

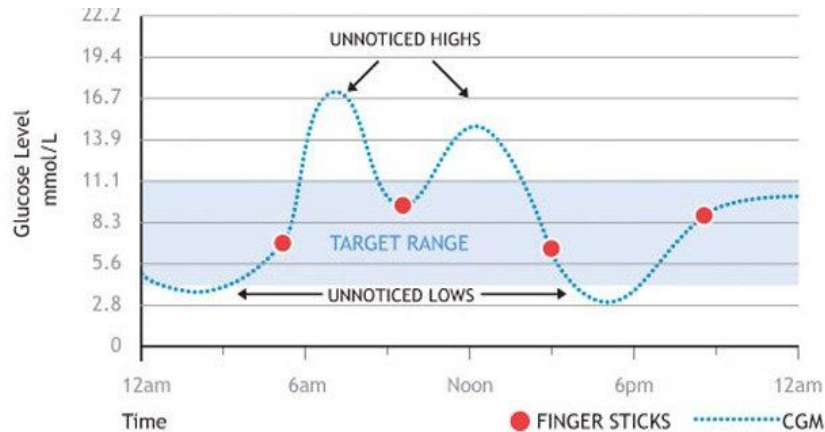
Assessing the Impact of Shortened Follow-up time in Continuous Glucose Monitor Clinical Trials

BIOSTAT 620 Final Project
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Wearable Devices in Diabetes Management

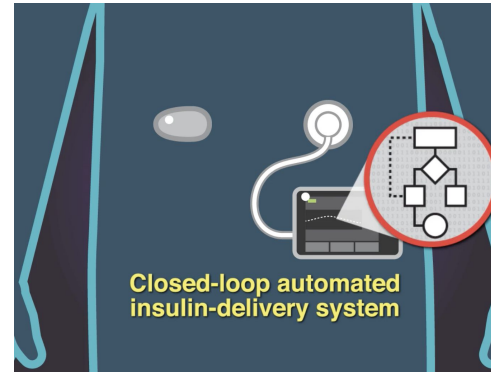
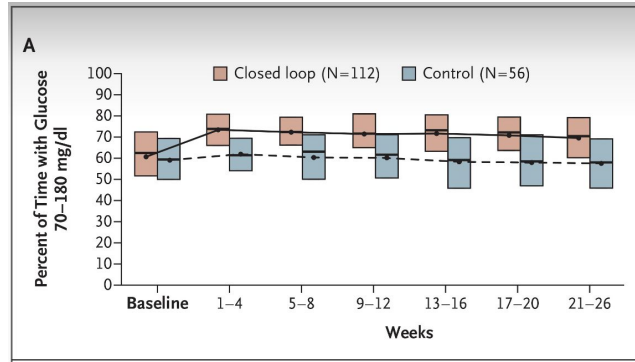
Type I Diabetes → autoimmune disease resulting in high/abnormal blood glucose levels

Solution: Continuous glucose monitoring



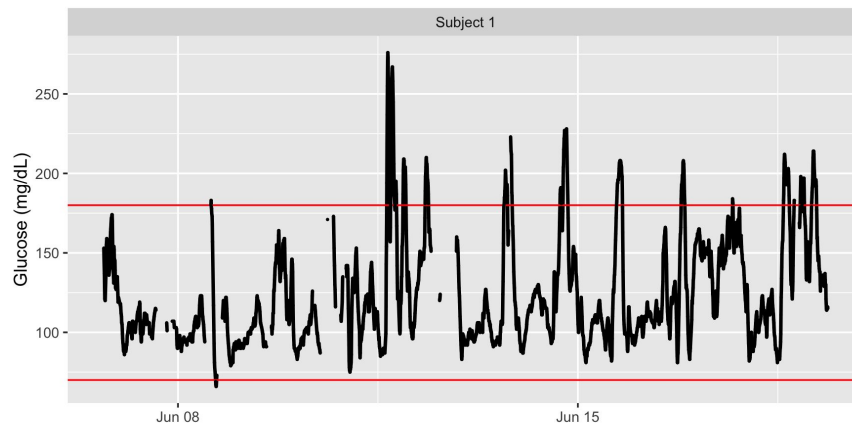
Clinical Trial - Brown et al. 2019

Randomized trial assessing the efficacy of a closed-loop system



Our Idea: **Are CGM metrics sensitive to differing follow-up period lengths after intervention in a clinical trial setting?**





Primary Outcome:

Time In Range (TIR): % of time spent between 70 mg/dL and 180 mg/dL

Secondary Outcomes:

Time Below Range (TBR): % of time spent below 70 mg/dL

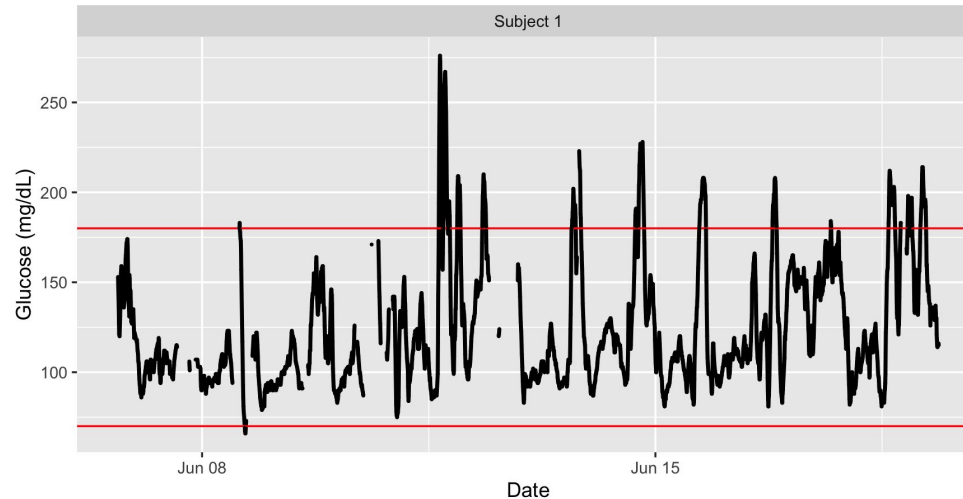
Coefficient of Variation: Standardized measure of variance: $\widehat{c_v} = \frac{s}{\bar{x}}$

Hyperglycemic episodes: count of 15 min + excursions above 180 mg/dL

Typically calculated with *at least 14 days of CGM data* (Battelino et al. 2019)

Continuous Glucose Monitor (CGM) Data

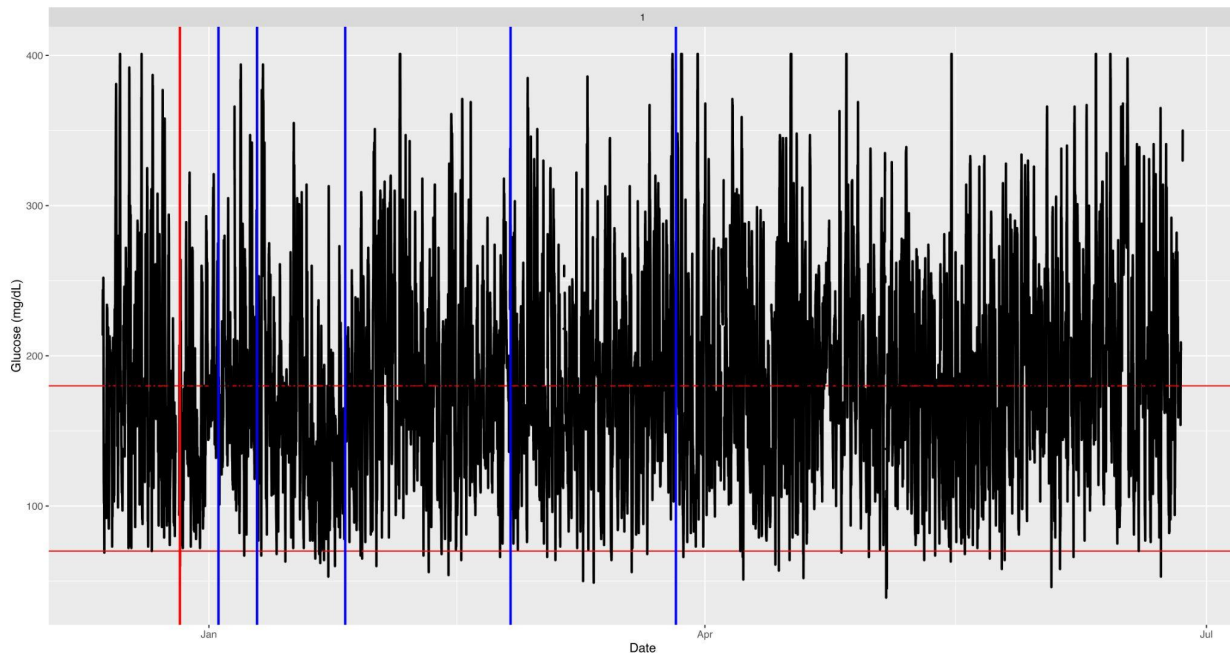
- Wearable device that tracks interstitial glucose level in real time.
- Most commonly used by individuals with diabetes



Methods

Our Idea: **Are CGM metrics sensitive to differing follow-up period lengths after intervention in a clinical trial setting?**

- Replicate trial analysis
 - Calculate outcome metrics for baseline and trial periods
- Reduce trial length
 - First 7, 14, 30, 60, 90 days
- Calculate outcome metrics on reduced trial lengths



Methods

- Create linear mixed effects model

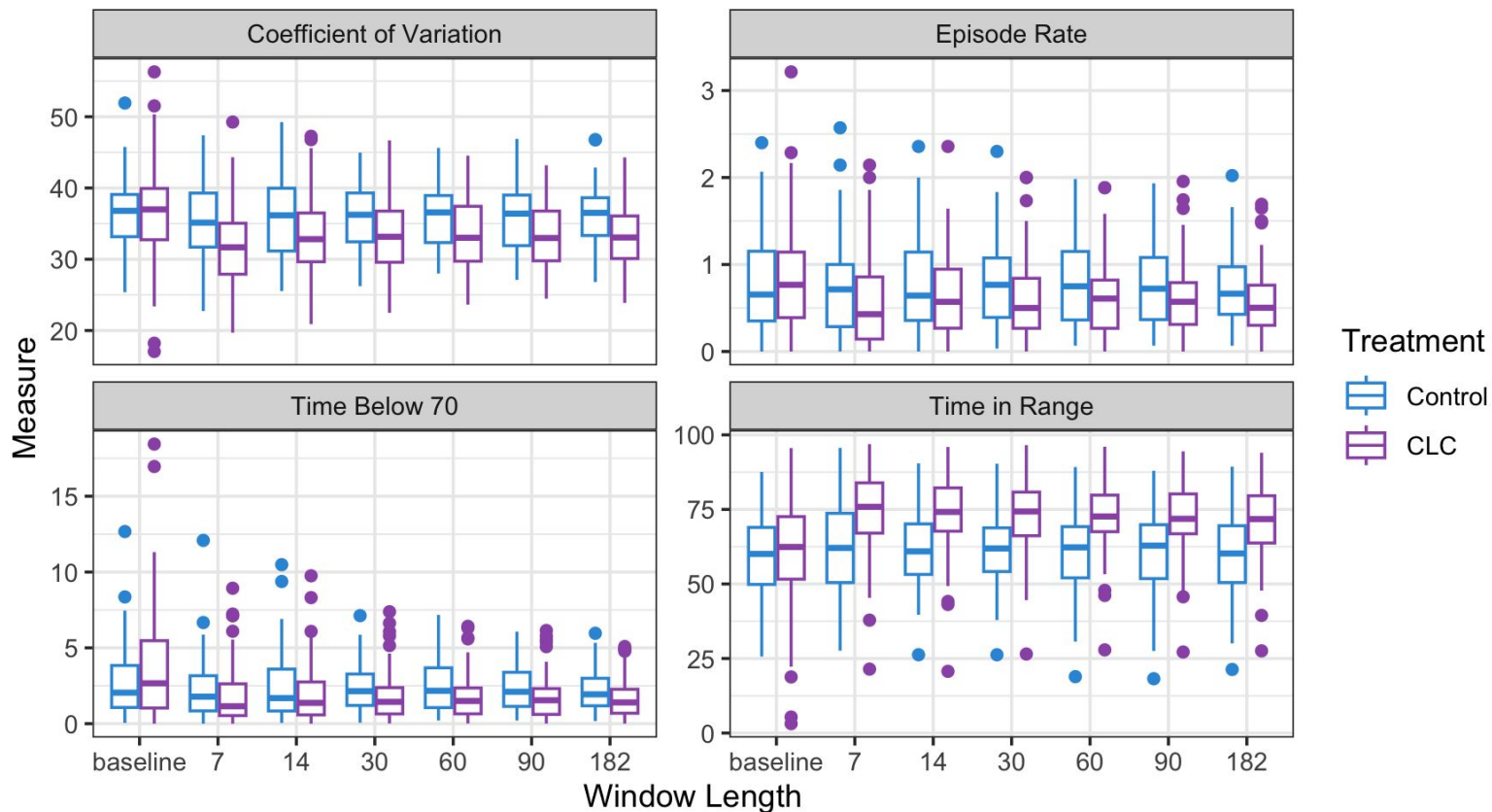
$$\Delta \text{Metric} = \text{Metric} - \text{Metric}_{\text{baseline}} \sim \text{Metric}_{\text{baseline}} + \text{Age} + \text{Insulin Modality} + \text{Previous CGM Use} \\ + \text{Treatment Group} \times \text{Time Window} + (1 \mid \text{Site}) + (1 \mid \text{Subject})$$

- If heteroskedasticity is detected, transform data

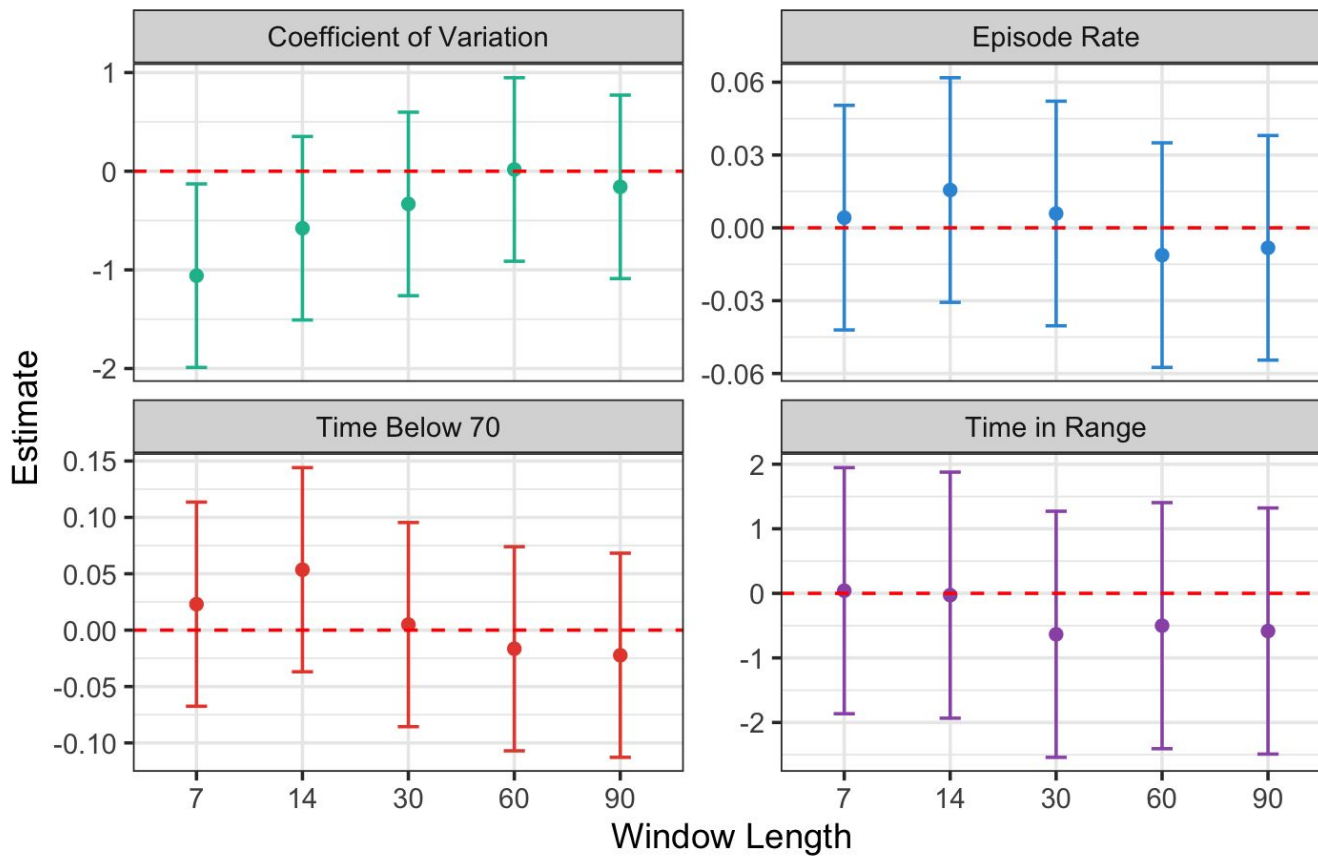
$$\Delta \log \text{Metric} = \log(\text{Metric} + 1) - \log(\text{Metric}_{\text{baseline}} + 1) \sim \log(\text{Metric}_{\text{baseline}} + 1) + \text{Age} + \text{Insulin Modality} + \text{Previous CGM Use} \\ + \text{Treatment Group} \times \text{Time Window} + (1 \mid \text{Site}) + (1 \mid \text{Subject})$$

- Test the individual effects of the interaction effects of each time window

Results - Metric Distributions



Results - Effect Size Comparison



Conclusions

Findings:

- Similar treatment effect observed with less follow up time
- Follows 14 days of data consensus
- This is just one intervention - safety considerations are important and should drive trial length consideration

Next Steps:

- Investigate adverse events frequency

Citations

1. Clinical Targets for Continuous Glucose Monitoring Data Interpretation: Recommendations From the International Consensus on Time in Range | Diabetes Care | American Diabetes Association. Accessed April 15, 2025.
<https://diabetesjournals.org/care/article/42/8/1593/36184/Clinical-Targets-for-Continuous-Glucose-Monitoring>
2. Six-Month Randomized, Multicenter Trial of Closed-Loop Control in Type 1 Diabetes | New England Journal of Medicine. Accessed April 15, 2025. <https://www.nejm.org/doi/full/10.1056/NEJMoa1907863>