Over the last few decades, the transplantation of solid organs has become a routine part of clinical care worldwide and has contributed to higher survival rates and greater quality of life among patients. Advancements in surgical techniques, standards of care, and immunosuppression have significantly improved transplantation outcomes. Unfortunately, the number of patients placed on kidney transplant waiting lists is rapidly increasing, resulting in a growing gap between organ demand and the availability of kidneys for transplantation. As a result, transplant centers face the challenge of maximizing their use of all available organ resources and extending the donor pool to close this gap. Among such methods, one of the most notable is using marginal (suboptimal) organs. Nonetheless, it is well known that donor organ quality affects long-term outcomes for renal transplant recipients. An additional problem is the lack of accurate methods of assessing graft quality and estimating donor risk, especially concerning marginal grafts. A kidney's suitability for transplantation is determined based on the donor's medical history, visual assessment, and examination results. Unfortunately, the decision-making process for accepting an organ for transplantation is always subjective to some extent and often lacks sufficient overall predictive power. Furthermore, many of the evaluated parameters cannot be used as independent predictors due to their low specificity. Thus, there is a great need for accurate methods of assessing graft quality and estimating donor risk, especially concerning marginal grafts.

The proposed project continues research on the search for new biomarkers of organ injury and aims to apply novel analytical approaches to assess the function and status of kidney grafts and predict the transplant outcomes. The project aims to develop a protocol combining sample collection and preparation through solid-phase microextraction (SPME) with methods allowing for the quantitative assessment of changes in potential biomarkers during the entire transplantation process. For the analysis of organ tissues, a chemical biopsy based on SMPE probes in a fiber format that allows the extraction of analytes in a low-invasive way without damaging the organ will be used. In addition, the project assumes the use of SPME modifications in the thin-film geometry to develop a high-throughput method for the analysis of biomarkers in patients' plasma. The final stage will be to propose a fast and environmentally friendly analytical method that will allow you to obtain results in a few minutes.

The analytical approach proposed in the project is in line with the trend of searching for new analytical methods that expand the possibilities of assessing graft quality during transplantation while respecting the ecological aspects that are important nowadays. Comprehensive analysis of patients' tissues and plasma will provide a much deeper insight into the biochemistry of kidney transplants, identifying a panel of metabolites that act as determinants of organ quality. It is assumed that the proposed solutions will improve the results of marginal organ transplantation in the future, offering clinicians a reliable tool for organ assessment and early identification of complications after transplantation.