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Approaches to Defining Scientific Priorities in Healthcare and Medicine: The Russian Experience

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Abstract—Most countries use their own procedures for decision making, as well as collecting and analyzing information to determine scientific priorities in medicine. This paper describes the system of organization and management for healthcare and medical science in Russia. The procedures for forming scientific priorities in medicine in the post-Soviet period are described. The necessity of applying modern methods in the selection of scientific priorities is substantiated.

Keywords: healthcare, medicine, scientific priorities, decision making
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INTRODUCTION

The collapse of the Soviet Union and the formation of new independent states led to significant changes in the system of organization of healthcare and medical science in Russia. The transformation of healthcare into a service sector, which began at the end of the Soviet period, accelerated. The healthcare management system has been repeatedly reorganized, sometimes merging and sometimes disconnecting from the social protection system. The budgetary financing of healthcare was noticeably reduced, the volume of paid medical services expanded, which began to increasingly crowd out free state medical care. The drug supply of the population has decreased, and there is a periodic shortage of essential drugs, preparations, and medicines in pharmacies and healthcare institutions. The widespread transition to compulsory health insurance has significantly hampered the general availability of medical and sanatorium services and decreased their quality. The notorious "optimization" has caused significant damage to the network of medical institutions in the country and, in fact, has boiled down to its destruction.

Most countries use their established procedures for decision making and collection and analysis of information when determining scientific priorities in medicine. The experiences of foreign countries and the Soviet Union were highlighted in [1–4]. Modern Russia is no exception. The problems of choosing priorities in the field of healthcare and medical science in the post-Soviet period were discussed in [5–8]. Specialized health services play a significant role in the implementation of scientific priorities [9, 10]. Much attention is paid to topical aspects of personalized medicine [11–13]. The advantage of patient orientation in the provision of medical care is substantiated in [14, 15]. The long-term influence of demographic factors and risk factors (environmental, social, psychological, behavioral, etc.) on the health status of the population is studied in [16–20]. The effectiveness of healthcare reform and improving the quality of medical care are analyzed in [21–24]. Compulsory health insurance issues are discussed in [25–28]. The role of informatization of the healthcare system in the selection of priority areas of medical research was noted in [29, 30]. The main approach to prioritization is cost-benefit analysis. At the same time, it is necessary to take into account other criteria, in particular, the opinions of medical workers and patients, the factor of fairness, ethical aspects, the transparency of the decision-making process, and the practical feasibility of priorities.

This study completes a series of articles on the analysis of the experience of defining scientific priorities in medicine [3, 4]. The paper analyzes the organization and management of healthcare and medical science in Russia. The procedures for the formation of scientific priorities in domestic medicine are outlined. The advantages and disadvantages of the applied approaches

are noted. The necessity of use of modern methods in the selection of scientific priorities has been substantiated.

1. ORGANIZATION AND MANAGEMENT OF HEALTHCARE AND MEDICAL SCIENCE

After the collapse of the Soviet Union, a mixed healthcare system has developed in Russia, including state federal and municipal institutions, as well as private medical and pharmaceutical organizations. The Ministry of Health of the Russian Federation carried out general management of the sphere of public health protection in the country. The Russian Academy of Medical Sciences (RAMS), which is the successor to the USSR Academy of Medical Sciences, determined the strategy for the development of medical research. The main scientific potential of domestic medicine was concentrated in the Russian Academy of Medical Sciences and the Ministry of Health of the Russian Federation. Fundamental studies in the field of life sciences were carried out by 50 institutes of the RAMS. Applied research and development were carried out at 54 scientific institutes and centers of the Ministry of Health of the Russian Federation. Most of the medical research organizations were located in Moscow, St. Petersburg, Novosibirsk, Kazan, and Nizhny Novgorod.

In 2013, the RAMS was included into the Russian Academy of Sciences (RAS) as one of its departments. The Russian Academy of Sciences itself was actually abolished as an independent state department, since all academic institutions were subordinate to the Federal Agency for Scientific Organizations (FANO), whose powers were transferred to the Ministry of Science and Higher Education of the Russian Federation in 2018.

Internal expenditures on research and development as a percentage of gross domestic product (GDP) were 0.85% in Russia in 1995, 1.05% in 2000, 1.29% in 2003, 1.07% in 2006, 1.13% in 2010, and 1.10% in 2016 (34th place in the world). In 2000–2016, the share of allocations varied in the range of 0.11%–0.21% for basic research and in the range 0.13%–0.43% for applied research and decreased after 2013, the year of the abolition of the RAS and RAMS [31]. The number of personnel engaged in research and development decreased in 1995 from 1061.0 thousand people, including 518700 researchers, to 722300 people, including 370400 researchers, in 2016. This happened mainly in fundamental research, whose volume ordered by the state significantly decreased. In 2010–2018 the number of graduate students decreased from 157400 to 90800, of which 32% study on a paid basis [32]. The brain drain to other countries increased. Research institutes sold science-intensive products, actively participated in contract research, and leased part of their premises to commercial structures.

Total expenditures on healthcare as a percentage of GDP was 3.9% in 2006 (public 3.2%, private 0.7%), 5.0% in 2010 (public 3.1%, private 1.9%), 5.1% in 2013 (public 3.2%, private 1.9%), and 5.3% in 2016 (public 3.0%, private 2.3%). Current per capita expenditures were equal to 493 USD in 2007, 567 USD in 2010, 811 USD in 2013, and 469 USD in 2016 [33].

According to the Federal State Statistics Service, the country had 9500 hospital organizations and 21800 polyclinics and outpatient clinics in 2005; in 2010, their number was 6300 and 15700, respectively; in 2016, their number was 5400 and 19100, respectively [34]. By 2019, the number of hospitals, clinics, outpatient clinics, and feldsher-obstetric points in rural areas significantly decreased and the bed capacity was reduced. The healthcare reform that began in 2015 has failed. As follows from the materials of the Accounts Chamber of the Russian Federation, as of the beginning of 2019, most of the buildings in which medical care is provided (more than 116800) were in an unsatisfactory technical and sanitary condition and 14% of them were in emergency condition; 30% of buildings lacked running water, 35% lacked sewerage, 41% had no central heating, and 52% lacked hot water supply. In 47% of the buildings, accessibility for disabled people and people with limited mobility was not provided. Compared to 1985, the situation became even worse than it was in the Soviet Union [4, 35, 36].

The number of doctors is decreasing and their quality characteristics are deteriorating. Thus, in 2000, 608700 doctors worked in medical organizations in Russia, of which 48% had a qualification category. In 2017, their number was reduced to 548400 doctors, of which 45% had a qualification category. The provision of the population with doctors per 10000 people decreased from 41.9 in 2000 to 37.2 in 2015 [33]. Due to the mass reduction in staff and low wages, there was an acute shortage of paramedical personnel, that is, nurses, medical assistants, hospital attendants, and ambulance drivers.

The situation with medical science is no better. In 2010–2012, out of the six priority areas of development of science, technology and engineering in the Russian Federation, life sciences accounted for the smallest allocations from the federal budget. In the United States, unlike Russia, life sciences account for more than half of government spending on the civilian science sector. In 2015, the base funding of the US National Institutes of Health, which unites 27 research centers, was 30.2 bln USD, and the base funding of 104 medical research institutes that are subordinate to the Ministry of Health of Russia and the FANO was 0.18 bln USD (at the rate of 60 rubles per dollar). For applied research, 63 medical universities received only 1.110 bln rubles, or 18.5 mln USD [37]. Due to the lack of government funding, many medical research institutions were forced to earn money by providing commercial medical services to the population, in particular, treating patients on a paid basis.

In Russia, internal expenditures on research and development in the field of medicine were distributed in 2007–2017 as follows: approximately 40% was used for basic research, 50%, for applied research, and 10%, for development. In the United States, about 60% of the budget is allocated for basic biomedical research, 30% for applied research, and 10% for other work. In the United States, the number of medical researchers has increased from 212000 to 283000 people over the past 10 years. The number of researchers is growing every year, including that due to the active migration of scientists from developing countries. In Russia, the number of researchers in the field of medical sciences has almost stabilized in recent years: 15700 people in 2005, 16500 people in 2010, and 16100 people in 2016 [31]. The average age of research workers has increased markedly. Under the conditions of financial instability and low wages, many workers in scientific institutions have gone into the commercial sector, including that not related to medicine. Leading scientists have been left almost without engineering, technical, and support personnel. The downward trend in postgraduate studies can also be traced in the areas of training such as fundamental medicine, clinical medicine, health sciences and preventive medicine, and pharmacy, where the number of postgraduates was almost halved from 2010 to 2018 from 7900 to 4800 people [32].

"Optimization" of healthcare has also affected the scientific organizations of a medical profile, which moved from the RAMS to the subordination of the FANO. All scientific organizations were divided according to the size of scientometric indicators into three categories of "efficiency" [38]. The third category of organizations that do not show significant scientific results include scientific centers that are recognized in the world. These include A.B. Zborovsky Research Institute of Clinical and Experimental Rheumatology, Research Institute for Complex Problems of Hygiene and Occupational Diseases, Research Institute of Eye Diseases, G.P. Somov Research Institute of Epidemiology and Microbiology, and the Research Institute of Human Morphology.

Thus, scientific organizations that conduct high-quality research that are necessary to ensure the health of Russian people will receive less funding compared to institutes of the first category on a formal basis. This formal approach has already led to irreversible changes. A number of institutions have been closed. Scientific and engineering personnel have been reduced. In developed countries, scientific organizations are not ranked. Stimulation is provided for their cooperation rather than competition in ratings.

2. SCIENTIFIC PRIORITIES IN MEDICINE IN THE POST-SOVIET PERIOD

Determination of priority areas of development is a key task in the development of forecasts, plans, socio-economic, and scientific and technical programs. In modern Russia, the priorities in healthcare and medical science are determined by the Government of the Russian Federation, the Ministry of Health of Russia, and scientific foundations.

The concept of development of healthcare and medical science in the Russian Federation for 1997–2005, which was approved by a decree of the Government of the Russian Federation [39], notes the deterioration of the health status of the population in recent years. The amount of funding for healthcare does not provide the population with free medical services and the available financial and material resources are used ineffectively. Imbalances in the provision of medical care are growing and social tensions are growing in the industry. A crisis in the activities of medical institutions is approaching, which may lead to the collapse of the entire healthcare system. A healthcare reform strategy is needed, which must be aimed at preserving and improving people's health and lowering direct and indirect losses to society by reducing morbidity and mortality. The main objectives are to increase the volume of disease prevention activities, to reduce the terms of restoration of the lost health of the population by introducing modern methods of prevention, diagnosis, and treatment into medical practice, and to improve the efficiency of resource use in healthcare.

The main priorities in the field of healthcare are as follows:

– improvement of the organization of medical care, development of primary healthcare on the basis of municipal healthcare, the institute of general (family) practice, consultative and diagnostic services in polyclinics, and the redistribution of part of the care from the inpatient sector to the outpatient one;

– improvement of the healthcare financing system, establishing a close dependence of the size of financing of medical institutions on the volume and quality of services provided by them;

– development and improvement of the state sanitary and epidemiological service, effective functioning of the service that ensures the improvement of health protection of the population;

– modernization of the industry management structure for the implementation of a unified state policy in the field of healthcare; improving medical education and personnel policy;

– creating the conditions for the development of the private sector with maintaining the dominant role of state and municipal healthcare and providing medical organizations of various forms of ownership with equal rights to participate in the implementation of state health programs and municipal orders on a competitive basis;

– ensuring the state guarantees for providing the citizens of the Russian Federation with free medical care at the expense of the corresponding budgets, payments for compulsory health insurance and other

receipts, improvement of drug supply, and guarantees in the field of drug care to the population.

The provision of high-quality medical care requires ensuring the continuity of the treatment and diagnostic process at all stages of treatment, the introduction of standards for the diagnosis and treatment of patients; developing a service for the protection of mothers and children while concentrating efforts on improving primary healthcare for children and adolescents, as well as psychiatric and drug addiction assistance to the population; strengthening the ambulance service, making it more mobile and equipped with modern means for the provision of emergency medical care and emergency hospitalization of patients; introducing modern technologies in the units of intensive care, cardiology, and cardiac surgery, oncology, as well as diagnostics and treatment of socially significant diseases; increasing the role of scientific centers and research institutes in the development and implementation of effective medical technologies, the use of unique methods for diagnosis and treatment; improving rehabilitation assistance, and developing sanatorium and health resorts and health institutions and organizations.

The main tasks of medical science are as follows:

– the formation of a strategy for maintaining and strengthening the health of the population, the development of scientific foundations for combating the most common diseases;

– obtaining new knowledge and deepening existing knowledge about a healthy and sick person, their life, and adaptation to environmental conditions on the basis of fundamental research;

– development of new methods of prevention, diagnosis, and treatment of diseases, restoration of lost health, and increasing the duration of a person's active life;

– development of new schemes for the organization of medical care and healthcare management.

The solution of the set tasks requires the following: concentration of scientific and technical potential and resources in priority areas of medical science; an increase in the role of target-oriented planning, an increase in the quality of expert examination of scientific research and ethical control over their conduct; budget financing of fundamental and applied research on a competitive basis; state support for research teams that make a great contribution to the development of domestic and world medical science, the use of off-budget sources of funding (international projects, foundations, etc.); development of regional scientific and practical units, development of programs and conduct of research; expanding links between science, technology, and production; legislative consolidation of legal mechanisms for the development of medical science; development of scientific and technical entrepreneurship, the creation of small innovative enterprises and pilot industries; and protection of the intellectual property rights of researchers to the results of scientific activity.

In 2014, the "Healthcare Development" State Program for 2013–2020 was approved [40]. The program is aimed at improving the health of the population and the performance indicators of healthcare organizations on the basis of constant modernization of the technological base of the industry, the development of medical science and education, the improvement of the staff, and the introduction of information technologies and modern management standards.

The goal of the program is to ensure the availability of medical care and increase the efficiency of medical services, whose volumes, types, and quality must correspond to the level of morbidity and the needs of the population and the advanced achievements of medical science. Within the framework of the program, the following tasks are being solved:

– ensuring the priority of prevention in the field of health protection and the development of primary healthcare;

– increasing the efficiency of the provision of specialized medical care, including high-tech care, as well as emergency medical care;

– development and implementation of innovative methods of diagnosis, prevention and treatment, as well as technologies of personalized medicine; increasing the efficiency of the obstetrics and childhood services;

– development of medical rehabilitation of the population and improvement of the system of sanatorium treatment;

– provision of palliative care for patients suffering from incurable diseases;

– providing the healthcare system with highly qualified and motivated personnel;

– increasing the efficiency and transparency of control and supervisory functions in the field of health protection.

The main planned results are as follows: creation of sustainable motivation of the population to maintain a healthy lifestyle; increasing the satisfaction of the population with the quality of medical care; creating the conditions for any citizen of the country regardless of his or her place of residence to receive a guaranteed volume of medical care that meets uniform requirements for accessibility and quality; the formation of scientific and educational clusters on the basis of the best medical universities; the establishment of uniform state priorities in the field of biomedicine, the creation of new scientific schools; increasing social attractiveness, the level of qualifications of medical personnel and the prestige of the profession, including on the basis of a significant growth in wages; and creation of the conditions for population growth and increase in life expectancy.

The effectiveness of the implementation of the state program is determined by the achievement of the following target indicators by 2020:

– reduction of mortality from all causes to 11.4 cases per 1000 people; reduction of infant mortality to 6.4 cases per 1000 live births;

– reduction of mortality (per 100000 people) from diseases of the circulatory system to 622.4 cases, from road traffic accidents to 10 cases, from neoplasms (including malignant ones) to 190 cases, from tuberculosis to 11.2 cases;

– reduction of the consumption of alcoholic products (in terms of absolute alcohol, liters per capita per year) to 10 and reduction of tobacco consumption to 25% among the adult population and to 15% among children and adolescents;

– reduction of the incidence of tuberculosis to 35 cases per 100000 people;

– increase in life expectancy at birth to 74.3 years;

– increase by 2018 in the average salary of doctors and workers of medical organizations with higher medical education (pharmaceutical) or other higher education that provide medical services from the average salary in the relevant region to 200%, increase in the average salary of nursing (pharmaceutical) personnel and junior medical personnel (personnel that ensures the conditions for the provision of medical services) from the average salary in the relevant region to 100%.

The program has not been fully completed. In 2017, a new version of the "Healthcare Development" State Program for 2018–2025 was approved [41]. The general orientation of the program was preserved. The terms and stages of the program were changed, the structure was revised, the target indicators and their values, the parameters of the financial support of the program as a whole, as well as subprograms and priority projects were adjusted. Since 2018, the program was transferred to project management. The implemented projects include the following: the formation of a healthy lifestyle (strengthening public health); creation of a new model of a medical organization providing primary healthcare; ensuring the timely provision of emergency medical care to citizens in hard-to-reach regions of Russia; and development of the export of medical services.

The main targets of the program are as follows:

– improving the provision of medical care, including the prevention of diseases and the formation of a healthy lifestyle;

– development and implementation of innovative methods for diagnosis, prevention and treatment, as well as the basics of personalized medicine;

– development of medical rehabilitation and spa treatment, including for children;

– development of human resources in healthcare;

– development of international relations in the field of health protection;

– expertise and control and supervisory functions in the field of health protection;

– medical and sanitary provision of certain categories of citizens;

– information technology and management of industry development;

– organization of compulsory medical insurance for citizens of the Russian Federation.

In 2019, a strategy for the development of healthcare in the Russian Federation for the period up to 2025 was approved and a new version of the Healthcare Development State Program for 2018–2025 was adopted, where an increase in the satisfaction of the population with the quality of medical care by 2025 was excluded from the program results [42].

At the end of 2019, a program of state guarantees for the provision of free medical care to citizens for 2020 and for the planning period of 2021 and 2022 was developed, but did not enter into force [43]. The program establishes a list of types, forms, and conditions of medical care that is provided free of charge; a list of diseases and conditions for which medical care is provided free of charge; categories of citizens for whom medical care is provided free of charge; average standards for the volume and financial costs per unit of the volume of medical care; average per capita financing standards; the procedure and structure for the formation of tariffs for medical care and methods of payment for it; requirements for territorial programs of state guarantees for free provision of medical care to citizens; and the procedure and conditions for the provision of medical care, as well as criteria for the availability and quality of medical care.

The Russian Foundation for Basic Research (RFBR) determines the priority areas of research when conducting targeted competitions [44]. The priority areas are formed by the management of the foundation and expert councils. All applications for research grant support submitted to the RFBR competition and the results obtained during the implementation of the projects are subject to an independent examination that is carried out by two or three experts. The content of the application, intermediate and final results are evaluated according to many criteria reflecting the specifics of the competition. For many years since the creation of the foundation, the procedures for expert evaluation of projects have been based on the methods of verbal analysis of decisions [45, 46].

As an example, projects of targeted fundamental research carried out in the interests of federal agencies and departments were evaluated according to 11 qualitative criteria combined into two groups: the scientific characteristics of the project and the assessment of the potential for the practical implementation of the project. The criteria for evaluating the scientific character-

istics of the project were as follows: the level of fundamental nature of the project; result orientation; research objectives; methods of achieving the goal of the project; nature of research; scientific significance of the project; the degree of novelty of the proposed solutions; the potential of the performers; and technical equipment. The criteria for assessing the potential for practical implementation of the project were as follows: the final stage of fundamental research proposed in the project and the scope of applicability of the results of the studies.

Most of the criteria had ordinal or nominal rating scales with verbal grades of quality. Thus, the scale of the criterion "The degree of novelty of the proposed solutions" was as follows: the solutions were formulated for the first time and significantly exceed the level of the existing ones; the solution is at the level of existing solutions; and the solution is inferior to the existing solutions.

During the expert examination of project reports, the results and expected results of the final stage of the project were assessed. The criteria for assessing the results of the project are as follows: the degree of implementation of the stated project objectives; assessment of the scientific level of the results; patentability of the results; and prospects for using the results. The criteria for assessing the expected results of the final stage of the project characterized the potential for practical implementation of the project. As an example, the degree of fulfillment of the tasks declared in the project was assessed on the scale: tasks have been completed in full, tasks have been partially completed, and tasks have not been completed.

The foundation is providing increasing support for large projects of fundamental interdisciplinary research, about half of which are related to medicine. These include the following: genomics for personalized medicine; fundamental problems of diagnosis and treatment of cancer; fundamental problems in research of mental health of individuals and society; study of the mechanisms of functional reactions of the central nervous system and cognitive activity to the effects of radiation and other extreme factors in model experiments on animals; the use of information and analytical methods in the development of biomedical cell technologies and technologies of regenerative medicine; complex technologies (methods) of biophotonics for the diagnosis and treatment of eye diseases; interdisciplinary fundamental problems in the reconstruction of organs and tissues; methods and models of artificial intelligence and their applications in computational linguistics, neurophysiological research and medicine; big data in the post-genomic era; ceramic materials for electronics and medicine; synthetic biology; fundamental problems of biomedical radio electronics; study of human brain gliomas using neuroimaging, molecular biological, optical-physical and digital technologies to optimize personalized algorithms for diagnosis, treatment, and prognosis; and legal regulation of genomic research.

In the Russian Science Foundation, scientific priorities are formed in the announcement of competitions for grants [44]. Priority proposals are reviewed by the foundation's expert council bureau and are then evaluated by the expert council according to three composite criteria that reflect the scientific, technological, and socio-economic aspects of research. Scientific areas are ranked on the basis of scores. Twelve priority areas with the highest rating are approved by the Board of Trustees of the Fund. The priorities are reviewed every 3 years. Two areas in the field of medicine are relevant: new approaches to combating infectious diseases and restorative, regenerative, and adaptive medicine.

3. FORECASTS OF THE DEVELOPMENT OF MEDICAL SCIENCE IN RUSSIA

Forecasts of the development of priority areas of scientific research serve as a starting point in the development of long-term socio-economic plans and programs.

The first post-Soviet forecast for the development of the most important areas of fundamental research and expected results was developed in 1999 by the Institute for Systems Analysis of the Russian Academy of Sciences on the initiative of the Ministry of Science and Technology of the Russian Federation within the framework of the interdepartmental scientific and technical program Prospects for the Scientific and Technological Development of Russia until 2010 [47, 48]. Formed with the involvement of highly qualified experts, the list of the most important areas included almost 160 areas of fundamental research in physical and mathematical sciences, technical sciences, chemical sciences and materials sciences, life sciences, earth sciences, agricultural, and medical sciences.

Forecasts in the field of medicine were made in the following areas:

– scientific foundations of human vital processes in health and disease;

– protection of the health of children and adolescents;

– new methods of prevention, diagnosis, treatment, and rehabilitation of cardiovascular diseases;

– new methods for prevention, diagnosis, treatment, and rehabilitation of oncological diseases;

– scientific foundations of the pathogenesis of tuberculosis and granulomatous respiratory diseases;

– scientific foundations of the pathogenesis, diagnosis, and treatment of diseases of the endocrine system;

– new methods for diagnosis, treatment, and prevention of nervous system diseases;

– fundamental problems of etiology, pathogenesis, and correction of mental illness;

– mechanisms of alcohol and drug addiction;

– experimental and clinical hematology, transfusiology, blood, and donor service;

– scientific foundations of the etiology and pathogenesis of rheumatic diseases;

– reconstructive surgery, transplantation and prosthetics, anesthesiology, and resuscitation;

– medical microbiology, virology, immunology, parasitology, and epidemiology;

– human ecology and environmental hygiene;

– patterns and mechanisms of the influence of factors of the working environment and labor process on health;

– pharmacological regulation of normal and pathological processes;

– scientific foundations of economics and healthcare management in Russia.

Leading Russian scientists provided the expertise of the areas. For each scientific area, an analysis of the state and trends in the development of research for the future was carried out, highlighting new points of growth of scientific knowledge and the most pressing problems, on which, according to the expert, the main attention will be focused in the next 10 years. The expert assessed the significance of each problem according to criteria reflecting the opportunities for discovering new promising ways of developing science and technology; significantly changing the idea of the world around us; creating new means to meet the most pressing and urgent practical needs; and having a noticeable impact on various spheres of human life and society and the state of the natural environment. For each problem, the position occupied by Russian science in the world scientific community was assessed, the most significant results in recent years in Russia and abroad were presented, and the most important results that could be obtained in the next 10 years were formulated. The expert also assessed possible areas of practical application of the results in developing new progressive technologies or improving existing ones.

An important part of the forecast was the analysis of factors affecting the effectiveness of research, including the level of their provision with scientific personnel (number and qualifications, age composition), material and technical equipment (availability of modern scientific equipment, computers, devices, materials, reagents), access to world information resources, and the level of development of international scientific relations of Russian scientists. In the final part of the forecast, the expert expressed his point of view on possible ways of preserving and developing fundamental science in Russia.

The expert examination technique was based on the methodology of verbal decision analysis [45, 46]. The criteria for assessing the areas had verbal gradations of scales with detailed formulations. Determination of the best object, ordering, or classification of objects were carried out only on the basis of qualitative assessments without converting them into a quantitative form. The results were also described in a qualitative form, which made it possible to interpret them in a language familiar to an expert or a decision maker. Based on the analysis and generalization of expert opinions, review materials were developed that reflected the state and prospects of development of the fields of domestic science, and proposals for the development of fundamental research in Russia were prepared.

In 2014, the Higher School of Economics developed a forecast for the scientific and technological development of Russia until 2030 by the order of the Ministry of Education and Science of the Russian Federation [49]. The forecast identified the following thematic areas of applied research in the field of healthcare that are most promising for Russia and provide a significant contribution to solving socio-economic problems and implementing the country's competitive advantages:

– promising drugs for the prevention and treatment of socially significant diseases (cardiovascular, neurological, oncological, hematological, autoimmune, endocrine, infectious diseases, etc.);

– molecular diagnostics; new diagnostic methods and systems based on technologies for determining the structure and function of biological molecules (nucleic acids, proteins, lipids, polysaccharides, and low-molecular-weight compounds);

– molecular profiling and identification of molecular and cellular mechanisms of pathogenesis;

– biomedical products based on regenerative and cellular technologies that are designed to restore the structure of organs or tissues disturbed by the disease in cardiovascular, oncological diseases, dysfunction of internal organs, burn disease, trophic ulcers, and metabolic diseases and injuries;

– biodegradable and composite materials for medical purposes, new generation products from multicomponent biocompatible materials for cardiology, oncology, orthopedics, traumatology, dentistry, and other areas of medicine;

– methods and hardware and software complexes for diagnostics and treatment based on technologies of directed action of electromagnetic fields, high-energy radiation; electrodynamic modeling of cells and tissues; and new interfaces for registration and correction of the state of the organism;

– national databases of genomic information; network of centers for applied genomic research; and a databank of potential biotargets.

As early as in the medium term, it is expected that the country will create biocompatible biopolymer materials; self-sterilizing surfaces for medicine; test systems based on genomic and post-genomic technol-

ogies for the diagnosis of cancer, systemic, infectious and hereditary diseases; biosensors and biochips for clinical diagnostics using new types of biological devices; and methods for the rapid identification of toxic substances and pathogens.

Forecasts were developed applying modern Foresight tools and the integration of normative and research approaches to forecasting was implemented [5]. The normative approach was problem-oriented (market) in nature: first, key challenges and windows of opportunities were identified for the selected scientific and technological areas and then the corresponding solutions in terms of "technology packages" or other answers were found. The research approach was aimed at identifying promising products and breakthrough technologies. The used forecasting tools were both traditional methods (prioritization, building images of the future, roadmaps, and analysis of global challenges) and fairly new approaches (scanning horizons, weak signals, wild cards, etc.).

To select the priorities of applied science aimed at creating scientific and technological groundwork, the following criteria were used. The priorities included research that could lead to the emergence of new markets or market niches, products with new properties, innovative services in the long term; they are interdisciplinary, intersectoral in nature; will allow answering the challenges facing the priority area; contribute to the formation of a technological platform for the future economy and society; and are able to solve key scientific problems in the considered area and create a reserve for the future.

The level of Russian research in each thematic area was assessed on the scale: blank spots: a significant lag behind the world level, the absence (or loss) of scientific schools; groundwork: the presence of basic knowledge, competencies, infrastructure that can be used for the accelerated development of the relevant areas of research; the possibility of alliances: the presence of individual competitive teams that carry out research at a high level and are able to cooperate on an equal footing with world leaders; parity: the level of Russian research is not inferior to the world level; leadership: Russian researchers are world leaders. It was assumed that the assessments of experts were in the range between several values.

The prospects of the areas were determined by the automated analysis of databases of patent services (Rospatent, the United States Patent Office (USPTO), the European Patent Office (EPO), the World Intellectual Property Organization (WIPO), etc.) and databases of international journals (ISI Web of Knowledge of the Thomson Reuters Company, and Scopus of the Elsevier Company, Russian Science Citation Index, etc.). For this purpose, scientometric indicators and indicators of thematic proximity were calculated using the keywords of scientific publications and patents related to the relevant areas. It is obvious that the representativeness of the forecast estimates and the obtained conclusions largely depends on the completeness and quality of the initial data. We also note that publications and especially patents quite often reflect yesterday's knowledge, which may be outdated by the time of publication. Every day brings about new results and new knowledge, which cannot be assessed without the help of experts.

CONCLUSIONS

As this study has shown, the situation in the field of health protection is characterized by a significant reduction in the potential for regulating the healthcare system and a decrease in the influence of the interests of society on the ongoing processes. Decentralization of industry management combined with the destruction of the RAMS was accompanied by the erosion of the responsibility of regulatory bodies for the development and implementation of state policy. The procedures for setting scientific priorities in medicine need to be strengthened. Poor coordination of federal, regional, and local health authorities has led to inefficient use of material and financial resources. The creation of an effective healthcare system requires reform of the forecasting, planning, and management of healthcare and medical science and the development of modern methods for supporting managerial decision making.

Healthcare must become more accessible and focused on prevention and early detection of diseases and providing high quality medical care. Preference is given to the development of primary healthcare and general practitioners. It is necessary to restructure the network of hospitals, outpatient clinics, emergency services, and emergency specialized medical care. The widespread introduction of new medical technologies is required. Attention must be paid to improving working and environmental conditions and promoting a healthy lifestyle. New organizational and legal mechanisms for interaction between authorities of different levels and the scientific community must be introduced for the effective use of resources.

In the field of health protection, a fruitful influence is exerted by the environment in which well-proven approaches are applied, namely: the organization, creation, and development of institutions and systems of institutional decision support, as well as deep integration of modern methods and management processes. It is important to involve representatives of the scientific community in the identification of priorities at the earliest possible stages. Weak participation or the absence of interested parties in the priority setting process reduces the degree of confidence in decisions. When solving practical problems of healthcare, it is necessary to make wider use of existing scientific developments on methods for determining priorities [4, 5, 44–50], then there will be more chances for making informed management decisions. Under the

conditions of a long-term financial deficit, society needs to unite its efforts around the common goal of ensuring human health. After all, if the health of the population is poor, there will be no economic development.

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