

Type 1 Glucose Management Advice in a Smartphone Application

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Objective:

To provide all type 1 patients individualized help with their glucose management. Do this by making the bolus advice (regarding meal carbohydrate content, pre-prandial BG, and Bolus on Board) that's available from insulin pump "Wizards" likewise available to MDI users, and going beyond that to provide help:

- Establishing the best possible *fasting* basal MDI regimen with NPH in minimal time, or
- Managing multiple pump basal rates, minimizing the effort needed to perfect a 24 hour *fasting* profile.
- Modifying the bolus dose for the imperfect NPH basal insulin action profile used in MDI.
- Calculating the optimal meal time delay, utilizing meal content and pre-prandial BG.
- Evaluating post-prandial BG, to determine and report:
 - 1) The actual carbohydrate content of the meal, and
 - 2) The bolus dose that should have been taken for that meal.
 - 3) If that dose was much higher than what *was* taken, the needed insulin supplement.
- If the bolus taken was so large that hypoglycemia is predicted,
 - 1) How much carbohydrate should be eaten to ensure normal BG at the next meal/bedtime, and
 - 2) How much time remains to eat it before debilitating hypoglycemia sets in.

Method:

Physiologic model parameters are fit to patients during setup, in the process learning patients' Insulin Sensitivity, Carbohydrate to Insulin ratio, and the shape of their Bolus on Board insulin action curve.

These models and parameters are used to calculate and deliver the advice outlined above, with the phone's timer alarm and graphic data display used for informative interaction with the patient.

Result:

- Users get optimized basal insulin.
- Users get bolus advice incorporating individualized Bolus On Board.
- Post-prandial Model Predictive Control corrects for any bolus error, including that leading to hypoglycemia, which is thereby prevented.

Conclusion:

Model-based advice, implemented on a smartphone already carried by type 1 patients, can give them feedback about meal content and fix any bolus errors, thereby minimizing HbA1c without hypoglycemia, while helping patients learn how to estimate food content for the meals they eat.