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MODELING OF LOCAL CONDITIONS FOR THE DISPERSION OF POLLUTANTS IN URBAN AREAS

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Abstract:
Studies of air quality in urban areas show that human health is affected by pollutants emitted by various sources or resulting from chemical reactions between exhaust gases and the atmosphere. This leads to the need to quickly obtain practical solutions about emissions and their corresponding pollution levels. Assessment of the state of the air basin is carried out in two directions: field observations and mathematical modeling. The most effective method for solving this problem is the combined use of measurement techniques and models that describe the distribution of impurities. Mathematical models that integrate knowledge about the emissions and dispersion of pollutants in the atmosphere are essential tools not only for estimating existing pollution levels, but also for predicting, for example, future air quality trends or identifying emission reduction strategies.The development of atmospheric models is carried out mainly in two directions. The first is to develop a theory of atmospheric diffusion. The models are based on the description of physical and chemical processes: calculation of emissions, atmospheric advection and dispersion, chemical transformation and deposition. This direction is more universal, since it allows one to study the distribution of impurities from sources of various types under different environmental characteristics. Another direction is associated mainly with the empirical-statistical analysis of the distribution of pollutants in the atmosphere and with the use for this purpose of interpolation models, mostly of the Gaussian type. Many currently existing atmospheric diffusion models that describe the transport and dispersion of pollutants in the city's atmosphere cannot be used to quickly predict pollution levels, since they require a significant amount of time to perform calculations.
The conducted studies show that statistical models, based, for example, on time series analysis, have significant limitations for use in air pollution modeling problems in cases where the main source is emissions from motor vehicles. The advantage of these schemes is the development of a formal apparatus, relative ease of implementation, and the possibility of effective use within automated air pollution control systems. But since such models use measurements in certain types of canyons, they are influenced by local scattering conditions. Therefore, the justification of models developed in this way is not high enough. Currently, the factor

of chemical pollution of the environment is one of the priority risk factors for public health and a factor that largely determines the level of sanitary and epidemiological well-being of the population. The growing chemical pollution of the environment, especially atmospheric air, combined with a decrease in the intensity of supervision over its parameters by Rospotrebnadzor institutions, creates a direct threat to the deterioration of public health.Ambient air pollution is one of the most serious environmental factors affecting the health of everyone in low-, middle- and high-income countries.In 2019, ambient (outdoor air) pollution in both urban and rural areas was estimated to cause 4.2 million premature deaths worldwide; this mortality is due to exposure to fine particulate matter, which leads to the development of cardiovascular, respiratory and cancer diseases. WHO estimates that in 2019, about 37% of premature deaths associated with air pollution occurred as a result of coronary heart disease and stroke, 18% and 23% as a result of chronic obstructive pulmonary disease and acute lower respiratory tract infections, respectively, and 11% - as a result of cancer of the respiratory tract.People living in low- and middle-income countries bear a disproportionate burden of disease caused by outdoor air pollution: these areas account for 89% of cases (of the 4.2 million premature deaths). The highest disease burden is found in the WHO South-East Asia and Western Pacific regions. Recent estimates of the burden of disease indicate a major role of air pollution in the development of cardiovascular diseases, including fatalities.

The study of the dependence of changes in the health status of the population under the influence of chemical environmental factors is of particular importance for large cities, where high morbidity and mortality rates remain (7). Ambient air pollution killed an estimated 4.2 million people prematurely in 2016 (9). Scientists estimate that in 2016, 286,000 children under 15 years of age died as a result of exposure to hazardous levels of air pollution (2). It is known that the main sources of air pollution in cities are thermal power plants, industrial enterprises, boiler houses, vehicles, and home furnaces (2). The creation of powerful industrial complexes leads to a significant concentration of sources of emissions of toxic substances, to the formation of multi-component pollution, which can spread over tens of kilometers, be accompanied by the appearance of specific odors, and lead to a decrease in the transparency of the atmosphere. All this causes a deterioration in the sanitary and hygienic living conditions of the population and its health indicators (8).

Purpose of the study:

To study the sources of air pollution and the health status of the population.

Research method

An integrated approach to the study was applied, including the theory of dispersion of harmful substances in the atmospheric air, the theory of artificial neural networks, analytical methods for calculating emissions of harmful substances into the atmosphere and statistical data analysis.

Results and their discussions

The medical-ecological approach to substantiating preventive measures involves taking into account a wide range of factors involved in shaping the health of the population (3). This approach involves zoning the territory, which is based on the regional characteristics of the cause-and-effect relationships between the health status of the population and the factors that determine it (1). A specific analysis of cause-and-effect relationships allows us to assess the specifics of the regional situation, determine the conditions for the occurrence of the most common diseases, identify the most important environmental factors for health, and develop appropriate health measures.

Recognizing the gravity and urgency of the problem, all WHO Member States endorsed resolution A68.8, Health and the environment: addressing the health impacts of air pollution, at the 2015 World Health Assembly, complemented by a road map for action the following year. WHO, as the coordinating body for international health, supports countries in protecting public health through evidence-based policies and actions. Given the significant health burden and the many potential benefits of action, WHO supports countries by providing evidence, building institutional capacity and using health advocacy to mobilize cross-sectoral efforts to combat air pollution. It should be taken into account that over the past decades, the structure of atmospheric air pollution has changed significantly, and in large cities, industrial and energy enterprises as the leading sources of chemical pollution of the environment have been replaced by motor vehicles, which make the main up to 95% “contribution” to the level of chemical pollution. atmospheric air pollution (4): This phenomenon is typical for many regions of the country, including the territory of the Krasnodar Territory. Dedicated to the influence of chemical air pollution on the health status of the population. numerous works by hygienists (7). At the same time, of particular interest are works that study the impact of air pollution on the health of children and adolescents, the most sensitive and defenseless group of the population, whose health largely determines the future health and survival of the nation (8). However, the problem of long-term exposure to chemical pollution on the processes of developing the health of children and

adolescents is multidimensional and has its own regional characteristics. (3). Atmospheric air pollution occurs for various reasons, both anthropogenic and natural. The reasons are different in urban and rural areas. In urban areas conditions, the main source of pollution is the burning of fossil fuels for energy, transport, domestic cooking, heating and waste burning.In rural communities of LMIC countries, the main source of pollution is the burning of kerosene, biomass and coal in the cooking process at home, for heating and lighting, burning of agricultural waste, and some types of agricultural and forestry work (5). These processes generate a complex mixture of pollutants that can react with each other, usually carbon monoxide (CO), nitrogen oxides (NOx) , lead, arsenic, mercury, sulfur dioxide (SO2), polycyclic aromatic hydrocarbons (PAHs) and fine particles (PM). The latter is distinguished by the fact that it affects more people than all other pollutants, and is therefore usually used as a rough indicator of air pollution in a broad sense. Addressing air pollution issues is a top priority for governments and multidisciplinary agencies around the world. There are many reliable ways to reduce the emissions of hazardous pollutants, including cleaner transport, cooking methods, technologies and heating fuels, energy efficient homes and urban planning, low- or no-emission energy production, safer and cleaner industrial technologies and improvement of methods for processing urban waste (7). At the same time, of particular interest are works that study the impact of air pollution on the health of children and adolescents, the most sensitive and defenseless group of the population, whose health largely determines the future health and survival of the nation (8). However, the problem of long-term exposure to chemical pollution on the processes of developing the health of children and adolescents is multidimensional and has its own regional characteristics. (3). Atmospheric air pollution occurs for various reasons, both anthropogenic and natural. The reasons are different in urban and rural areas. In urban areas conditions, the main source of pollution is the burning of fossil fuels for energy, transport, domestic cooking, heating and waste burning.In rural communities of LMIC countries, the main source of pollution is the burning of kerosene, biomass and coal in the cooking process at home, for heating and lighting, burning of agricultural waste, and some types of agricultural and forestry work (5). These processes generate a complex mixture of pollutants that can react with each other, usually carbon monoxide (CO), nitrogen oxides (NOx) , lead, arsenic, mercury, sulfur dioxide (SO2), polycyclic aromatic hydrocarbons (PAHs) and fine particles (PM). The latter is distinguished by the fact that it affects more people than all other pollutants, and is therefore usually used as a rough indicator of air pollution in a broad sense. Addressing air pollution issues is a top priority for governments and

multidisciplinary agencies around the world. There are many reliable ways to reduce the emissions of hazardous pollutants, including cleaner transport, cooking methods, technologies and heating fuels, energy efficient homes and urban planning, low- or no-emission energy production, safer and cleaner industrial technologies and improvement of methods for processing urban waste (7). WHO air quality guidelines (5) provide recommended thresholds and limits for major air pollutants that should be met to protect health.

Conclusions:

A large number of short-term and long-term epidemiological studies consistently show that exposure to particulate air is associated with an increased risk of premature death from pneumocardial disease [3]. Pneumocardiac diseases account for most of this increased mortality. The association between air pollution and increased mortality persisted even after adjusting for individual risk factors, including smoking, gender, body mass index, education, occupation, hypertension and diabetes. The most consistent relationship was established for elevated levels of pollutants such as dust particles less than 2.5 microns in size and sulfates. The environmental policy of our country is aimed at making a transition from the protection of individual elements of nature to the overall protection of ecosystems, guaranteeing optimal parameters of the human environment. The implementation of such environmental policy should become one of the conditions for sustainable development of society [4].

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