Application of sentiment analysis to aid in evaluation of Patient-Reported Outcome Measures: Analysis of qualitative cognitive debriefing interviews

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Introduction

- Qualitative analysis of cognitive interviews is typically used to examine respondent comprehension of items, instructions, and response options of patient-reported outcome measures (PROMs)¹
- Parmar and colleagues² developed a quantitative method using sentiment analysis (the computational treatment of opinion and subjectivity in text)³ in R-Studio to analyze qualitative data via the calculation of sentiment scores
- Sentiment scores range from -1 (completely negative) to 1 (completely positive), with 0 being neutral, and are calculated by tagging polarized words (defined by a dictionary) and analyzing nearby words (neutral, negators, amplifiers, or de-amplifiers) to adjust sentiment⁴
- No quantitative method currently exists to evaluate respondents' understanding of PROMs

Objectives

- Evaluate the utility of a quantitative method (sentiment analysis) for determining PROM comprehension
- Compare the results from the sentiment analysis to the qualitative analysis of cognitive interviews

Methods

Data Source

- Transcripts (n=16) from cognitive interviews conducted during the development of a COVID-19 electronic symptom diary (eDiary)⁵
- eDiary consisted of 10 items measuring symptom severity with 3- or 4- point verbal ratings scales (Figure 1)
- Participants were interviewed using think-aloud techniques to ascertain comprehension of eDiary content

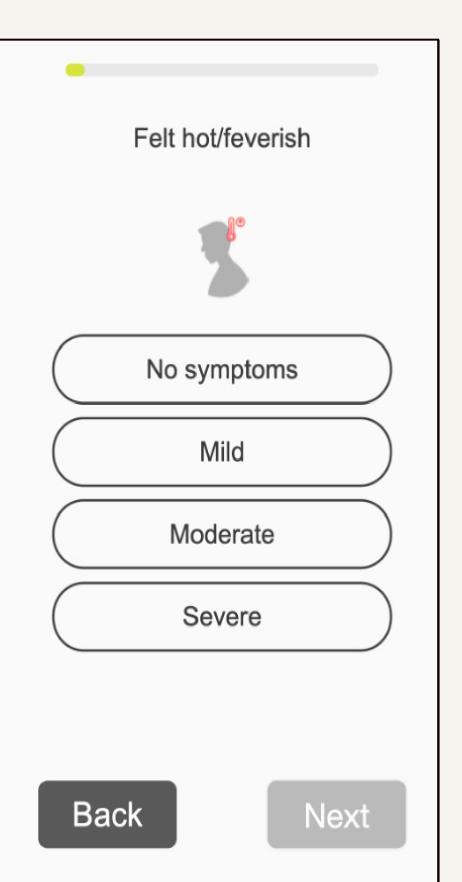
Data Extraction and Cleaning

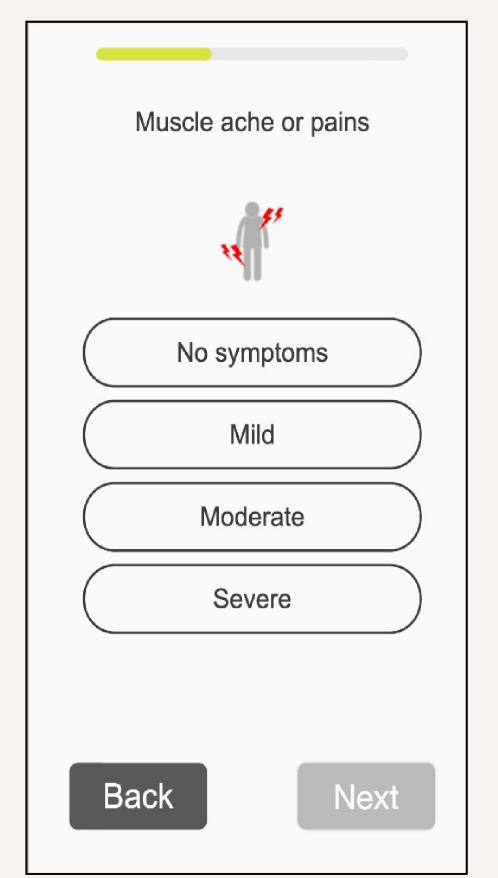
- Text for responses to questions about items (What did you think of this question?) instructions (Are the instructions clear? Why or why not?) and response options (Do these response options make sense to you in terms of your own experience with COVID-19 symptoms?) were imported into Excel
- Context was added to yes/no responses for analysis (e.g., 'Yes' [response options made sense in terms of my experience with COVID-19])
- Personal accounts of COVID-19 were removed to reduce noise
- Stripped white space and removed punctuation, stop words and numbers

Sentiment Analyses

- Sentiment scores were calculated with the polarity.frame argument from the QDAP package⁴
- Polarized words were classified using the prebuilt dictionary, key.pol
- Individual sentiment scores from eDiary content were averaged for each run to determine the overall PROM score
- 3 iterations of runs were conducted:
- 1. Default valence shifters (4 words before and 2 words after)
- 2. Trimmed (removed terms [e.g., symptoms, response options, filler words] that skewed sentiment)
- 3. Adjusted valence shifters (2 words before and 2 words after)

COVID-19 Symptoms Diary People experience COVID-19 differently. We are interested in the COVID-19 symptoms that you have experienced in the past 24 hours. For each symptom please choose the response that best captures your experience at its worst in the past 24 hours. There are no right or wrong answers. Begin





straightforward difficult Calfine

better

better

better

goodissue

Figure 3. Word Map of Polarized Words

Table 1. Comprehension of eDiary Instructions, Items and Response Options

Figure 1. Example Screenshots of COVID-19 eDiary

Description	Statistic
Overall Impressions	
Accurately reflects experience with COVID-19, n (%)	16 (100.0)
Ease of comprehension, mean (SD) [min, max]	9.3 (1.03) [7,10]
Instructions	
Easy to read and understand n (%)	15 (93.7)
Item Comprehension	
Easy to read and understand n(%)	14 (87.5)
Response Options	
Easy to understand, range across all items (%)	87.5-100.0

Table 2. Sentiment Scores Across Runs for eDiary Content

eDiary Content	Sentiment Score		
	Run 1	Run 2	Run 3
Instructions	0.15	0.23	0.23
Item 1: Felt hot/feverish	0.18	0.32	0.33
Item 2: Chills or shivers	0.29	0.28	0.29
Item 3: Trouble breathing	0.10	0.29	0.30
Item 4: Coughing	0.18	0.35	0.35
Item 5: Tiredness	0.07	0.28	0.28
Item 6: Muscle aches or pain	0.04	0.39	0.42
Item 7: Stuffy or nose	0.26	0.38	0.39
Item 8: Sore throat	0.04	0.23	0.24
Item 9: Headache	0.23	0.38	0.40
Item 10: Nausea	0.49	0.45	0.46
Response options	0.47	0.63	0.63

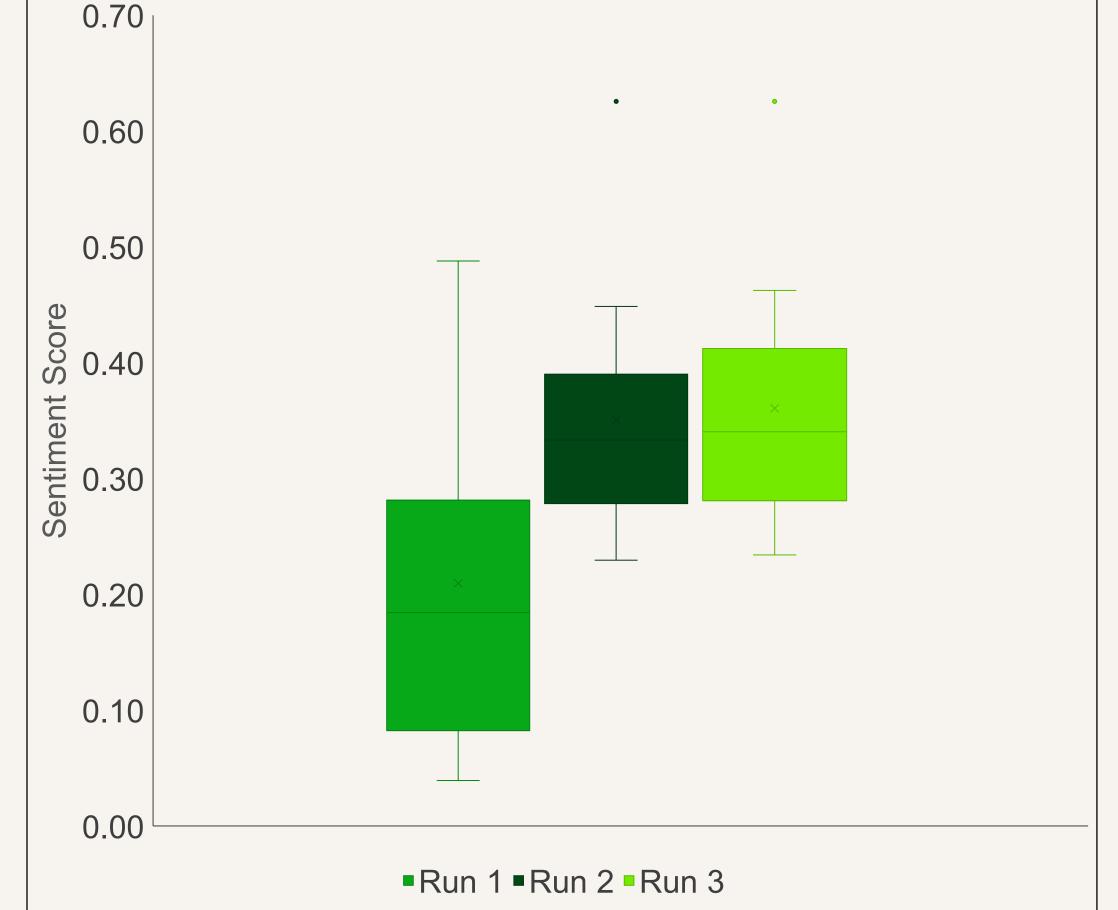


Figure 2. eDiary Average Sentiment Scores Across Runs

Results

Analysis Sample

• Participants (n=16) had an average age of 45.9 years, were mostly female (56.2%), and approximately a third (32.1%) had a high school education

Qualitative Analysis

 Participants indicated that items were relevant to their experience with COVID-19 and that the instructions, individual items, and response options were easy to read and understand (Table 1)

Sentiment Analysis

- Sentiment scores for the eDiary were variable in Run 1 (default valence shifters), ranging from neutral (0.04) to moderately positive (0.49) (**Figure 2**)
- For Run 2 (trimmed), sentiment scores were positive (range: 0.24 to 0.36) and less variable. Adjusting the valence shifters in Run 3 did not significantly affect scores (**Figure 2**)
- Variability was observed in sentiment scores across eDiary instructions, items, and response options (Table 2)

Polarized Words

 Positively valent words were more frequently used than negatively valent words when talking about eDiary content (Figure 3)

Conclusions

- Sentiment analysis results were consistent with the qualitative analyses and provide additional quantitative data that can help inform decisions to refine/ retain/ or remove items
- Consideration should be given to creating a dictionary tailored to PROM comprehension to enhance the utility of this approach

References

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²Parmar M et al. *2018 ICACCI:* 1063-1068

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⁵Baranov et al. Value in Health 2022; 25(6), S1

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Disclosures

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