

# Uremic and urinary peptide optical signatures for personalized renal replacement therapy

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## Summary

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*This is a 3-year PhD position, that is part of a European Doctoral Network (DN) program entitled "Personalized medicine in Chronic Kidney Disease (PICKED)" involving 10 research centers from France, Austria, Spain, Greece, Germany, Denmark and Estonia. The PhD position is hosted in the Optofluid Technologies OÜ and Centre of Biomedical Engineering, Department of Health Technologies, School of Information Technology at Tallinn University of Technology,*

Research field:	Biomedicine and health technology
Supervisors:	Prof. Dr. Ivo Fridolin Dr. Jana Holmar
Availability:	This position is available.
Offered by:	School of Information Technologies Department of Health Technologies
Application deadline:	Applications are accepted between September 01, 2024 00:00 and October 31, 2024 23:59 (Europe/Zurich)

## Description

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### **The PICKED Consortium / Background**

Kidney diseases both chronic (CKD) and acute (AKI) should be considered as a priority, but also a challenge, for Public Health Policies as they concern >850 million persons in the world. The major urgent needs that have been identified over the last years include early detection in "at-risk" patients of CKD, detection and prediction of CKD progression/complications and personalized treatment avoiding over- or unnecessary treatment, that collectively contribute to the adoption of Personalized Medicine (PM) in CKD. To address such ambitious challenges, it is essential to embark and train professionals to identify these issues. Constituting a network of 10 PhD students, 6 public laboratories, 4 research and development companies and several associated partners, the PICKED consortium will work on different aspects of PM aiming to significantly reduce the burden of CKD including: early detection of CKD and its progression; personalized drug and dialysis treatment and the social-economic impact of PM in CKD.

Personalized renal replacement therapy (RRT) - dialysis: Since 1960, dialysis has prolonged the lives of millions of people with kidney failure worldwide. However, while the global dialysis population is growing rapidly, the status quo of dialysis care is suboptimal. Mortality is very high among patients on dialysis, in addition with a high symptom burden and a low health-related quality of life. One of the main challenges preventing optimal management of these patients is the current lack of dialysis personalization. Dialysis efficacy in ESKF patients is highly variable, especially for optimal removal of uremic toxins. Optimization of the dialysis process has been developed by the PICKED consortium partners Optofluid Technologies OÜ (OFT) and RD-Néphrologie but needs development towards personalization of the removal of uremic toxins to reduce the high CV mortality observed in dialysis patients.

### **The research**

The overall objective of this PhD-project in PICKED is to identify and validate optical signatures of peptides-biomarkers in serum, residual urine of end-stage kidney failure (ESKF) patients and spent dialysate from renal replacement therapy (RRT) in order to develop algorithms for personalized assessment of uremic peptides' removal kinetics from end-stage kidney failure patients during RRT.

### **Responsibilities and tasks:**

- Validation of previously published optical signatures of peptides-biomarkers in serum, residual urine of ESKF patients and spent dialysate from RRT (e.g. Paats et al 2021, <https://www.mdpi.com/2072-6651/13/4/255>)
- Identification of optical signatures of peptides-biomarkers in serum, residual urine of ESKF patients and spent dialysate from RRT
- Development and test of algorithms for personalized assessment of uremic peptides' removal kinetics from end-stage kidney failure patients during RRT

## Methods

The PhD student will work with the methods in wet laboratory (spectrophotometry and -fluorometry, HPLC, MS-HPLC) and on data analysis using existing data or collected data. Data will be acquired from in vitro sample analysis and in vivo sample collection during RRT hemodialysis therapies.

## Applicants should fulfil the following requirements:

- You hold a master's degree in biomedical engineering/biomedicine
- Solid knowledge in biochemistry, experience in statistics and biosensors
- You have an interest in health and biomedical sensor technologies
- You speak and write fluent English
- You are ambitious, well organized and have excellent communication skills
- You have the ability to work effectively and collaboratively
- You are an enthusiastic and motivated person, ready to participate in personal training, international travel and public awareness activities
- You have demonstrated your commitment to high quality research
- Marie Skłodowska-Curie ITN rules
  - You must not have a doctoral degree at the date of the recruitment
  - You must comply with the mobility rule: not have resided or carried out your main activity (work, studies, etc.) in Estonia for more than 12 months in the 36 months immediately before the recruitment date.

The candidate should submit a research plan for the topic, including the overall research and data collection strategy. The candidate can expand on the listed research questions and tasks, and propose theoretical lenses to be used.

## We offer:

- The positions are available for a 36-month period at 1.0 FTE and are funded through Horizon Europe MSCA DN grant number 101168626 The ideal starting date is October 1st, 2024.
- The PhD position is hosted in the Optofluid Technologies OÜ and Centre of Biomedical Engineering, Department of Health Technologies, School of Information Technology at Tallinn University of Technology, Akadeemia tee 1, Tallinn, Estonia
- You will benefit from all Marie Skłodowska-Curie Action scheme advantages.
- You will participate in web-seminars (in English) of the collaborative network of the laboratory.
- You will attend yearly meetings organised by the PICKED consortium, as well as international and national congresses.

## Supervision

- You will be enrolled in a PhD program at the Tallinn University of Technology
- You will be supervised by Prof. Ivo Fridolin, Dr María Dolores Sánchez Niño and Prof. Jana Holmar

## Planned secondments

The position includes 2 mandatory stays in partner laboratories to complete training:

1. Universite Paul Sabatier Toulouse III, France (2 months), training for identification of ethical obstacles of personalized RRT;
2. Universitätsklinikum Heidelberg, Germany (1.5 months), training for analysis of uremic peptides in serum of the pediatric cohorts.

## About the department

OÜ Optofluid Technologies (OFT) was founded in 2012 as a spin-off company emerged from successful R&D from Department of Health Technologies, Tallinn University of Technology, Estonia. OFTs main activity is developing sensors for real time and online dialysis quality monitoring. A new concept and sensor technology for multi component uremic toxins' intradialytic optical monitoring of spent dialysate demonstrates that optical dialysis monitoring can simultaneously reveal removal patterns of low molecular weight and middle uremic retention solutes during various dialysis treatment modalities without any blood or dialysate sampling (Lauri et al 2020, <https://doi.org/10.1097/MAT.0000000000001058> ). It is in this latter context that this specific PhD-project is set.

The Department of Health Technologies in Tallinn University of Technology combines biomedical engineering and digital health (E-health) competencies, performs innovative research and development activities in the named areas, and offers education at the master and PhD-level. The core competencies of the department lie within:

A. Biomedical engineering. The development of flexible and novel sensor technologies and algorithms in biomedical engineering applications.

More specifically:

(1) development of new optical methods and technologies for early diagnosis of atherosclerosis, and digital decision support systems and communication tools for personalised medicine for diagnostics and treatment of cardiovascular diseases;

(2) to develop the applications incorporated into a smart wearable multi-sensor fusion system for generating valuable data about the persons' location, locomotion, physical activity, energy consumption, wellbeing, and physiological status;

(3) development of an optical sensor technology to estimate dialysis adequacy and quality, securing end stage renal disease (ESRD) patients' care quality; optical sensors for liquids analysis;

(4) to detect and interpret the features in the brain electroencephalography (EEG) signal characteristic for mental disorder (e.g., depression), occupational and/or environmental stressors comprising the advanced methods of signal analysis and the knowledge about brain neuronal;

(5) studies and expertise in radiation safety.

B. E-Health.

(1) Supporting the development of IT solutions for digitalisation of healthcare and examining interoperability factors (strategies, standards, IT architecture, data sets, databases) needed for the implementation of digital health solutions;

(2) evaluation of digital health technologies and developing the necessary framework for deployment; (3) testing and development of solutions related to personalized medicine.

For further information, please contact [ih@taltech.ee](mailto:ih@taltech.ee).



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