

# In Silico Monte Carlo Virtual Trials of a Model-Based Adaptive T1DM Control Protocol

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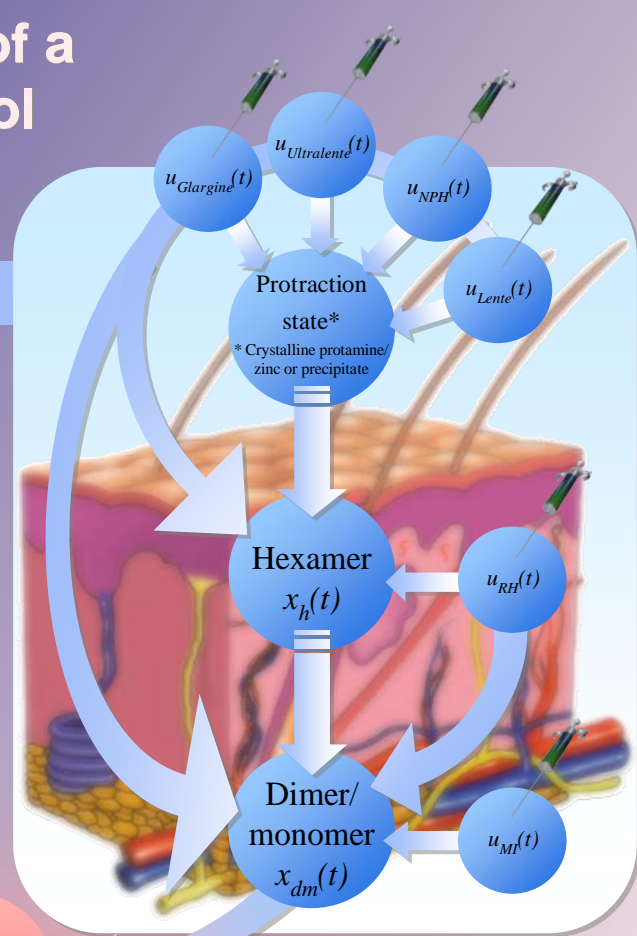
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## 1 The Background...

- The hormone *insulin* controls blood glucose levels. **Diabetes** results from defective *insulin secretion and/or action*, causing wildly fluctuating glucose levels
- Low levels (**hypoglycaemia**) and high levels (**hyperglycaemia**) increase the risk of complications and death
- Diabetes** is an **epidemic** in developed countries. In 2002, the disease cost **US\$132 billion**, was the **6<sup>th</sup> leading cause of death**, and affected **7% of the population** (US figures)<sup>1</sup>. In NZ, that cost is **NZ\$400 million**, set to rise to **NZ\$1 billion by 2020**<sup>2</sup>
- Complications and associated healthcare costs can be **reduced by up to 76%**<sup>3</sup> with good control. **But, ~45% of people with diabetes** are deemed **'poorly controlled'**<sup>4</sup>
- This Research:** Examines an adaptive protocol using Monte Carlo analysis for robustness, performance and safety

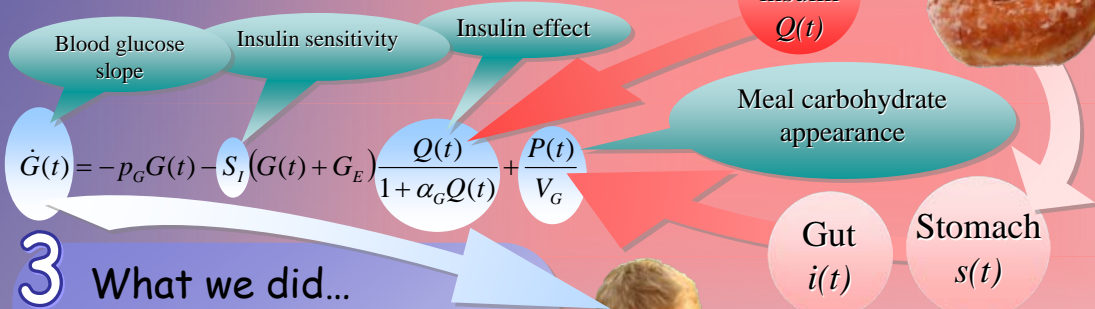
## 2 The Protocol

- Basal:** Titration based on published methods (Fritsch & Riddel et al).
- Prandial:** 2 measurements / meal at t=0 and t=90 mins for correction
- Correction Bolus:** Only on those meals requiring it uses the model to determine it (fit  $S_t$  + carb count).
- Use up to 3 meals and 2 snacks (**Measure: 10 total, goal is 4 or less**)
- Goal:** The system must rely on **minimal glucose measurements** and **minimal technology** for the 85% or more who don't use pumps.



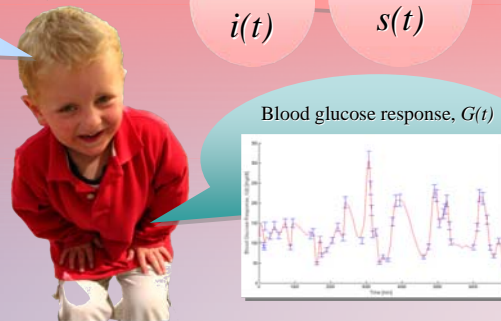
## Insulin Absorption Model

## Glucose-Insulin Model



## 3 What we did...

- Monte Carlo virtual patient (simulation) study using 40 AIDA cohort patients as a basis
  - Average HbA1c = 8% matching US
- Account for **variability** and **error** in model parameters (physiology, dosing, carb counting, etc) with published data or larger
- Each patient simulated 1 week x 8300 variations** → 1.4M different patient hours
- HbA1c estimated with published formula



## 4 The Results...

- Our findings...**
  - 6 measmt/day** satisfy ADA guidelines<sup>5</sup> for **100%** of patients.
  - Using conventional control (CC), just **~49-52%** meet guidelines<sup>4</sup>
  - Hypoglycaemia reduced by ~8x**
  - Time below 54mg/dL ~0
  - Barely different for 4/day**
- Conclusions:** This control approach **doubled** the number of patients **safely** meeting clinical guidelines. It uses common low cost treatment methods.

## References

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