CHEMICALS AS A TOOL FOR PREDICTING PROBABLE ADVERSE EFFECTS IN HUMAN BEINGS

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Protein composition characterization of biological media is used to study the molecular response of an organism to existing environmental conditions and to predict potential adverse effects at the earliest stage of their formation. The aim of the study was to identify and evaluate changes in the proteomic profile of rat blood plasma during experimental combined inhalation exposure to chemicals to predict the adverse effects on critical human organs and systems (using nickel and chromium oxides as an example). The study involved chemical-analytical, statistical, proteomic, and bioinformatics analysis methods. The study determined functional characteristics of the identified proteins and peptides (class, localization, molecular functions, participation in the life cycle and biological processes). The obtained results of disease associations for the identified proteins and peptides in the experiment suggest the development of adverse effects, primarily from the digestive, nervous, urinary and cardiovascular systems in humans at increased intake of nickel and chromium.

Keywords: proteomic profile; experimental animals; nickel and chromium in blood; prediction of adverse effects; human health.

PECULIARITIES OF THE PROTEOMIC PROFILE OF BLOOD PLASMA UNDER CONDITIONS OF INHALATION EXPOSURE TO BENZ(A)PYRENE IN AN EXPERIMENT FOR PREDICTING ADVERSE EFFECTS IN HUMAN BEINGS

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The methods of proteomic analysis make it possible to predict the development of negative effects of critical human organs and systems at the earliest stages of their formation. When com-

bined with toxicological studies, this method allows extrapolating the changes in blood plasma proteins, revealed in the experiment on a biological model, to humans.

The purpose of this work is to identify the peculiarities of the proteomic profile of rat blood plasma during experimental inhalation exposure to benz(a)pyrene to predict negative effects on the part of critical human organs and systems. We modeled inhalation exposure to benz(a)pyrene corresponding to real conditions in an experiment on rats, studied the content of this substance in blood and conducted a comparative analysis of the proteomic profile of blood plasma of experimental and control groups. The results obtained in the experiment and processed by methods of statistical and bioinformatics analysis were extrapolated to humans.

We identified 10 proteins, the expression of which changes in different directions with increasing benz(a)pyrene content in blood. Using bioinformatics analysis, we found that increased benz(a)pyrene intake into the organism can cause an increase in the expression of proteins of lung, thymus, liver, and heart tissues. Human orthologous genes were identified. The identified proteins can be used as markers for adverse effects in humans. The results extend the theoretical understanding of the mechanisms of toxic effects of benz(a)pyrene.

Keywords: proteomic profile; biological model; benz(a)pyrene; bioinformatics analysis; adverse effects; human health.

ON THE ORGANIZATION OF A HEALTH-SAVING ENVIRONMENT IN INDOOR SPACES USING THE INTERNET OF THINGS TECHNOLOGY

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The study is devoted to the problem of creating a health-saving environment in indoor spaces, where a modern person spends more than 90 % of their time. This can be solved by ensuring that optimal parameters are maintained through the use of digital technology.

Experts of the Research Institute of Hygiene and Occupational Pathology has implemented the assembly of a biotechnical system for managing the internal environment of the indoor space based on the above technology. The development of algorithms for automated control of the system operation requires the collection of data on the dynamics of various air quality indicators during the year, in particular, temperature and relative humidity, which are among the main characteristics of the microclimate. Thus, the purpose of the study was to investigate the dynamics of temperature and relative humidity in a selected closed room during the year in the city of Nizhny Novgorod using data collection tools of a digital biotechnical system based on the technology of the “Internet of Things”. During the continuous annual observation with the help of sensors of the indoor environment control system, we revealed fluctuations of the studied indicators and periods of their exceeding the limits of optimal and permissible values.

Keywords: health-saving technologies; indoor space environment; temperature; humidity; digital technologies.

DETERMINATION OF ANTIMONY CONTENT IN BIOLOGICAL MEDIA BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY

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Antimony and its compounds belong to the 3rd class of hazard, have toxic, neurotoxic, allergic, carcinogenic effects, cause reproductive disorders, and have an accumulating effect. The content of these substances is monitored in air and water (SanPin 1.2.3685-21). Antimony determination is included in the list of clinical and diagnostic studies of health status of workers and population living in the areas exposed to hazardous facilities. It is advisable to measure antimony and its compounds in all areas with developed metallurgical and steel industries.

The level of antimony and its compounds in human biological media is the most significant exposure marker, an element of the evidence base for exposure. In this regard, it is necessary to use selective and highly sensitive methods for measuring antimony in biological media (blood, urine). The Russian methodological guideline MUK 4.1.1483-03 allows the determination of antimony in biological objects in the ranges from 0.1 to 1000 $\mu\text{g/l}$ by inductively coupled plasma mass spectrometry (ICP-MS). The limit of detection by this methodology does not allow the determination of antimony content at the reference level in blood and urine (0.01 $\mu\text{g/L}$).

The study presents brief analytical review of scientific and methodological literature on the use of the ISP-MS method for measuring antimony mass concentrations in biological media.

Keywords: antimony; blood; urine; sample preparation; inductively coupled plasma mass spectrometry.

DETERMINATION OF ACUTE TOXICITY PARAMETERS OF ZINC OXIDE NANOPARTICLES AT INHALATION EXPOSURE

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Due to the wide range of applications of zinc oxide nanoparticles (ZnO nanoparticles), the population exposed to inhalation of the nanomaterial is increasing. Due to this, research aimed at studying the parameters of the ZnO nanoparticles toxicity during inhalation exposure to the body is becoming particularly relevant. The purpose of this study is to determine the parameters of acute toxicity of ZnO nanoparticles during inhalation exposure.

Wistar rats were exposed to a single inhalation aerosol exposure of an aqueous suspension of ZnO nanoparticles at a concentration of 50 mg/m^3 for 4 hours. The study revealed that no

deterioration in the general condition and death of rats due to the toxic effects of the tested nanomaterial occurred. LD₅₀ for ZnO nanoparticles was > 50 mg/m³, which, in accordance with GOST 32646-2014, corresponds to hazard class 2 (highly hazardous substance). In this regard, it is necessary to conduct additional studies aimed at studying and clarifying the negative effects associated with inhaled exposure to low-frequency ZnO nanoparticles.

Keywords: zinc oxide; nanoparticles; microparticles; acute toxicity; inhalation exposure.

DETERMINATION OF THE PARAMETERS OF ACUTE TOXICITY OF ZINC OXIDE NANOPARTICLES UPON ORAL INGESTION

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The active use of zinc oxide nanoparticles (ZnO nanoparticles) in various spheres of human economic activity causes the penetration of nanomaterial into environment and, as a result, the exposure of the population. In this regard, studies aimed at studying the toxicity parameters of ZnO nanoparticles at various routes and duration of entry into the body are relevant. The purpose of this study is to determine the parameters of acute toxicity of ZnO nanoparticles when orally ingested. Wistar rats were exposed to a single oral exposure with an aqueous suspension of ZnO nanoparticles at a dose of 2000 mg/kg body weight. According to the results of the study, there is no visible deterioration in the general condition and death of animals caused by the toxic effect of the tested material. LD₅₀ ZnO nanoparticles was > 2000 mg/kg of body weight, which according to GOST 12.1.007-76 corresponds to hazard class 3 (moderately hazardous substance), GOST 32644-2014 – hazard class 5 (practically non-hazardous substance). In this regard, it is necessary to conduct additional studies aimed at studying and clarifying the adverse effects associated with oral exposure to ZnO nanoparticles.

Keywords: zinc oxide; nanoparticles; microparticles; acute toxicity; oral exposure.

NUMERICAL STUDY OF THE UNSTEADY AIR FLOW IN THE UPPER AND LOWER HUMAN AIRWAYS

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The study investigates unsteady air flow in the section of air-conducting ways from the entrance to the nasal cavity to the fifth generation of bronchi. The movement of air is described by the ratios of gas dynamics. The numerical solution was obtained using the

ANSYS CFX software product. The fields of air flow velocity in the airways at different time points are demonstrated.

Further development of the model involves the study of non-stationary multiphase flow of dusty air in the airways; forecasting the formation of diseases caused by the negative impact of inhalation environmental factors.

Keywords: mathematical model; respiratory system; airways; unsteady air flow.

ASSESSMENT OF MODIFICATION OF CELLULAR IMMUNITY CLUSTERS IN AN *IN VIVO* EXPERIMENT (ON THE EXAMPLE OF BENZ(A)PYRENE AND CGF)

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We performed a comparative evaluation of the features of innate and adaptive immunity in mice modified *in vivo* by benz(a)pyrene and Chlorella Growth Factor (CGF). The results of the experiment show benz(a)pyrene induced suppression of phagocytic activity, differentiation clusters and increase in mouse leukocyte and lymphocyte levels. Chlorella Growth Factor administration induced multidirectional changes in cell clusters; in general, the results of three weeks of CGF administration achieved the range of physiologic normality in the main quantitative and functional indicators of cell phenotypes (leukocytes, lymphocytes, phagocytic count).

Keywords: benz(a)pyrene; Chlorella Growth Factor; *in vivo*, phagocytosis; immunoregulation; clusters of differentiation.

Section VII

Health risks associated with exposure to biological factors (infectious diseases, antimicrobial resistance, etc.). Epidemiologic health risks and modifying factors

CYLINDROSPERMOPSIN CONTENT IN DRINKING WATER AND RECREATIONAL WATERS: ASSESSMENT OF EXPOSURE ON THE POPULATION

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The article presents the results of establishing the exposure dose on the exposed population due to the content of one of the priority cyanotoxins – cylindrospermopsin in drinking water, water from surface sources of drinking water supply and recreational waters. Studies of waters for the content of cylindrospermopsin were conducted by enzyme immunoassay using a commercial test system Cylindrospermopsin ELISA Kit manufactured by Eurofins Abraxis, USA. The results of the calculations, taking into account oral and transdermal administration, showed that the reference dose of cylindrospermopsin for oral administration was not exceeded for any route of administration under the worst-case scenario and cumulatively for the different age groups.

Keywords: drinking water; recreational water use; cyanobacteria; cylindrospermopsin; dose load.

ASSOCIATION OF COVID-19 EPIDEMIC PROCESS PARAMETERS WITH PRIORITY ENVIRONMENTAL FACTORS (ON THE EXAMPLE OF DELTA STRAIN)

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The study is devoted to establishing priority factors modifying variations in the course of the COVID-19 epidemic process in the regional aspect on the basis of its parameterization.

Materials and methods. The modifying factors included anti-epidemic measures, sanitary and epidemiological, social and demographic, economic, weather and climatic conditions, indicators of the health care system and lifestyle of the population of 85 regions of the Russian Federation for 2020–2021. The dynamics of the epidemic process (using the Delta strain of SARS-CoV-2 virus as an example) was modeled using the classical SIR model. We used the methods of correlation and

regression analysis to study the relationships between the parameters of the epidemic process model and the regional conditions modifying it.

Results. We determined that among the anti-epidemic measures, vaccination coverage of the population, especially in the age group of 31–40 years (r up to -0.37), has the highest significant positive effect on the reduction of the virus reproduction index (R_0). An increase in average monthly daily temperatures during the fall-winter period and for the year as a whole contributed to an increase in the rate of transition of susceptible individuals into the infected category ($r = 0.21–0.22$). From the group of sanitary-epidemiological indicators, non-normative working conditions (physical factors) and the quality of atmospheric air of residential areas significantly increased the rate of infection ($r = 0.29–0.24$).

In the territories with comparatively higher consumption of alcoholic beverages, the recovery time of the sick extended ($r = -0.32$).

Conclusions. The observed regional differentiation in the development of individual stages of the epidemic process of the spread of Delta strain COVID-19 is due to the complex interaction and influence of modifying factors that form a multicomponent system with the properties to transform the course of the epidemic process.

Keywords: COVID-19; SIR model; epidemic process; environmental factors.

ANTICOVIDAL POTENTIAL OF DONOR BLOOD PLASMA AND IMMUNOGLOBULIN PREPARATIONS FOLLOWING THE COVID-19 PANDEMIC

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The pandemic of the novel coronavirus infection has become a serious challenge to the health of the human population. Several approaches have been proposed to treat this infection. A separate direction is the development of preparations containing antibodies for both passive immunity and direct neutralization of SARS-CoV-2 virus. It is proposed to use specially created monoclonal antibodies, antibodies isolated from eggs of immunized chickens, nano-antibodies or antibodies obtained from the colostrum of vaccinated cows.

An undoubted achievement is the creation of a targeted preparation "Covid-globulin", prepared from blood plasma of recovered patients. However, its production requires constant availability of high-titer plasma. The study suggested that in some cases it is possible to use immunoglobulin preparations that contain an average set of population antibodies.

To confirm this hypothesis we studied the content of antibodies to SARS-CoV-2 coronavirus in donor plasma and commercial preparations of human immunoglobulin of different routes of administration in the period from 2018 to 2023. Antibodies to SARS-CoV-2 virus were detected in 53 % of donors starting in mid-2021, and in 2023, 97 % of donors already had antibodies.

In immunoglobulin preparations (gabriglobin, complex immunoglobulin preparation, Cypferon, nasal immunoglobulin) antibodies to SARS-CoV-2 virus were detected in series released in mid-2022. These data indicate the development of stable population immunity and the possibility of using immunoglobulin preparations of different routes of administration with averaged antibody titers to a wide range of pathogens, including SARS-CoV-2 virus.

Keywords: COVID-19; therapy; antibodies; immunoglobulin preparations; nasal agents.

SANITARY AND MICROBIOLOGICAL CHARACTERIZATION OF THE WATER OF THE LOWER DON RIVER AS AN INDICATOR OF POTENTIAL EPIDEMIC RISK. STATUS, TRENDS AND FORECAST

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We conducted a comprehensive analysis of sanitary and bacteriological indicators of the water of the Lower Don River within the city of Azov, Rostov region for the period 2005–2020 with the assessment of the potential microbial risk of epidemic spread of water-related infectious diseases.

The study considered the results of detection in river water of sanitary microorganisms (total, thermotolerant and glucose-positive coliform bacteria); potentially pathogenic microorganisms (*Klebsiella* and *Pseudomonas aeruginosa*) and pathogenic *Enterobacteriaceae* (*Salmonella*).

The study involved retrospective analysis of long-term and monthly dynamics of sanitary and bacteriological indicators, determination of correlations between them and comparative assessment of forecasting accuracy based on regression and neural network models.

The sanitary and bacteriological indicators of water in the study area of the Lower Don, according to the complex indicator of potential microbial risk of epidemic spread of water-related infectious diseases, were found to correspond to a very high level. Significant epidemic risk is confirmed by the high frequency of detection of salmonellae, as well as potentially pathogenic microorganisms – *Klebsiella* and *Pseudomonas aeruginosa* – in the samples examined.

Keywords: social and hygienic monitoring; sanitary and bacteriological indicators; microbial risk; epidemic danger; water-related infectious diseases.

ANALYSIS OF RISK FACTORS IN HEALTH CARE PERSONNEL DURING THE COVID-19 PANDEMIC

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The aim of the study was to analyze the risk factors affecting the incidence of COVID-19 in health care personnel during various periods of the pandemic.

We conducted a prospective cohort observational epidemiologic study. The sample consisted of 503 health care workers (doctors and mid-level health professionals) of a multidisciplinary medical institution. Statistical analysis was carried out using descriptive statistics using standard techniques. The tables of conjugacy, calculation of relative risk and odds ratio were used. The study determined statistical significance and differences in groups of qualitative variables at a statistical significance level of $p < 0.05$. Statistical analyses used the SPSS V20.0 program.

In the analyzed cohort, a positive test result for SARS-CoV-2 was obtained in 45 cases (9.0 %). For the majority of detected COVID-19 cases, the source of infection was not identified (33.3 %). The risk of infection for healthcare personnel was highest when exposed to a confirmed source in the family (Relative Risk = 2.08). Healthcare professionals working in direct contact with patients had a significant risk of infection (Relative Risk = 3.0). Re-vaccination did not have a significant effect on the incidence of COVID-19 in healthcare personnel. The presence of comorbid status in healthcare personnel significantly increased the risk of disease (Relative Risk = 9.85).

The study of the influence of risk factors on the incidence of COVID-19 helps to ensure the effectiveness of preventive and anti-epidemic measures reduces the likelihood of cross-infection within a medical institution and affects the preservation of the health of medical professionals and patients.

Keywords: COVID-19; epidemiological risks; morbidity; healthcare personnel.

INTERAGENCY COOPERATION IN THE ELIMINATION OF THE OUTBREAK OF HAFF DISEASE AMONG THE POPULATION OF THE TYUMEN REGION

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The problem of a rather rare disease of alimentary toxic paroxysmal myoglobinuria (often called Haff disease) remains topical for the Tyumen Region at the present stage. This disease of humans and animals (mammals, fish-eating birds, fish) occurs when consuming fish that has acquired toxic properties during its life in a water reservoir.

Currently, four lakes in the region remain vulnerable to Haff disease – Andreevskoye, Ishmenevskoye, Eichlykul, Izymetskoye, located in a remote area of the Tobolsk district.

This study analyzes the interagency activities, including hygienic activities, carried out in the region, aimed at preventing the occurrence and spread of alimentary toxic paroxysmal myoglobinuria among the population. Since the registration of the first cases of Haff disease in 2019, to date, constant monitoring of water bodies has been carried out in order to timely organize measures to prevent the occurrence of diseases among the population, laboratory studies of environmental media, fish with taking biological samples and work on health education and awareness.

Keywords: alimentary toxic paroxysmal myoglobinuria; Haff disease; lake; fish; outbreak of disease.

MICROBIOME IMBALANCE AND ITS IMPLICATIONS FOR GUT-BRAIN AXIS FUNCTIONING: AN ANALYSIS OF MENTAL HEALTH ISSUES

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Studies of the intestinal microflora have significant potential for practical application in the prevention and diagnosis of psychological disorders. In particular, such studies may be useful in the treatment of multiple sclerosis, depressive states and anxiety. Unique areas of analysis related to the biomolecular foundations of communication in the gut-brain axis include the search for biomarkers, individualization of treatment, development of new drugs, as well as disease prevention and symptom mitigation

The microbiome inhabiting the human gastrointestinal tract consists of a huge number of microorganisms. It plays an important role in the body by producing effector molecules that interact with the nervous system through the communication network of the enteric and central nervous systems. The microbiome is able to modulate the nervous system by producing neurotransmitters, which is important for the health of human cognitive, motor, emotional and mental functions.

However, an imbalance in the microbiome can lead to a decrease in neurotransmitter levels and contribute to the development of anxiety, depression, sleep disorders and appetite. In addition, the microbiota of intestinal microglia regulates the permeability of the endothelium. Impaired barrier function due to dysbiosis can lead to an increase in the content of inflammatory factors in the blood, which causes inflammation of microglia in the brain and impaired neuronal transmission.

Studying the composition of microorganisms inhabiting the intestine can be useful for identifying disease risks and monitoring disease progression. Such research can contribute to the development of strategies to prevent mental disorders, especially among people at risk.

The practical application of microbiome imbalance research in the context of mental health is still not fully understood, and new research is needed to better understand the mechanisms underlying the interaction between the microbiome, gut, and brain.

Keywords: microbiome; gut-brain; dysbiosis; multiple sclerosis; depression; anxiety.

PRACTICAL SIGNIFICANCE OF TESTING PROTECTIVE EFFECTIVENESS OF COMPLEX BIOLOGICAL SAFETY ENGINEERING SYSTEMS WHEN WORKING WITH MICROORGANISMS OF PATHOGENICITY GROUPS I–IV IN LABORATORIES OF VARIOUS LEVELS OF BIOLOGICAL PROTECTION

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The materials are presented based on 40 years of experience in the operation of a biologically hazardous facility, as well as 10 years of experience in testing biological safety engineering systems using engineering methods in laboratories of various levels of protection. The issues concerning recommended approaches to the procedure for evaluating the effectiveness of protective properties and characteristics of special engineering systems (enclosing building structures, ventilation, boxing structures) in laboratories of level 1–4 of biological safety are considered. The work determines the stages of research, the scope of work and includes the assessment of critically important operational characteristics of engineering systems for efficiency. The researchers focus on the need to follow a certain algorithm, observe the order of stages and composition of works, which allow to collect an information array of statistical data for an objective assessment of the characteristics of isolating, localizing and boxing systems, structures and devices, which are necessary, both as independent positions and in a complex. Mandatory tests are carried out for a comprehensive assessment of the effectiveness of the protection of biological safety engineering systems, including each individual unit, regardless of the level of protection of the laboratory. The work expresses the need for the development and manufacture of standard modular ventilation chambers for rectangular and coil-type air purification filters for work with pathogenic biological agents, which can significantly affect the safety of the air basin in the area of biologically hazardous facilities. Furthermore, the design issues of filter chamber placement require special attention, which is essential in terms of their monitoring capabilities and replacement.

Keywords: biosafety engineering systems; biosafety levels; operational efficiency; assessment.

Section VIII

Methodological support of control and monitoring of human environment safety

EXPERIENCE OF ESTABLISHING SANITARY PROTECTION ZONES IN THE REPUBLIC OF BASHKORTOSTAN

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This article considers the essence, main tasks, and problems of establishing sanitary protection zones on the territory of the Republic of Bashkortostan.

The study revealed the most acute issues, accentuated the decisions to establish sanitary protection zones, and developed proposals to improve the sanitary protection zone projects for consideration.

Keywords: sanitary protection zone; zone with special conditions of territories use.

MODERN METHODOLOGICAL SUPPORT FOR THE DETERMINATION OF SULFONAMIDES IN AQUEOUS MEDIA

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Sulfonamides are a group of synthetic antibiotics derived from sulfonamide (streptocide). Sulfonamides are widely used in medicine and veterinary medicine for the treatment of infectious diseases. The use of sulfonamides results in large amounts of sulfonamides entering the environment through inadequately treated wastewater and unused waste. Contamination of water reservoirs with sulfonamides endangers human health. To control pollution of water bodies, it is necessary to develop modern methods for analyzing trace amounts of sulfonamides. We conducted a literature review on the methods of analysis of antibacterial drugs of the sulfonamide group in aqueous media over a period of 5 years. The currently proposed analytical approaches to the detection of sulfonamides are mainly based on high-performance liquid chromatography with tandem mass spectrometric detection (HPLC-MS/MS). The priority method of sample preparation is the method of solid-phase extraction.

Keywords: sulfonamides; aqueous media; sample preparation; high-performance liquid chromatography.

REGARDING THE TOXICITY OF SUBMICRON PARTICLES (PM₁)

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Suspended solids are one of the main pollutants of atmospheric air. The most dangerous of them are fine fractions of suspended particles, especially PM₁. However, in Russia the content of PM₁ in atmospheric air is not standardized. The article offers a review of foreign and domestic scientific literature on the toxicity of submicron particles PM₁. We analyzed a total of 26 sources within the analyzed period of five years.

One of the main risk factors for public health is air pollution. One of the main pollutants of atmospheric air is suspended solids, comprising many primary and secondary components containing various substances. Micron-range particles are particularly dangerous, since they can remain suspended in the air for a long time and be transported over long distances. In the last decade, fine particles in the atmospheric air have been associated with adverse effects on public health. PM₁ (particles of 1 micron or less in size) have a higher surface area to volume ratio compared to particles of other sizes, which affects their physical and chemical properties and, ultimately, their ability to penetrate deep into the lungs.

Following the Russian sanitary regulations and standards SanPiN 1.2.3685-21, the content of suspended particles of 2.5 microns (PM_{2.5}) and 10 microns (PM₁₀) in the atmospheric air of populated areas is standardized at maximum single, average daily and average annual maximum permissible concentrations. At the same time, the content of PM₁ particles in atmospheric air is not regulated, despite existing studies confirming their toxicity and prevalence in atmospheric air.

Keywords: fine fractions; PM₁; atmospheric air; health effects.

DEVELOPMENT OF METROLOGICALLY CERTIFIED METHODS FOR MEASURING THE LEVEL OF MIGRATION, EXPRESSED IN MASS CONCENTRATION UNITS, INTO THE AIR OF VINYL ACETATE CONTAINED IN PRODUCTS MADE OF TEXTILE MATERIALS AND POLYMERS BASED ON IT

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The researchers have developed a technique for measuring the mass concentration of vinyl acetate released into the air from textile products and vinyl acetate-based polymers using a gas chromatography method combined with thermal desorption extraction. Sampling was performed by

aspiration of a certain volume of air through two sorption tubes with a volume flow rate of $100 \text{ cm}^3/\text{min}$ for 25 min. After thermal desorption at 250°C , the sample was analyzed by gas chromatography with flame ionization detection. The substance was determined by retention time and quantified by absolute calibration. Recovery of vinyl acetate in air medium was 94.6 % in the concentration range $0.075\text{--}0.300 \text{ mg}/\text{m}^3$ (at sampling 2.5 dm^3 of air), and the relative expanded uncertainty of the measurement procedure was 24.0 % in the whole measurement range. The limit of quantitative determination of mass concentration of vinyl acetate in air from consumer goods was $0.032 \text{ mg}/\text{m}^3$.

Keywords: vinyl acetate; confined air analysis; analytical method; gas chromatography; thermodesorption.

MONITORING THE CONTENT OF POTENTIALLY DANGEROUS HIGHLY TOXIC COMPOUNDS IN DRINKING WATER

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According to WHO, drinking water is one of the risk factors of human health disorders. The formed level of anthropogenic pollution is one of the main reasons causing deterioration of water quality of surface and underground water bodies used as sources of drinking water.

To treat wastewater and ensure high quality of drinking water, reagent methods (flocculation water treatment) are used at water treatment plants. Universal synthetic flocculants based on acrylonitrile (hypane) are used for this purpose. Efficient flocculants of K series (K-4, K-6, K-9, etc.) containing nitrile, amide and carboxyl groups in different ratios were obtained by incomplete saponification of polyacrylonitrile with various reagents. K series flocculants are widely used in oil and gas industry, hydrometallurgy for industrial wastewater treatment.

Methods for controlling the level of acrylonitrile content in aqueous media should provide the results of analysis with high accuracy, reliability and correctness for the possibility of their comparison by different laboratories. Determination of nitrogen-containing organic compounds in aqueous media at the level of hygienic standards is a challenging analytical task. It is necessary to apply high-tech, informative modern methods of analysis such as gas chromatography-mass spectrometry and gas chromatography.

The existing methods of determination of acrylonitrile in water do not meet the requirements of SanPiN 1.2.3685-21.

In this connection, for chemical-analytical control of acrylonitrile content in water bodies it is necessary to develop a highly sensitive and selective method of determination.

Keywords: acrylonitrile; gas chromatography (GC); drinking water; vapor-phase analysis; completeness of extraction.

ON THE PROBLEM OF STATE MONITORING AND REGULATION OF THE TREATMENT OF CERTAIN TYPES OF WASTE IN ORDER TO PREVENT ENVIRONMENTAL POLLUTION BY PHARMACEUTICAL PRODUCTS

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The study is dedicated to the problem of organization of state monitoring and regulation of handling of certain types of waste in the city of Taganrog, Rostov region to prevent the risk of environmental pollution by expired pharmaceutical products.

We have conducted a comparative analysis of regulatory legal acts covering the circulation of production and consumption waste, including medical waste.

We have assessed the organization of measures in relation to pharmaceutical products that are medical waste and have lost their consumer properties, including those with expired shelf life, in healthcare institutions of the city of Taganrog, Rostov region.

Keywords: medical waste; pharmaceutical products; pharmacologic activity; environment contamination; antibiotic resistance.

TO THE TASKS OF INTEGRATING DATA FROM SOCIAL AND HYGIENIC AND ENVIRONMENTAL MONITORING SYSTEMS IN ASSESSING THE QUALITY AND SAFETY OF THE LIVING ENVIRONMENT

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The study deals with the issues of data integration of environmental and social and hygienic monitoring systems at the regional (Rostov region) and municipal (Taganrog city) levels. The article reviews the peculiarities of social and hygienic and environmental monitoring with an assessment of the current state of organization of interdepartmental information-analytical interaction.

We have identified the main problems of activity organization, which determines the high relevance of the development of a set of optimization measures within the framework of

implementation of the “Concept of development of the system of social and hygienic monitoring in the Russian Federation for the period until 2030”.

Keywords: social and hygienic monitoring; environmental monitoring; risk factors; atmospheric pollution; anthropogenic technogenic load; information and analytical support.

ON THE NECESSITY TO CREATE A UNIFIED INFORMATION SYSTEM FOR CONTROL AND MONITORING OF ELECTROMAGNETIC RADIATION ON THE TERRITORY OF PERM CITY

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Nowadays, mobile communication systems, digital television and radio broadcasting have become widespread. Electromagnetic fields of the radio frequency range belong to harmful types of radiation, and experts assess their impact on the population as significant. There are no data on the electromagnetic situation in the territory controlled by the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being, or on the influence of objects on each other. It is necessary to develop an electromagnetic environment monitoring system.

Keywords: radioelectronic devices; electromagnetic radiation; sanitary protection zone; information system; restriction zone.

METHODOLOGICAL SUPPORT OF MODERN ANALYTICAL CONTROL OF HABITAT POLLUTANTS IN THE SYSTEM OF SOCIAL AND HYGIENIC MONITORING

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In solving the problems of health protection, prevention and reduction of morbidity, ensuring sanitary and epidemiological well-being of the population, studying cause-and-effect relationships in the system “environment-health of the population”, the need to improve the system of laboratory support of state sanitary and epidemiological supervision over the safety of environmental objects is becoming increasingly relevant.

The most essential system-forming indicator of sanitary and epidemiological well-being of the country is the state of public health, which is considered as a criterion of environmental quality.

Improving the efficiency and effectiveness of supervision activities in the field of consumer protection and human well-being includes the introduction of a methodology for assessing and managing the risks of exposure to chemicals that pollute the environment; improving the effectiveness of supervision of compliance with sanitary and epidemiological rules and hygienic standards on the basis of modern information technologies, field and laboratory observations; intensification of scientific research in the field of ensuring sanitary and epidemiological well-being. All this is covered in the "Concept of Development of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being".

At the present stage, the role and importance of unbiased methods of qualitative and quantitative assessment of unfavorable factors (chemical, biological and physical) of the environment on the human body and the state of public health will significantly increase.

The introduction of high-tech, precision methods of control, development of priority methods of screening analysis as a prerequisite for effective sanitary and hygienic research is promising in terms of methodology. The methodological approach to the analysis of non-invasive biological materials for the purpose of biomedical monitoring in the development of one of the directions of prenosological diagnostics is equally significant.

All of the above was the basis for the present study and determined its purpose.

Keywords: atmospheric air; biological media; food products; modern methods; chemical analysis; sample preparation.

METHODOLOGY FOR DETERMINATION OF MASS CONCENTRATION OF SELENIUM IN EGGS USING INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY TECHNIQUE

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The object of the study – chicken eggs enriched with selenium in the process of rearing and feeding of laying hens with food and water with the addition of food additives containing selenium.

The aim of this study is to develop a method for the determination of selenium in eggs based on the inductively coupled plasma atomic emission method. The method for determination of selenium content in eggs using ICP-OES is based on the measurement of atomic emission of this element after autoclave mineralization of samples in the environment of concentrated nitric acid and hydrogen peroxide.

The researchers developed the method of selenium determination in eggs characterized by high sensitivity (0.1 mg/kg) and metrological characteristics (repeatability limit 23.8 %, intermediate precision 26.2 %, expanded uncertainty 36.6 %).

Keywords: selenium; eggs; inductively coupled plasma atomic emission spectrometry; measurement technique; ICP-OES.

DEVELOPMENT OF A LIST OF PRIORITY SUBSTANCES FOR TERRITORIES SERVICED BY THE RUSSIAN FEDERAL MEDICAL AND BIOLOGICAL AGENCY

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The study presents direct and indirect indicators (criteria) of chemical risk for the selection of the nomenclature of priority toxins in the human environment. Development of the list of priority substances for the territories serviced by the Russian Federal Medical and Biological Agency included several stages. The final list of priority chemicals is determined based on the results of pollutant ranking, taking into account their gross emissions into atmosphere, indices of comparative carcinogenic and non-carcinogenic hazards, results of analysis of chemicals in environmental objects based on the principle of samples of unknown composition and biomonitoring of the population.

Keywords: priority chemicals; habitat; sample of unknown composition; biomonitoring.

HEALTH RISK CRITERIA IN THE ASSESSMENT OF VIOLATIONS OF SANITARY AND EPIDEMIOLOGICAL REQUIREMENTS IN THE PROVISION OF MEDICAL SERVICES

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The reform of the system of state regulation, including sanitary legislation, is currently underway in the Russian Federation. However, not all proposals to the sanitary regulations consider health risk criteria. The aim of the study was to assess the health risk of violating sanitary and epidemiologic requirements (SER) in the provision of medical services to the population.

We analyzed the domestic and foreign experience in the development of SER to the services provided to the consumer. The study summarized the practical experience of work of the Federal Service for Consumer Rights Protection and Human Well-Being in the Perm Territory after the introduction of the new sanitary rules and the experience of work on the remarks received

within the framework of public discussion of the draft of amendments and additions to the sanitary rules. The review included more than 150 remarks and proposals of various agencies and business associations and 650 documents executed in the course of control and supervisory activities. We applied the method of logistic regression to establish cause-and-effect relationships between the indicators.

The study established that in a particular territory, when analyzing violations of SER in medical organizations, risk levels ranged from $2.1 \cdot 10^{-6}$ up to $8.3 \cdot 10^{-5}$. The obtained risk levels made it possible to conclude that the planning and implementation of the activities of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being ensures a stable sanitary and epidemiological situation in a particular territory. At the same time, the health risk from SER violations detected at specific facilities does not exceed the acceptable level and does not allow the risk of harm to health to reach an unacceptable level.

Keywords: sanitary and epidemiological requirements; health risk assessment; medical services to the population.

COMPARATIVE ASSESSMENT OF THE RESULTS OF THE STUDY OF METHODS OF BLOOD SAMPLE PREPARATION FOR CHEMICAL ANALYSIS OF N-NITROSODIMETHYLAMINE

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Sample preparation is an important stage in sample analysis, in the process of which the analyzed compounds are separated as much as possible from the complex composition of the sample matrix of biological media. In the course of research on the development of a method for preparing blood samples for chemical analysis of N-nitrosodimethylamine (NDMA), we used the solid-phase extraction method (TFE) and the QuChERS method. At the first stage of the study, we selected various parameters for effective extraction using the QuChERS method: buffer salts, solvents and pH of the medium. At the second stage of the study, we developed an optimal scheme using the TFE method, taking into account the effect of the solvent on the elution process and the presence of a salting reagent. All studies were performed on a matrix with a standard NDMA sample. We found that the completeness of NDMA extraction using a standard blood sample was achieved for TFE 98 % and for the QuChERS method 91.8 %.

Keywords: gas chromatography; chromatate-mass spectrometry; solid-phase extraction; QuChERS method; blood sample.

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