



# GluCal In-Vitro Testing System

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## Abstract

Type 1 Diabetes is a chronic illness in which the body cannot regulate its blood glucose levels. Continuous glucose monitors (CGMs) help manage the disease, but they are expensive and painful. Laxmi Therapeutic Devices is developing a new, painless, affordable CGM, but before it can go to human trials it needs to be tested for reliability and accuracy in-vitro. This is where GluCal comes in. We designed GluCal to reproduce the blood glucose profile of a Type 1 Diabetic throughout the day. It achieves this by mixing two solutions of different concentrations of glucose, to produce any concentration in between. GluCal will be used to validate Laxmi's CGM.

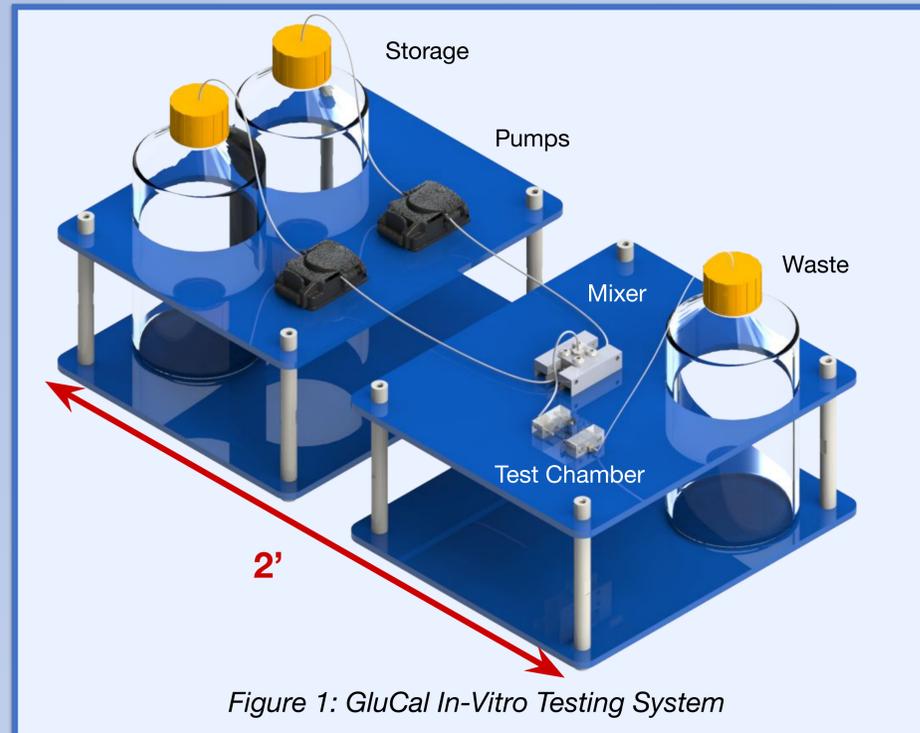


Figure 1: GluCal In-Vitro Testing System

## System Validation

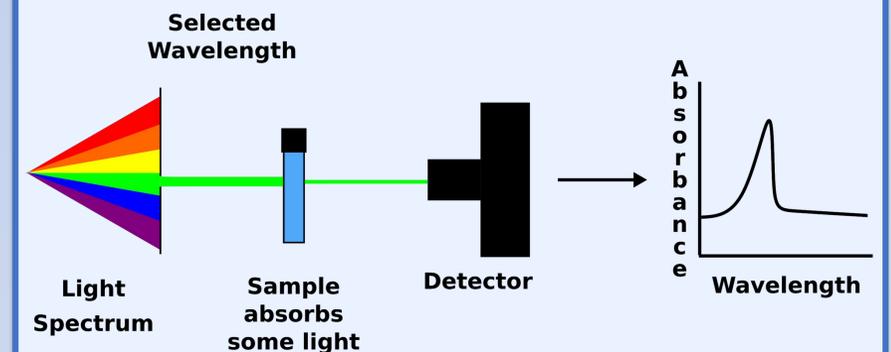


Figure 2: Functional diagram of UV-VIS spectroscopy

- Fluorescein used as an analog for glucose due to similar diffusion coefficients

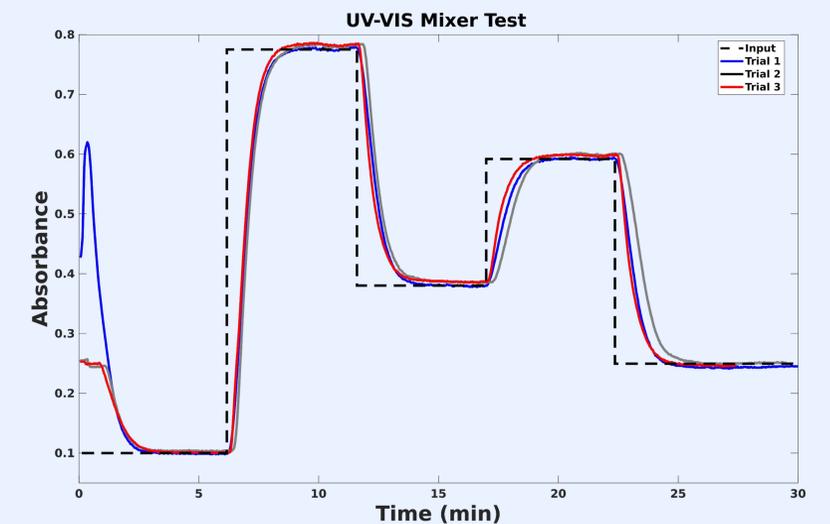


Figure 3: Step inputs and measured transient response

Absorbance values settle without significant oscillation, indicating solution is well mixed, and thus Laxmi's CGM can be validated with GluCal.

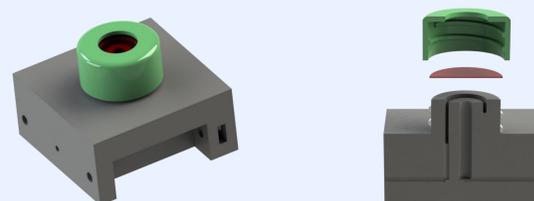
## Engineering Specifications

Max rate of change	5 mg/dL/min
Concentration profile	0-500 mg/dL
No leak	Binary
Flow rate	Run for 24 hours without refill
Fit within a glovebox	1ft x 1ft x 2ft

## Optimizing Components

### Test Chamber

- Minimizes bubbles by filling from bottom
- Design ensures flow path intersects the sensor without leaks

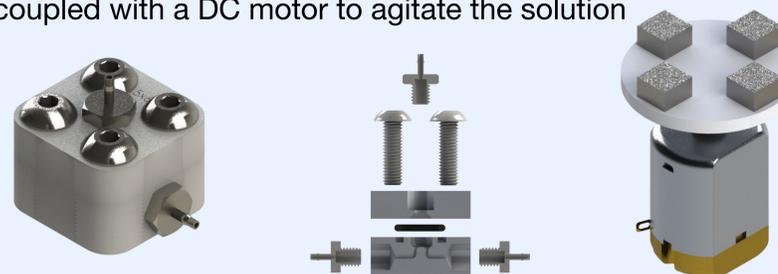


### Pumps

- Miniature peristaltic pumps accurately pump at specified flow rate 10  $\mu$ L/s

### Mixer

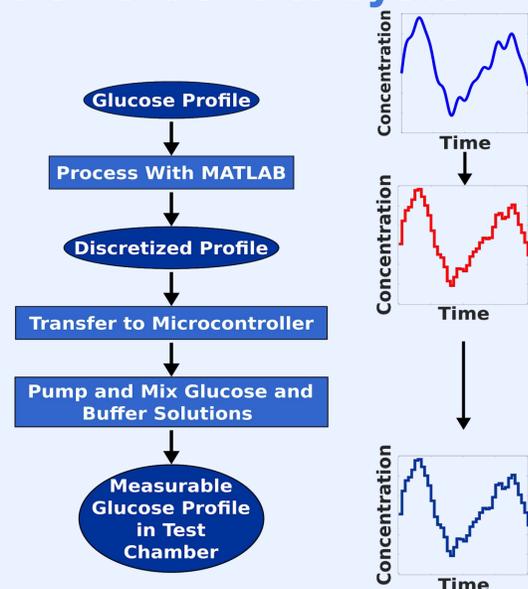
- Ensures well-mixed outflow using a stir bar and magnetic stirrer coupled with a DC motor to agitate the solution



### Liquid Storage and Waste

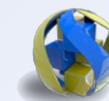
- 1L Pyrex bottles hold sufficient volume for 24-hour experiment

## Electronic Control System



## Acknowledgements

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