

Repetitive Non-Invasive Glucose Monitoring in the same Subjects on different Study Days with Identical Calibration Parameters

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A non-invasive multisensor device (MD) for continuous glucose monitoring, based on dielectric spectroscopy, combined with additional sensors for optical, sweat/moisture and temperature measurement has been developed. The motivation for the MD is based on the understanding that various temporal fluctuations of the properties of skin, can introduce significant perturbations to the actual glucose related measurement. The aim of this study was to measure glucose excursions on different study days in the same subjects using an identical set of calibration parameters.

The multisensor system was worn on the upper right arm by 10 patients with Type 1 Diabetes (age 45 ± 13 y, BMI 25.5 ± 2.2 kg/m², duration of diabetes 22.5 ± 10.5 y, HbA1c $7.0 \pm 0.5\%$). Glucose was administered orally to induce two consecutive hyperglycemic excursions (12-15 mmol/L) within 8 hours. Euglycemia was re-established by i.v. insulin administration. Based on the sensor signals registered after the first study day, a global calibration model was derived, and the respective coefficients of the individual sensor signals were determined. The model included one coefficient specific to each run. On the second study day, 5 of these patients were again administered glucose orally to induce a glucose profile with one hyperglycemic excursion. The coefficients from the first study day were re-applied to the 5 test runs of the second study day in order to study the prediction power of the model. Both study days for all subjects were performed within a period of two months. Application of the calibration model from day one to day two yielded an $R^2 = 0.68$ and $MARD = 27.3\%$. These data indicate that a global model can be derived using training runs and successfully applied to a set of test runs with a different glucose profile. The global parameterisation is shown to be transferable, leading to a successful tracking of glucose variations. Repeating this in a larger study group and under less experimentally controlled conditions, will be another important step towards non-invasive glucose monitoring.

