Investigating the Relationship Between Dexcom Clarity Notification Settings and Change In Users' Time-In-Range Over 90 Days

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CONTINUOUS GLUCOSE MONITORING

INTRODUCTION

Research Objective
- How do Dexcom Clarity notification settings correlate with changes in users' Time In Range (TIR) levels?

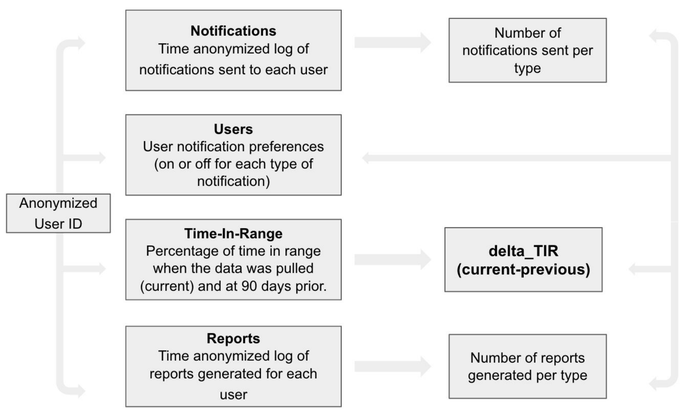
Methods
- Multiple linear regression (MLR) with three way interactions
- Bootstrap pivotal 95% confidence intervals (CIs) used to provide uncertainty quantification on functions of coefficients

Results
- Notification settings had varying impact on change in TIR
- Further analysis including demographic variables in future analysis may better indicate the association between tailored Clarity app notifications and improved diabetes management

DATA DESCRIPTION

- Four datasets from Dexcom were matched by anonymized user ID and text entries were manipulated into one comprehensive aggregate dataset for analysis

Figure 1. Pre-Processed Datasets and Post-Processed Dataset



Variables
- Response variable**:** Delta TIR was created to represent TIR change over the previous ninety days (current-previous)
- Explanatory variables: five types of notification settings, number of reports received, and other controls

Table 1. Types of Notifications

Time In Range	Percentage of time in range from prior week
Patterns	Patterns list Clarity found from prior week
In Range Goal	Days over the last 7 days reached TIR goal
Email Report	Summarize TIR, patterns, trends prior week
Best Day	Days most in range over the last 7 days

METHODS

Subset Method
- For each notification type, users were categorized into four groups based on their notification status ('On' or 'Off') and the number of notifications (zero or greater than zero).
- Users' TIR at the start of the 90 day period were dichotomized by quantile to form a categorical variable with levels (low, mid, high)

Table 2. Subsets of Users

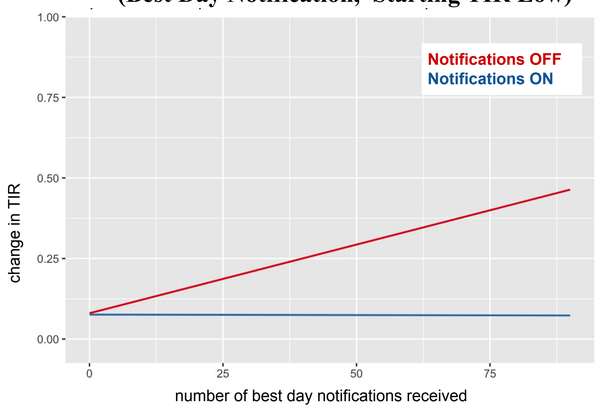
Type	# Notifications = 0	# Notifications > 0
ON	On-Zero	On-Greater
OFF	Off-Zero	Off-Greater

MLR Model with Three Way Interactions
- Including a three way interaction among starting TIR level, notification status, and number of notification received enabled separate analysis of users in each of the subsets and in different starting TIR levels by examining combinations of coefficient estimates for slope and intercept

For a fixed notification type, change in TIR is modeled as:

$$\beta_0+\beta_1*\mathbb{1}_{Subscribed=Yes}+\beta_2*\mathbb{1}_{Num>0}+\beta_3*\mathbb{1}_{level=Mid}+\beta_4*\mathbb{1}_{level=High}+\beta_5*\mathbb{1}_{Subscribed=Yes}*\mathbb{1}_{Num>0}+\beta_6*\mathbb{1}_{Subscribed=Yes}*\mathbb{1}_{level=Mid}+\beta_7*\mathbb{1}_{Subscribed=Yes}*\mathbb{1}_{level=High}+\beta_8*\mathbb{1}_{Num>0}*\mathbb{1}_{level=Mid}+\beta_9*\mathbb{1}_{Num>0}*\mathbb{1}_{level=High}+\beta_{10}*\mathbb{1}_{Subscribed=Yes}*\mathbb{1}_{Num>0}*\mathbb{1}_{level=Mid}+\beta_{11}*\mathbb{1}_{Subscribed=Yes}*\mathbb{1}_{Num>0}*\mathbb{1}_{level=High}$$

Figure 2. Difference in Slope between ON and OFF Group (Best Day Notification, Starting TIR Low)



Bootstrap Pivotal 95% CIs
- Residuals clearly violated Normality assumption thus pivotal bootstrap intervals were used to provided uncertainty quantification for estimated regression coefficients and sums of coefficients of interest

RESULTS

Figure 3: Pivotal 95% CIs for slope between notifications and change in TIR

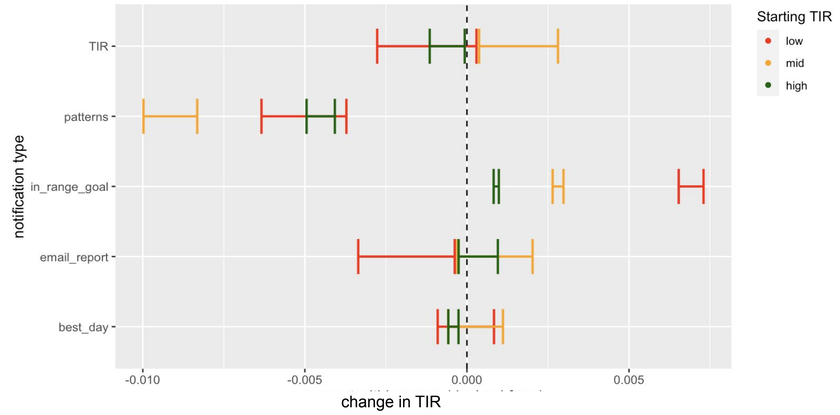


Figure 4: Pivotal 95% CIs for intercept of notification status ON

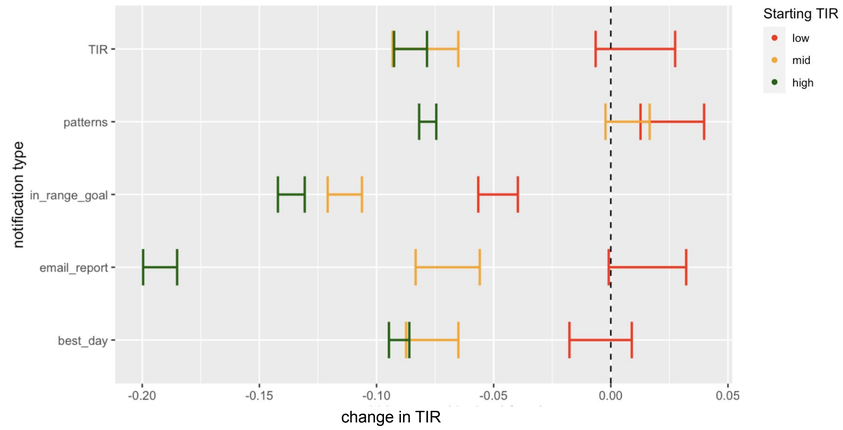


Fig. 3: Positive association of receiving in range goal notifications for all levels of Starting TIR
Fig. 4: Intercept represent baseline change in TIR for users who had notifications ON but received no notifications compared to users who had notifications OFF. Users in low and mid Starting TIR had the lesser decrease in TIR compared to high starting group.

DISCUSSION

- Associations for TIR notifications (mid level, positive; high level, negative), email report notifications (low level, negative), best day notifications (high level, negative)

Limitations
- Lack demographic information of Clarity users (age, gender, diabetes duration, marital status, etc.) limited the ability to explain variability in change in TIR

Future Works
- Previous research suggested importance on demographic information - users who viewed their weekly TIR report with their family members showed greater improvements (Polonsky Et al.)
- Controlling for the demographic information of users in the model will likely provide more reliable estimates of associations between notification settings and change in TIR

References

Polonsky WH, Soriano EC, Fortmann AL. The Role of Retrospective Data Review in the Personal Use of Real-Time Continuous Glucose Monitoring: Perceived Impact on Quality of Life and Health Outcomes. Diabetes Technol Ther. 2022 Jul;24(7):492-501. doi: 10.1089/dia.2021.0526. Epub 2022 Apr 26. PMID: 35255224.