

Name of the project: «Development of measures to reduce the epidemiological risks of the spread of zoonoses in Kazakhstan».

Aim of project. Identification of veterinary objects of epidemiological significance in the territory, country and development of methods for visualizing and analyzing data using information and communication technologies that allow forecasting and assessing the risk of the spread of diseases of contagious etiology for the subsequent development of effective preventive measures.

Relevance. The territory of Kazakhstan is historically considered unfavorable for many diseases of contagious etiology common to humans and animals. And if some nosological forms have a natural focal character, then other diseases are anthroponotic, that is, the development of the epizootic process of such diseases depends directly on human activity. In this regard, the objects that a person uses in animal husbandry, in the processing of animal products, can potentially be the link where the pathogen, directly or through transmission factors, can be transmitted to susceptible animals.

Information about epidemically significant veterinary objects is one of the important parameters necessary for assessing and interpreting the manifestation of the epizootic process and planning anti-epizootic measures. Therefore, the definition and identification of epidemically significant veterinary objects will make it possible to compile a single register of data on such objects, with their characteristics and the degree of potential danger.

In the future, using the methods of mathematical modeling and information and communication technologies, an assessment of the risk of occurrence, transmission and possible spread of socially significant infections common to animals and humans in the study areas will be implemented, taking into account the location of epidemically significant objects.

Expected results. As a result of the project, at least 2 (two) articles and (or) reviews will be published in peer-reviewed scientific journals indexed in the Science Citation Index Expanded of the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 35 (thirty-five). Also, at least 2 (two) articles or reviews will be published in a peer-reviewed foreign or domestic publication recommended by the Committee for Quality Assurance in Science and Higher Education of the Republic of Kazakhstan.

Based on the results of the research, a monograph "Application of ICT technology in assessing the risk of the territory of Kazakhstan in terms of biological safety categories, for certain socially significant animal diseases" will be prepared and published.

An electronic atlas of epidemically significant veterinary facilities in the regions will be developed, with the visualization of objects on electronic maps and the possibility of assessing the risk of their impact on the epidemiological situation of a particular infection. Guidelines will be developed and published for the use of the geographic information system ArcGIS in mapping epidemiologically significant veterinary objects.

As a result of scientific research, identification and ranking according to the classification of veterinary objects of epidemiological significance located on the territory of the Republic of Kazakhstan will be carried out. A database has been formed on veterinary objects of epidemiological significance, with their epidemiological and production characteristics and an assessment of potential well-being. Symbols have been created for designating veterinary objects of epidemiological significance for use in visualizing the objects under study on electronic maps. Methods of quantitative epidemiology will be used to model and predict the epidemiological process and assess the risks of the emergence and spread of socially significant animal diseases.

The results obtained for 2023. The definition and identification of epidemiologically significant veterinary objects of epidemiological importance has begun. The following epidemiologically significant veterinary facilities located in the territories of Akmola,

Karaganda, East Kazakhstan, Turkestan, Zhambyl, Kyzylorda, and Almaty regions were identified: cattle farms, small cattle farms, horse farms, pig farms, cattle burial grounds and Beccari pits, slaughterhouses and sites, meat processing enterprises, cattle markets. It should be noted that only objects functioning at the time of the study were subject to identification

The formation of a database (collection of information) on epidemically significant veterinary facilities located on the territory of the republic has begun. The database includes 1,072 farms engaged in breeding farm animals, 658 abattoirs and Beccari pits, 125 slaughterhouses, 241 slaughterhouses, 31 meat processing enterprises, and 43 cattle markets. The database being formed includes such data as the name of the object, location, number of animals for livestock farms, and geographical coordinates. The analysis of the formed base showed that the concentration of certain epidemically significant objects by region is determined by their geographical location and the direction of livestock production of the main producers of livestock products.

Conventional forms of designation of epidemically significant veterinary objects on electronic maps have been developed. Epidemiologically significant objects are conditionally classified into 4 areas: veterinary epidemiologically significant objects (veterinary points, clinics, pharmacies, laboratories, cattle burial grounds; including anthrax burials, Beccari pits, bio-enterprises); agricultural (production) epidemically significant facilities (enterprises for the production of agricultural products, processing enterprises; meat/milk/tanneries, slaughter sites; slaughter points, sites, sanitary slaughterhouses); communal epidemiological facilities (landfills, transport hubs (railway and car stations, airports), veterinary, biomedical scientific and educational institutions) and other facilities (zoos, reserves, vivariums, etc.).

During the reporting period, conventions were developed for 45 epidemiologically significant objects, including 11 veterinary epidemiologically significant objects, 20 agricultural epidemiologically significant objects, 6 communal epidemiological objects (landfills, transport hubs (railway and car stations, airports), veterinary, biomedical scientific and educational institutions) and 8 other objects. The forms of each reference designation are defined, and the figure and figure of the reference designation are developed, which reflect the characteristic features of each epidemically significant object.

The collected data are systematized and converted into a format for display by GIS (grouping of collected data by object) depending on epidemiological and production characteristics. The collected data on epidemically significant objects of Akmola, Karaganda, East Kazakhstan, Turkestan, Zhambyl, Kyzylorda, and Almaty regions are systematized into a single format in Excel, the objects are grouped as veterinary and agricultural objects. As a result, data 2170 of epidemically significant objects are grouped by their directions and formed in the form of attribute tables, which contain all information about the object and its geographical coordinates. Subsequently, the table data is converted into shapefiles and can be used for epidemiological analysis.

Table 1 - Members of the research group

№	Surname, first name, education, degree, academic title	Main place of work, position	Position in the project	Hirsch Index, Researcher ID, ORCID, Scopus Author ID
1	Mykhanbetkaliyev Yersyn Yergazyievich Candidate of Veterinary Sciences, Associate Professor	NCJSC «S.Seifullin KATRU», Head of the Department of Veterinary Medicine	Scientific supervisor	Hirsch Index 4 https://orcid.org/0000-0003-3320-7182 , https://www.scopus.com/authid/detail.uri?authorId=57194544992 , Researcher ID: S-8811-2016, https://publons.com/researcher/S-8811-2016

2	Abdrakhmanov Sarsenbay Kadyrovich, Doctor of Veterinary Sciences, Professor	NCJSC «S.Seifullin KATRU», Professor of the Department of Veterinary Sanitation	Chief Scientific Officer	Hirsch Index 6 http://orcid.org/0000-0003-3707-3767 , https://www.scopus.com/authid/detail.uri?authorId=57189578133 , Researcher ID: O-5800-2017, Author ID57189578133
3	Korennoy Fedor I., Candidate of Geographical Sciences	FGBI «Federal Centre for Animal Health», Senior Researcher	Senior Researcher	Hirsch Index 9 http://orcid.org/0000-0002-7378-3531 , Researcher ID: I-9428-2016, Scopus Author ID: 46461328200
4	Mykhanbetkaliyeva A.A., Candidate of Veterinary Sciences, Associate Professor	NCJSC «S.Seifullin KATRU», Associate Professor of the Department of Veterinary Medicine	Senior Researcher	индекс Хирша 1 https://orcid.org/0000-0003-3232-9831 , Researcher ID: O-8690-2017
5	Bayniyazov Aslan Abdulkhanovich, Candidate of Veterinary Sciences, Associate Professor	NCJSC «S.Seifullin KATRU», Associate Professor of the Department of Veterinary Sanitation	Research Associate	Hirsch Index – 1 ORCID: 0000-0003-3232-9831
6	Bakishev Temirlan Gomarovich, Doctor of PhD	NCJSC «S.Seifullin KATRU», Senior lecturer of the Department of Veterinary Sanitation	Research Associate	Hirsch Index 1 https://orcid.org/0000-0001-7845-975X , Scopus Author ID: 56007665400
7	Kadyrov Ablaihan S.		Research Associate	Hirsch Index 3 https://orcid.org/0689-0986
8	Akmambayeva Botakoz Yesimovna	NCJSC «S.Seifullin KATRU», senior lecturer of the Department of Veterinary Medicine	Junior research assistant	https://orcid.org/0000-0002-9427-6432
9	Abenova Asem Zhandarbekova	NCJSC «S.Seifullin KATRU», assistant of the Department of Veterinary Medicine	Junior research assistant	Scopus Author ID: 58177236900 https://orcid.org/0000-0002-8360-1527

Significant publications of the project manager and members of the research group:

1. Sultanov A.A., Abdrakhmanov S.K., Paul Torgerson et.al. Rabies in Kazakhstan PLOS Neglected tropical diseases Published: August 3, 2016. PLoSNeglTrop Dis 10(8). DOI: 10.1371/journal.pntd.0004889. (Web of science 4,487, Q1, Cite Score 95).
2. Abdrakhmanov S.K., Beisembayev K.K., Korennoy, F.I., Kushubaev D.B., Yessembekova G.N. Revealing spatio-temporal patterns of rabies spread among various categories of animals in the Republic of Kazakhstan, 2010-2013 // Geospatial Health 2016, volume 11:455, 199-205 pp. doi:10.4081/gh.2016.455.
3. Abdrakhmanov S.K., Sultanov A.A., Beisembayev K.K., Korennoy F.I., Kushubaev D.B. Kadyrov A.S. Zoning the territory of the Republic of Kazakhstan as to the risk of rabies among various categories of animals // Geospatial Health. – 2016. – 11:429. – P. 174-181. **DOI:10.4081/gh.2016.429; Q3, Cite Score 64.**
4. Abdrakhmanov S.K., Mykhanbetkaliyev Y.Y., Korennoy F.I., Sultanov A.A., Kushubaev D.B., Bakishev T.G. Maximum entropy modeling risk of anthrax in the Republic of Kazakhstan // Preventive Veterinary Medicine. – 2017. – Vol. 144. – P. 149-157; **DOI: [10.1016/j.prevetmed.2017.06.003](https://doi.org/10.1016/j.prevetmed.2017.06.003); Q1, Cite Score 98.**
5. Abdrakhmanov S.K., Beisembayev K.K., Korennoy F.I., Spatiotemporal analysis of foot-and-mouth disease outbreaks in the Republic of Kazakhstan, 1955 – 2013. Transboundary and Emerging Diseases, 2018. DOI: 10.1111/tbed.12864, (Web of science 3,554, Q1, Cite Score 99).
6. Kanankege K., Abdrakhmanov S., Alvarez J., Glaser L., Bender J., Mukhanbetkaliyev Y., Korennoy F., Kadyrov A., Abdrakhmanova A., Perez A. Comparison of spatiotemporal patterns of historic natural Anthrax outbreaks in Minnesota and Kazakhstan // PlosONE. – 2019. – Vol. 14(5): e0217144; **DOI: [10.1371/journal.pone.0217144](https://doi.org/10.1371/journal.pone.0217144); Q2, Cite Score 89.**
7. Abdrakhmanov S., Mukhanbetkaliyev Y., Ussenbayev A., Satybalдина D., Kadyrov A., Tashatov N. Modeling the Epidemiological Processes of Economically Significant Infections of Animals // Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). – 2019. – Vol. 11621. Springer, Cham. 2019; **DOI: [10.1007/978-3-030-24302-9_39](https://doi.org/10.1007/978-3-030-24302-9_39); Cite Score 51.**
8. Abdrakhmanov S.K., Mykhanbetkaliyev Y.Y. Zoning of the republic of Kazakhstan as to the risk of natural diseases in animals: The case of rabies and anthrax. // Geography, Environment, Sustainability, 2020; **DOI: [10.24057/2071-9388-2020-10](https://doi.org/10.24057/2071-9388-2020-10); Cite Score 37.**
9. Shopagulov O., Tretyakov I., Ismailova A., Aitimova U., Beisembayev K., Mukhanbetkaliyeva A. An expert system for diagnosis cow diseases // Journal of Theoretical and Applied Information Technology. – 15th August 2020. – Vol.98. – No 15. – P. 3106-3115. **<https://jaitit.org/volumes/Vol98No15/17Vol98No15.pdf>, Cite Score 30.**
10. Schettino D.N., Abdrakhmanov S.K., Beisembayev K.K., Korennoy F.I., Sultanov A.A., Mukhanbetkaliyev Y.Y., Kadyrov A.S., Perez A.M. Risk for African Swine Fever Introduction into Kazakhstan // Frontiers in Veterinary Science. 11 February 2021. Volume 8. Article 605910. **DOI: [10.3389/fvets.2021.605910](https://doi.org/10.3389/fvets.2021.605910); Q1, Cite Score 82.**
11. Abdrakhmanov S.K., Mukhanbetkaliyev Y.Y., Sultanov A.A., Yessembekova G.N., Borovikov S.N., Namet A., Abishov A.A., Perez A.M., Korennoy F.I. Mapping the risks of the spread of peste des petits ruminants in the Republic of Kazakhstan // Transboundary and Emerging Diseases. 2021;1–10. **DOI:10.1111/tbed.14237; Q1, Cite Score 98.**
12. Abdrakhmanov S.K., Beisembayev K.K., Sultanov A.A., Mukhanbetkaliyev Y.Y., Kadyrov A.S., Ussenbayev A.Y., Zhakenova A.Y., Torgerson P.R. Modelling bluetongue risk in Kazakhstan // Parasites & Vectors, 14, 491 (2021), **<https://doi.org/10.1186/s13071-021-04945-6>; Q1, Cite Score 74.**
13. Zakharova O.I., Korennoy F.I., Iashin IV., Toropova N.N., Gogin A.E., Kolbasov D.V., Surkova G.V., Malkhazova S.M., Blokhin A.A. Ecological and Socio-Economic Determinants of Livestock Animal Leptospirosis in the Russian Arctic // Frontiers in Veterinary Science. 11 February 2021. Volume 8. Article 605910.

<https://doi.org/10.3389/fvets.2021.658675>; Q1, Cite Score 82.

14. Uakhit, R., Smagulova, A., Syzdykova, A., Abdrakhmanov, S., Kiyan, V. Genetic diversity of *Echinococcus* spp. in wild carnivorous animals in Kazakhstan. *Veterinary World*, 2022, 15(6), pp. 1489–1496. (Web of Science Q2, Cite Score 79).

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16. Sultanov A.A., Tyulegenov S., Yessembekova G.N., Berdikulov M.A., Mukhanbetkaliyev Y., Akhmetzhanova A., Perez A.M., Abdrakhmanov S.K. The progressive control of foot-and-mouth disease (FMD) in the Republic of Kazakhstan: Successes and challenges // *Frontiers in Veterinary Science*, – 2023, – Volume 10, <https://doi.org/10.3389/fvets.2023.1036121>; Q1, Cite Score 84.

17. Yessembekova G.N., Xiao S., Abenov A., Karibaev T., Shevtsov A., Asylulan A., Mukhanbetkaliyev Y.Y., Shuai L., Bu Z., Abdrakhmanov S.K. Molecular epidemiological study of animal rabies in Kazakhstan // *Journal of Integrative Agriculture*, – 2023, – Volume 22, Issue 4, Pages 1266-1275, <https://doi.org/10.1016/j.jia.2022.11.011>; Q1, Cite Score 96.

18. Cui Q., Shi Zh., Yimamaidi D., Hu B, Zhang Zh., Saqib M., Zohaib A., Baikadamova G., Mukhanbetkaliyev Y., Hu Z., Li Sh. Dynamic variations in COVID-19 with the SARS-CoV-2 Omicron variant in Kazakhstan and Pakistan // *Infect Dis Poverty* 12, 18 (2023). <https://doi.org/10.1186/s40249-023-01072-5>; Q1, Cite Score 92.

19. Kabzhanova A.M., Kadyrov A.S., Mukhanbetkaliyeva A.A., Yessembekova G.N., Mukhanbetkaliyev Y.Y., Korennoy F.I., Perez A.M., Abdrakhmanov S.K. Rabies in the Republic of Kazakhstan: spatial and temporal characteristics of disease spread over one decade (2013–2022) // *Frontiers in Veterinary Science*. – 2023. – Volume 10. <https://www.frontiersin.org/articles/10.3389/fvets.2023.1252265>. DOI=10.3389/fvets.2023.1252265; Q1, Cite Score 84.

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Information about existing patents and other security documents.

1. Abdrakhmanov S K., Mykhanbetkaliyev Y.Y., Kushubaev D.B., Kadyrov, A.S., Balji Y.A. A method for visualizing an epizootic focus, using GIS technology. Innovative patent №03090, from 16.01.2016

Information for potential users. The target consumers of the research results will be the veterinary and medical services of the country. The generated data on objects of epidemiological significance can be used in planning and organizing preventive and anti-epizootic measures.

The results obtained will have an impact on the development of veterinary epidemiology, and will serve as the basis for further application of mathematical modeling and quantitative epidemiology in ensuring the epidemiological well-being of the country in other socially significant zoonanthroponic diseases.

The obtained scientific results will be used to ensure the veterinary and biological safety of the country. That is, the results of the study, by improving the epidemiological well-being in certain territories, will help increase the country's export potential for livestock products, thereby providing the country with a subsequent multiplicative economic effect.