ASSESSMENT OF THE RELEVANCE OF PREDICTED BLOOD GLUCOSE CURVES AS A SUPPORT TO DECISION MAKING IN PATIENTS WITH TYPE 1 DIABETES

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BACKGROUND AND AIMS

To maintain normal blood glucose (BG) level, and therefore prevent complications, it is critical for patients with T1DM to self-administer insulin according to their fluctuating needs. But assessing the most appropriate dosing is highly complex since there are many parameters governing blood glucose levels, and their impact varies widely. Patients must make those decisions on-the-spot, using data at their disposal, personal knowledge and experience, and what they lack is a way to anticipate.

We conducted an observatory study at the Montpellier University Hospital in France, CDDIAB study, in order to evaluate a new machine learning approach to produce reliable and personalized predictions of BG levels. This study was extended in order to assess the impact and relevance of these predictions in the decision-making process of the patient.

MATERIALS AND METHODS

The extended sample included 15 new patients with T1DM, who volunteered to track BG measurements, meal intakes and insulin doses in real life conditions. The study ran over 30 days, and no specific intervention on the usual treatment was undertaken during this period.

Sample Characteristics	
Group Size	n = 15
M / F	6 (40%) / 9 (60%)
Age (years)	45 ± 15
T1DM Duration (years)	28 ± 16
Body Mass Index (kg/m²)	24.1 ± 2.9
HbA1c (%)	7.32 ± 0.66

Table 1: Characteristics [M ± SD, n (%)]

Collected data has been used to train predictive models for each patient, in order to estimate future BG fluctuations for horizons up to 90 minutes. We used the same method as in CDDIAB study **[A]**, which combines pharmacokinetic modelling to generate informative features regarding past physiological state, and machine learning algorithms to provide prediction models.

Then, for each patient's dataset, events concerning low BG with no or late sugar intakes and high BG with no or late correction bolus were extracted, and predictions computed.

Patients were presented each event with and without prediction, and they were asked to make a therapeutic decision, including: «no action», «BG checks», «sugar intake», «correction bolus», «pump suspension» and/or «temporary basal adjustment».

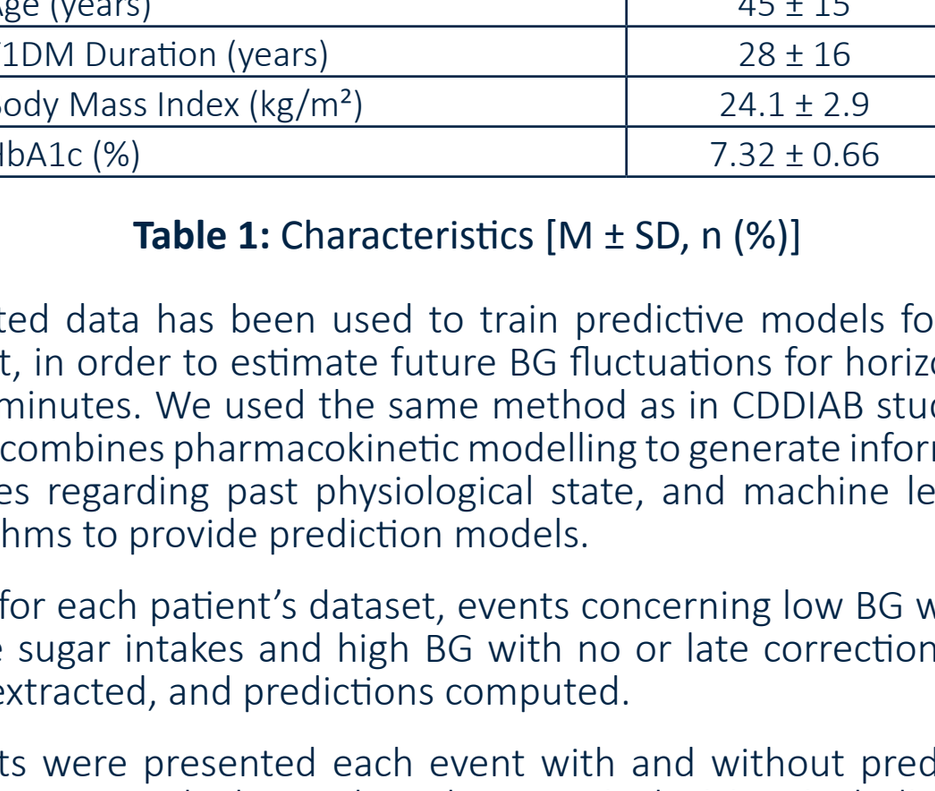

Figure 1: Example of patient's form

RESULTS

Results were analysed by diabetologists of Montpellier Hospital, in order to evaluate the relevance of patients' therapeutic decisions:

- CASE 1: with prediction versus actual action performed;
- CASE 2: with prediction versus conventional treatment.

The first analysis aims to assess the usefulness of the prediction for the patient, versus conventional treatment. The second analysis aims to ensure that decision made by patients are relevant due to prediction data and not only due to a «signalling effect».

Events		Relevance of prediction in CASE 1	
Type	Nb.	Yes	No
High BG	41 (56%)	33 (80%)	8 (20%)
Low BG	32 (44%)	29 (91%)	3 (9%)
	73	**62 (85%)**	**11 (15%)**

Table 2: Results of first analysis [n (%)]

Events		Relevance of prediction in CASE 2	
Type	Nb.	Yes	No
High BG	41 (56%)	32 (78%)	9 (22%)
Low BG	32 (44%)	25 (78%)	7 (22%)
	73	**57 (78%)**	**16 (22%)**

Table 3: Results of second analysis [n (%)]

DISCUSSIONS

Results of the first analysis show that in 85% of the cases presented to patients, prediction data drives better decision-making. For instance:

- facing a predicted low BG curve, a patient tends to take sugar or suspend his pump, in anticipation of an hypoglycemia, which would probably avoid it;
- facing a predicted high postprandial BG curve, a patient tends to make a correction bolus or adjust his basal rate, which would probably bring BG back in target range quicker.

When compared with a simple alert, prediction still drives better decison-making, except in some cases of low BG where the alert alone is enough for the patient to take a relevant decision.

CONCLUSION

The previous CDDIAB study has shown that our prediction technology is accurate enough to allow therapeutical decisions based on it with no to little clinical outcomes **[A]**.

This study provides insight into the benefits of implementing this technology in an open-loop system: a predicted BG curve is an easy-to-read and relevant information to support patient during their decision making process.

The next step will be to test a decision support system, based on our prediction algorithms, which will provide therapeutic advices directly to the patient.

REFERENCES

[A] S. Bidet, N. Caleca, E. Renard, T. Camalon, L. De La Brosse, M. Rehn, O. Diouri and J. Place. First assessment of the performance of a personalized machine learning approach to predicting blood glucose levels in patients with Type 1 diabetes: The CDDIAB study. *ATTD 2019.*