

Contextual Annotations Predict Digital Health Solution Persistence and Diabetes Outcomes

Outcomes

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Background and Objectives

- ❖ Digital health solutions typically help patients manage chronic diseases by leveraging structured data like blood glucose, diet, and medication adherence
- ❖ Patient-generated annotations to such data may help patients and providers make sense of trends by tracking unique concerns
- ❖ The purpose of this research was to:
 - explore how patients use annotation features
 - explore the relationship between annotations and persistent engagement as well as diabetes outcomes

Sample and Data

- ❖ Data from 3,142 patients users of BlueStar with Type 2 diabetes (50.3% women; 62.1% aged 40-63 years; 44.1% A1c ≥ 8.0)
- ❖ Users can contextualize self-management entries with structured (e.g., 'I feel sad') or patient-generated freetext (e.g., 'feeling bad, groggy, can't focus on work') annotations
- ❖ Annotation themes related to diet, medication, biomedical readings, health symptoms, mood, sleep, and activity

- ❖ 91,551 structured notes from 1,045 (33.3%) users
- ❖ 31,422 freetext notes from 941 (29.9%) users

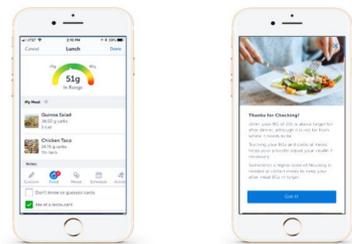


Figure 1. Screenshots of BlueStar app.

Results

Early Annotation Usage and Persistence

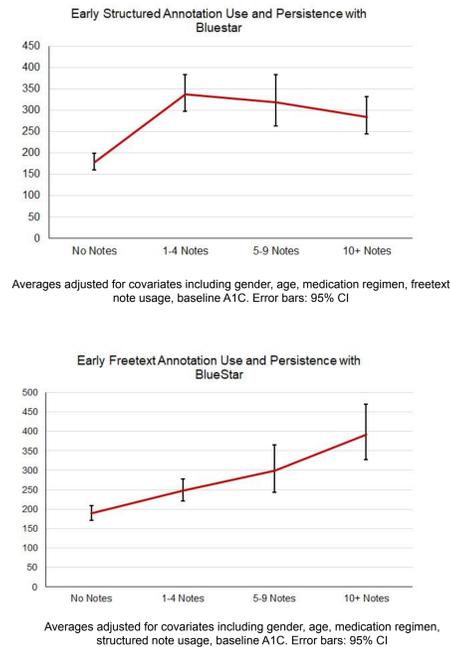


Figure 2. Trends in early annotation usage and total duration of BlueStar usage.

- ❖ Early usage of structured and freetext annotations associated with greater persistence
- ❖ General increasing monotonic relationship for freetext annotation usage
- ❖ Structured annotations show only significant increase in persistence in contrast to no notes

Total Annotation Usage and A1C Improvement

- ❖ Highest freetext note takers exhibiting significantly larger declines in A1C compared to all other categories of freetext annotation usage ($ps < .02$)
- ❖ No relationship with structured annotations ($p = .08$)

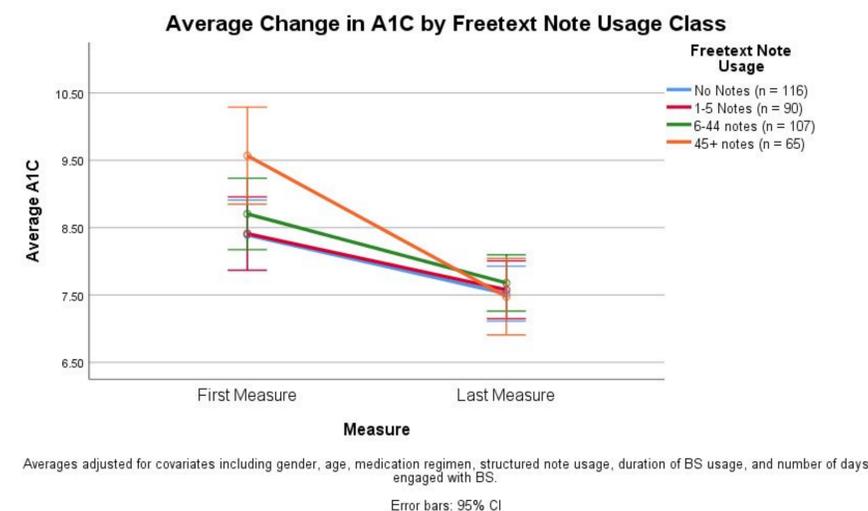


Figure 3. Trends in first and last measures of A1C by usage of annotations.

Indicators of Patient Burden and Glucose Control

- ❖ Also investigated specific content in annotations and relationship with glucose control
- ❖ Computed a Patient Burden Annotation Index (PBAI) by summing annotations that reflected negative mood or health-related symptoms in a user's first 14 days of use
- ❖ Patient burden associated with fewer 'in target' readings ($p = .04$), more 'low' readings ($p = .01$), and more 'high' readings ($p = .06$)

Theme	Example Annotations
Negative Mood	Structured: 'I feel stressed', 'I feel sad' Free-Text: 'stress levels on overload right now', 'I get very depressed when my BG is high because I want it to stay in the proper range'
Health-Related Symptoms	Structured: 'I feel sick', 'I am feeling light-headed' Free-Text: 'did not check b/s. still not feeling good', 'not sleeping well'

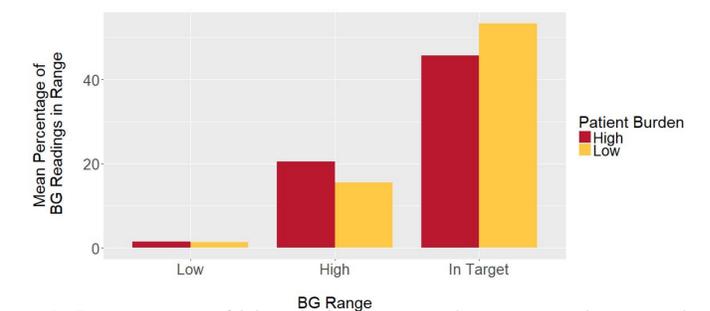


Figure 4. Proportion of blood glucose readings in each range by burden.

Conclusion

- ❖ Early usage of annotations is associated with greater persistence in using a digital health solution
- ❖ High levels of annotation usage associated with greater improvements in A1C
- ❖ However, annotation content reflecting high levels of patient burden during early engagement was associated with worse glucose control