

## THE SYSTEM OF OBJECTIVE ASSESSMENT OF THE MEDICAL AND ENVIRONMENTAL SITUATION IN THE AREAS FACING DISEASE RISKS FOR THE PURPOSES OF FUTURE MONITORING

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*In order to determine the cause-and-effect relationship between hazardous factors and public health at the factories specializing in disposal of missiles and destruction of chemical weapons, it is suggested to carry out a comprehensive study of public health status and conduct a targeted monitoring study at the enterprises and in areas of increased man-made hazards. The study includes medical and geography, population clinical and epidemiological; screening (considering the growing pathology) and in-depth etiopathogenetical researches. While carrying out the studies in Russia and Kazakhstan it has been detected, that the levels of the prevalence of diseases of the circulatory system, mental disorders, diseases of the nervous and digestive systems of the personnel working on the facilities for disposal of chemical weapons, is lower than in the population living in the protective action zones. Chronic nonspecific lung diseases occur 4.2 times more frequently in the staff occupied on a dangerous technical facility than in the working-age population of the protective action zones, what may be associated with working environment.*

*The groups of persons with an increased risk of diseases are distinguished during prophylactic examinations of the working contingent and population living in the areas that are close to a dangerous object. The groups are further to be examined, and if necessary, cured in a specialized clinic.*

**Key words:** chemical weapon destruction, medical-ecological situation, health risks.

Introduction. Current interest to the assessment of medical and environmental situation in the areas associated with the rocket-and-space industry determines the necessity of improvement of the theoretical and practical approaches to health assessment in the spheres of industrial and environmental medicine [5, 13, 15]. Health studies carried out in the areas of different environmental, climate and geographical, ethnic and cultural conditions are the key for forecasting health changes in different population groups. Industrial medicine, healthcare and economy are in great need of a comprehensive health assessment methodology that could be used to identify the basic research

principles of and approaches to the implementation of the state programs on medical, environmental, social, psychological and psychiatric protection of the employees and the general public residing in the areas of potential environmental stress [1, 2, 4-13, 16]. This is determined by the growth of hazardous factors affecting public health and the complexity of identifying the individual role of each factor in the deterioration of somatic and mental health as well as by the need for a comprehensive assessment of somatic, psychological, and social health [4, 5, 9, 16].

It is important to study the cause-and-

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effect relationship between the environmental factors and public health because of the growing incidence of environmental diseases in the areas of imbalanced environmental situation and occupational diseases in emergency employees. It must be stressed that the changes in the somatic and mental health and behavior are also caused by psychological stress determined by the socio-psychological and socio-economic factors as well by the place of residence – areas with industrial enterprises that bring harm to public health and the environment [6, 11-13].

The purpose of the study is to develop a framework for the objective assessment of the medical and environmental situation in the areas facing disease risks for the purposes of future monitoring.

**Materials, methods and results.** A comprehensive clinical and epidemiological study of public health was conducted in Russia and Kazakhstan involving the population residing in close proximity to the sites that carry industry-related hazards.

We used a system approach in order to determine the cause-and-effect relationships based on a comprehensive clinical and epidemiological assessment and clinical and statistical analysis of health of the employees and the general public. Assessment of endogenous and exogenous factors that impact the state of health can serve as the basis of the development of a global concept of how to maintain and improve public health in Russia.

The main point underlying the concept is the development of theoretical and methodological principles behind the medical health studies among the employees and the general public; development of the scientific foundation and recommendations on preserving the somatic, psychological and social health for the purposes of improving the health of the nation in general; development of recommendations on preventive services with the account for the priority medical criteria and forecasts; development of the scientific basis for the future medical studies of the consequences of primary deterioration of the psychological and somatic health in employees under exposure to hazardous factors and in the general public residing in the areas with unfavorable environment. The use of a system approach that helps determine the nature of an environmental pathology in the comprehensive diagnostics of the psychological and somatic health of people residing in the areas of presence of potentially harmful enterprises must include the following: differentiation of the factors that cause

somatic and psychological disorders and the factors that impact pre-existing psychological and somatic diseases; identification of various factors and triggers that cause the same somatic and psychological diseases; quantification of the role of specific factors that become active in different industrial, environmental and socio-economic conditions that determine the specificity or the lack thereof in the development of psychological and (or) somatic disorders, distinguishing the specificity only for certain conditions; identification of inherited somatic and psychological disorders as well as disorders associated with a stressful impact of the environment (socio-psychological, socio-economic, environmental, etc.).

The concept of comprehensive programs that we have developed and implemented is aimed at preserving the health of the employees and the general public residing and working in close proximity to the enterprises that bear industry-related hazards and includes the following components: carrying out scientific studies on the fundamental medico-social and medico-psychological aspects of the health of the employees and the general public; justification and selection of the state programs aimed at predicting the health situation, preserving and improving the state of health of the selected groups of employees and the general public; identification of the pathogenic and sanitary factors in some nosological forms of pathologies; scientific justification of the activities aimed at developing, maintaining, and preserving health, development of the activities aimed at social and medicobiological prevention of various forms of pathologies as well as use of a special type of monitoring and methods of comprehensive assessment of ‘risk factors’; development of integrated information systems (Health Registers) for the assessment of individual and population somatic, psychological and social health of the employees and the general public; determination of the indicators and criteria in regards to specific industries, areas, climate zones, and ethnic groups.

In order to determine the cause-and-effect relationship, it is necessary to use the methodology of comprehensive medical evaluation based on the evaluation of different study methods for the assessment of the state of and change in health, in other words, “human-environment” system. The research framework that we used includes field and experimental studies such as: medico-geographic, clinic-epidemiological; screening (with the account

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for growing pathology); in-depth etiopathogenetic studies.

From the practical point of view, determination of the cause-and-effect relationships is carried out within a comprehensive medical evaluation in the following way: organization and implementation in the experimental conditions of a comprehensive health evaluation among the employees and the general public residing in the areas of possible negative environmental impact; implementation of regular health examinations among the employees in order to identify the “risk groups” who will be further referred to specialized clinic for thorough medical examination; clinic-psychological and psychosomatic evaluation of the employees and the adult/child population residing in the areas under study including data processing and analysis; specialized medical examinations of the adult and child population residing in the areas of potential industrial hazard, etc.; collection of the raw information about the death rate among the adult and child population residing in the above areas including data processing and analysis; collection of the raw information about the incidence of disabilities among the adult and child population residing in the above areas including data processing and analysis; collection of raw information about the morbidity (somatic and psychological diseases) among adult and child population; collection of raw information about the number of ambulance call-outs; collection of raw information about the demographic situation in the area including data collection and analysis; clinic-epidemiological analysis of the medico-statistical indicators of health of the employees and the general public by regions and towns (demographic indicators, disease rate, disability rate, etc.); assessment of the medico-biological indicators that characterize the changes in health in “risk groups” (including the results of sampling in-depth clinical studies); organization and carrying out of the biochemical, physiological, cytogenetic, embryologic etc. studies involving subject matter experts; analysis of the cause-and-effect relationships within the “human-environment” framework with the use of the developed methodology of a comprehensive medical evaluation of the situation and current information technologies.

In trying to determine the cause-and-effect relationships between the factors, the main challenges faced by the areas with potentially hazardous enterprises include the following: for each nosological form, to determine a threshold level for a

disease which in the future will be used as a critical reference point; clinic-statistical analysis and evaluation of the disease and death rates of various population groups (adults, children, etc.) residing in different territories; to determine indicative nosological groups of diseases for each territory; to determine higher risk groups among the employees and the general public under exposure to hazardous environmental factors; to conduct additional special psychophysiological, clinic-instrumental, biochemical and immunological studies; to develop clinic-psychopathological and clinic-physiological criteria for early diagnosis of an occupational disease.

In order to maintain a health register of workers and the general public residing in the areas of potential industrial hazard, it is necessary to do the following: collect, systematize and store information in electronic databases about the state of health of workers and the general public residing in the areas of potential industrial hazard; create electronic databases on the state of health of workers; maintain a health register of the general public residing in the areas of potential environmental hazard associated with the rocket-and-space industry taking into account the course of a disease, results of additional medical examinations and identification of hazardous risk factors; control of the timeliness and completeness of regular medical examinations to maintain the electronic health register; analysis of the obtained medical information and comparison of the obtained indicators with the reference health indicators; organization of medical control over the accuracy of health report forms and transferring of the obtained information to the main center for the purposes of health monitoring; regular health monitoring of higher risk groups conducted by the Federal Medical and Biological Agency of Russia in the areas of potential industrial hazard and making decisions regarding referrals to specialized clinics; developing relationships with the local healthcare authorities and making joint decisions regarding health protection concerning the employees in the event of emergencies or industrial accidents.

A series of studies aimed at protecting the state of health under exposure to hazardous environmental factors conducted over the period of 50 years by the Scientific Research Institute of Human Hygiene, Occupational Pathology and Ecology under the Federal Medical and Biological Agency of Russia can serve as an example that shows the efficiency of the suggested framework for a comprehensive evaluation of health of the

employees and the general public residing and working in the areas adjacent to the high-risk industrial enterprises.

For example, only in recent years the Institute has carried out extensive medical and environmental studies as part of the seven Russian federal programs developed for the areas of storage and destruction of chemical weapons and the space industry: a comprehensive assessment of the physical and mental health of the employees at enterprises specializing in the development, testing and operation of the rocket and space technology; a comprehensive assessment of the state of physical and mental health of the employees at enterprises specializing in utilization of space rocketry and rocket fuel components (RFC); a comprehensive assessment of the state of physical and mental health of the persons who had previously worked at the space enterprises; medical and environmental support of the activities within the international program "Assessing the impact of launches of carrier rockets from Baikonur on human health and the environment"; development of a system to establish and analyze the causes and methods of preclinical diagnosis for early detection and examination of medical and environmental situation in the region and some areas specializing in the space industry; development and support of informative parameters of the new psychophysiological equipment and testing it in clinical

and field conditions; study of the prevalence and clinical features of somatic, borderline mental disorders and psychosomatic disorders in the employees working with the rocket fuel components; development of databases on the health registers of the employees working with the rocket fuel components or at the rocket and space recycling facilities, development of information and analytical support, maintaining the health registers; development of databases on the health registers of the employees working at the chemical weapons destruction enterprises and the general public residing in the adjacent areas.

The analysis of the somatic diagnosis in employees of the chemical weapon destruction enterprises showed that the most prevalent pathology is circulatory system diseases as shown in Table 1 below. Of the circulatory diseases, the most prevalent was CAD: it was registered in more than half of the employees; in women it was registered more frequently than in man, in older employees – more frequently than in younger employees. Other frequent circulatory system diseases included idiopathic hypertension. It is noteworthy, however, that the prevalence rate of the circulatory diseases among the residents of the areas with regular protective activities (APA) was higher than among the workers of the chemical weapon destruction enterprises.

Table 1

Prevalence of diseases in the workers of CWD enterprises and the employable residents of APA detected during a medical check (per 100 persons)

Final Diagnosis	Workers of CWD enterprises			Residents of APA		
	Men	Women	Total	Men	Women	Total
1. Diseases of the blood, the endocrine system and metabolism	12.5	34.8	20.6	6.0	24.9	20.4
Inducing anemia					5.5	4.2
thyroid disease		4.3	1.6		10.6	8.1
diabetes				1.5	1.4	1.4
obesity	12.5	30.5	19.0	4.5	9.2	7.8
2. Mental disorders and diseases of the nervous system	17.5		11.1	19.4	24.0	22.9
3. Diseases of the eye and ear		4.3	1.6	3.0	2.8	2.8

4. Diseases of the circulatory system	17.5	47.8	28.6	38.8	34.1	35.2
Including idiopathic hypertension	5.0	21.7	11.1	22.4	24.0	23.6
CAD	12.5	26.1	17.5	14.9	5.5	7.1
Rheumatism					3.7	2.8
5. Respiratory diseases	20.0	17.4	19.0	14.9	14.7	14.8
Including COPD	17.5	17.4	17.5	12.0	3.2	4.2
Bronchial allergy					0.9	0.7
6. Digestive tract diseases	20.0	34.8	25.4	59.7	50.7	52.8
Including chronic gastritis	10.0	26.1	15.9	28.4	26.7	27.1
peptic ulcer	5.0		3.2	10.4	2.3	4.2
liver disease	5.0		3.2	1.5	18.4	14.4
7. Diseases of the skin and subcutaneous tissue				1.5	1.4	1.4
8. Diseases of the musculoskeletal system	10.0	8.7	9.5	10.4	4.6	6.0
9. Diseases of the genitourinary system	5.0	17.4	9.5	7.5	36.9	29.9
Other diseases		4.3	1.6	7.5	11.1	10.2
No diseases	35.0	21.7	30.2	11.9	14.7	14.1

Digestive tract diseases take the second place in the list of pathologies detected among the employees of CWD enterprises, among them – chronic gastritis. The level of prevalence of the digestive tract diseases in the employees of CWD enterprises is 2.1 times lower as compared to the general population of the region.

The third place in the list of detected pathologies is held by the diseases of the endocrine system and deficiency diseases including different levels of obesity. Then, in terms of frequency, are respiratory diseases represented mainly by chronic non-specific lung diseases. The number of chronic non-specific lung disease cases is 4.2 times higher in the employees of CWD enterprises as compared to employable population of APA – probably due to the labor conditions (requirement to wear individual protective equipment at all times or occasionally).

As a result of the medical examination, two people with massive rhythm disturbance were referred to emergency hospital admission, and one person was offered a planned medical stay at an occupational pathology center at the Institute of Human Hygiene, Occupational Pathology and Ecology with the following diagnosis: suspected chronic occupational intoxication.

When conducting a health assessment study in the area of potential environmental exposure, it is reasonable to use the following algorithm: a comprehensive study of the level of “background” health among the adult and child population (main group and comparison group) using relevant mathematical and statistical data processing methods for the subsequent assessment of all the changes by diseases classes; monitoring the state of public health in the areas of possible exposure to hazardous industrial factors for timely detection of disease disorders and identification of the clinical and pathological mechanisms of disease development; a comprehensive assessment and analysis of changes in the state of public health in the areas of possible exposure to hazardous industrial factors using the “dose-effect” relationship; a comprehensive assessment of public health in the areas of possible exposure to hazardous industrial factors using a special scheme and organization of medical observations of higher risk groups; carrying out an expert assessment on the relationship between a disease and the operations of an industrial enterprise using a specially developed program that includes admission to a specialized hospital at the Institute; maintaining health registers for the public residing and working in the areas of possible exposure to hazardous industrial factors; an expert report on the

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relationship between the diseases and the environment in the areas of possible exposure to hazardous industrial factors at a specialized clinic at the Institute.

A higher risk group is formed during a medical examination of the employees working with RFC or involved in rocket and space equipment utilization as well as the residents of the adjacent areas. The groups have to go through an examination and, if necessary, a course of treatment at a specialized clinic. As a rule, such groups include the following patients: patients with suspected chronic or acute RFC intoxication; patients with chronic intoxication or those who have recently experienced acute RFC intoxication and are currently under medical supervision; patients with pre-nosological conditions and working with RFC or involved in rocket and space equipment utilization; patients with chronic lung diseases, lung diseases, and diseases of the nervous system, precancerous state or cancer.

Conclusion. A comprehensive assessment of the somatic and mental health helps identify the risk groups, differentiate from the groups who do not contact with toxic chemical substance, and determine the cause-and-effect relationships. Moreover, potential emergency situations at the enterprises cause changes in the state of health that illustrate the cause-and-effect relationships.

Consequently, in order to determine the cause-and-effect relationships between the hazardous factors and public health, it is necessary to use the organizational, research and clinical potential of the specialists from specialized institutes of the Federal Medical and Biological Agency of Russia that conduct a comprehensive study of the background state of health and a specialized monitoring study of the employees at the enterprises of high industry hazard as well as the residents of the areas adjacent to the enterprises of high industry hazard, as well as other factors.

Here it is quite helpful to use the studies focusing on the assessment of the background state of health among the residents of the areas adjacent to the enterprises of rocket weapon utilization and chemical weapon destruction.

As a result of rational planning and material input, the specialists of the Institute managed to conduct an objective health assessment among the general population and the employees of the enterprises of chemical weapon destruction in five different regions of Russia, develop an objective monitoring framework that allows monitoring of the impact of chemical factors on the state of health of residents living in the areas under study, as well as relieve social and psychological distress of the public.

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