

Vitaly Dmitrievich Belyakov – an outstanding scientist and epidemiologist

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Vitaly Dmitrievich Belyakov is one of the foremost scholars of epidemiology. He has had a significant influence on the development of Russian epidemiological and medical science in general. His theory on internal regulation of parasitic systems has boosted the formation of many scientific fields, including molecular epidemiology and population genetics. Belyakov was one of the first people in Russia to begin to study epidemiology as a science that examines the incidence of disease and other mass phenomena, reflecting the outcomes of the disease, to identify the causes and risk factors of infectious and non-infectious diseases and to use these data to develop measures to prevent disease. He can rightly be considered one of the founders of epidemiological diagnosis. Ahead of his time, he determined the epidemiological-diagnostic (analytical) activities of specialist epidemiologists to be fundamental. Academic Belyakov's ideas are largely reflected in the structure of modern epidemiology and the basic guidelines of the scientific profession. Currently epidemiology includes the epidemiology of communicable and non-communicable diseases. Belyakov developed the original concept of epidemiological surveillance, which was a significant achievement in the management of anti-epidemic efforts. He defined the theoretical, methodological and organizational basis of epidemiological surveillance.

Keywords: *V.D. Belyakov, epidemiology, epidemic process, epidemiological surveillance, epidemiological diagnosis, history of epidemiology*

Vitaly Dmitrievich Belyakov was an academic of the Academy of Medical Sciences (AMN) of the USSR and the Russian Academy of Natural Sciences (RANS), MD, and professor. As one of the foremost academic epidemiologists, he had a significant influence on the development of the national epidemiological and medical science in general. In 1964, he headed the department of general and military epidemiology at the S. M. Kirov Military Medical Academy (VMA). It was in this department that he emerged as an outstanding academic epidemiologist, a talented teacher and leader of a major academic-research and educational staff. He was awarded a title reserved exclusively for exceptional military medical personnel – Major-General of the Medical Service. His life was a journey of noble service in epidemiological science, preventive

medicine, training and education of future physicians and epidemiologists for the medical service of the armed forces and public health.

Belyakov was born on November 10, 1921, in the village of Yurtsino in the Komsomolsk district of the Ivanovo region. After graduating from high school with distinction in 1938, he entered the VMA and was a Stalin scholarship student, stoically enduring the hardships of the war years. In September and October of 1941 in besieged Leningrad, he took an active part in the night watches on the rooftops of the academic buildings, locating and extinguishing German incendiary bombs. He graduated from the VMA in 1942 in Samarkand, to where the academy had been evacuated.

During World War II and in the postwar years, Belyakov served in various positions in medical military units and formations, including as head of the sanitary-epidemiological laboratory of one of the Border Troops Directorate's districts. In April 1952, he enrolled in a postgraduate military

course at VMA's department of epidemiology with disinfection and finished ahead of schedule in 2 1/2 years, brilliantly defending his thesis. Belyakov's first teachers were Professor G. A. Znamensky and I. I. Rogozin – well-known organizers of the armed service's anti-epidemic service (navy) and the successors of the founder of the department – Professor D. K. Zablotny. Having remained at the department as a junior lecturer, Belyakov then became a teacher, and in 1957 a senior teacher. In 1959, he was awarded the academic title of assistant professor. In 1963, Belyakov received his doctorate and in 1964 he was appointed head of the department. He was awarded the title of professor in 1965.

From the beginning of his scientific and pedagogical work, Belyakov was deeply interested in the problems of general epidemiology and paid special attention to the theory of the epidemic process. His ideas were formed in the process of teaching and research work at the department, as well as while preparing together with Professor Rogozin and department staff several textbooks and teaching aids for military, public and private epidemiology (1957, 1962), which are found in the monograph "The Epidemic Process. Theories and Methods of Learning." [1] From the moment of its publication in 1964, this book (also a remarkable coincidence) remained a reference for epidemiologists. The book put forward the idea of revising certain classical provisions of the national epidemiology, which were gradually growing out of date with the application of new methods of research and problem-solving in the practice of anti-epidemic work.

The idea of improving the theory was partly achieved in a textbook for VMA students and military doctors, "Military Epidemiology" (1976) [2], and in its final form it was issued later as a textbook for medical schools, written in collaboration with Professor A. D. Yafaev. [3] This textbook has been recognized as the best in spite of the abundance of various other textbooks used in medical schools to date. The book covered for the first time the issues of the autoregulation of parasitic systems, explained in detail in the eponymous monograph of Belyakov et al., which was popular among scholars and practitioners. [4] This monograph is now a bibliographic rarity,

although its content does not lose relevance, moreover, it is a testament to the amazing foresight of the theory's author. The result of many years of fruitful work by the academic, it was a clear structuring of epidemiological science, updating the content of its sections, regulating its terminology, substantiating the concept of epidemiological surveillance and prediction of disease, as well as creating programs to combat important infections, and later, infectious health problems of the population.

The theoretical basis of the modern theory of infectious diseases' epidemic manifestations among people became generally accepted after long discussions on the theory of autoregulation of parasitic systems, developed in the 1970s by Belyakov and a group of staff members, and was finally adopted in the epidemiology of infectious diseases in the 1980s. It absorbed the entire rationale from the works of L. Gromashevsky [5] and his followers, a significant part of the scientific heritage of academician E. N. Pavlovsky [6] and his school, the achievements of modern domestic and foreign scholars in epidemiological science and practice, and finally moved the epidemiology of infectious diseases closer to biological sciences.

The creative spirit of Belyakov always pervaded studies carried out by the staff of the department under his leadership in the military collectives, and in the performance of complex scientific research in collaboration with specialists from other institutions and in other types of teams. They gave food for thought and beneficial ideas, which were then tested in practice. The most impressive results were achieved in the study of the unique features of the epidemic process in the military (navy) – influenza and other viral respiratory infections, viral pneumonia and bacterial etiology of acute intestinal, staphylococcal and streptococcal (including nosocomial) infections. Through Belyakov's efforts, the latter began to be seriously studied by epidemiologists, clinicians received evidence-based recommendations for prevention efforts and the concepts of "epidemic (hospital) strain (clone)", "microbiological monitoring," "immunological screening," and "internal reservoir of infection in groups" were finally anchored in science and practice. The phenomenon of autoregulation of parasitic

systems was confirmed with all relevant infections, including zoonoses and sapronoses, as a general biological law of the existence of living organisms. Many provisions and categories of the theory were also applicable to non-infectious human pathology.

Rightly considering that the most interesting discoveries in science are made at the point where disciplines meet, Belyakov spent much effort improving both natural and applied classifications of infectious diseases. His unified classification of streptococcal infections was unique (1978) [7]. It was further developed in the fundamental works of students and successors, armed with a unified approach to the diagnosis, treatment and prevention of the most current and extensive group of diseases. He made a significant contribution to clarifying the classification of infections in terms of mechanisms of transmission, which is now considered the most successful. In the last years of his life, working with microbiologists and geneticists, he came to the conclusion that it was necessary to create a universal taxonomy of infectious diseases on the basis of molecular-biological criteria. This work was continued by his successors. Belyakov always sought to use the knowledge gained through the use of the latest research methods developed in other disciplines in epidemiology and introduced them into the learning process and epidemiological practice.

In addition, Belyakov always kept in mind the achievements of immunology, as evidenced by the number of his publications, including the well-known monograph "Immunological Analysis in Epidemiology." [8] In the 1970s, he was one of the first to draw epidemiologists' attention to the problem of people who were often ill with one and the same disease. Susceptibility to infectious diseases and the problem of immunodeficiency remain on the "frontier" of the struggle of medical science and medical and preventive-medicine specialists in maintaining the population's general health. These areas of applied research continue to develop along the path forged by Belyakov more than 40 years ago.

Guided by the principle he promoted of defining what is most important in any endeavor, he paid close attention to issues of immunization in the armed forces. And Belyakov had conducted

his first research in line with this topic. He performed brilliantly in defending his Ph.D. thesis on "Comparative Evaluation of Methods of Prevention of Graft Dysentery" (1954) and then continued to follow closely the development of this important direction in preventive medicine, analyze its status and prospects and to put forward new ideas. On this subject, Belyakov not only defended his doctoral dissertation (1963), but also wrote the monographs "Immunization in Epidemiology" (1961) and "Associate Immunization and Emergency Preventative Medicine," co-authored with Rogozin, and published a number of other works [9].

The department's many years of work in this area included the testing of different types of needleless injectors, the testing of new vaccines, and combinations thereof, as well as means of emergency prevention of infections in both civilian and military situations. Many of these tools and proven methods of their use were put into service and used in the medical service's preventative activities. Furthermore, a large number of articles were published on the subject, as were instructional-teaching and guidance documents, and several theses were defended on the subject as well. In the last years of Belyakov's leadership of the department, he drew attention to the need for study of immunostimulants to increase resistance to infections in immunocompromised people, which has not lost its relevance today and remains an area of interest for his students.

Belyakov devoted much attention to improving the organization of prophylactic sanitation (anti-epidemic) measures, especially rationalizing the organizational structure of the sanitary-epidemiological institutions, the division of responsibilities of departments and specialists, the regulation of their work and the defining of criteria for evaluating the work's quality and effectiveness. Belyakov was first to summarize the work of department members A. A. Degtyarev, A. P. Khodyrev and others. He introduced the teaching of a new section, "The Epidemiological Diagnosis" [10], containing the methodology for performing epidemiological diagnosis and disease prognosis using the results of operational and retrospective analysis. The work of the department on epidemiological diagnosis and

organization of anti-epidemic measures was widely used not only by military doctors, but also by educators and health professionals. In addition to the manuals and textbooks devoted to this subject, Belyakov and colleagues published the monograph "The Quality and Effectiveness of Anti-Epidemic Measures." [10] Its authors were awarded the Professor N. F. Gamaleya diploma prize by the Presidium of the USSR Academy of Medical Science.

Belyakov's diverse research interests and tremendous work capacity were amazing. His daily activities included constant familiarization with the contributions of domestic and foreign scholars on a wide range of microbiology, immunology, surgery, biology, philosophy, genetics, and systems theory, not to mention works on epidemiology and infectious diseases. He worked closely with well-known scientists from the academy and other institutions, resulting in original and often "pioneer" joint works. This applies to a number of publications on the problems of streptococcal and nosocomial infections, as well as collaborations with eminent microbiologists D. B. Golubev, A. A. Totolyan and others. In connection with this, another fundamental work should be mentioned: "Pseudomonas and Pseudomonosis," which was produced in Moscow. [11] Vitaly Dmitrievich eagerly collaborated with the Department of Philosophy at the VMA (Professor V. P. Petlenko). No wonder many of those who read these works began to associate epidemiology with the "philosophy of medicine." Undoubted credit for this belongs to Belyakov's complete mastery of impeccable logic, dialectical thinking and a systematic approach in dealing with any issue.

His diverse activities included the exemplary performance of his official duties as the head of the department: leadership in teaching methods, research and organizational work of the team, lecturing, planning of scientific research and monitoring of its performance, holding meetings, writing and editing textbooks and manuals, case plans and programs, guidelines of the medical service, research materials, including monographs and collections, preparation of reports and presentations at meetings of congresses, conferences, scientific societies, academic

councils, inter-chair and intercollegiate meetings, review of dissertations and other academic papers, educational literature, leadership of the adjuncts and competitors, and more.

Belyakov was one of the founders of the Academy of Natural Sciences and chairman of its biomedicine section. Even with such a workload, he led educational courses, as well as methodological and educational work with the department staff, paying particular attention to the training of young teachers and researchers. He had a phenomenal ability to guess the potential and abilities of his students, which they often did not know themselves, and involve them in their work to produce the maximum benefit for their activities and for themselves. He usually combined his vacation with the creative work of writing monographs and textbooks. Of course, in organizing the functioning of such a complex mechanism as a department of general and military epidemiology, Belyakov was assisted by his colleagues and students, who he himself had trained and who had been trained by his predecessor – Professor Rogozin. His amazing ability to guess and find something new, progressive and useful in any undertaking allowed him to stay one step ahead. His foresight was revealed in his special attention to the scientific search for the meeting point of related disciplines, opening the way to new knowledge. Belyakov was characterized by his self-criticism and the high demands he placed on himself. With his leadership the department reached its heyday, coming to the forefront of science and teaching.

Belyakov carefully used the ideas of a systematic approach to science. He had a clear idea that the open and non-rigid nature of the systematic approach often leads to insufficient qualified theorizing and separation of the system from the phenomenon in question. Examples of the use of a systematic approach to population phenomena can be seen in the allocation by Belyakov of six sections (subsystem) instead of three in the textbook "Military Epidemiology" [2], in the system of unification of epidemiological diagnosis techniques, in approaches to classification of zoonoses, in the division of parasitic systems into three systems depending on the habitat of pathogens, parasites, in his approach to the structuring of medical disciplines, etc.

Thus, while working in the VMA, Belyakov created his own capable Leningrad scientific-pedagogical school and in 1982 (after retirement) he was elected head of the Department of Epidemiology of the 1st Moscow Medical Institute (MMI; from 1990 – the I. M. Sechenov 1st Moscow Medical Academy)¹), which he led until the autumn of 1996.

It was a new and fruitful stage in his life and work as a scholar, teacher and leader of scientific and educational staff.

While working at the I. M. Sechenov 1st Moscow Medical Institute, Belyakov continued to develop his concept created at the VMA of autoregulation of parasitic systems and long-cherished idea of the development of epidemiology as a science that studies the incidence of infectious as well as non-contagious diseases among the population.

Belyakov was a reformer, both in education, and in science, so with his arrival there were significant changes in the teaching of epidemiology, and in the research activities of the Department of Epidemiology at the I. M. Sechenov 1st Moscow Medical Institute. This was due primarily to the revision of existing ideas about the subject of epidemiology. Belyakov viewed epidemiology as a science that examines the incidence of disease and other mass phenomena, reflecting the outcomes of the disease, to identify the causes and risk factors of infectious and non-infectious diseases and to use these data to develop measures to prevent disease. In this regard, there was a need to expand the teaching of one of the main sections of epidemiology – epidemiological diagnosis.

One of the epidemiological diagnosis textbooks for students and teachers remains "Selected Lectures on General Epidemiology of Communicable and Non-Communicable Diseases," published during Belyakov's lifetime. Ahead of his time, he determined the epidemiological-diagnostic (analytical) activities of specialist epidemiologists to be fundamental. [10]. At the present time, this postulate remains unquestioned.

The constant search for new forms of teaching methods led to the need to develop a specialist model – the doctor epidemiologist. In 1986, a new epidemiology program for students in the sanitary department was developed. Belyakov's contagious enthusiasm spread to his department's staff, and with his characteristic energy he worked on this program. In accordance with the program's sections, department staff created six teaching materials (covering general epidemiology, disinfection, immunization and epidemiology of anthroponoses, zoonoses and parasitic diseases).

In addition to programs for the hygiene faculty, programs were developed for the medical faculty, as well as a program for general epidemiology of communicable and non-communicable diseases (basic medical ecology) for medical students at higher institutions. Belyakov attached great importance to continuity in the preparation of specialist epidemiologists at the undergraduate and postgraduate level. In 1993, on his initiative an epidemiology course was established at the Faculty of Postgraduate Education at the 1st MMA, and in 1994 a standard educational program developed by them was published for primary specialization (internship) of graduates of health-care departments at medical institutions to train physician-epidemiologist specialists.

The emergence of new educational programs led to the need for a revision of teaching materials for students. A new textbook on epidemiology was written, which was the first time epidemiology was defined as general medical science [3]. In accordance with this program, the department staff with the direct involvement of Belyakov and under his leadership created methodological study aids for students on almost all the course's topics.

Belyakov always worked to improve the educational process at the department, which is reflected in the training of doctors working in the preventive-medicine sphere.

Belyakov constantly worried about the development of medical science and pedagogy. In 1989, at the the 1st MMI, Belyakov read a commencement address, dedicated to the evolution of the structure of medical science and how it was reflected in the system of medical education. The speech paid particular attention

¹ Currently, the State Budget Educational Institution of Higher Vocational Education at the I. M. Sechenov First Moscow State University under the auspice of the Ministry of Health.

to the principles of the formation of individual medical sciences, the modern nomenclature of medical specializations and trends in medical education.

Belyakov always emphasized that epidemiology was the main diagnostic discipline of preventive medicine. However, it did not find its proper place in the training of doctors. The preventative medicine faculty prepares doctors for two specializations – hygienists and epidemiologists, but the teaching of epidemiology is allocated a third as many hours as the teaching of hygiene. The situation changed for the better with the introduction of the 2010 state standard. The study of epidemiology was allocated 15 credits (540 hours): this is the number of hours called for by Belyakov, who considered them necessary for a full study of epidemiology.

The plan for the department's scientific work also changed. On Belyakov's initiative, an order of the USSR Ministry of Health set up a scientific-based laboratory for managing the epidemic process. It was assigned the task by the State Committee on Science and Technology for "The development of criteria for the elimination of manageable infectious diseases (measles, polio, diphtheria)." Analysis of international experience with measles, polio and diphtheria, as well as assessing the epidemiological characteristics of these infections and means of immunization allowed for the formulation of general and specific criteria for their regional elimination. A departmental program in the field of medicine for 1986-1990 was created, approved and circulated – "The study of scientific and organizational aspects for further reduction of the incidence of infectious diseases and the elimination of manageable diseases," according to which the department became the leading body. The department's staff conducted research on the tasks of "Improving the surveillance system at the regional level" and "Molecular genetic mechanisms of the life of infectious agents, determining their ecology." To achieve these objectives the department of epidemiology was supported by microbiologists, biochemists, geneticists, molecular biologists and mathematicians.

Taking into account the current theoretical, methodological and organizational principles of epidemiology, under the leadership of Belyakov

and with his direct participation the functioning of parasitic systems and mechanisms of development of the epidemic process for individual infections were characterized. It has been shown that the development mechanisms of the epidemic process depend on the ecology of the pathogen, the nature of parasitism and transmission mechanism. A proposal was made for the concept of the nature of random poly-pathogenicity of parasites and the connection of regular and irregular manifestations of the epidemic process with specific mechanisms of adaptation of natural populations of organisms. New definitions were proposed for taxonomic and biological species of bacteria, ideas were formulated about the basic and superordinate genotype systems, both unsecured and secured gene pool of procaryotes.

These developments have allowed for the clarification of the role of variability of the idio-type and processes of microevolution in regular and irregular forms of the epidemic process, mechanisms of formation of epidemiologically significant (hospital) variants of pathogens, capabilities and limitations of the methods used for the detection of intra-typing patterns of populations of medically important microorganisms and their clonal propagation. In addition, they expanded the understanding of the possible mechanisms for the formation of new pathogens and new disease syndromes.

Belyakov developed the original concept of epidemiological surveillance, which was a significant achievement in the management of anti-epidemic measures. He defined the theoretical, methodological and organizational basis of epidemiological surveillance [12]. Under his leadership, the department's staff developed new guidelines for epidemiological surveillance of mumps infection, typhoid, salmonella enteritidis and typhimurium, pseudomonas infection, streptococcus serogroup A, hepatitis A and E and shigellosis.

The main results of the research were presented in the monographs "Self-regulation of parasitic systems," [4] and "Pseudomonas and pseudomonas" [11].

Using these materials the staff of the Department of Epidemiology of I. M. Sechenov MMA defended two doctoral theses (G. Kaminsky, 1994; N. I. Briko, 1995) and 12 master's theses.

In total, according to the results of the research carried out by the C.14 departmental program and the topics with state registration, more than 160 works were published.

Belyakov's theory on internal regulation of parasitic systems has boosted the formation of many scientific fields, including molecular epidemiology and population genetics. Belyakov was one of the first in Russia to begin to view epidemiology as not only the study of the incidence of infectious diseases, but also non-infectious ones. He can rightly be considered one of the founders of epidemiological diagnosis. The training process uses Belyakov's "Selected lectures on the general epidemiology of communicable and non-communicable diseases." It is in these that the epidemiology and diagnostic (analytical) activities of epidemiologists were identified as fundamental. The development of this area and its improvement is a priority: it is no coincidence that the department at the I. M. Sechenov First MG MU was renamed to the department of epidemiology and evidence-based medicine. [13]

Teaching and guidance work always took its rightful place in the multifaceted activities of Belyakov. For many years he headed the Central Problems of Teaching and Guidance Commission for Epidemiology. Belyakov's ideas were largely reflected in the work of members of the current Teaching and Guidance Commission for Epidemiology on the present-day structure of epidemiology and standards for the scientific specialization. At the current stage, epidemiology includes the epidemiology of communicable and non-communicable diseases.

Belyakov constantly worried about the development of medical science and pedagogy. He paid particular attention to the principles of the formation of individual medical sciences, the modern nomenclature of medical specializations and modern trends in medical education.

Belyakov developed the original concept of epidemiological surveillance, which was a significant achievement in the management of anti-epidemic measures. Belyakov defined the theoretical, methodological and organizational basis of epidemiological surveillance.

For many years, Belyakov was a member of the department of preventive medicine at the

Academy of Medical Sciences, a member of the Presidium of the I. I. Mechnikov All-Russian Society of Epidemiologists, Microbiologists and Parasitologists. He was the deputy chief editor of the "Journal of Epidemiology, Microbiology, and Immunobiology," as well as being a member of many scientific councils.

On his initiative, the Center for Preventive Medicine was established in which members of the department of epidemiology and evidence-based medicine at I. M. Sechenov First MG MU conduct joint research.

Belyakov was the author and co-author of over 500 scientific publications, including 12 books and teaching aids, about two dozen monographs and scientific collections on major theoretical problems of epidemiology. Under his leadership 12 doctors and 40 candidates of medical sciences were trained.

For services to the country and its armed forces and national scientific development, Belyakov was awarded the Order of Red Banner of Labor, Order of the Great Patriotic War – 1st Degree, the Red Star, the medal "For Military Merit" and many other medals. He was elected as an honorary member of the Kazakh and Azerbaijani scientific societies of epidemiologists and microbiologists, and was awarded the Gold Medal of the Society of Military Medicine of the GDR.

Belyakov was a bright personality, an excellent lecturer and teacher, possessing a deep, philosophical mind. He made significant contributions to the theory of epidemiology and the improvement of its teaching and throughout his life remained a great teacher and example for his many students. This is how he is remembered by all staff, students and cadets of S. M. Kirov Military Medical Academy, students of I. M. Sechenov 1st MMI, and the academics and practitioners in the field of preventive medicine in St. Petersburg, Moscow and other cities around the country. Belyakov laid a solid foundation for further research of new fields and improvements in the theoretical, methodological and organizational foundations of one of the most fascinating sciences – epidemiology. Belyakov's ideas were brought to life by his many students, and he will remain forever in the memory of those who were fortunate to work with him.

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