

Facial and vocal markers of schizophrenia measured using remote smartphone assessments

Vidya Koesmahargyo¹, Anzar Abbas¹, Vijay Yadav¹, M. Mercedes Perez-Rodriguez², Paul Rosenfield², Omkar Patil³, Marissa F. Dockendorf³, Matthew Moyer³, Lisa A. Shipley³, Isaac R. Galatzer-Levy^{1,4}, Bryan J. Hansen³

¹ AiCure, New York, NY

² Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY

³ Merck & Co., Inc., Kenilworth, NJ, USA

⁴ Psychiatry, New York University School of Medicine, New York, NY

Introduction

There is rapidly increasing utilization of remote digital measurements in clinical research and practice. These machine learning-based facial and vocal measurements have demonstrated relationships with schizophrenia diagnosis and severity. We determine their accuracy when acquired through automated assessments conducted remotely through smartphones.

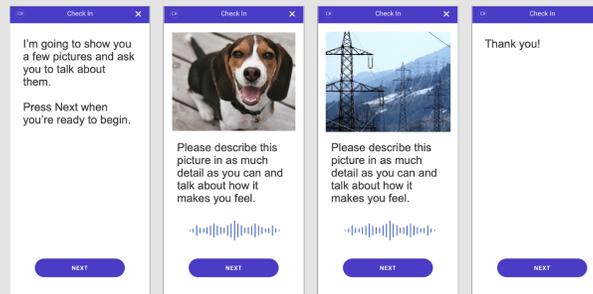
Demonstrating utility and validity of remote and automated assessments conducted outside of controlled experimental settings can facilitate scaling such measurement tools to aid in risk assessment and tracking of treatment response in difficult to engage populations.

Methods

Measurements of facial and vocal characteristics including facial expressivity, vocal acoustics, and speech prevalence were assessed in 20 schizophrenia patients over the course of 2 weeks in response to two classes of prompts previously utilized in experimental laboratory assessments: *evoked* prompts, where subjects are guided to produce specific facial expressions and phonations, and *spontaneous* prompts, where subjects are presented stimuli in the form of emotionally evocative imagery and asked to freely respond.

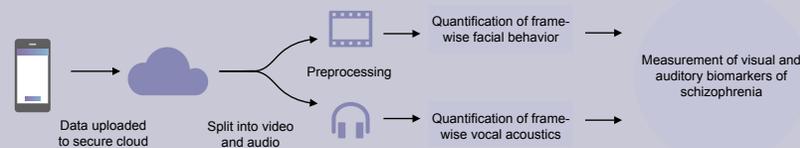
A combination of computer vision and digital signal processing tools were used for quantification of facial and vocal behavior and subsequent derivation of visual and auditory markers of schizophrenia. The code used to acquire these measures have been packaged as an open source software library and made available for use: https://github.com/aicure/open_dbm.

Depiction of remote smartphone assessments



All study participants took assessments for remote and automated collection of video and audio data. During each of the prompts, the app speaks the text displayed on the screen and awaits a verbal and visual response from the participant, all while recording video and audio from the front-facing camera and microphone.

Processing of collected data for measurement of visual and auditory markers of Schizophrenia



Facial and vocal measurements were then assessed in relation to schizophrenia symptom severity using the Positive and Negative Syndrome Scale (PANSS). The digital measures were compared to overall severity (PANSS Total), along with the subscales reflecting negative symptom severity (N Total), positive symptom severity (P Total), and general severity (G Total) using Pearson's correlation.

Results

Multiple vocal markers were significantly correlated with overall negative symptom severity (N Total) after correcting for multiple comparisons. This includes *fundamental frequency mean* ($r = -0.64$; *adjusted p* = .02), *vocal jitter* ($r = 0.56$; *adjusted p* = .02), and *harmonics to noise ratio* ($r = -0.61$; *adjusted p* = .02). *Vocal intensity* measured during free behavior also demonstrated significance ($r = 0.50$; *adjusted p* = .05).

Facial expressivity demonstrated significant relationships with overall schizophrenia severity PANSS Total ($r = -0.71$; *adjusted p* = .002) and severity on all PANSS subscales (N Total, $r = -0.50$; *adjusted p* = .035; P Total, $r = -0.63$; *adjusted p* = .006; G Total, $r = -0.70$; *adjusted p* = .009).

Conclusion

We demonstrate that facial and vocal markers, measured using computer vision and vocal analytics from video captured remotely via smartphones demonstrates validity as a marker of schizophrenia and is a promising metric for negative symptom severity.

Use of such technology in clinical care and clinical research settings could allow for more frequent, remotely assessed, objective measurement of disease symptomatology and treatment response in a scalable and accessible manner, which can support development of novel treatments and risk assessment among individuals with schizophrenia.

Disclosures

Authors IGL, AA, VY and VK were employed at AiCure, LLC at the time of the study. Authors OP, MD, MM, LS, and BH are employees of Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc., Kenilworth, NJ, USA and may own stock/stock options in Merck & Co., Inc., Kenilworth, NJ, USA.