

# SCIENTIFIC AND METHODOLOGICAL APPROACHES TO RISK ANALYSIS IN HYGIENE AND EPIDEMIOLOGY

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## HISTORY OF "HEALTH RISK" AND ITS PLACE IN THE DEVELOPMENT OF PREVENTIVE MEDICINE

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*The main stages of the introduction and development of preventive medicine and the term HEALTH RISK are described. The "risk" definition is related to the works by Max Fasmier and Frank Knight. The development of preventive medicine was also influenced by the works of scientists and physicians of the ancient world and the Middle Ages. Particular attention is paid to the appearance, formation and development of the medical school of Salerno, and the impact of its work and the activities of scientists and teachers on further development of prevention and treatment. The relationship of these two concepts and their history is shown. The author dwells on the prevention development in Russia, paying particular attention to domestic researchers, especially after the victory of the Great October Revolution. Works by N.A. Semashko, Z.P. Soloviev, G.V. Khlopin, A.N. Sysin and F.G. Krotkov played a huge role in the development of preventive medicine in Russia and in the world. The article also represents the prevention medicine development facts in the post-war years – the creation of large schools of medicine, aimed at the prevention of diseases and epidemiological studies of the risk incurred. The article also pays attention to the foundation of International Institute for Applied Systems Analysis (IIASA), some areas of its work, especially in relation to research on the health risks. The integration at mathematical modeling and forecasting with medicine in general and health in particular, as well as the study of the health concepts of risks at individual nosological examples are written.*

**Key words:** preventive medicine, risk factors, health risks, history of medicine, epidemiological studies, industrial hygiene, occupational health.

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The word "risk" has a very ancient origin and multifaceted meaning. Deriving from the ancient Greek vocabulary almost three thousand years ago, it literally means "cliff", "rock", and "foot of the mountain." And the verb "to risk" meant "to maneuver between the rocks", exposing yourself to danger. This was the literal definition by a famous linguist and expert on ancient Slavic languages and German origin, a foreign member of the USSR Academy of Sciences Max Julius Friedrich Vasmer [8].

The term "risk" entered the scientific and journalistic literature in 1921, when the monograph by Frank Knight Heineman "Risk, Uncertainty and Profit" came out. The book enjoyed unprecedented popularity. Since its appearance almost a hundred years ago, it has been repeatedly re-published and translated into

many languages, including in Russian in 2003. A graduate of Cornell University, who later became a prominent American scientist, one of the founders of the Chicago School of Economics, was the first to use the term "risk" in scientific and business literature. However all of his research and analytical findings were associated with purely economic issues and profits. But it was Knight who introduced the very first definition of "risk" as "rigid structure combining the probability and effects of hazardous events." [5].

With regard to health and scientific medical issues, the term "risk" appeared later, approximately in the middle of the XX century. However, similar terms that imply the same meaning, appeared together with the first sprouts of preventive thinking in medicine. The works of

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some doctors and healers of the ancient world already contained statements about disease prevention. Often it was given as much attention as therapy. In other words, it was the first attempt to analyze health risk.

It was in those days when the first works on the causes of certain diseases and environmental conditions in which they arose were published. Hippocrates in one of his works wrote: "... not only the physician should use all that is necessary to treat a disease, but also the patient, and the surrounding, and all external circumstances should help the doctor in his work."

In the heyday of ancient Egypt there were works, in which the need for an early waking-up, gymnastics and rubdown with cold water, were seen as the ways to protect health. Later, during the times of slavery, the concept of public sanitation was generated. For example, in the Greek Sparta, there was an expanded concept of hygienic and physical education; and the law of ancient Rome included basic sanitary measures (normalized and careful use of water, food control, etc.) [1].

One of the major scientific works of the Middle Ages was the work by an alchemist-physician Arnoldus de Villa Nova, 1235-1311 "The Code of Salerno's health." The book was published in 1480 and was written in the verses by the canons of the time. Arnold, being of Hispanic origin, created a voluminous work which paid particular attention to preventive measures. In one of the chapters the author wrote: "If there are not enough doctors, let the following three doctors treat you: a cheerful character, peace and moderation in food."

This work could be possibly called the primary source of the concept of risk. It was there that the author for the first time in literature showed a variety of circumstances that lead to a disease. The author discussed the combined effect of several factors, ie a systematic approach to the emergence of diseases. Particular attention was paid not to a person's lifestyle, but to the person's surroundings, focusing on the hardships of labor in agriculture [2].

In general, Schola Medica Salernitana, which arose in the second half of the IX century as the highest medical school in Salerno near Naples, rightfully claims the title of the earliest supreme scientific institution in Europe. However, it was never called a University, which was essential in those days. Great Emperor Frederick II (1212-1250) gave the school, the only one in the Holy Empire, the exclusive right to assign the name of the doctor, and prohibited to practice medicine without such license [3, 10]. Study it lasted 9 years: the first 3

years taught logic and the foundations of the natural sciences; the next 5 years to study the theory of medicine and items; last year was given to practical work.

It's quite interesting that schools were open not only to the laity and the priests, but also to women. Studies like "On the human bile", "On Melancholy" and "On the origin of human nature" were written almost a thousand years ago by the famous Abella, a doctor from Rome, and "On the embryo" and "On fevers" – by Rebecca Guarne from Mesopotamia. The most famous female teacher, according to available information, was Trotula. The legacy left by her to future generations, included the works "On the women's diseases" and "On the preparation of medicines" (1050). The latter was used by, doctors and medical scientists for nearly 700 years, and they constantly relied on those findings and conclusions [12,14].

Russia also kept up with such studies. Many archaeological findings in our country confirm the presence of the concept of personal hygiene, detailed recommendations on the cleanliness of the body, house, benefits of baths and even disease prevention. This is evidenced in oral tradition, fine and applied arts, iconography, church documents and chronicles written publications.

It is necessary to mention the merits of Peter the Great. It was during his reign when the first land and naval hospitals in Moscow, St Petersburg, and Kronstadt were discovered. That's where for the first time in Russia soldiers and sailors were given medical assistance with the account for the job-related considerations. The risk of a disease was considered, and the general and individual preventive measures were introduced in the military order.

The priority of preventive measures in medicine was reflected in the works of AN Radishchev, MV Lomonosov, AI Herzen, VG Belinsky, NG Chernyshevskogo, NA Dobrolyubov. Much later, MJ Wise, GA Zakhar'in, AA Ostroumov, NI Pirogov, AP Dobroslavin, FF Erismann, and SP Botkin pointed out a strategic role of preventive measures in prevention and treatment of diseases.

But until the XIX century, preventive medicine was based not on sound scientific evidence, backed up by a serious study of its various issues, but on a purely emotional, subjective view of a scientist. Interestingly, the people, as a result of accumulated knowledge and experience, learned to prevent disease before causes and courses were studied.

After the victory of the Great October Revolution, the government of the young republic created a favorable environment for a powerful development of preventive medicine. This was evidenced in the first decrees: On the anti-typhus activities (28 January 1919), On measures to combat epidemics (April 10 1919), On mandatory vaccination (April 10, 1919), On provision of institutions and bacteriological laboratories with necessary materials and supplies (10 April 1919), On the sanitary protection of homes (June 18, 1919), On control of typhus in the Eastern and Turkestan fronts (5 November 1919), On soap provision for the Red Army and the civilians (30 December 1919), On the sanitary checkpoints at Moscow railway stations (13 May 1920), On public baths (30 September 1920), and many others. [6]

In early 1900s, there was a lot of agitational propaganda including posters, lectures on healthy lifestyle and disease prevention. Only in 1920-1950s, Sanprosvet publishing house published over 80 thousand kinds of posters on health and health-related information [7].

A big contribution to the development of preventive medicine in Russia was made by N.A. Semashko (1874-1949). After World War I, Russia was poor and battered, and many healthcare and research institutions were destroyed. And Semashko created a progressive practical healthcare system which was later borrowed by many other countries. Its basic principles are still used in the healthcare system of England, Belgium, Japan, etc. Semashko paid a lot of attention to disease prevention emphasizing its equal importance to treatment.

In 1926-1940, standard medical examination was the main disease prevention method in the USSR. Moscow, Leningrad, Kyiv, Gorky were the first to introduce this method as mandatory procedure. Professional medical exams at enterprises were quite common as well. Though the quality of medical approach, diagnostic procedure, and equipment left better to be desired, those were the first steps in occupational disease prevention. Research works by ZP Soloviev, GV Khlopin, and later AN Sysin, FG Krotkov played an important role in the development of preventive measures and related medical fields.

After World War II, the development of preventive medicine and medical science took a different turn. In 1950-70s, departments specializing in non-infectious epidemiology, risk detection, and risk development were established at large medical research institutions including the All-Union Cardiological Research Center. Before

the War, the Center conducted major research on epidemiology and cardiovascular diseases. After the war, the Center became home to new scholarly traditions (IS Glazunov, GS Zhukovsky, LV Chazova, VI Metelitsa, RG Oganov, NA Mazur). Similar research departments were set up at other scientific centers and institutes.

The international scientific community was also making the first steps in the development of preventive measures. In 1970s, the USSR and the USA jointly opened an International Institute for Applied Systems Analyses in Laxenburg, near Vienna, Austria. It was the first international research institution specializing in system and interdisciplinary approach to Physics, Chemistry, Biology, Geography, and Medicine. The works by the Institute researchers contained science-based data on the causes of various phenomena, events, and issues, and the probability (risk) of those processes [13, 15].

The history of this Institute dates back to 1966, when the 36th US President Lyndon Johnson in the midst of the Cold War gave a speech, that "... the time has come for the United States, and the Soviet Union scientists to work together on many issues ... that have plagued all developed societies, among them energy, our oceans, environment, and health. " It was a time when a vast majority of research institutions were engaged in purely national issues. The work and achievements of the Institute were to give clear guidance to policymakers to address global issues of improving social wellbeing and environmental protection. Prominent scientists from the Soviet Union involved in the work of the Institute in the first years included the following: academician DM Gvishinani, LV Kantorowicz (Nobel Prize winner in Economics), Professor JM Albegov, GI Potemkin, GM Golubev, YI Dobrov, AI Propyl, YV Butrimovich.

In 1986 Professor EN Shigan published a monograph "Methods of forecasting and modeling in socio-sanitary research". It discusses the identification of population groups at risk of particular diseases. By analyzing the scientific literature in this area of medical science and summarizing the experience and achievements of predecessors, the authors confirm that decreased or increased health risk depends on the qualitative and quantitative mix of the various factors, the discipline of the patient in the treatment, as well as a wide range of socio-economic conditions [9].

One of the divisions of the Institute in their research brought together not only the questions

about the risk of various diseases, but also the questions of health effects associated with environmental, biological, physiological and psychological factors. Disease risks and their relation to the environment, including occupational exposure, were studied. For the first time, the problem of systematic approach to solving these issues was studied.

In 2010, the Institute developed nine "Global Research Programs" for 2011-2021. One of them was "Risk, Policy, and Vulnerability." The program clarifies the understanding of the risks to the economic, environmental, and social systems resulting from the various global changes in the world. It helps adapt and transform the joint actions to mitigate those risks. The program aims to involve the international community, with an emphasis on integration and analytics of the national health profiles [11].

So what do we mean by "health risk" or "risk to health"? All definitions and attempts to explain this concept are relative. Yet it can be defined as the probability of an adverse or negative "effect in an individual or a group of people under the impact of a certain dose or concentration of a hazardous agent in particular circumstances."

This definition, as well as others ("risk assessment", "acceptable risk", "risk analysis", "risk factors", "risk management", "control action", "risk monitoring", "Comparative analysis of risk", "identification danger", etc.) are described in detail in the guidelines for the processing and analysis of data for decision-making in environmental protection and public health, approved by the RF Ministry of Health of 27.02.2001 № 11-3 / 61-09 [4] and a number of other Russian and international documents.

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