Brief information about the project

Title	**AP23486255 «The Study of Functional Brain Networks and Cognitive Function Mapping in Patients with Brain Tumors»**
Relevance	The study of functional brain networks and cognitive function mapping in patients with brain tumours using non-invasive multimodal neurovisualization is an important task for advancing pre-surgery diagnostics of brain tumour pathologies. According to literature preoperative functional magnetic resonance imaging (fMRI) helps minimise cognitive impairments after surgical procedures. Therefore, the investigation of the functional brain networks and cognitive mapping on an expanded sample by using Diffusion Tensor Imaging (DTI), functional Magnetic Resonance Imaging (fMRI), functional near-infrared spectroscopy (fNIRS), and electroencephalography (EEG) during resting state and the performance of cognitive tasks is necessary. The application of modern brain signal analysis, including machine learning and artificial intelligence, will allow the prediction of tumour impact on cognitive functions.
Goal	The project aims to examine the functional brain networks and cognitive function mapping in patients with brain tumours using non-invasive multimodal neurovisualization during resting state and cognitive tasks performance.
Tasks	- Describe research background and validation of methodology in Kazakh and Russian language to conduct complex multimodal study in patients with brain tumour. - Development of pipeline for multimodal brain signals statistics in patients with brain tumour and control group. - Determination of functional connectivity in patients with brain tumours compared to the control group. - Comparison of BOLD (Blood Oxygenation Level Dependent) signal during resting state among patients with different levels of malignancy. - Defining differences in brain signal during the cognitive tasks performance in patients with brain tumours compared to the control group. - Determination of the informativeness of source activity of signal. Development and validation of EEG and fNIRS signals for cognitive function mapping. - Application of machine learning algorithms to predict the impact of tumours on the functional brain networks and cognitive functions. - Articles will be published in accordance with the requirements for the project in section 7 of the competition documentation.
Expected and Achieved Results	Expected Results: - Complex methodology for multimodal examinations of patients with brain tumours will be developed and validated in Kazakh and Russian languages. - Multimodal experiment design in participants with brain tumours and the control group will be validated. Optimal preprocessing protocols for individual and group brain signals analysis will be determined. - Differences in functional brain network connectivity during the resting state between patients with brain tumours and control group will be identified. - The informativeness of BOLD (Blood Oxygenation Level Dependent) signals for determination of the level of malignancy will be established. - Characteristics of signal during the performance of cognitive tasks in patients with brain tumours compared to the control group will be determined. - Informative parameters of EEG and fNIRS will be identified based on acquired (bought) equipment. The informativeness of the sources imaging

	will be revealed. Additional methods for accurate mapping of cognitive function will be developed. - Machine learning algorithms will be applied to the results of preprocessed individual data to predict the impact of tumours on the brain networks and cognitive functions. - Articles will be published in journals according to project requirements set out in part 7 of competition documentation.
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Publications list with links to them	Kamzanova A., Zholdassova M., Tastanbekova A., Berdibayeva D., Kustubayeva A. Assessment of Cognitive Functions in Patients with Brain Tumor//Вестник КазНУ Серия психология и социология. 2024 - №3(90). – С. 30-37 https://doi.org/10.26577/JPsS.2024.v90.i3.03 https://bulletin-psysoc.kaznu.kz/index.php/1-psy/article/view/2052