



# Slowed Meal Appearance May Enable Hybrid Closed Loop System in Type 1 Diabetic Patients: *in silico* Results

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**BACKGROUND/OBJECTIVE** Several novel adjunctive treatments in type 1 diabetes (T1D) result in slowed and/or delayed postprandial glycemic rise (e.g. pramlintide, GLP1-RA, SGLT1). Their association with hybrid closed-loop (HCL) systems may free patients from carbohydrate counting, while maintaining adequate glycemic control.

## Method

We combined the UVA HCL system with a new meal control module combining temporarily increased basal rate triggered by meal announcement (snack/regular/large size without carbohydrate counting) and body-weight dependent priming bolus triggered by glycemic rise.

This new carbohydrate independent methodology was compared to standard HCL (using carbohydrate counting and carbohydrate:insulin ratios) on the platform of the UVA/Padova T1D simulator. Single meals of varying size were simulated in 100 virtual adults, from a variety of fasting glycemic states (90/120/150 mg/dl). Meals were slowed down to achieve half-appearance time of 60min on average. Glycemic control was assessed by computing the time spent between 70 mg/dL and 180 mg/dL; and time spent below 70 mg/dL over the prandial excursion.

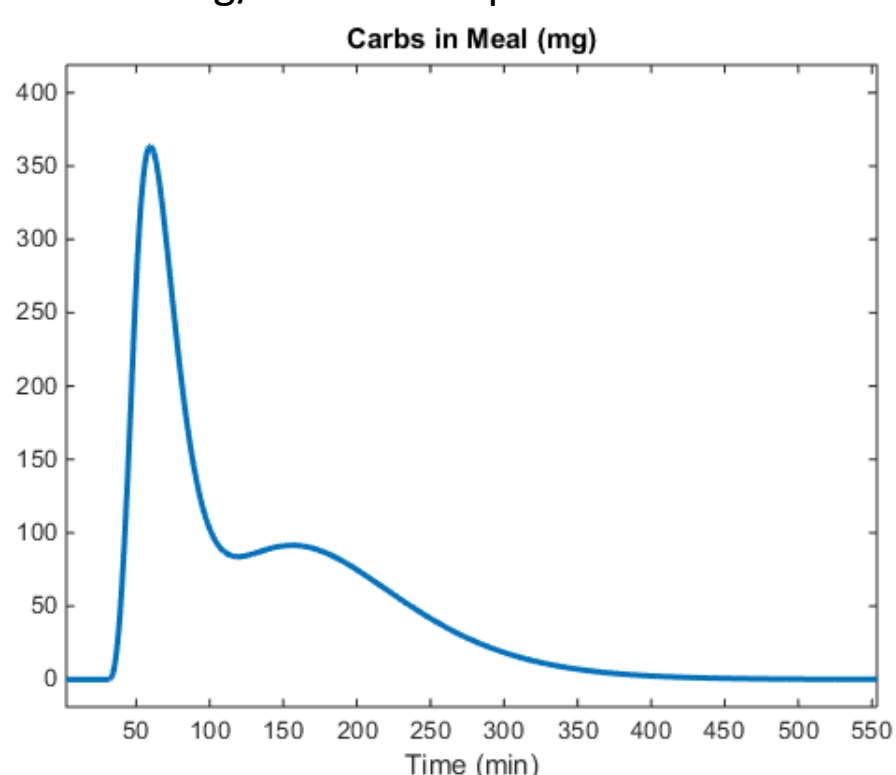


Figure 1: Demonstration of a slowed, mixed meal.

Table 1: Percentage of time of BG below 70 mg/dL.

Meal (g/kg-BW)	HCL	New Strategy	P-value
0.01	0	0.071±0.78	ns
0.2	0	0.027±0.46	ns
0.4	0.22±2.04	0	ns
0.8	2.58±7.19	0	<0.0001
1	3.63±8.78	0	<0.0001
1.5	5.11±10.07	0.059±1.02	<0.0001

Table 2: Percentage of time of BG between 70 and 180 mg/dL.

Meal (g/kg-BW)	HCL	New Strategy	P-value
0.01	100	99.93±0.78	ns
0.2	100	99.97±0.46	ns
0.4	99.78±2.04	100	ns
0.8	97.08±7.98	97.87±9.41	ns
1	94.58±11.83	91.16±18.76	<0.01
1.5	87.06±17.80	74.29±28.76	<0.0001

## Results

The new carbohydrate independent strategy achieved similar or better protection against hypoglycemia and similar glycemic control when compared with HCL, but for particularly large meal. For these, hypoglycemia exposure was significantly reduces, but at the cost of time spent in range.

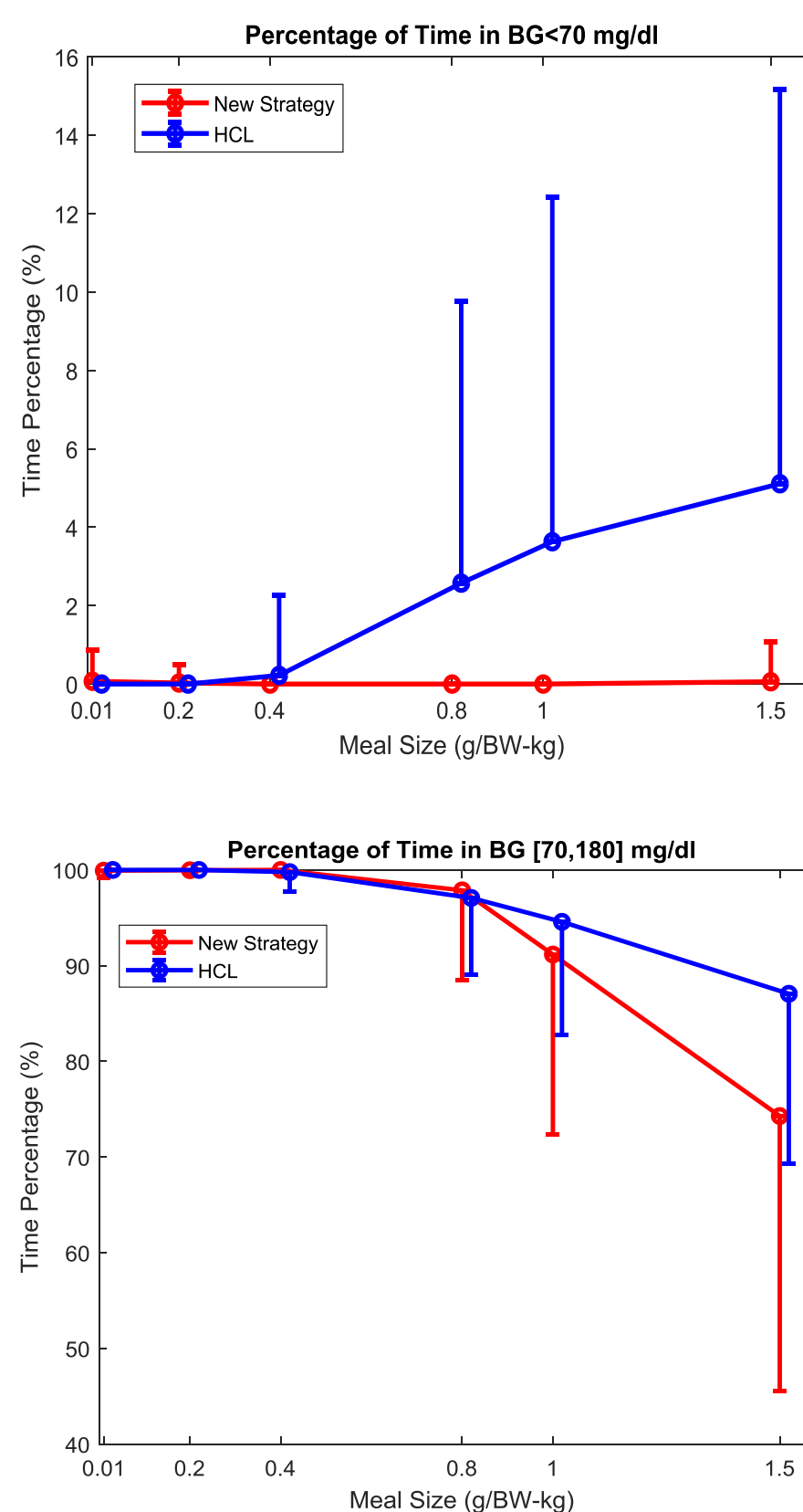


Figure 2: Average time percentage below 70mg/dl (upper panel), between 70 mg/dL and 180 mg/dL (lower panel), for varying meal sizes (standardized by bodyweight), for standard HCL (blue) and carbohydrate independent closed loop control (red).

## Conclusion

A new closed loop strategy, independent of prandial carbohydrates estimation, was shown in-silico to have similar performances and an improved safety profile when compared with standard HCL in case of mild prandial delays/slow down commensurate with available non-insulin adjuvants. Combining such methodology with automated meal detection and/or eating pattern recognition may enable fully automated closed loop systems.

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