

Brief information about the project

Title	AP23489229 «Development of a multimodal artificial intelligence-based application for kidney transplant data preprocessing and analysis»
Relevance	<p>In recent years, healthcare costs worldwide have been steadily increasing. This is driven by several factors, including increased life expectancy, a rise in chronic diseases, and the development of new, costly treatment methods. Artificial Intelligence (AI) can help mitigate the effects of these factors by improving the quality of healthcare and making it more cost-effective [1]. These benefits are already beginning to be felt in the industry. According to [2], the AI market in healthcare is expected to quadruple in the next six years, from 14,6 billion dollars in 2023, to 102,7 billion dollars in 2028. However, despite such forecasts, AI methods have not yet become widespread in clinical practice for kidney transplantation. The main reasons for this are: a) data set imbalance; b) missing values and/or incorrect filling; c) the need for collaboration between specialists in two fields. The goal of the research is to develop an AI-supported method for analyzing and predicting kidney transplantation data, taking into account all the above reasons. The uniqueness of the research lies in its combination of: (i) a large amount of data, (ii) class imbalance, (iii) a prediction model, and (iv) a cloud application. Preliminary research results have shown that the developed class balancing algorithm can improve prediction. The synthetic data created using the algorithm do not contain duplicates. The next stage of the research plans to use ensemble methods of machine or deep learning to predict the functional state of the transplant in patients before transplantation. Based on the research results, a cloud application is planned to be developed, which will accumulate transplantation data, as well as dynamically analyze and self-update. This application can simplify the work of Kazakhstani clinicians in making decisions about kidney transplantation.</p>
Goal	Development of a cloud-based artificial intelligence system for dynamic prediction of kidney rejection risk after transplantation based on unbalanced big data

Tasks	<p>The task of this research is a comprehensive study of data to identify early functional disorders of the kidney transplant and predict its survival. The following tasks will be solved for this:</p> <ul style="list-style-type: none"> • We will apply machine learning (ML) methods and an artificial neural network (ANN), which will be trained on a large dataset consisting of over 150,000 objects. This will allow us to obtain more accurate and reliable results than existing studies that train on small datasets. • We will implement an adaptive imputation method that takes into account the specifics of kidney transplantation data. The method is based on the analysis of types of missing values (MCAR, MNAR, MAR) and interrelationships between variables. The analysis of types of missing values allows us to determine which variables can be filled using the MICE method, and which require a more precise approach. In similar studies, either the MICE method is used, or missing values are removed from the sample. • We will develop a hybrid class balancing algorithm for the kidney transplantation dataset, which will consist of ensembles of re-discretization and under-sampling. Unlike similar studies where usually one of these approaches is used, the proposed algorithm combines the advantages of both method. • We will implement a hybrid method of feature selection based on unsupervised learning principles and dimensionality reduction methods. In similar studies, statistical methods and supervised learning methods were used. • We will develop an ensemble method for personalized prediction of kidney transplant survival for both machine learning and the neural network. • We will develop a web application that can process kidney transplantation data.
Expected and Achieved Results	<p>To date, the following has been achieved: one review has been published in a Web of Science or Scopus journal within the first or second quartile with a corresponding CiteScore percentile, and one article has been published in a journal recommended by KOKSNVO. An artificial intelligence-based web application for predicting kidney transplant survival is currently under development. The publication of a second article or review in highly-ranked international databases and the presentation of research results at international conferences are expected.</p>
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Publications list with links to them	<p>1. Salybekov A. A. et al. Ethics and Algorithms to Navigate AI's Emerging Role in Organ Transplantation //Journal of Clinical Medicine. – 2025. – T. 14. – №. 8. – P. 2775. doi.org/10.3390/jcm14082775</p> <p>2. Buribayev Z., Yerkos A., Zhetpisbay Z. NEW APPROACH TO ADDRESSING CLASS IMBALANCE IN MEDICAL DATASETS CONSIDERING SPECIFICS //Scientific Journal of Astana IT University. – 2025. – P. 78-87. doi.org/10.37943/21VWQH9068</p>
Patent information	<u>not having</u>