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MEETING PROCEEDINGS

Update on Mathematical Modeling Research to Support the Development of Automated Insulin Delivery Systems

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Abstract

One year after its initial meeting, the Glycemia Modeling Working Group reconvened during the 2009 Diabetes Technology Meeting in San Francisco, CA. The discussion, involving 39 scientists, again focused on the need for individual investigators to have access to the clinical data required to develop and refine models of glucose metabolism, the need to understand the differences among the distinct models and control algorithms, and the significance of day-to-day subject variability. The key conclusion was that model-based comparisons of different control algorithms, or the models themselves, are limited by the inability to access individual model–patient parameters. It was widely agreed that these parameters, as opposed to the average parameters that are typically reported, are necessary to perform such comparisons. However, the prevailing view was that, if investigators were to make the parameters available, it would limit their ability (and that of their institution) to benefit from the invested work in developing their models. A general agreement was reached regarding the importance of each model having an insulin pharmacokinetic/pharmacodynamic profile that is not different from profiles reported in the literature (88% of the respondents agreed that the model should have similar curves or be analyzed separately) and the importance of capturing intraday variance in insulin sensitivity (91% of the respondents indicated that this could result in changes in fasting glucose of ≥15%, with 52% of the respondents believing that the variability could effect changes of ≥30%). Seventy-six percent of the participants indicated that high-fat meals were thought to effect changes in other model parameters in addition to gastric emptying. There was also widespread consensus as to how a closed-loop controller should respond to day-to-day changes in model parameters (with 76% of the participants indicating that fasting glucose should be within 15% of target, with 30% of the participants believing that it should be at target). The group was evenly divided as to whether the glucose sensor *per se* continues to be the major obstacle in achieving closed-loop control. Finally, virtually all participants agreed that a future two-day workshop should be organized to compare, contrast, and understand the differences among the different models and control algorithms.

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Abbreviations: (AR) autoregressive, (CGM) continuous glucose monitoring, (GMWG) Glycemia Modeling Working Group, (ISF) interstitial fluid, (MPC) model predictive control, (MVP) Medtronic Virtual Patient, (PK/PD) pharmacokinetic/pharmacodynamic, (UVA) University of Virginia

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