

RISK MANAGEMENT. RISK COMMUNICATION

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TO ESTIMATION OF HEALTH RISKS OF WORKERS DURING CLASSIFICATION OF OBJECTS OF SANITARY AND EPIDEMIOLOGICAL SURVEILLANCE AND PLANNING OF STATE CONTROL (BY THE EXAMPLE OF MOSCOW)

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When estimating of health risks of workers for planning tasks of audits of compliance with health legislation on facilities of Moscow, it is found that most often non-compliances with requirements for working conditions are registered in industrial enterprises, among other, on wood-shaving material production facilities; air and water transport facilities, and in a number of communication facilities. The most serious consequences of breach of statutory requirements for working conditions are typical for activity in the sphere of motor transport and industrial production. It is defined by the structure of the types of deterioration of health among which there are traumas, diseases of a cardiovascular and nervous system. Analysis of more than 35.5 thousand facilities of sanitary and epidemiological supervision showed that the highest levels of health risks for workers are formed on industrial facilities (the risks are classified as "average", "significant" and "high"), in construction («significant» or «moderate»), on a number of manufacturing activities and in energy engineering. For the mentioned facilities the risks to workers can define the main class of an object based on the risk of infliction of harm, in general, the audits must be based on profound analysis of working conditions and include a complete complex of laboratory researches. When checking of legal entities and individual entrepreneurs, carrying out such kinds of activity as chain retailing, provision of services health care, education, etc., the highest risks are formed for consumers of goods and services. On these facilities the control in the sphere of occupational hygiene can occupy a smaller share in a total volume of a scheduled activity. Relevant direction of further perfection of the risk-based surveillance is formation of an exhaustive list of the statutory requirements for working conditions with differentiation of these requirements on levels of severity of negative consequences of their non-compliance.

Key words: risk-based surveillance, occupational hygiene, types of activity, occupational diseases, industrial facilities, Moscow

Implementation of risk-oriented approach into the RF executive bodies' activities is an integral part of the reforms which the public management system is now undergoing; it is also a very important condition of the economic growth [4,5,7]. And here risk analysis methodology is applied in most developed countries in the world in practically all spheres of surveillance over economic activities, starting from banking sector and up to industries [1,2,13-16,18-21], including surveillance in the sphere of sanitary and epidemiologic welfare provision [3,9]. Legal and methodical grounds of risk-oriented surveillance are constantly being modernized; it often happens due to political declarations made by governmental bodies and calling for more efficient policy which will allow assessing various risks systematically and reacting to

them in a most adequate way in order to minimize human resources losses in the country and economic damages related to them [6, 12, 17].

Risk-oriented model of sanitary and epidemiologic surveillance in the Russian Federation includes the system of surveillance objects differentiation as per health damage risks caused by breaches of sanitary legislation as well as legislation in the sphere of consumer rights protection. It helps to concentrate surveillance authorities' activities on objects which represent the greatest danger for people health (population, workers, and consumers); whereas a number of inspections at objects which generate low level of health risks can be significantly reduced. Risk-oriented model also allows motivating surveillance objects to conform to sanitary legislation requirements as it offers a possibility of well-

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grounded decrease in scheduled inspections' periodicity [8].

The created methodology means not only surveillance objects classification as per health damage risk but also risk structuring according to population categories who might be exposed to a risk (workers, goods and services consumers, population constantly living in emission zones and waste storage places, exposed to waste discharges) [3].

Quantitative risk assessment and risk defragmentation including risks for different population groups allows solving a whole set of vital tasks which Rospotrebnadzor regional offices face. The most important task is targeted prevention of health disorders evolving in health risk groups. Besides, risk assessment gives the possibility to evaluate whether management staff structure is adequate and sufficient for levels and structure of actual risks existing in a region. It also provides optimal planning of complex scheduled inspections with assigning workloads for sections dealing with communal hygiene, labor hygiene, children and teenagers' hygiene etc., as well as gives grounds for justification of targets and order of priority (urgency) for preventive activities in relation to risk groups.

The research goal was to assess risks for workers' health when classifying sanitary and epidemiologic surveillance objects (on the example of Moscow) in order to achieve proper planning of labor hygiene surveillance.

Data and methods. We assessed potential health risk caused by surveillance objects' economic activities in accordance with the guidelines approved by the Order of the RF Chief sanitary inspector [8].

On the whole for each separate l -type of activity, taking place at an organization's property complex, health risk for separate j -group (population, workers, consumers), being exposed to, (R_j^l) due to legislation breaches was calculated by (1):

$$R_j^l = \mathring{a} \left(p_k^l u_k^l M_j \right),$$

where p_k^l is probability of sanitary legislation breach as per k -clause of the RF Federal Law «On Sanitary and Epidemiologic Welfare of the Population», the RF Federal Law «On Consumer Rights Protection» and any other legislation in the sphere of consumer rights protection in l -type of activity; u_k^l is a parameter characterizing health damage done to j -group at breach of k -clause of the legislation in l -type of activity;

Here for surveillance objects having workplaces with harmful and dangerous labor conditions we calculated risk R_j^l by an adjusted formula

$$R_j^l = \mathring{a} R_j^l + \mathring{a} \left(d_i R_i^{Pr} \right) N^{Pr},$$

where R_j^l is health damage risk for separate j -groups (population, consumers); d_i is a share of workers being under harmful labor conditions of i -category generating occupational diseases risk in a certain type of activity; R_i^{Pr} is an individual risk of occupational disease for a worker being in harmful labor conditions of i -category in terms of a year; N^{Pr} is number of workers occupied with a certain type of activity in an organization, people.

Share of workers being exposed to harmful labor conditions is assumed as average for this type of activity in the whole country in accordance with the data given by Federal Statistics Service and the RF Ministry of Labor and Social Protection [11].

When calculating R_i^{Pr} we took account of occupational risk and average service record during which an occupational disease can evolve for workers having different labor conditions [10,11] (table 1).

Table 1
Values of occupational diseases risk for workers being exposed to harmful and dangerous labor conditions

Labor conditions category	Occupational disease risk (R^{Pr})
3.1	0.0076
3.2	0.0076
3.3	0.065
3.4	0.065
4	0.1

We calculated health risk for workers allowing for frequency of non-observation of Clause 25 of The RF 52 Federal Law «On Sanitary and Epidemiologic Welfare of the Population» («Sanitary and epidemiologic requirements to labor conditions»). We determined the frequency of Clause 25 non-observations as 95%-percentile of all registered breaches basing on the results of surveillance and control activities in all the RF regions over the last three years (2012-2014). We assumed reduced values to be quantity specifications for probability of non-observations of this Clause included into the RF sanitary legislations at present. We also saw them as general

characteristics of sanitary and epidemiologic situation in the sphere of observing existing obligatory requirements to labor conditions.

We assessed risks for 35.5 thousand of surveillance objects situated in Moscow which employed about 1,740 thousand workers. The assessment comprised all economic spheres of activity existing in the RF capital.

We based our calculations on the data obtained from the regional register of sanitary and epidemiologic surveillance objects created by Rospotrebnadzor regional office in Moscow. Data on number of people being exposed to an object's activities and workers employed by it were presented by economic entities themselves as well

as taken from state statistics materials, tax inspections database, social insurance funds and other relevant information sources.

Main results. When we analyzed how often obligatory requirements to labor conditions were broken we saw that such breaches were most frequently detected at industrial enterprises, from 4.7 breaches per 1 inspection at wood-chip material manufacturing up to 1 breach per 1 inspection at water and air transport and in some communication spheres (table 2). And here we should mention that non-observation frequency at objects dealing with other economic activities, as a rule, doesn't exceed 1.

Table 2

Frequency of non-observation of Clause 25, the RF Federal Law "On Sanitary and Epidemiologic Welfare of Population" at surveillance objects operating in various economic spheres of activity

Spheres of activity	Frequency of non-observation of Clause 25, FL 52 (per 1 inspection)	
	average	95% percentile
1	2	3
Wood-chip manufacturing	0.95	4.70
Construction and finishing agents and articles production	0.71	2.90
Television stations' operation	0.51	2.44
Mining operations (10-14)	0.80	2.27
Construction	0.64	1.98
Industrial manufacturing using ionizing radiation sources	0.28	1.85
Manufacturing activities	0.70	1.81
Transport infrastructure	0.51	1.67
Hot water production, distribution and supply	0.36	1.63
Industrial enterprises, total	0.57	1.57
Production, supply and distribution of electricity, gas, steam and hot water	0.36	1.56
Broadcasting stations' operation	0.37	1.50
Other industrial enterprises' activities	0.42	1.50
Furniture production	0.52	1.50
Railroad transport	0.23	1.37
Supporting and additional transport activities	0.48	1.25
Communication	0.34	1.05
Radio stations' operations	0.28	1.01
Base stations of cellular and trunking communication	0.16	1.00
Air transport	0.22	1.00
Electric transport	0.15	1.00
Passenger water transport	0.09	0.96
Water transport	0.13	0.82
Dry cleaners' and laundries	0.14	0.75
Sanatorium-and-spa institutions (except children's sanatoriums)	0.14	0.60
Higher educational establishments and institutions of education for adults	0.08	0.55
Medical and prevention organizations' activities (except children's sanatoriums)	0.12	0.51
Foodstuffs manufacturing including beverages; cigarettes manufacturing	0.10	0.49
Dental clinics and offices	0.10	0.48
Providing personal services	0.07	0.35
Organization of leisure, entertainments, cultural and sport activities	0.07	0.32
Providing healthcare, communal, social and personal services, total	0.07	0.28
Retail trade in pharmaceutical goods	0.05	0.23
Foodstuffs manufacturing, catering and retail trade in foodstuffs, total	0.03	0.18
Catering	0.02	0.13
Organizations providing social services	0.01	0.08
Educational organizations' activities	0.02	0.06

Modeling of relations between Clause 25 non-observations and disorders of working population health in various spheres of activity helped us to detect and parameterize more than 40 authentic dependencies being the evidence of health risk probability occurring when obligatory requirements to labor conditions were not observed. All the dependencies were tested in terms of their biological plausibility and confirmation by relevant scientific data. For example, we obtained mathematical models of dependency existing between increase in working population's morbidity and mortality caused by circulatory system and respiratory organs diseases and breaches of sanitary and epidemiologic requirements to labor conditions at mining enterprises in various regions (regression models coefficients (b) amounted to 0.003 and 0.0002 correspondingly; and 0.0004 at $p < 0.05$). We also obtained dependency models for growth of respiratory organs morbidity in working population caused by increase in requirements' non-observation frequency when labor conditions didn't conform to safety standards at such manufacturing objects as wood-chip manufacturing and furniture production ($b = 0.013$; $p < 0.05$), construction and finishing materials manufacturing ($b = 0.040$, $p < 0.05$). Authentic dependencies between increase in pneumonia morbidity and labor conditions not conforming to safety standards were obtained for water transport objects ($b = 0.0018$, $p < 0.05$) etc.

When we analyzed parameters of health disorders gravity associated with non-observation of obligatory requirements we found out that the highest gravity levels occurred in motor transport and industrial manufacturing. High gravity level was determined by health disorders structure which included injuries (weighted-mean health disorder gravity as per category was equal to 0.44), cardiovascular system diseases (0.58), and nervous system diseases (0.42).

Generally potential damage to workers' health associated with sanitary legislation breaches in terms of 1 breach amounted to about 0.043 for industrial enterprises in total, including 0.030 for mining enterprises, 0.016 for metallurgy; 0.01 for motor transport, 0.005 for power engineering. Potential health damage for workers in public health sphere amounted to values from 0.001 (sanatorium-and-spa organizations) to 0.003 (maternity homes); the figure was about 0.004 in education.

Moscow as a territory can be characterized with such structure of surveillance objects where a share of industrial enterprises is quite small; therefore, health risks for working population associated with sanitary legislation breaches in the city in general amounted to not more than 5% of

total amount of risks comprising potential damage to workers, population, and consumers of goods and services.

But still in such spheres of activity as industrial manufacturing, construction, and transport, health risks for workers were significant and served as a ground to include such objects into "high risk", "significant risk" or "average risk" categories (table 3).

Assessment of health risks for workers occupied at various objects with different staff number enabled us to tentatively define priorities and frequency of involvement for labor hygiene specialists into carrying out scheduled surveillance inspections within risk-oriented model.

Thus, carrying out scheduled inspections at industrial objects with staff number of more than 1,000 workers requires frequency equal to not less than 1 inspection every two years (inspections should check observation of obligatory requirements in labor hygiene sphere); if staff number amounts to more than 50 workers such inspections are to take place every three years. The same frequency of labor hygiene inspections is required for manufacturing companies and construction sites with number of workers being more than 600 etc. If an object can generate high health damage risk for workers it is advisable to support inspections with laboratory and instrumental research aimed at detecting whether hygienic standards related to chemical and physical factors are observed at workplaces.

If risk matrix for risks related to workers' health takes number of workers, how often breaches of obligatory requirements to labor conditions occur, and peculiarities of health reactions, into account, it enables us to concentrate the efforts and surveillance specialists' workload on the aspects of activities which generate the greatest risks and dangers. This necessity is also justified by the fact that time and financial resources allocated for each surveillance activity are limited.

Thus, for example, in Moscow a number of retail networks dealing with foodstuffs trade are included into extremely high and high risk category in the general classification as per population health risk criteria. But if we take risk for workers' health the same objects are classified as generating moderate risks provided that the number of their workers does not exceed 600 people. When we plan surveillance activities such classification peculiarities enable us to increase time for assessment of obligatory requirements in the sphere of catering and communal hygiene and simultaneously decrease time allocated for analysis of staff labor conditions.

Table 3

Levels of health disorders risks for workers at objects operating in various spheres and with various number of workers

Sphere of activity	Number of workers, people				
	50	200	600	1000	3000
Industrial enterprises	1.00E-06	2.04E-05	4.91E-05	1.06E-04	2.45E-04
Construction	2.54E-06	4.89E-06	1.17E-05	2.54E-05	5.87E-05
Manufacturing companies	2.24E-06	4.30E-06	1.03E-05	2.24E-05	5.16E-05
Production, supply and distribution of electricity	2.15E-06	4.13E-06	9.92E-06	2.15E-05	4.96E-05
Foodstuffs and cigarettes production	2.00E-06	3.84E-06	9.21E-06	2.00E-05	4.61E-05
Transport infrastructure	1.97E-06	3.79E-06	9.10E-06	1.97E-05	4.55E-05
Trade in foodstuffs, beverages and cigarettes	1.60E-06	3.08E-06	7.40E-06	1.60E-05	3.70E-05
Communication	1.40E-06	2.69E-06	6.46E-06	1.40E-05	3.23E-05
Auxiliary and supplementary transport activities	1.40E-06	2.69E-06	6.46E-06	1.40E-05	3.23E-05
Catering	1.04E-06	2.00E-06	4.81E-06	1.04E-05	2.41E-05
Base stations of cellular and trunking communication	1.01E-06	1.94E-06	4.66E-06	1.01E-05	2.33E-05
TV-broadcasting	1.01E-06	1.94E-06	4.66E-06	1.01E-05	2.33E-05
Radio-broadcasting stations	1.01E-06	1.94E-06	4.66E-06	1.01E-05	2.33E-05
Medical and preventive institutions	2.99E-07	5.76E-07	1.38E-06	2.99E-06	6.91E-06
Organizations for orphans and children left without parents' care	2.61E-07	5.01E-07	1.20E-06	2.61E-06	6.01E-06
Children's rest and rehabilitation facilities	1.50E-07	2.88E-07	6.91E-07	1.50E-06	3.46E-06
Professional education organizations	1.05E-07	2.03E-07	4.86E-07	1.05E-06	2.43E-06
Social services providers	3.67E-08	7.06E-08	1.69E-07	3.67E-07	8.47E-07
Higher education establishments and adults' education institutions	3.16E-08	6.07E-08	1.46E-07	3.16E-07	7.29E-07
Dental clinics and offices	2.47E-08	4.75E-08	1.14E-07	2.47E-07	5.70E-07

Notes:

	High risk
	Significant risk
	Average risk
	Moderate risk
	Low risk

Frequency of surveillance activities at objects operating in social sphere, first of all, public health care and education, is also determined by risks for consumers of services. The same risks define the primary contents of each scheduled surveillance inspection. However, labor conditions for workers in public health and education are also to be inspected, although not with the same frequency.

When carrying out surveillance inspections at industrial enterprises, transportation and communication companies, especially when their number of workers is significant we should remember that issues of surveillance over communal hygiene and labor hygiene require equal time and financial resources.

In general the obtained results prove that methodical approaches which serve as the ground for risk-oriented model of Rospotrebnadzor

surveillance activities give us the possibility to solve a wide range of tasks and accomplish analytical generalizations. For example, the obtained results can be used as a tool helping to create risk profiles for sanitary and epidemiologic surveillance objects.

Risk structuring, definition of the most important spheres in each scheduled surveillance activity and formulating contents of each particular inspection according to it are all vital parts of risk-oriented approach development. But beside of it, we think that formulating comprehensive list of obligatory requirements to labor conditions in each particular sphere of economic activity is extremely vital. And here we should not forget about differentiation of these requirements taking probability and gravity of harm done to workers' health in case of their non-observation, into

account. Such differentiation will let us form check-lists and laboratory support of scheduled inspections in labor hygiene sphere as per risk criteria. As the active discussion about making alterations into Administrative Infractions Code is now taking place and warnings are suggested to be fixed as minimal punishments for businesses, risks assessment development and their comparative analysis are becoming the most vital part of surveillance development on the whole.

Conclusions:

-the suggested risk assessment methodology when classifying surveillance objects gives the possibility to structure risks including determining risks for workers' health;

-as we analyzed more than 35.5 thousand sanitary and epidemiologic surveillance objects in Moscow, we determined that the highest health risks for workers were generated at industrial objects (risks are classified as "average", "significant" and "high"), in construction ("significant" or "moderate"), at some processing plants and in power engineering; risks for workers

can determine the main risk category of an object as per general damage risk for such type of objects;

-we defined that scheduled inspection frequency in labor hygiene sphere could differ from general scheduled inspection frequency. When inspecting legal entities and private entrepreneurs dealing with such activity types as network trade, public health services, and education, we should remember that the highest risks in these spheres are generated for consumers of goods and services. Surveillance over labor hygiene can take smaller part in an overall plan of a scheduled inspection;

-risk values can be used as grounds for planning contents of an inspections and its laboratory support;

-creating a comprehensive list of obligatory requirements to labor conditions with differentiation of these requirements as per gravity of negative consequences caused by their non-observation is seen as a vital trend in further risk-oriented surveillance development.

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