

**Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN)**

SUBJECT: Optimizing hemodialysis treatment by computational methods

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SCIENTIFIC DISCIPLINE: biomedical engineering

DESCRIPTION: Worldwide more than 850 mln individuals have kidney disease including 3.9 mln patients on renal replacement therapy [1]. In Poland more than 20 thousand patients receive dialysis - life maintaining treatment [1]. Crucial objective of dialysis treatment is the removal of water and waste products of metabolism while kidneys are not working. There are many parameters that need to be set and checked to ensure dialysis efficiency. The aim of the planned PhD thesis is to explore potential new approaches for optimizing hemodialysis treatment using computational methods (mathematical modeling, machine learning, statistics with survival analysis, etc.), [2].

Nephrologist while planning dialysis treatment has to set quite many parameters: treatment time, frequency, dialyzer type, drugs facilitated treatment, ultrafiltration, blood flow and rate of dialysis fluid, composition of dialysis fluid, etc. On the other hand, the patient's clinical outcomes inform about dialysis efficiency. In PhD project we plan to use patient data and relate them to dialysis settings. Concentrations of different solutes (urea, creatinine, calcium, phosphate, glucose, bicarbonate, sodium, potassium, etc.) derived from blood and dialysate and other parameters will serve as input parameters for mathematical models of solute transport between blood and dialysate, whereas repeated measurements of chosen parameter can provide information about its long-term effect on patient outcome. The developed comprehensive approach will suggest nephrologists possible roads to optimize dialysis treatment.

The project will be carried out at IBBE PAS in cooperation with domestic clinics and Karolinska Institute (Stockholm, Sweden).

BIBLIOGRAPHY:

1. Dębska-Ślizień A, Rutkowski B, Rutkowski P et al. Aktualny stan dializoterapii w Polsce - 2018. *Nefrologia i Dializoterapia Polska* 2019; 23: 113-122.
2. Debowska M, Poleszczuk J, Wojcik-Zaluska A, et al. Phosphate kinetics during weekly cycle of hemodialysis sessions: Application of mathematical modeling. *Artif Organs* 2015;39: 1005-1014.