

Sensitivity Analysis and Subset Selection: A Clinical Application

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Abstract: The dynamics of blood volume during hemodialysis (HD) is determined by fluid removal from the intravascular space due to ultrafiltration and by vascular refill from the interstitium. A compartment model is developed in [1] that describes the short-term dynamics of vascular refill. Fluid movement across the compartment is governed by lymphatic and microvascular fluid shifts. Relative blood volume (RBV) is monitored during hemodialysis (HD) using a non-invasive measurement device (CritLine monitor).

Data on RBV dynamics during HD provide not only insight on the fluid status of the patient but, in combination with the mathematical model, also allow to estimate patient specific parameters. Capillary tissue characteristics, such as the hydraulic conductivity, or the hydrostatic pressure in the capillaries are of special interest as those quantities are not accessible to direct measurements, but would provide valuable insight on (patho) physiological processes in the patient and could prove to be highly relevant in the care of HD patients.

In order to use the parameter estimates for clinical decision making it is absolutely essential to only provide estimates that were identified with some degree of certainty. Traditional sensitivity analysis and subset selection are employed to determine a priori on a per patient per treatment level which subset of parameters is estimated.

[1] de los Reyes V, A., Fuertinger, D.H., Kappel, F., Meyring-Wosten, A., Thijssen, S., Kotanko, P., A model of vascular refilling during ultrafiltration in hemodialysis, J Math Biol, manuscript submitted Feb. 2015