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METHODICAL APPROACHES TO MEDIUM-TERM PLANNING AND ASSESSING HEALTH RISK MANAGEMENT EFFICIENCY IN A MUNICIPAL ENTITY (BY THE EXAMPLE OF AN INDUSTRIALLY DEVELOPED CITY)

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A system of activities aimed at managing health risks caused by environmental factors has been created and successfully implemented in Sverdlovsk region. The system covers risks detected as per social-hygienic monitoring results. Priority tasks and measures that should allow risk management experts to provide sanitary-epidemiologic safety and to manage health risks are annually substantiated basing on systemic analysis and risk assessment.

Health risk management system in municipal entities is a key component in a unified regional system for providing sanitary-epidemiologic welfare and protecting population health taking into account peculiarities related to a sanitary-epidemiologic situation in a specific municipal entity. Such risk management systems should be created and developed basing on unified goals, tasks, and parameters for assessing activities performed by all the participants in risk management processes as well as on applying a unified information and analytical database containing social and hygienic monitoring data as such a database can ensure appropriate management of risks and threats to population health. The paper dwells on methodical approaches, basic results, and scientific and practical experience in medium-term planning and assessing efficiency of activities performed to manage population health risks in an industrially developed city in Sverdlovsk region. The authors also give recommendations and set tasks which are to be solved in order to create and develop municipal systems for managing population health risks.

Key words: *population health risk management, municipal entity, planning, efficiency assessment, epidemiologic welfare, social-hygienic monitoring, health protection, Sverdlovsk region.*

Population health risk management is a multi-level system that comprises various risk management subjects such as regional and municipal authorities, economic entities, state surveillance and municipal control bodies, and population; risk management techniques such as risk prevention, decrease, compensation, risk communication and informing about risks; risk management objects such as risk factors, territories, surveillance objects, and population groups. Its functioning is aimed at achieving socially significant results, namely, providing

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sanitary-epidemiologic welfare and protecting population health.

Health risk management system in a municipal entity is a key component in a unified regional system for providing sanitary-epidemiologic welfare and protecting population health in RF regions. Its goal is to solve priority problems in a region taking into account a specific sanitary-epidemiologic situation in a municipal entity. Such a system should be created basing on unified goals, tasks, and parameters for assessing efficiency of activities for all risk management subjects as well as on applying a unified information and analytical database containing social and hygienic monitoring data collected in a specific RF region. Social and hygienic monitoring is to provide adequate and timely management of risks and threads for population health.

Urgency to create and develop health risk management systems in municipal entities is determined by a necessity to create and apply approaches, methods, and technologies that allow solving two interrelated tasks [1]:

– to optimize budgetary and program-targeted middle-term planning of activities performed by local authorities in a municipal entity and aimed at providing sanitary-epidemiologic welfare of population;

– to predict economic efficiency and productivity of activities performed by local authorities in a municipal entity and aimed at achieving key medical and demographic parameters that are socially significant for municipal entity development (increase in life expectancy, natural population growth, decrease in overall mortality and mortality among employable population, decrease in overall morbidity and morbidity among children).

There was a scientific and practical work performed in 2015–2017 by Yekaterinburg Medical Scientific Center for Prevention and Health Protection for Workers Employed at Industrial Enterprises together with Rospotrebnadzor's Regional Office in Sverdlovsk region and Sverdlovsk Regional Center for Hygiene and Epidemiology. The work dwelled on creating and testing above-mentioned methodological approaches; it had been requested by municipal authorities of an industrially developed city in Sverdlovsk region in order to help them improve demographic, ecological, and sanitary-epidemiologic situation in it.

Also we applied results of some other research that mostly focused on testing and implementing health risk assessment and management methodology (including issues related to risk assessment, management, and communication as well as monitoring and control) and research in human social biology accomplished under supervision and with participating of RAS Academician B.T. Velichkovskiy.

Data and methods. Techniques applied for planning and analyzing health risk management activities performed by local authorities in a municipal entity are based on multi-criteria assessment that usually comprises a set of parameters describing sanitary-epidemiologic welfare and population health. We applied unified scenario-based approaches to planning and economic tools for assessing efficiency and productivity of health risk management activities based on «cost – effectiveness» and «costs – benefits» techniques recommended by MG 5.1.0030-11 «Methodical guidelines on economic evaluation and substantiation of decisions on health risk management under exposure to environmental factors»[1].

Health risk management activities aimed at providing sanitary-epidemiologic welfare and improving medical and demographic situation in a municipal entity were analyzed, assessed, substantiated, predicated and planned for a middle term within social and hygienic monitoring performed in a specific RF region.

An algorithm for middle-term planning of health risk management activities in a municipal entity is given in Figure 1. Its performance comprises interrelated stages.

[1] MG 5.1.0030-11. Methodical guidelines on economic evaluation and substantiation of decisions on health risk management under exposure to environmental factors [web-source] // KODEKS: an electronic fund of legal and reference documentation. – URL: http://docs.cntd.ru/document/1200088393 (date of visit January 03, 2019).

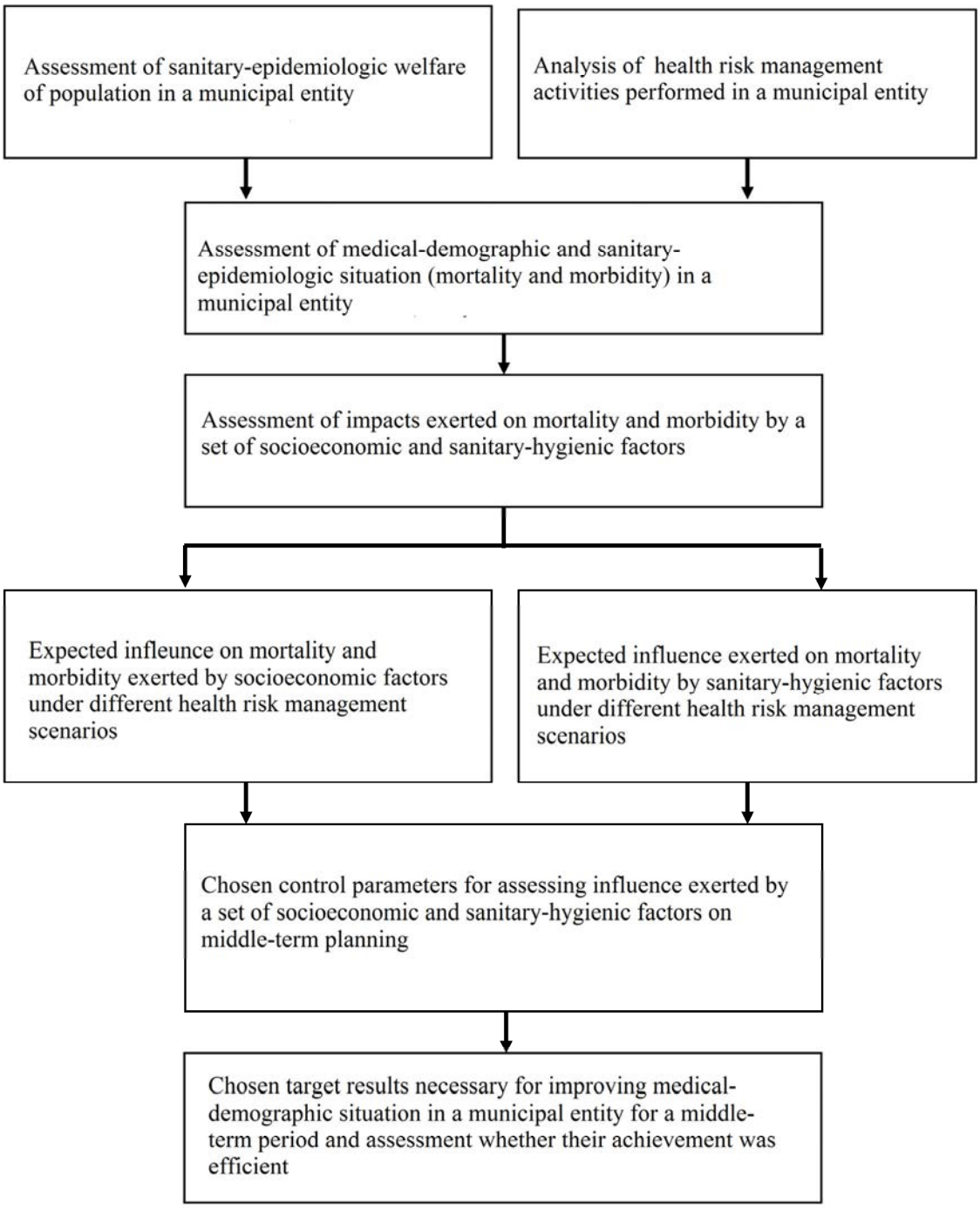

Figure 1. An algorithm for middle-term planning and assessing efficiency of health risk management activities in a municipal entity

Stage 1 involves analyzing medical-demographic situation, sanitary-epidemiologic welfare and performed health risk management activities in a municipal entity.

An information and analytical database that is applied to assess sanitary-epidemiologic welfare in a municipal entity is based on regional information social-hygienic monitoring funds, annual reports "On sanitary-epidemiologic welfare of the population in a specific RF region", reports (or information bulletins) "On sanitary-epidemiologic welfare of the population in a municipal entity" or sanitary-epidemiologic profiles created for specific municipal entities over a recommended period not shorter than five years [2]. The research that

we consider here focused on analyzing sanitary-epidemiologic situation and its influence on basic medical-demographic parameters (life expectancy, mortality, morbidity, and natural population growth) performed with data collected in 2004-2014. That analysis included medical-demographic parameters (19 overall, including mortality and morbidity); 27 socioeconomic parameters; 29 sanitary-hygienic parameters; 6 socially significant parameters that allowed assessing whether health risk management activities were efficient.

Analysis of medical-demographic situation and sanitary-epidemiologic welfare revealed priority issues related to providing sanitary-epidemiologic welfare that were common for all municipal entities in any RF region as well as some issues that were specific for that particular municipal entity.

Efficiency of health risk management activities has been assessed in Sverdlovsk region since 2008 as per basic socially significant parameters (mortality, morbidity, natural population growth, and life expectancy) [1]; assessment results provided some additional data for analyzing and assessing situation in the chosen municipal entity. Analysis revealed existing problems related to functioning and development of health risk management system in the municipal entity; it also allowed comparative assessment of its efficiency against systems existing in other similar municipal entities in the given RF region.

Results obtained at Stage 1 in the middle-term planning algorithm give grounds for assessing influence exerted by environmental factors on medical and demographic parameters (mortality and morbidity) in a municipal entity.

Stage 2 involved assessing influence exerted by socioeconomic and sanitary-hygienic factors on medical and demographic parameters (mortality and morbidity) in a municipal entity.

At stage 2 in middle-term planning algorithm we analyzed dynamics of population mortality (overall one and among employable population) and morbidity (among overall population and among children), what causes led to mortality and morbidity cases, as well as dynamics and causes for annual growth (decrease) in these parameters over a period not shorter than 10 years [3]. We also analyzed dynamics of parameters that described socioeconomic factors (social welfare, social tension, and economic and industrial development) and changes in annual growth (decrease) in parameters of socioeconomic development in a municipal entity over e period of time not shorter than five years.

We analyzed changes (annual growth or decrease) in parameters related to sanitary-hygienic factors (ambient air quality, soil and drinking water quality, quality and safety of food products, learning and educational conditions for children, working conditions, incidence with infectious and parasitic diseases, injuries and intoxications); also, as deep as it was possible, we analyzed lifestyle parameters (smoking, alcohol intake, drug addiction, physical activities, etc.) [4].

We assessed impacts exerted on mortality and morbidity by a set of socioeconomic and sanitary-hygienic factors mostly with health risk assessment methodology and human social biology techniques[2] [5–8]. We also applied statistic and mathematical techniques for assessing health risks, expert evaluations and other techniques recommended by the RF State Standard GOST R ISO/MEK 31010-2011 «Risk management. Risk assessment techniques»[3].

So, we assessed impacts exerted by socioeconomic and sanitary-hygienic factors on medical and demographic parameters (mortality and morbidity) in a municipal entity and it allowed substantiating and creating statistic and (or) other quantitative or semi-quantitative models for assessing such impacts with a possibility to predict them depending on changes in parameters related to socioeconomic and sanitary-hygienic environmental factors [1].

[2] G 2.1.10.1920-04. Guidelines on assessment of population health risk under exposure to chemicals which pollute environment [Web-source] // KODEKS: an electronic fund of legal and reference documentation. – URL: http://docs.cntd.ru/document/1200037399 (date of visit January 04, 2019).

[3] GOST R. ISO/MEK 31010-2011. Risk management, Risk assessment techniques [Web-source] // KODEKS: an electronic fund of legal and reference documentation. – URL: http://docs.cntd.ru/document/gost-r-iso-mek-31010-2011 (date of visit January 04, 2019).

Stage 3 involved predicting effects that could be produced by socioeconomic and sanitary-hygienic factors on mortality and morbidity under different health risk management scenarios in a municipal entity.

When predicting impacts exerted by environmental factors on population health, we created several scenarios for managing population health risks. Basically, we considered an optimistic, realistic, and a pessimistic scenario. A specific health risk management scenario is a set of activities aimed at solving priority issues related to medical and demographic situation and sanitary-epidemiologic welfare in a municipal entity; these activities are coordinated as per their place, time, funding, as well as personnel, organizational, and regulatory-methodical provision necessary for their implementation [9]. A middle-term health risk management scenario should be implemented over a period of time not shorter than 5 years.

Middle-term prediction of impacts exerted by socioeconomic factors on mortality and morbidity among population took into account both data on predicted socioeconomic development of a specific municipal entity as per all the parameters that described social welfare, social tension, and economic and industrial development, and the same data on a region as a whole where that municipal entity was located. When creating health risk management scenarios depending on changes in socioeconomic factors, we applied results and opportunities granted by cyclic economic development models; in particular, we applied Kitchin and Juglar cycles for middle-term planning to create an optimistic, realistic, and pessimistic scenario [10].

Middle-term prediction of impacts exerted by sanitary-hygienic factors on mortality and morbidity among population took into account predicted changes in ambient air quality, soils and drinking water quality, learning and educational conditions for children, working conditions, incidence with infectious and parasitic diseases, injuries and intoxications, as well as overall development of health risk management system in a municipal entity [2]. When creating an optimistic, realistic, and pessimistic health risk management scenario depending on changes in sanitary-epidemiologic parameters, we applied evaluations given by experts who dealt with providing sanitary-epidemiologic welfare, ecological safety and health protection as per Delphi method and risk indexes technique[3].

After Stage 3 in the middle-term planning algorithm had been completed, we predicted sanitary-epidemiologic welfare and population health (as per population mortality and morbidity) depending on combined effects produced by socioeconomic and sanitary-hygienic factors as well as factors related to lifestyle.

Stage 4 involved creating a middle-term program for providing sanitary-epidemiologic welfare and health risk management in a municipal entity.

When creating the above-mentioned program, we considered all three variants based on an optimistic, realistic, and pessimistic health risk management scenario. To substantiate and correctly choose a program for providing sanitary-epidemiologic welfare and health risk management, we determined control parameters for assessing program implementation. We also outlined what target socially significant results could be applied to assess an expected effect which was a decrease in impacts exerted by socioeconomic and sanitary-hygienic factors on health as well as improved medical and demographic situation in a middle-term period of time as per all the priority problems revealed at Stages 1 and 2 in the algorithm for middle-term planning of activities aimed at managing health risks in a municipal entity [11].

A middle-term program aimed at providing sanitary-epidemiologic welfare and health risk management in a municipal entity was created for a period up to 2020. It outlined the following:

– a sphere significant for providing sanitary-epidemiologic welfare in which a suggested activity was to be performed;

– a task to be completed to provide solution to priority issues related to sanitary-epidemiologic welfare which could be achieved with a suggested activity;

– an activity itself, necessary funding and its sources, terms and personnel responsible for its implementation;

– control parameters and target results that can be applied to assess efficiency and productivity of an activity as well as people responsible for control over its implementation.

We substantiated a choice on a variant of middle-term program for approval and implementation by local authorities in a municipal entity and assessment how efficient its implementation was for an intermediate period up to 2020 in conformity with MG 5.1.0030-11[1]. We performed basic evaluations that described «costs – efficiency» and «costs – benefits» relations for various program scenarios. We also estimated minimal funds necessary for achieving target socially significant results via predicting prevented economic losses related to population health (decrease in losses of gross regional product).

Results. We analyzed effects produced by sanitary-hygienic situation on medical and demographic parameters in an industrially developed city within human social biology, in particular, taking into account considerable influence exerted by socio-economic factors (first of all, purchasing capacity and material motivation to work) on sanitary-hygienic factors and, accordingly, their cumulative effects produced on population health directly or via impacts exerted by sanitary-hygienic factors[4].

Over 2010–2014 first there was a stagnation and then a drastic deterioration of primary medical and demographic parameters both in Sverdlovsk region and, to a much greater extent, in the examined industrially developed city. Thus, population mortality among overall population reached 15.1 cases per 1,000 people in the city while in Sverdlovsk region it amounted to 14.0 cases (Figure 2). Mortality grew by more than 13.5% since 2012 in the city and it was considerably higher the same parameter in Sverdlovsk region as a whole (almost 2 times higher).

Mortality among employable population grew by 14% and reached 6.5 cases per 1,000 people while the same parameter amounted to 6.3 cases in Sverdlovsk region as a whole (Figure 3).

There was a drastic deterioration in natural population growth. Population continued to grow in Sverdlovsk region (natural population growth stabilized at 0.5 per 1,000 people), but natural population loss continued to increase in the industrially developed city in Sverdlovsk region.

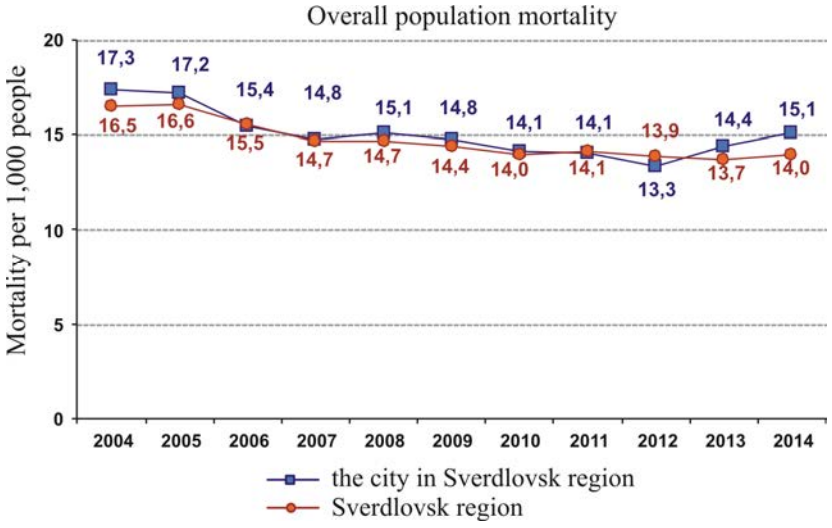

Figure 2. Dynamics of overall mortality in the city in Sverdlovsk region ad Sverdlovsk region as a whole (per 1,000 people) in 2004–2014

[4] V.B. Gurvich. Systemic approach to managing ecologically induced health risks on an example of aluminum-production enterprises: Doctor of medical sciences dissertation. – Saint Petersburg, 2008. – 345 p.

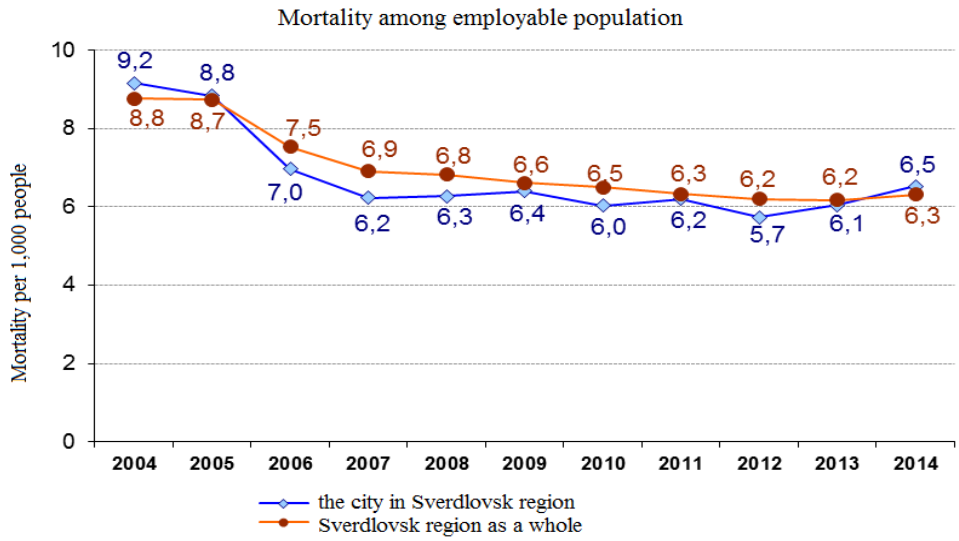

Figure 3. Dynamics of mortality among employable population in the city in Sverdlovsk region ad Sverdlovsk region as a whole (per 1,000 people) in 2004–2014

Table 1

Efficiency of health risk management activities in municipal entities located in Sverdlovsk region: comparative assessment, 2004–2014

No.	Municipal entity	Overall multi-criteria score	Rank place
1	Municipal entity No. 1	14	6
2	Municipal entity No. 2	23	4
3	Municipal entity No. 3	30	3
4	Municipal entity No. 4	22	5
5	Municipal entity No. 5	33	1
6	Municipal entity No. 6	31	2

Natural population loss amounted to –1.8 per 1,000 people in 2014 while it was 0.0 per 1,000 in 2012[5].

We comparatively assessed efficiency of health risk management activities in six municipal entities in Sverdlovsk region; the results are given in the Table where the examined industrial city is given as Municipal entity No. 1, other five entities being quite comparable to it. The higher total score as per multi-criteria assessment scale is the more efficient and productive is a health risk management system in a municipal entity.

Therefore, Municipal entity No. 1 has greater population loss and population mortality, both overall and among employable population, than in Sverdlovsk region in general and there is practically no trend for any improvement in these medical and demographic parameters. The system for managing sanitary-epidemiologic welfare and health risks that exists there can only be considered unsatisfactory and inefficient. This municipal entity takes the 6th rank place as per economic efficiency of health risk management activities among 6 municipal entities in Sverdlovsk region that are comparable in terms of population number, their economic and industrial development[6].

We applied Spearman correlation coefficients to assess impacts exerted by integral

[5] Human social biology. Experience in practical application: Methodical manual / B.T. Velichkovskiy, V.B. Gurvich, S.V, Yarushin, O.L. Malykh, E.A. Kuz'mina, T.M. Tsepilova, I.I. Oranskaya. – Yekaterinburg: Yekaterinburg Medical Scientific Center for Prevention and Health Protection for Workers Employed at Industrial Enterprises, 2017. – 81 p.

[6] The Concept for long-term social and economic development of the Russian Federation up to 2020 / Approved by the RF Government Order No. 1662-r Issued on November 17, 2008 [web-source] // KonsultantPlus. – URL: http://www.consultant.ru/document/cons_doc_LAW_82134/28c7f9e359e8af09d7244d8033c66928fa27e527/ (date of visit January 4, 2019).

Table 2

Pair Spearman correlation coefficients for socioeconomic and sanitary-hygienic factors and medical and demographic parameters in industrially developed city, 2004–2014

Parameters	Years	Spearman correlation coefficient	p-value
Overall population mortality			
An integral parameter for socioeconomic factors	11	0.76	0.007
An integral parameter for sanitary-hygienic factors	11	0.85	0.001
Overall population morbidity			
An integral parameter for socioeconomic factors	11	0.77	0.005
An integral parameter for sanitary-hygienic factors	11	0.89	0.000
Employable population mortality			
An integral parameter for socioeconomic factors	11	0.75	0.008
An integral parameter for sanitary-hygienic factors	11	0.73	0.011
Morbidity among children			
An integral parameter for socioeconomic factors	11	0.94	0.000
An integral parameter for sanitary-hygienic factors	11	0.90	0.000

socioeconomic and sanitary-hygienic parameters on population health in the examined city over 2004-2014; the results are given in Table 2.

All the obtained data are statistically significant and indicate there is significant influence exerted both by socioeconomic factors (Spearman correlation coefficient varies from 0.75 to 0.94) and by sanitary-hygienic factors[7] (Spearman correlation coefficient varies from 0.73 to 0.90) on primary medical and demographic parameters (overall population mortality, employable population mortality, overall population morbidity and morbidity among children). We applied created one-factor and multi-factor statistical models (based on integral parameters that described socioeconomic and sanitary-hygienic situation) to predict efficiency and productivity of planned scenario activities included into a program aimed at improving medical and demographic and sanitary-epidemiologic situation in the industrially developed city in Sverdlovsk region for e period up to 2020, together with experts evaluations as per Delphi method.

Data and information included into the analysis as well as prediction techniques were oriented at a period from 2015 to 2020. We performed our assessment as per an optimistic, realistic, and pessimistic health risk management scenario. When creating health risk management scenarios, we took socioeconomic development parameters in the industrially developed city in Sverdlovsk region as our basic ones; the parameters were assessed taking into account cyclic economic development models for Sverdlovsk region for a middle-term period. We applied Kitchin and Juglar cycles to create all three scenarios for socioeconomic development of a municipal entity. Socioeconomic factors that influenced health were ranked as per their impacts; we detected the following priority ones (in a descending order): social tension, quality and availability of medical aid, economic development, and social improvement [12].

We determined priority tasks that had to be solved in order to provide sanitary-epidemiologic welfare taking into account evaluations given by experts in Sverdlovsk region as per Delphi method and risk indexes technique.

We quantitatively assessed how significant those priorities were as well as suggested health risk management scenarios and it allowed us to predict population health losses prevented due to their implementation and, accordingly, recommended funding necessary

[7] On sanitary and epidemiologic welfare of the population in the Russian Federation in 2017: State Report. – M.: Federal Service for Surveillance over Consumer Rights Protection and Human Well-being, 2018. – 268 p.

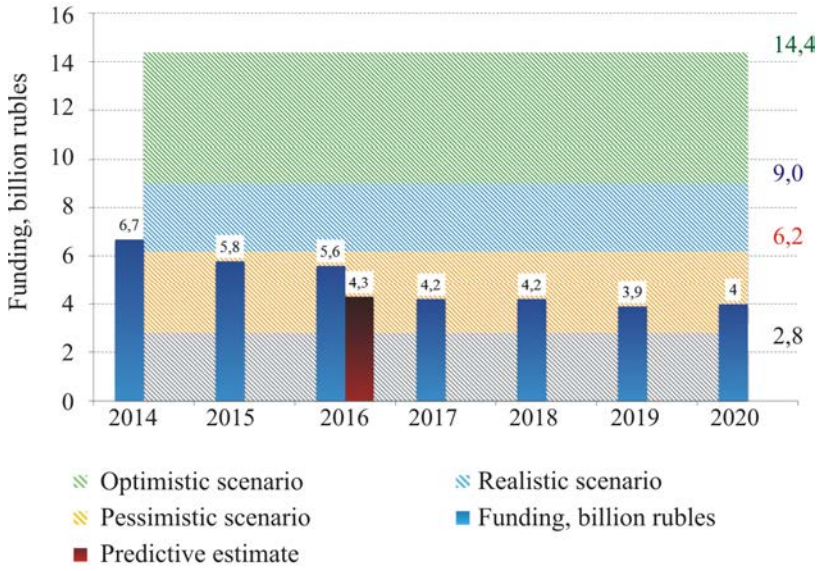

Figure 4. Funding provided for the Complex program for health risk management in the industrially developed city in Sverdlovsk region, predicted and actual funding, 2016

for it [13, 14]. These evaluations and prediction taken into account, we calculated expected socially significant results obtained due to implementation of the Complex health risk management program in 2018 (intermediate results assessment) and in 2020 (ultimate results assessment) as per three considered scenarios, optimistic, realistic, and pessimistic one.

Predictive estimate of necessary annual funding for the Complex program as per various health risks management scenarios and actual funding spent in 2015 and 2016 are shown in Figure 4.

We applied two economic criteria to assess different variants of the Complex program:

1. Criterion 1 («necessity»). It was applied to evaluate necessary funding for a set of activities as per different health risks management scenarios in a municipal entity (optimistic, realistic, and pessimistic one);

2. Criterion 2 («sufficiency»). We assessed structure of funds for a set of activities aimed at health risks management in a municipal entity as per priority tasks to be solved to provide sanitary epidemiologic welfare for population.

A variant of the Complex program that was actually implemented corresponds to a pessimistic scenario of socioeconomic development in the given industrially developed city in Sverdlovsk region. Planned funding varied from 4.3 billion rubles in 2016 to 4.0 billion rubles in 2020; actual funding reached 5.6 billion rubles.

Figures 5 and 6 show actual socially significant medical and demographic parameters (in 2015 and 2016); Figure 5 shows overall population mortality, Figure 6 shows mortality among employable population.

Changes in these parameters are the most significant for an industrially developed city as they determine overall medical and demographic situation and sanitary-epidemiologic welfare of population in a municipal entity [15, 16].

Under an optimistic health risk management scenario, overall population mortality can reach 11.6 cases per 1,000 people by 2020; under realistic one, 12.3 cases per 1,000 people; under pessimistic one, 14.2 cases per 1,000 people. But in 2016 actual mortality was equal to 14.9 cases per 1,000 people, and possible trends in changes in it are worse than pessimistic forecasts.

The same unfavorable trend remains for mortality among employable population. Under an optimistic health risk management scenario, mortality among employable population can reach 4.1 cases per 1,000 people by 2020; under realistic one, 4.6 cases per 1,000 people; under pessimistic one, 6.2 cases per 1,000 people. Actual mortality among employable population amounted to 6.9 cases per 1,000 people.

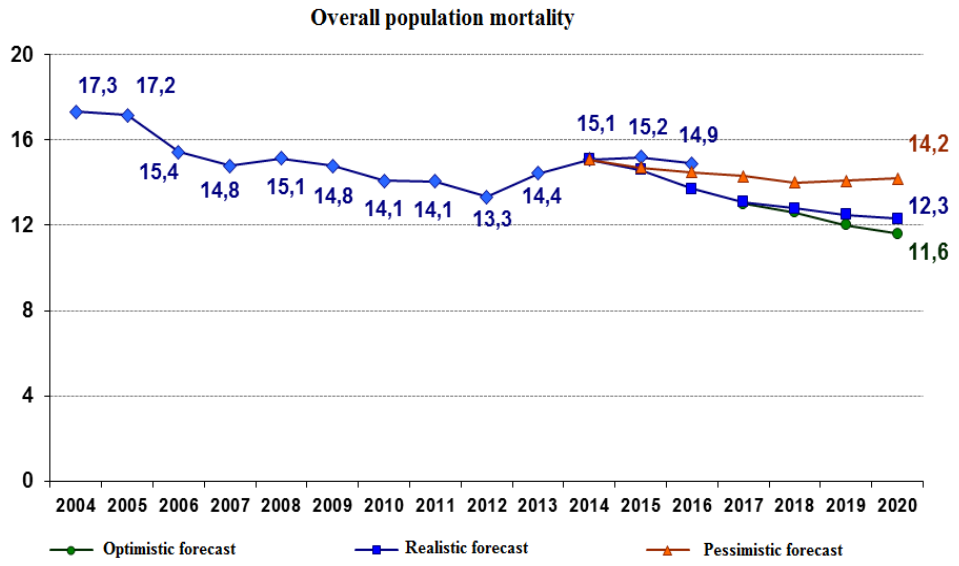

Figure 5. Actual overall population mortality up to 2016 and expected one up to 2020 in an industrially developed city In Sverdlovsk region (per 1,000 people)

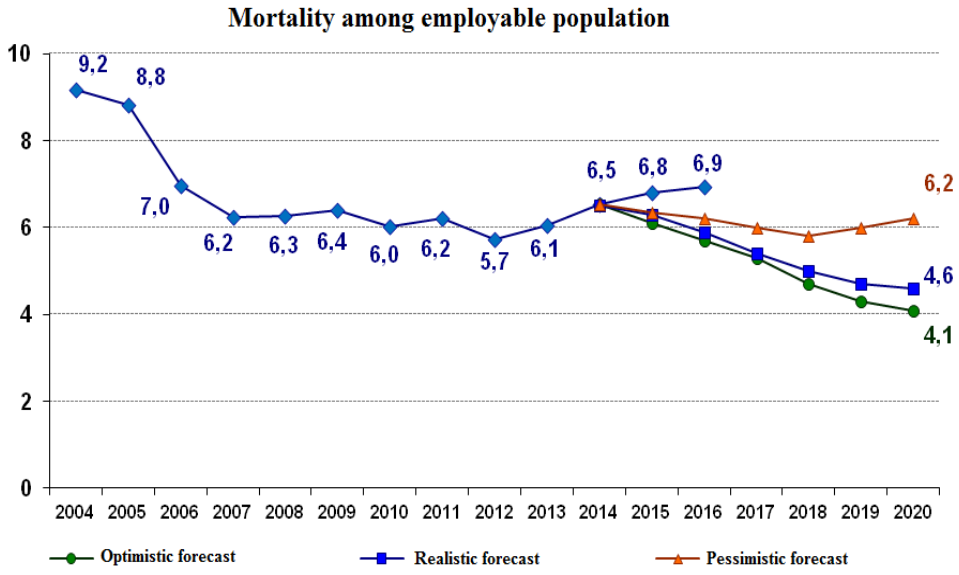

Figure 6. Actual mortality among employable population up to 2016 and expected one up to 2020 in an industrially developed city In Sverdlovsk region (per 1,000 people)

Any changes in mortality are rather inert (drastic ones are not possible) and it exerts its influence on en existing situation; another significant effect is produced by chosen priorities in funds allocated to solve key issues related to providing sanitary-epidemiologic welfare [17–19]. Figure 7 shows that there are discrepancies between recommended priorities based on predicted changes in impacts exerted by environmental factors on population health and priorities that were actually given financial support in 2015 and 2016.

Risk indexes as per specific tasks were determined for all 9 priorities in providing sanitary-epidemiologic welfare; they are given in % and correspond to the following priorities (in a descending order):

The 1st priority is poor quality of drinking water supply (risk index amounts to 32.4%, actual share of allocated funds amounts to 13.5%);

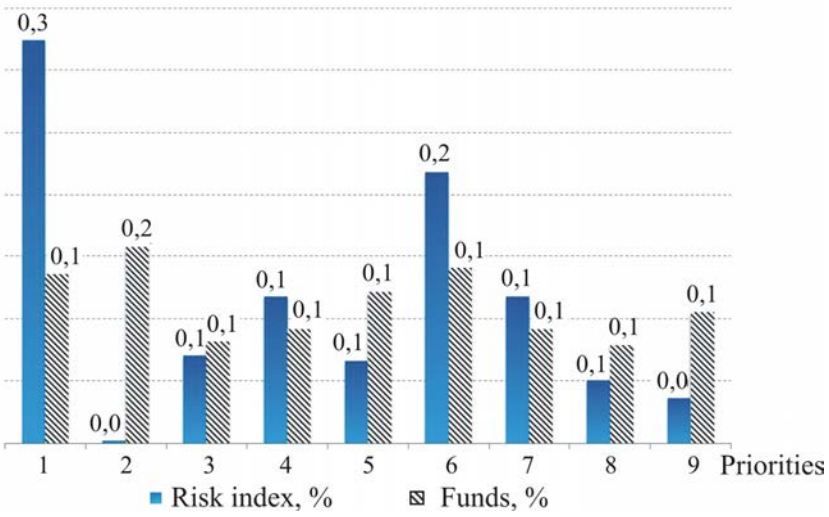

Figure 7. Priorities in providing sanitary-epidemiologic welfare recommended as per risk indexes and actual funds allocated for their implementation according to the Complex health risks management program

The 2nd priority is high mortality among employable population (risk index amounts to 21.8 %, actual share of allocated funds amounts to 14.0%);

The 3rd and 4th priorities are low quality nutrition and high prevalence of injuries and intoxications (risk index amounts to 11.7%, actual share of allocated funds amounts to 9.1%);

The 5th priority is ambient air and soil contamination (risk index amounts to 7.0%, actual share of allocated funds amounts to 5.0%);

The 6th priority are risk factors related to educational and learning conditions for children and teenagers (risk index amounts to 6.6%, actual share of allocated funds amounts to 12.1%);

The 7th priority is infectious and parasitic diseases (risk index amounts to 5.0%, actual share of allocated funds amounts to 7.9%)

The 8th priority is low efficiency of health risk management system (risk index amounts to 3.6 %, actual share of allocated funds amounts to 10.5%);

The 9th priority is adverse effects produced by physical factors, first of all, noise (risk index amounts to 0.2%, actual share of allocated funds amounts to 8.1%).

More significant priority tasks were given two times lower funds than they should have; on the contrary, less significant priorities were given more funds than actually required. Considerable financial resources that are available are not allocated efficiently and target results therefore can't be achieved.

Taking all research results and performed assessments into account, we recommended adjusting the Complex health risk management program in the given municipal entity in order to make funds [20] allocated for solving priority tasks closer to their recommended volumes starting from 2018 and to make sure target socially significant medical and demographic parameters are achieved by 2020.

Conclusions and recommendations.

1. Methodical approaches, algorithm, and middle-term planning procedures for health risk management in a municipal entity can be applied in order to:

– create and develop a health risk management system and techniques as support for making management decisions aimed at providing sanitary-epidemiologic welfare and health protection;

– implement health risk management techniques based on a systemic approach within activities aimed at providing sanitary-epidemiologic welfare and health protection taking into account effects produced by socioeconomic factors, sanitary-hygienic factors, as well as factors related to lifestyle;

– test health risk management techniques and technologies oriented at risk tolerability

(acceptability) concept together with hygienic standards created for environmental factors;

– plan and choose health risk management scenarios, a focus being shifted from technical requirements and possibilities related to social and economic potential to availability of resources necessary to achieve tolerable (acceptable) health risks in a middle-term period;

– perform economic evaluation, substantiate and select probable health risk management scenarios aimed at providing sanitary-epidemiologic welfare of the population within support systems for making managerial decisions;

– develop state social and hygienic monitoring basing on implementation of health risk management techniques and approaches in order to obtain and analyze the most complete, timely, and reliable information necessary to assess influence exerted by environmental factors on population health;

– make health risk management systems more efficient due to performing activities aimed at preventing, decreasing, and compensating risks outcomes and to applying scenario-based approach to their substantiation and implementation;

– implement measures aimed at raising awareness about factors related to environmental contamination that produce adverse effects on health and health risk management techniques, both among decisions-makers and population in general.

2. There are certain basic uncertainties and assumptions that are characteristic for assessing and predicting effects produced by socioeconomic and sanitary-hygienic factors on medical and demographic parameters; they should be taken into account when performing middle-term planning of health risk management activities and providing sanitary-epidemiologic welfare of the population. They are:

– whether data on population health (mortality and morbidity) in a municipal entity are complete and reliable;

– whether an existing situation is consistent with chosen scenarios of socioeconomic development in a municipal entity;

– whether models applied for predicting medical and demographic situation in a municipal entity are reliable;

– whether it is possible to accumulate financial resources from various sources to solve issues related to improvement of medical and demographic situation and sanitary-epidemiologic welfare provision.

3. We obtained significant results and gained substantial experience in creating and testing a municipal health risk management system; tested methodical and organizational approaches, methods and procedures for flexible middle-term planning and assessing efficiency and productivity of middle-term programs for providing sanitary-epidemiologic welfare and health risk management. These approaches, methods, and procedures turned out to have high potential for finding solutions to tasks related to social and economic development of municipal entities and can be considered suitable for any industrially developed city in any RF region.

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References

1. Malykh O.L., Kochneva N.I., Nikonov B.I., Shevchik A.A., Tsepilova T.M. Methodological approaches to the assurance of sanitary-epidemiological welfare on the base of the methodology of population's health risk management. *Гигиена и санитария,* 2017, vol. 96, no. 12, pp. 1136–1140 (in Russian).

2. Gurvich V.B., Kuz'min S.V., Dikonskaya O.V., Malykh O.L., Yarushin S.V. Health risk management to provide health and epidemiological well-being to the population in municipalities (the experience of the Sverdlovsk region). *Materialy vserossiiskoi nauchno-prakticheskoi konferentsii s mezhdunarodnym uchastiem*, Perm, 2013, pp. 521–532 (in Russian).

3. Derstuganova T.M., Velichkovsky B.T., Gurvich V.B., Varaksin A.N., Malykh O.L., Kochneva N.I., Yarushin S.V. The impact of socio-economic factors on mortality rates among the working age popula-

tion (the experience of the Sverdlovsk region). *Zdorov'e naseleniya i sreda obitaniya*, 2013, no. 9, pp. 12–14 (in Russian).

4. Blagodareva M.S., Kornilkov A.S., Yarushin S.V., Malyh O.L. On methodological approaches to evaluation of multifactor risk for population exposed to environmental hazards. *Meditsina truda i promyshlennaya ekologiya*, 2018, no. 11, pp. 41–45 (in Russian).

5. Onishchenko G.G., Novikov S.M., Rakhmanin Yu.A., Avaliani S.L., Bushtueva K.A. Principles of Risk Assessment for Health of the Population with Exposure to Chemical Substances, Polluting the Environment. Moscow, Nauchno-issledovatel'skii institut ekologii cheloveka i gigieny okruzhayushchei sredy im. A.N. Sysina Publ., 2002, 408 p. (in Russian).

6. Kuz'min S.V., Privalova L.I., Katsnel'son B.A., Gurvich V.B. Otsenka riska i ekologicheskaya epidemiologiya: sbornik instruktivno-metodicheskikh dokumentov [Risk assessment and ecological epidemiology: a collection of information and methodical documents]. Yekaterinburg, 2000, 204 p. (in Russian).

7. Katsnel'son B.A., Privalova L.I., Kuz'min S.V., Chiburayev V.I., Nikonov B.I., Gurvich V.B. Otsenka riska kak instrument sotsial'no-gigienicheskogo monitoringa [Risk assessment as a tool of social-hygienic monitoring]. Yekaterinburg, 2001, 244 p. (in Russian).

8. Onishchenko G.G., Zaitseva N.V., Mai I.V. [et al.]. Analiz riska zdorov'yu v strategii gosudarstvennogo sotsial'no-ekonomicheskogo razvitiya: monografiya [Health risk analysis within a state strategy for social and economic development: a monograph]. Perm, Perm National Research Polytechnic University Publ., 2014, 738 p. (in Russian).

9. Kuzmin S.V., Dikonskaya O.V., Gurvich V.B., Malykh Olga Leonidovna, Yarushin S.V. The role of Rospotrebnadzor bodies and institutions in the system of health risk management at the regional level. *Zdorov'e naseleniya i sreda obitaniya,* 2011, vol. 223, no. 10, pp. 4–6 (in Russian).

10. Drozdova I.V. Teoreticheskie aspekty, problemy, vozmozhnosti realizatsii sotsial'no-ekonomicheskoi politiki gorodov monospetsializatsii v usloviyakh tsiklichnosti razvitiya ekonomiki [Theoretical aspects, problems, and possibilities for implementing social and economic policy in mono-cities given cyclic development of an economy]. Yekaterinburg, 2014, pp. 11–16 (in Russian).

11. Kuzmina E.A., Vinokurova M.V., Gazimova V.G., Busyrev S.A., Gurvich V.B., Malykh O.L., Kochneva N.I., Zaikina T.M., Yarushin S.V. Practice and perspectives of applying economic instruments of substantiation and evaluation of effectiveness of risk management actions and securing sanitary and epidemiologic welfare of population (on the example of Sverdlovsk region). *Zdorov'e naseleniya i sreda obitaniya,* 2010, vol. 202, no. 1, pp. 20–25 (in Russian).

12. Kuz'min S.V., Kuz'mina Ye.A., Katsnel'son B.A., Yarushin S.V., Privalova L.I., Degtyareva T.D. Otsenka i upravlenie riskom dlya zdorov'ya naseleniya: sbornik informatsionno-metodicheskikh dokumentov [Population health risk assessment and management: a collection of information and methodical documents]. Yekaterinburg, 2009, 488 p. (in Russian).

13. Gurvich V.B., Kornilkov A.S., Privalova L.I., Lavrent'ev A.N., Yarushin S.V. Health risks for residents of cities with developed copper industry. *Meditsina truda i promyshlennaya ekologiya*, 2016, no. 10, pp. 1–4 (in Russian).

14. Kuzmin S.V., Gurvich V.B., Romanov S.V., Dikonskaya O.V., Yarushin S.V., Malykh O.L. The optimization of the activity of organs of Federal Service for Supervision of Consumer Rights protection and Human Welfare in the Sverdlovsk Region. *Gigiena i sanitariya*, 2012, vol. 94, no. 2, pp. 114–119 (in Russian).

15. Onishchenko G.G. Health risk assessment and management as an effective tool to solve issues to ensure the health and epidemiological well-being of the Russian Federation population. *Health Risk Analysis*, 2013, no. 1, pp. 4–14. DOI: 10.21668/health.risk/2013.1.01.eng

16. Vasil'ev A.V., Zabolotskikh V.V., Tereshchenko I.O., Tereshchenko Yu.P. Information Analysis System for Population Health Risk Assessment under the Conditions of Urban Lands. *Ekologiya i promyshlennost' Rossii*, 2013, no. 12, pp. 29–31 (in Russian).

17. Bobkov V.N. O doktrinal'nykh polozheniyakh strategii sotsial'nogo razvitiya Rossii [On doctrines in the social development strategy in Russia]. *Uroven' zhizni naseleniya regionov Rossii*, 2008, no. 5, pp. 48–62 (in Russian).

18. Balyukina L.A., Gusev A.L., Zaitseva N.V., Shur P.Z. Planirovanie vybora modeli dlya upravleniya riskami zdorov'yu naseleniya v sisteme Rospotrebnadzora [How to plan on selecting a

model for population health risk management within Rospotrebnadzor system]. *Nauchnye osnovy i mediko-profilakticheskie tekhnologii obespecheniya sanitarno-epidemiologicheskogo blagopoluchiya naseleniya: sbornik statei Vserossiiskoi nauchno-prakticheskoi konferentsii s mezhdunarodnym uchastiem,* 2009, pp. 230–234 (in Russian).

19. Zaitseva N.V., Goleva O.I., Shur P.Z. Sistema pokazatelei otsenki ekonomicheskoi effektivnosti meropriyatii po snizheniyu riska dlya zdorov'ya naseleniya [A system of parameters for assessing economic efficiency of measures aimed at reducing population health risks]. *Gigienicheskie i mediko-profilakticheskie tekhnologii upravleniya riskami zdorov'yu naseleniya v promyshlenno razvitykh regionakh: materialy II nauchno-prakticheskoi konferentsii s mezhdunarodnym uchastiem*, Perm, 2011, pp. 7–10 (in Russian).

20. Zaitseva N.V., Shur P.Z., Goleva O.I. An economic assessment of population health risk in region. *Ekonomika regiona*. 2012, no. 2, pp. 178–185 (in Russian).

Barmin Yu.Ya., Gurvich V.B., Kuz'min S.V., Malykh O.L., Tsepilova T.M., Shevchik A.A., Yarushin S.V. Methodical approaches to medium-term planning and assessing health risk management efficiency in a municipal entity (by the example of an industrially developed city). Health Risk Analysis, 2019, no. 2, pp. 21–34. DOI: 10.21668/health.risk/2019.2.03.eng

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