

RISK ASSESSMENT PRACTICE IN HYGIENIC AND EPIDEMIOLOGICAL STUDIES

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METHODICAL APPROACHES TO MANAGING RISKS FOR ENDOCRINE DISEASES EVOLVEMENT IN CHILDREN RELATED TO IMPACTS OF ENVIRONMENTAL FACTORS OCCURRING ON AREAS AIMED FOR DEVELOPMENT

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It is vital to develop systems of preventing risk-associated pathology due to constantly high levels of endocrine diseases in children exposed to chemicals with trophic effects on endocrine system (lead, cadmium, manganese, chromium, nickel, benzene, phenol, formaldehyde, benzpyrene, chlorine-organic compounds, and nitrates). Applying risk management techniques is one of the most promising trends in prevention of diseases related to environmental impacts. We offer methodical approaches based on system combination of activities at various management levels aimed at improving risk-oriented model of surveillance and control. These approaches enable allowing for detected trophic risk factors in regional social-hygienic monitoring programs, implementing algorithms of case monitoring over exposed children population, and applying contemporary prevention technologies.

Social-hygienic monitoring improvement at territorial level implies stricter control and more comprehensive lists of monitored components. This can be achieved by studying compounds which form risks for endocrine system, by working out scientific-methodological grounds for accounting chemical compounds which are trophic for endocrine system, as well as by refining volumes and contents of scheduled inspections performed at high risks objects together with laboratory examination of chemical compounds including those trophic for endocrine system. Local level includes algorithms and schemes of prevention activities aimed at early detection of endocrine disorders related to chemicals impacts. When we give grounds for personified technologies of endocrine diseases prevention (alimentary disorders, physical retardation and obesity related to impacts exerted by chemicals which are trophic for endocrine system) we should remember that individual programs choice is based not only on their capacity to eliminate priority compounds determining total chemical load on a person faster but also on possibility to correct basic pathophysiological and pathomorphological disorders.

Key words: *prevention system, endocrine system diseases, social-hygienic monitoring, surveillance and control, sanitary-epidemiologic wellbeing, chemical compounds with trophic impacts on endocrine system, prevention technologies.*

Negative influence exerted by environmental risk factors on population health as well as prevention of diseases related to it are a challenging task; searching for ways to solve it is a leading trend in contemporary prevention medicine [1, 8, 9, 15, 16, 19]. Over the last years attention of the international scientific community has been focused on steady growth in en-

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endocrine pathology all over the world, especially in economically developed countries [16–18]. In the RF, population morbidity in terms of endocrine system diseases, nutrition disorders, and metabolic disorders on urbanized areas aimed for development is 1.2–1.5 higher than in rural areas [3, 6]. There is growth in such diseases as obesity, pancreatic diabetes, and thyroid gland pathology both among adults and children living on territories with high industrial and technological potential; one can say it now looks like a true non-infectious epidemics [5, 9–14].

The State Report issued by Federal Service for Surveillance over Consumer Rights Protection and Human Well-being which is entitled "On sanitary-epidemiologic welfare of the RF population in 2014–2016" contains data on risk-associated endocrine pathology involvement on territories where environment quality is unsatisfactory as per sanitary-chemical parameters [1].

But still, if we wish to develop a unified system for preventing endocrine diseases which are associated with environmental factors impacts we need to solve certain tasks on improving social-hygienic monitoring programs, hygienic assessment, risk identification and quantitative parameterization; we should make them more concrete; we should also develop a risk-oriented model of surveillance activities [2, 4, 7]. Preventive activities programs and programs of dynamic monitoring over exposed children health are often created without allowing for risks caused by adverse impacts of environmental factors; such programs are to be adjusted. All the above-stated determined the relevance of our research and gave grounds for setting goals of this work.

Our research goal was to lower risks of environmentally-associated endocrine diseases involvement in children living in areas aimed for development.

The existing level of children morbidity with endocrine diseases associated with negative impacts exerted by environmental factors requires targeted complex scientifically

grounded solutions aimed at lowering impacts risks and at creation of new system approaches to prevention of associated endocrine pathology on territories with poor sanitary and hygienic situation.

Primary prevention of endocrine diseases associated with environmental factors on territories where risk of health disorders involvement in adults and/or children is considered to be unacceptable requires the following actions:

1) to identify basic sources of environment contamination with priority chemicals which endanger population health;

2) to create and stepwise implement activities aimed at lowering emissions (discharges) of hazardous admixtures to levels which make for population health risks becoming acceptable;

3) to adjust programs of ecological and social-hygienic monitoring and industrial surveillance allowing for assessing effectiveness of implemented activities (Figure 1).

On federal level, such approaches imply fixation of health risk parameters as population safety criteria in legal regulations (for example, safety can be determined as unacceptable risk absence in definitions set forth by the Federal Law No.52 dated March 30, 1999 "On sanitary and epidemiologic welfare of the population"¹). Introduction of health risk criteria into ecological standardization system is another important step. It means setting standards for permissible emissions and discharges for juridical persons and private entrepreneurs as per health risk criteria. The existing system of permissible emission and discharges standardization is oriented at the mildest hygienic standards which are fixed for only short-term impacts on people; therefore, it doesn't provide full safety of population living under multi-component chronic exposure. Standardized fixation of risk criteria will require reliable account of danger and threats sources.

It is vital to completely identify and inspect sources of environmental contamination with chemical which are trophic for the endocrine system, first of all, on those territories where endocrine system morbidity is persis-

¹ Collection of the Russian Federation laws. – 1999. – No. 14, p. 1650; 2011; No. 30, p. 4596; 2013, No. 27, p. 3477; No.48, p. 6165.

tently high; it is also vital for settlements which are enlisted by Federal Service for Hydrometeorology and Environmental Monitoring and social-hygienic monitoring as cities with the highest frequency of such admixtures occurrence. They are Chelyabinsk, Barnaul, Bratsk, Kemerovo, Lesosibirsk, Magnitogorsk,

Novokuznetsk, etc., where, for example, concentrations of aromatic hydrocarbons, benzpyrene, metals, chlorine and its organic compounds reached levels equal to 40 MPC in 2015-2016. An economic entity itself is responsible for such inspections but they can and should be initiated by surveillance authorities.

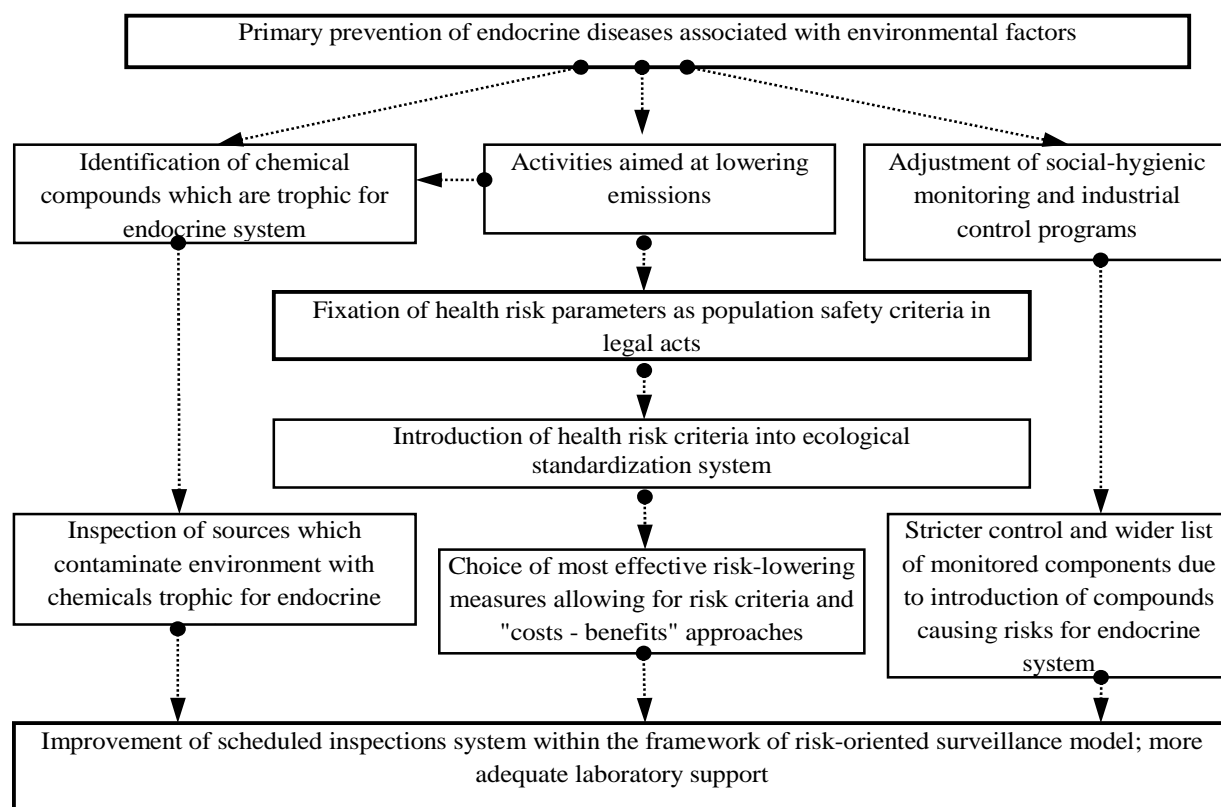


Figure 1. Basic elements in managing risks of endocrine diseases associated with environmental factors in living in areas aimed for development

After risk sources have been detected, creation and stepwise implementation of activities aimed at lowering emissions include several stages: consolidated admixture dispersion (mixing - diluting) calculation → integration of calculation results with vector cartographic information which allows to assess influence zones and number of people who are exposed to emissions → assessment of share contribution made by various economic entities and determination of contamination levels and health risks → choice of most effective measures aimed at lowering emissions allowing for "costs - benefits" approaches → implementation of chosen measures. It is this chain of actions which will help to achieve de-

sirable results in terms of minimizing threats for population.

But still situation with emissions and discharges is to be permanently monitored by economic entities themselves and surveillance authorities. The latter is provided by systematic observation in social-hygienic monitoring system and here experts observe the level of priority chemical admixtures and endocrine diseases associated with environmental factors on areas aimed for development.

Instrumental examination points within social-hygienic monitoring activities are to be chosen correctly; they are to be located in zones influenced by surveillance objects with these admixtures in their emissions. It will allow to

view social-hygienic monitoring as a surveillance activity without any direct interaction with juridical persons or private entrepreneurs. Detected violations, if any, can be used as grounds for unscheduled surveillance inspections and/or for applying certain administrative measures.

Scheduled inspection system within risk-oriented surveillance model is improved through more adequate laboratory support for such inspections. When inspections take place at objects which have a big share of chemicals

trophic for endocrine system in their emissions, discharges, and wastes, laboratory support in such cases can focus on concentrations of most dangerous admixtures in environmental objects (lead, cadmium, manganese, chromium, nickel, benzene, phenol, formaldehyde, benzpyrene in air at the boundary of a sanitary-hygienic zone and in the nearest housing or chloroform and nitrates concentrations in water coming from treatment facilities of water intake stations and distribution networks).

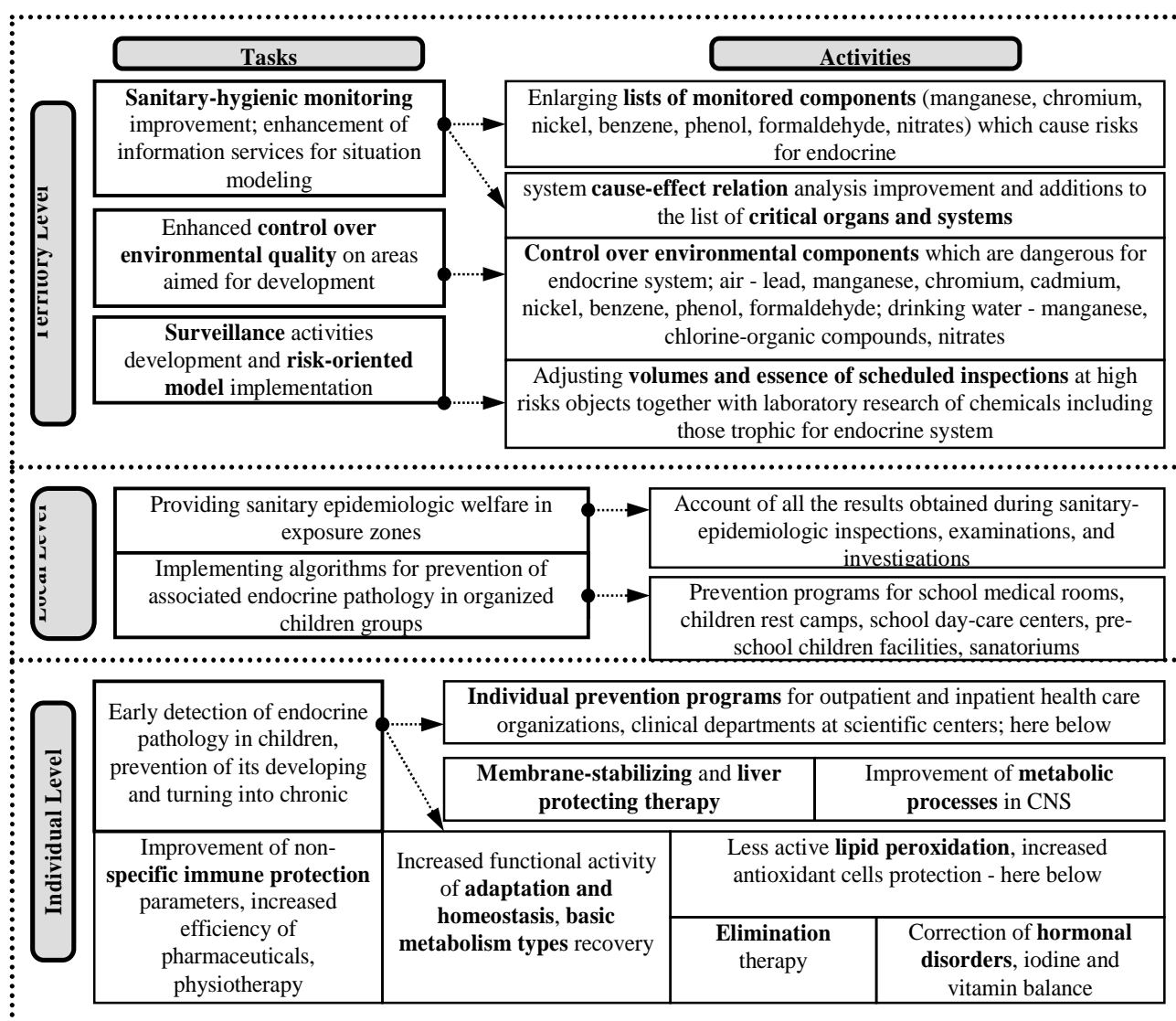


Figure 2. Organizational and functional model for managing risks of endocrine diseases associated with environmental factors in children living on territories aimed for development

The suggested prevention system is based on social-hygienic monitoring platform which is a united state structure created for observing population health and environment; it includes three levels of preventive activities implementation (Figure 2).

Local level of social-hygienic monitoring improvement means stricter control and wider list of monitored components due to introduction of compounds (manganese, chromium, nickel, benzene, phenol, formaldehyde, and nitrates) which cause risks for endocrine system and other systems which are pathogenetically bound to it.

Improved procedure for determining and analyzing cause-effect relations between impacts exerted by environmental factors and associated endocrine pathology allows for preparation of scientifically grounded standards and sanitary requirements via situational modeling. Risk assessment methodology application implies analyzing correlations in "environment - health" system and it will help to detect reasons and conditions of associated endocrine diseases evolvement in children.

The system allows to structure risks; to assess contribution made by specific trophic factors into total risk; to highlight priorities; to detect areas (zones or districts) with highest health risks; to predict negative or positive changes in population health via analyzing trends in environment quality changes.

Sanitary-hygienic monitoring modernization is hardly possible without conjugation of social-hygienic monitoring system and risk-oriented surveillance activity; such conjugation increases analytical capabilities of both systems substantially. Surveillance activity advancement and risk-oriented model implementation implies creating scientific and methodological grounds for account of chemicals trophic for endocrine system. It will necessarily involve adjusting volumes and content of scheduled inspections at high risk objects and laboratory examination of chemicals including those trophic for endocrine system. And here choice of examination points and programs should eventually provide obtaining reliable and convincing results which, notably, indicate:

- threats of causing harm to people's lives and health;

- objects which form threats of causing harm to people's lives and health (if there is such a threat).

Quality parameters of environmental objects which are trophic for endocrine system should be analyzed in dynamics in zones influenced by surveillance objects with various danger categories and we should also analyze changes in children health; it will make for decrease in associated endocrine pathology. We assume it will be possible to detect cause-effect relations within "risk factors - environmental quality - population health" system as per results of social-hygienic monitoring and surveillance activities; it will also help to perform "Rospotrebnadzor activities - environmental quality - population health" conjugated analysis. The suggested approach will allow to assess surveillance activities efficiency as well as to work out certain recommendations for external participants in the process of managing environment and population health, namely, for municipal authorities, enterprises and organization, and civil society.

Sanitary-epidemiologic welfare provision in exposure zones on a local level involves development of a system for proving and registering cases of doing harm to children's lives and health with the use of the results obtained earlier during sanitary-epidemiologic inspections, examinations, and investigations. To solve such a task, social and hygienic monitoring authorities should both perform their basic function of creating a database comprising evidences of cause-effect relation existence in "environment - health" system, and a new one of detecting a source of a threat.

Local level involves prevention activities aimed at early detection of endocrine disorders associated with impacts exerted by chemicals including:

- diagnostics if there are or there are no signs of insufficient nutrition, physical retardation, excessive body mass and obesity, on territories where air and drinking water supply quality is unsatisfactory as per sanitary-chemical

parameters (manganese, lead, nickel, chromium, cadmium, and chloroform are detected in concentrations higher than 1 MPC) and where there are moderate/high risks of endocrine pathology involvement in children;

" for children who have signs of physical retardation, excessive or insufficient body mass: chemical and analytical examination of biological media (blood and urine) to detect manganese, lead, chromium, nickel, cadmium, and chloroform concentrations;

" if increased concentrations (more than 1RL) of manganese, lead, nickel, chromium, cadmium, or chloroform, are detected in blood, the following examinations are to be performed: electrocardiography, ultrasonic examination of thyroid gland and gastrointestinal tract, X-ray study of hands, together with a set of laboratory diagnostics including detecting free thyroxine, TSH, IGF-1, hydrocortisone, serotonin, glutamate, and γ -aminobutyric acid, for children with insufficient nutrition; heart rate assessment, ultrasonic examination of thyroid gland and adrenals, together with a set of laboratory diagnostics including detecting crude cholesterol, LDL, HDL, dextrose, C-peptide, leptin, free thyroxine, TSH, anti-bodies to thyroid peroxidase, hydrocortisone, serotonin, glutamate, and γ -aminobutyric acid, for children with excessive nutrition and obesity.

If the obtained results correspond to criteria of insufficient nutrition, physical retardation, excessive body mass and obesity associated with impacts exerted by manganese, lead, nickel, chromium, cadmium, and chloroform for more than 80%, specialized medical-preventive activities are to be organized on individual and group level in children health centers, sanatoriums, and medical rooms at children educational facilities.

Implementation of specialized prevention programs on territories where sanitary and hygienic conditions are unsatisfactory can be based on:

" results of hygienic and medical-biological studies performed within sanitary-epidemiologic inspections, investigations, and examinations, as well as results of social and hygienic monitoring of environment and popula-

tion health including detection of unacceptable risk levels in terms of impacts exerted on population health by environment-polluting chemicals;

" complaints of citizens, private entrepreneurs, juridical persons, state and local authorities, on harm to people's lives and health, as well as on threats of harm to people's lives and health;

" the results of regular medical check-ups of children.

When we give grounds for personified programs aimed at preventing endocrine diseases associated with impacts exerted by chemicals which are trophic for endocrine system, our basic tasks and technology trends are:

– prenatal prevention of associated endocrine pathology which should stimulate greater functional activity of adaptation and homeostasis;

– recurrences prevention, recovery of adaptation and homeostasis functional activity, increase in functional resistance of critical organs and systems;

– diagnostics and prevention of chronic endocrine diseases, pathogenetic correction of adaptation and homeostasis functional activity, recovery of critical organs and systems morphofunctional resistance;

– prevention of complications and disability, correction of pathogenetic mechanisms underlying associated pathology involvement, correction of enzymatic disorders in cellular and sub-cellular structures of target organs, recovery of basic metabolism types and maintenance of adaptation and homeostasis functional activity.

When we give grounds for personified technologies for endocrine diseases prevention (nutrition disorders, physical retardation, and obesity, associated with impacts exerted by chemicals which are trophic for endocrine system), our choice on individual programs is determined not only by their capability to promptly eliminate priority compounds which form total individual chemical load, but also by possibility to correct basic pathophysiological and pathomorphologic disorders in target organs. Here we can mention improvement in neuro-vegetative regulation, functional and

metabolic processes in CNS (including nootropic, antiaggregant, and antioxidant effects of hopantenic and γ -aminobutyric drugs); membrane-stabilizing and liver-protecting technologies (with the use of phospholipids, glycyrrhizin acid, and phytocholeretics); basic metabolic types normalization, oxidative and antioxidant processes balance (less active lipid peroxidation, higher cells antioxidant protection, acid-base balance recovery on system, cellular, and sub-cellular levels); stimulation of immunologic protection and non-specific reactivity factors; recovery of organs and systems adaptation reserves and hormonal homeostasis; improvement in membrane-cellular and organ mechanisms for biological transformation and elimination of chemicals and their metabolites (sorbptive technologies with the use of polydimethylsiloxane, polyhydrate, lignin, and lactulose).

Early detection and prophylaxis of associated endocrine pathology in children makes for prevention of its developing and becoming chronic; it allows to decrease mediated pathology in adults (obesity, pancreatic diabetes, and primary hypertension).

So, we suggest methodological approaches which will help to efficiently manage risks of

endocrine diseases associated with impacts by environmental factors evolvement in children living on territories aimed for development. Such approaches are based on system combination of activities on various management levels in improvement of risk-oriented surveillance model, on account of detected trophic risk factors in regional social-hygienic monitoring programs, on implementation of dynamic observation over exposed children, and on up-to-date preventive technologies.

The suggested organizational-functional model for managing risks of endocrine diseases associated with impacts by environmental factors evolvement in children living on territories aimed for development was tested in 4 RF regions. It appeared to be highly efficient and economically justified. The priority territories included those with most unfavorable sanitary-hygienic parameters of air as per lead, manganese, nickel, chromium, and cadmium content (Kirovskiy district of Perm and Kungur), and of water in terms of chlorine organic compounds contents (Krasnokamsk and Nytva), nitrates contents (Sylva settlement), benzene, phenol, formaldehyde, and benzpyrene contents (Nizhniy Tagil in Yekaterinburg region).

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