

**BR24992881 "Development of cellular, genomic and proteomic technologies
for the diagnosis of socially significant diseases
in the Republic of Kazakhstan".**

The program implementation period is 2024-2026.

Importance. In the Republic of Kazakhstan, the government pays special attention to the development of highly sensitive and accurate methods for diagnosis of various diseases. The Ministry of Health has approved a list of socially-significant diseases, such as malignant neoplasms, diabetes, a number of cardiovascular and infectious diseases, diseases of the nervous system, etc. (Decree № DSM-108/2020 from the Ministry of Health of the Republic of Kazakhstan from September 23, 2020). As part of this scientific and technical program, methods and technologies will be developed for the effective diagnosis of socially significant diseases using modern cellular, genomic, proteomic technologies and instrumental methods, such as next-generation sequencing (NGS), mass spectrometry, digital PCR, real-time PCR, CRISPR/Cas technology, DNA barcoding, etc. Within the framework of the Program, it is planned to develop methods for early diagnosis of orphan diseases, including phenylketonuria and Gaucher disease, diagnosis of Alport syndrome, MODY diabetes, ischemic stroke, colorectal cancer; as well as develop technologies and test systems for detection of a number of infectious diseases caused by pathogens of both bacterial (*Borrelia burgdorferi*, *Borrelia miyamotoi*, *Acinetobacter baumannii*) and viral origin (rotaviruses and adenoviruses). To ensure further production of domestic test systems, it is proposed to develop a technology for obtaining thermostable RNA and DNA dependent polymerases used in PCR test systems, and a high-precision DNA technology for the authentication of herbal medicine. These developments will not only improve the quality of medical care and quality of patient's life in Kazakhstan, but will also increase its competitiveness at the international level, promoting the widespread use of modern diagnostic technologies in clinical practice and laboratory diagnostics.

Thus, in order to achieve progress in this relevant area, the main goal of our study was formulated and the expected results were determined.

Aims. To develop cellular, genomic and proteomic technologies for the diagnosis of socially-significant diseases in the Republic of Kazakhstan.

Expected results

As a part of the program, the following steps will be carried out:

1. Target sequencing method of phenylalanine hydroxylase gene will be developed for the diagnosis of phenylketonuria.
2. A novel method for determining proteomic biomarkers of stroke using mass spectrometry will be obtained.
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4. An immunochromatographic test system will be developed, allowing to determine the immune status in acute respiratory infections.
5. The development of a method for diagnosing antibiotic resistance of *Acinetobacter baumannii* nosocomial infections based on CRISPR/Cas technology.
6. A mass spectrometry-based diagnostic method for Gaucher disease will be implemented to improve the accuracy and speed of disease identification.
7. The technology for diagnosing Alport syndrome will be developed using next-generation sequencing.
8. A new approach for identifying mutations in the KRAS/BRAF genes will be developed for the effective diagnosis of metastatic colorectal cancer.
9. A thermostable RNA-dependent and DNA-dependent polymerase will be obtained for the molecular and genetic detection of pathogens of urogenital infections.
10. The development of a test system based on real-time PCR will ensure the detection of pathogens of Lyme disease (*Borrelia burgdorferi sensu lato*) and tick-borne relapsing fever (*Borrelia miyamotoi*).

11. DNA barcoding and high-throughput sequencing technologies will be implemented for herbal medicine authentication used in pediatric practice.
12. At least 9 (nine) articles and (or) reviews have been published in peer-reviewed scientific journals that are in the 1st (first), 2nd (second) and (or) 3rd (third) quartiles by impact-factor in the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 50 (fifty). At least 10 (ten) articles in journals recommended by the SHEQAC (Science and Higher Education Quality Assurance Committee), and at least 1 (one) monograph recommended by the academic council of the applicant's organization. At least 5 (five) intellectual property objects (patents or copyright certificates in the field of information technology) have been registered with the National Institute of Intellectual Property of the Republic of Kazakhstan).

About program executors

LLP “National Center for Biotechnology” (NCB); The branch of LLP “National Center for biotechnology” in Almaty.

Head of program

Tarlykov Pavel Viktorovich - Ph.D., Associate Professor, Head of the Laboratory of Proteomics and Mass Spectrometry of LLP “National Center for Biotechnology”.

Specialist in the field of genomics, proteomics and mass spectrometry, the author of more than 100 scientific papers, Hirsch index - 11 (Scopus). Studied in the master's program “Bolashak” (USA, Montana State University, 2007-2009). Scholarship holder of the World Federation of Scientists (Switzerland, 2010). Completed internships in France (Institute Gustave-Roussy, 2011-2012), Russia (“Medical and Genetic center of N.P. Bochkov”, 2012).

Responsible executors

Aleksandr Borisovich Shevtsov, Candidate of Biological Sciences, Associate Professor, Head of the Laboratory of Applied Genetics of the NCB (ResearcherID: P-2717-2017, Scopus Author ID: 52664422400, ORCID: 0000-0002-0307-1053). Age - 43 years, scientific experience - 16 years. Hirsch index - 9 (Scopus). Specialist in the field of genomic research. Author of more than 100 scientific papers, including 49 in journals indexed by the Web of Science (Clarivate Analytics) and Scopus databases; has 9 certificates of authorship.

Elena Vitalievna Zholdybaeva, Candidate of Biological Sciences, Associate Professor, Head of the National Scientific Shared Laboratory of Biotechnology of the NCB (ResearcherID: AAB-1509-2020; ORCID: <https://orcid.org/0000-0002-9677-008X>; Scopus Author ID: 55640278400). Age - 44 years, scientific experience - 21 years. Hirsch index - 9 (Web of Science, Scopus). Specialist in the field of population genetics and genomic research. Author of more than 100 scientific papers, including 27 in journals indexed by the Web of Science (Clarivate Analytics) and Scopus databases; has 9 certificates of authorship.

Gulmira Nigmatzhanovna Kulmambetova, PhD in Biology, Associate Professor, Leading Researcher at the National Scientific Shared Laboratory of Biotechnology of the NCB. Age - 42 years, scientific experience - 20 years. Hirsch index - 3, ResearcherID N-5975-2017, ORCID 0000-0001-8723-3752, Scopus ID (56387533800).

Sabina Shamshiddinkyzy Atavlieva, researcher at the Laboratory of proteomics and mass spectrometry of the NCB, Master of Science in Natural Sciences. Hirsch index – 5 (Scopus), ORCID 0000-0002-7565-9454, Scopus Author ID 57204157988. Specialist in proteomics and mass spectrometry.

Arman Tabylovich Kulyyasov, Candidate of Chemical Sciences, Chief Researcher of the Laboratory of Proteomics and Mass Spectrometry of the NCB (ResearcherID: K-9148-2017; ORCID: <https://orcid.org/0000-0002-7932-5689>;

Scopus Author ID: 7004152301). Age - 56 years, scientific experience - 30 years. Hirsch index - 10 (Scopus). Specialist in the field of organic chemistry, chemistry of natural compounds, biochemistry, molecular and cellular biology, proteomics, mass spectrometry. Author of 76 articles published in near and far-abroad countries; has 3 certificates of authorship.

Kanatbek Naizabekovich Mukantayev, Doctor of Biological Sciences, Associate Professor, Head of the Laboratory of Immunochemistry and Immunobiotechnology of the NCB (ResearcherID: AAM-8674-2020; ORCID: <https://orcid.org/0000-0002-6048-0232>; Scopus Author ID: 57211138932). Age - 58 years, scientific experience - 35 years. Hirsch index - 3 (Scopus). Specialist in the field of genetic engineering, microbiology and immunobiotechnology. Author of more than 140 scientific papers, including 12 in journals indexed by the Web of Science (Clarivate Analytics) and Scopus databases; has 20 authorships certificates for inventions.

Sailau Kasenovich Abeldenov, PhD, Head of the Laboratory of Molecular Biotechnology of the NCB. Hirsch index – 3. ResearcherID F-5139-2015 ORCID 0000-0002-6974-9138 Scopus Author ID 56674705400. Specialist in the field of molecular genetics of microorganisms, genetic engineering, and DNA reparation of pathogenic microorganisms. Author of more than 40 scientific publications, 4 patents of the Republic of Kazakhstan.

Ekaterina Olegovna Ostapchuk, PhD, Associate Professor. Head of the Laboratory of Immunology and Immunobiotechnology of the NCB branch in Almaty. Hirsch index - 10. ORCID: 0000-0002-3771-423X. Researcher ID: D-1254-2015. Scopus ID: 56823472400. Total - 29 publications, 246 citations. Specialist in molecular and cellular immunology. Has experience in studying natural focal zoonotic infections.

Bekbolat Baurzhanovich Khassenov, Candidate of Chemical Sciences, professor in the specialty "Biological Sciences". Hirsch index - 9 (Scopus), ResearcherID: AAM-8657-2020, ORCID: 0000-0003-4572-948X, Scopus Author ID: 36096620800. Specialist in the field of molecular genetics of microorganisms,

protein mass spectrometry and proteomics, recombinant DNA technology. The author of more than 30 scientific papers, has copyright certificates for recombinant strains of microorganisms producing proteins with enzymatic and antigenic properties.

Oksana Nikolaevna Hapilina, Candidate of Biological Sciences. Head of the Laboratory of Plant Genomics and Bioinformatics. Hirsch index - 4 Researcher ID: J-4151-2017 ORCID: 0000-0002-7256-568X Scopus Author ID: 57194829297. Specialist in the field of biotechnology, selection, molecular biology of plants. Author of more than 140 scientific publications in domestic and foreign journals, has 6 authorship certificates for inventions.