

November 9, 2020

Statistical Analysis Plan: Implementing mHealth for Schizophrenia in Community Mental Health Settings

Title of Study	Implementing mHealth for Schizophrenia in Community Mental Health Settings
Investigator	Dror Ben-Zeev
NCT:	NCT04147897
CR ID	CR00008895
Funding	National Institute of Mental Health (NIMH) Grant Office ID: A132489 Funding Source ID: R01MH116057-01A1
Original Statistical Analysis Plan Date:	11/9/2020

Analytic Approach. Our analyses seek to test the overall effect of our implementation strategies on implementation outcomes (Aim 1), mediators and moderators of those effects (Aim 2), and the impact of the strategies on patient outcomes (Aim 3). In Aim 1, the dependent variables of interest will be penetration and provider acceptability assessed at baseline (prior to initiation of the facilitation strategies), at 3 months (following the completion of the facilitation period), and at 6 months (following 3 months of having no exposure to facilitation). Given the nested data (i.e., time nested within clinicians and clinicians nested within agencies), analyses will rely on 3-level mixed effects regression models. Negative binomial regression with log offsets will be used to model rates, and linear regression will be used to model continuous outcomes. For all models, our independent variables of interest will be a binary indicator of internal versus external facilitation (measured at the organizational level), time, and their interaction. The magnitude and statistical significance of the interaction term will estimate the effect of the implementation strategy on change, or “growth,” in outcomes over time. The impact of the intervention strategy on each outcome at each time will also be derived from these models. In addition, we will aggregate facility-level data and estimate the average weighted cost metrics across the sample of sites. Future commercial pricing of mHealth technology is unknown, so we will run scenarios that have different ranges of costs for FOCUS and explore the impact on the total program costs.

In Aim 2, mediation will be tested using the product of coefficients approach for multilevel mediation analysis, building on the models in Aim 1. In this approach, the total effect of the implementation strategy is parsed into direct and indirect pathways associated with absorptive capacity, the mediator. Path “a” will represent the effect of the implementation strategy at the organizational level on the clinician-level assessment of absorptive capacity. Path “b” represents the relationship between this mediator and the clinician-level growth parameter, signifying change in outcomes over time. An unbiased estimate of the mediated effect is derived via the product of the “a” and “b” paths (i.e., $a*b$) from these analyses. We will test the statistical significance of the mediated effects using the joint significance test and use Monte Carlo simulation methods to derive confidence intervals. Separate mediation models will assess whether absorptive capacity mediates the relationship between implementation strategy and, respectively, penetration, cost, and acceptability outcomes. Moderators of the implementation strategies’ effects will be tested by adding terms for each hypothesized moderator and its interaction with the implementation strategy to the Aim 1 models. Specifically, these models will estimate the conditional relationships between the implementation strategies and implementation outcomes across different values of the putative moderators. Organization-level moderators (i.e., Readiness for Change, Organizational Culture, Urban or Rural designation) will be examined. The magnitude of the moderator effects will be probed using simple slopes analysis and region of significance analysis for multilevel models.

In Aim 3, we will use the same techniques as described in Aim 1 to develop 3-level linear mixed regression models that account for the nesting of time within patient and patient within organization to assess the impact of the implementation strategy on patient outcomes over time. We will use the methods described in Aim 2 to examine whether this relationship is moderated by organizational moderators and selected patient demographic characteristics (i.e., gender, race). We will also determine if patients’ level of mHealth engagement mediates the relationship between implementation strategy and patient outcomes. All analyses will be conducted using MPlus to

appropriately estimate multilevel regression models and to conduct Monte Carlo simulations. Our multilevel models in MPlus will allow us to accommodate likelihood-based ignorable analyses to obtain unbiased model inference without directly modeling drop-out associated with attrition.

Power Analysis. The sample size for the project is limited by the maximum number of organizations and clinicians that can be recruited within the logistical and financial constraints of an R01. With our available resources, we expect to enroll 20 CMHCs, with 5 clinicians per CMHC, and 3 patients per provider (n=300 patients, 100 providers). Based on our prior work (see Pilot Study B), we were able to calculate a between-organization ICC of 0.19 and a between-patient ICC of 0.45 for patient-level outcomes similar to those being tested in this study. With an average of 15 patients per site, we will have 80% power to detect small to moderate effects of the implementation strategy on patient outcomes (Cohen's $d=0.44$). For provider-level outcomes, assuming a between-provider ICC of 0.30, we will have power to detect moderate effects of the implementation strategy (Cohen's $d=0.55$). Alpha is set at .05 (two-tailed) and will not be adjusted for multiple comparisons because we prefer to explore leads that may turn out to be wrong rather than miss potentially important findings. Using similar model assumptions, the study will have sufficient power to detect moderate effects of organizational-level moderators on patient outcomes (Cohen's $d=0.50$) and provider outcomes (Cohen's $d=0.61$). For the mediation analysis, the proposed sample size will yield sufficient power to detect a large indirect effect (Cohen's $d=0.85$) of the strategy through the practitioner-level mediators and a large indirect effect (Cohen's $d=0.65$) of the strategy through the patient-level mediators, assuming there is a moderate effect of the implementation strategy.