Beyond Tracking: The Benefits of Contextual Annotation in a Diabetes Digital Therapeutic

M. Dugas¹, K. Crowley¹, W. Wang¹, A. K. Iyer², M. Peeples², M. Shomali², and G. Gao¹

¹Center for Health Information and Decision Systems, University of Maryland, College Park
²WellDoc Inc., Columbia, MD

Background and Objectives

- Digital therapeutics typically help patients manage chronic diseases by leveraging structured data like blood glucose, diet, and medication adherence.
- The addition of unstructured data may help patients and providers make sense of trends by tracking unique concerns.
- The purpose of this research was to:
  ➢ develop a lexicon to characterize annotations made by patients using a digital therapeutic
  ➢ explore the impact of annotations on diabetes outcomes

BlueStar Digital Therapeutic

- Retrospective data on users of BlueStar, an FDA-cleared digital therapeutic for Type 2 Diabetes.
- BlueStar is a primarily mobile platform that facilitates self-monitoring of diabetes management and provides automated coaching.¹ ²
- 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.

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).
- 941 users (29.9%) recorded 31,443 annotations.
- NLP techniques used to identify most frequent words used in free-text annotations.
- Annotation themes were then identified according to frequent words.

Results

Table 1. Annotation themes, their frequency, and top words.

<table>
<thead>
<tr>
<th>Theme</th>
<th>No. of Notes (%)</th>
<th>Top Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td>13,498 (42.9%)</td>
<td>Ate, dinner, lunch, breakfast, salad, chicken, snack, eat, cheese, carbs</td>
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<tr>
<td>Medication</td>
<td>7,409 (23.6%)</td>
<td>Meds, units, took, insulin, take, taken, taking, Humalog, Novolog, Lantus</td>
</tr>
<tr>
<td>Biomedical Readings</td>
<td>6,860 (21.8%)</td>
<td>BG, blood sugar, reading, BP, glucose, low, meter, pulse, check</td>
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<tr>
<td>Health</td>
<td>5,734 (18.2%)</td>
<td>Pain, sinus, sick, allergies, back, legs, cold, hot, better, headache</td>
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<tr>
<td>Mood</td>
<td>3,092 (9.8%)</td>
<td>Stressed, depressed, feeling, feel, pressure, stress, tired, felt</td>
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<tr>
<td>Sleep</td>
<td>2,339 (7.4%)</td>
<td>Sleep, bed, bedtime, woke, slept, sleeping, awake, sleepy, awake</td>
</tr>
<tr>
<td>Activity</td>
<td>2,001 (6.4%)</td>
<td>Gym, exercise, workout, miles, walked, walk, steps</td>
</tr>
</tbody>
</table>

Association with A1C

- Examined moderating effect of annotations on BlueStar outcomes with repeated measures ANCOVA, controlling for demographics and usage.
- Highest note takers exhibiting significantly larger declines in A1C compared with those who took no notes or very few notes ($F(3,357) = 3.55, p = .02$).

Conclusion

- A substantial subgroup of users made annotations to their data entries.
- Annotations reflected a diverse range of themes including wellbeing and core diabetes concerns.
- Annotation is associated with greater A1C improvement.
- Free-text annotation may offer unique benefit to digital therapeutic users.

References