Study Protocol with Statistical Analysis Plan (SAP)

Development and Testing of a Just-in-Time Adaptive Smart Phone Intervention to Reduce Drinking Among Homeless Adults

NCT03746808

Date of Continuing Review Approval: 11/02/22

Date of Document: 11/02/22

A. Specific Aims

This project will:

1. Use phone-based ecological momentary assessment (EMA) to identify environmental (i.e., geolocation), cognitive, and behavioral antecedents of alcohol use among 80 homeless adults with an AUD who are receiving shelter-based treatment.
2. Develop a "just-in-time" adaptive intervention to reduce alcohol use, including an alcohol use risk algorithm and corresponding theory-based treatment messages.
3. Examine feasibility, acceptability, and preliminary effectiveness of a just-in-time adaptive smartphone app among 40 homeless adults with an AUD who are receiving shelter-based treatment.

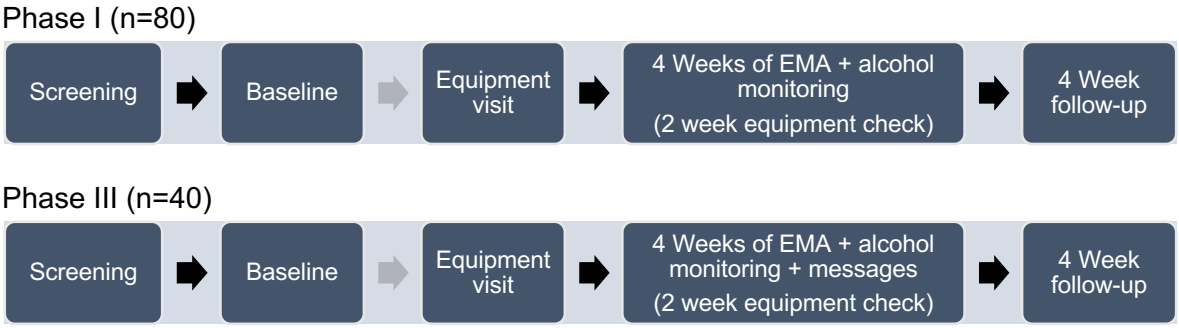
B. Background and Significance

An estimated 6.2% of US adults will be homeless at some point in their lifetime.[1] Homeless adults have higher rates of disease, greater risk of interpersonal violence, shorter life expectancies, and disproportionately higher health care utilization and costs compared to housed individuals.[2-5] A significant contributor to morbidity and mortality among homeless adults is the high prevalence of alcohol use.[6-9] Approximately 33% of homeless adults have current alcohol dependence,[10,11] a rate nearly 8 times that of the general population.[12] Although shelter-based treatments are common,[13] compliance is typically poor.[9] Identifying factors that influence alcohol use would significantly improve our ability to develop effective interventions and engage homeless adults in treatment.

Relatively little is known about the environmental, cognitive, and behavioral antecedents of alcohol use in homeless adults. Like other subgroups, alcohol use has most often been examined using traditional lab/clinic based assessment methods that are not well suited to capturing the complicated street-level interactions experienced by most homeless adults.[14,15] Ecological momentary assessment (EMA), in which handheld devices (e.g., smartphones) are used to capture moment-to-moment experience, is currently the most accurate way to measure phenomena in natural settings.[14,16-18] Additionally, recent technological advances have made it possible to collect continuous geolocation data alongside EMA. Researchers can now link environmental risks and protective factors to outcomes, without reliance on subjective reporting alone.[19,20]

This study will develop and test a "just-in-time" adaptive intervention to reduce alcohol use among homeless adults. During Phase I, we will use smartphones and passive sensing to monitor geolocation, psychosocial variables (e.g., stress, urge to drink), and alcohol use in a group of 80 homeless adults enrolled in shelter-based treatment. In Phase II, we will use this information to create a risk algorithm and tailored treatment messages that anticipate and intervene to prevent alcohol use (there are no human subjects in Phase II). We will modify an existing app, previously validated for smoking cessation, to create the intervention. In Phase III, we will pilot test the newly developed app for utility, satisfaction, and preliminary effectiveness in a group of 40 homeless adults enrolled in shelter-based treatment. In Phase I, alcohol consumption will be validated via a transdermal alcohol sensor (i.e., SCRAM) worn by all participants. If effective, this smartphone app could significantly improve treatment engagement, drinking outcomes, and quality of life among homeless adults with AUDs.

Figure 1. Phase I and III Flowcharts



In Phase I, this project will provide urgently needed data on the ways that street-level factors interact with alcohol use in a homeless population. In Phase II, this information will be used to create treatment messages that support motivation and self-efficacy.[96,97] Motivational (derived from MI and the transtheoretical model) and self-efficacy (derived from SCT) themed messages are commonly used in technology-based alcohol interventions,[98] but mobile interventions have the additional strength of fostering self-regulation during high-craving situations through triggering goal salience and re-evaluation of short vs. long-term goals.[99] For example, SMS interventions for AUD have focused on encouraging self-regulation and planning *prior* to drinking episodes.[100,101] For those who continue to attend shelter-based treatment, the messages will reinforce common treatment concepts. For those who discontinue shelter-based treatment, the messages may serve as a primary intervention (or at least a reminder of past concepts) in order to short-circuit alcohol use before it occurs.

C. Experimental Design and Methods

1) *Methods and Procedures*

Setting

Phases I and III will be conducted at the Bridge Homeless Recovery Center (i.e., the Bridge) located in Dallas, TX. The Bridge's 80 employees and on-site partners provide services (e.g., meals, mental health and substance abuse counseling, care management, housing placement, job readiness training) to approximately 85% of all homeless adults in Dallas County each year. The Bridge conducts approximately 366 new intakes each month and approximately 32% of all new intakes report current "problems with alcohol." We expect Phase I enrollment to take approximately 9 months (n=80) and Phase III enrollment to take approximately 6 months (n=40).

Screening Procedures

Homeless adults receiving treatment at Metrocare at the Bridge will be given a flyer that briefly outlines this study. Interested individuals will be scheduled for a screening visit to determine study eligibility. We may give participants a card to remind them of their appointment time. Prior to screening, potential participants will receive information about this voluntary study and will be informed that Bridge and Metrocare services are not contingent upon study enrollment. Interested participants will sign a consent form prior to completing the screener. The screener includes questions about demographics, alcohol use, use of technology, and other questions.

We will notify subjects in real-time whether or not they are eligible to be in the study and can proceed with the baseline survey. Eligible participants will complete a separate consent form and then complete the in-person baseline assessments as described below. On the baseline they will provide identifiers that will be linked to the screener information We will retain screening data for both eligible and ineligible participants.

Participants

Participants will be eligible if they: 1) receive a score of 8 or above on the AUDIT (a measure of alcohol dependence); 2) report consuming at least 1 drink of alcohol in the past week; 3) are receiving treatment at Metrocare; 4) are willing and able to complete the baseline and follow-up visits; 5) score ≥ 4 on the REALM-SF indicating > 6th grade English literacy level (i.e., a 7th grade reading level is necessary to complete assessments; 12% to 14% of those screened for Projects Advance and Aspire had REALM scores <7th grade reading level; <1% of Bridge guests are non-English speakers), and 6) score ≥24 on the Mini-Mental State Exam indicating no substantial cognitive impairment. Individuals will be excluded from participating if they indicate on the screener that they would be uncomfortable wearing an alcohol sensing bracelet for 4 weeks (Phase I only). Individuals will be excluded from participating in Phase III if they participated in Phase I.

Individuals who meet the study inclusion criteria and provide informed consent will complete the baseline assessment and 4-week follow-up assessments in a space that is set aside at the Bridge specifically for this study. All participants will receive a smartphone and SCRAM at the first equipment visit, returning the devices at the end of the 4-week period.

Table 1. In person assessment measures.

Background/History
Locator Form
Demographic Information Questionnaire*
Subjective Social Status[102]
Brief Homelessness Questionnaire
Homelessness Timeline Follow-Back[103]*
Health/Mental Health
SF-12[110]
Health Related Quality of Life[111]
Self-Rated Health
Tobacco Questionnaire
Inadequate Sleep
Time Line Follow-Back[112] (past month alcohol)
Short Inventory of Consequences[113]
Stress/Affect
Personal Victimization[104]
Perceived Stress Scale – Short Version[105]
Urban Life Stress Scale
Depression[108]
Interpersonal/Intrapersonal
Interpersonal Support Evaluation List Brief COPE
Religious Participation
Treatment Satisfaction
EMI Satisfaction Survey **

*Baseline only
**Follow-up only

In-person Assessments

In-person assessments will be administered at the baseline and 4-week visits. The surveys will ask about demographics, social network, experiences with homelessness, stress/victimization, social support, mood, health, quality of life and substance use. Some of the questions are asked to evaluate the effect of the intervention (e.g., alcohol, consequences, satisfaction); other questions are asked to determine whether there are factors that moderate (e.g., self-rated mental/physical health diagnosis, stress, status, religious participation) or mediate (e.g., sleep, stress, coping) the effects of the intervention. The locator form and homelessness timeline follow-back will be administered at baseline only. Data will be collected on laptop/tablet computers using Questionnaire Development System (QDS) software. QDS utilizes a computer-administered self-interview format where each item appears on the computer screen while the program simultaneously reads the item (participants use a mouse or touch screen to

select answers only after QDS reads each item). Participants wear headphones so that others do not hear the survey items. Staff will be available to help participants who may have difficulty. We estimate that the baseline visit will take approximately 1 to 2 hours to complete, and the follow-up visit will take approximately 50 to 80 minutes to complete.

Equipment Visits

Approximately 2-3 days after the baseline assessment, participants will receive the cellphone (including instructions on how to complete the phone assessments), and will be fitted with the SCRAM bracelet (Phase I only). In order for the SCRAM to function properly, we will breathalyze participants at this equipment visit to ensure a zero BAC. Participants who do not register a zero BAC will be asked to come back later (or another day if BAC is very high) at a time when it is estimated to be zero. We will review the functioning of both devices, and participants will sign form indicating that they understand how to care for the devices. Additionally, participants will be asked to complete an equipment visit at 2 weeks (the mid-point of the study period) to verify that the phone and SCRAM are working properly. At the 2-week visit, people can receive payment for the phone assessments they have completed thus far. There are no research assessments at the equipment visits.

Phone Procedures

A Samsung Galaxy Core Prime smartphone (or equivalent) will be loaned to each participant so that they may complete EMAs. Participants navigate through the EMA program and enter data by touching their response on the screen. Participants will be able to call (e.g., if they have problems completing EMAs) and receive calls from research staff through the smartphone free of charge. During their participation in the study:

a. Subjects are not responsible for any costs related to the cell phone (e.g., lost, stolen, damaged and/or data overages).
b. Phone services (data I phone package) will be terminated if the phone is lost or stolen, or once the subject completes the intervention.
c. One replacement will be provided in the event the phone is lost, stolen or damaged.
d. Subjects can charge their phones at the Bridge, or in any other local establishments.

Table 2. EMA measures.

Daily Diary
Sleeping Arrangements
Social Support and Interactions
Treatment Attendance
Current Stressors & Perceived Stress
Alcohol Consumption
Other Substance Use
Core/Random/Event Sampling
Affect/Stress
Urge to Drink
Alcohol/Money Availability
Social setting/Location
Recent Alcohol Consumption
Expectancies
Abstinence Motivation
Abstinence Self-Efficacy
New/Ongoing Stressful Events*
Reasons for Drinking*
Modified Conflict Tactics Scale

**Drinking assessments only*

Phone Assessments

Smart Phone Training. Participants will receive hands-on training on study phone use and will watch a brief step-by-step video tutorial (created by the researchers) at the first equipment visit that demonstrates use of the study phone and app features. This video will also be preloaded onto the home screen of study phones. We have achieved high EMA compliance rates (i.e., 82% of all EMAs completed) using this protocol in a sample of homeless adults.[23,121]

Three types of EMAs will be used: daily diary, random

sampling, and event sampling. Random sampling and daily diary EMAs will be initiated by the phone. The phone will audibly and visually cue these EMAs for 30 seconds. If the participant has not responded after 5 prompts, the assessment will be recorded as missed. Event sampling is initiated by participants if/when they consume the first drink in a day. On average, random and event sampling assessments take 2 minutes to complete and daily diary assessments take less than 5 minutes to complete.

Daily Diary EMAs will be completed each day (prompted 30 minutes after waking time); questions will ask about the previous day and current experiences. Alcohol consumption will be assessed with the item "Did you drink any alcohol yesterday?" If the participant answers "yes," he/she will be prompted to indicate the type and quantity of the alcohol that was consumed. Additional items will assess sleeping arrangements from the prior night, social support and types of social interactions, discrete stressors, other substance use, and treatment session attendance. Daily Diary assessments will cease after 4 weeks.

Random Sampling will occur 4 times each day, during each participant's normal waking hours. Participants will rate their affect by indicating the extent to which they agree or disagree with each of thirteen statements: I feel irritable, happy, content, angry, sad, worried, miserable, restless, stressed, hostile, calm, bored, and depressed. In addition, participants will describe their current environment (e.g., shelter, work, outside, bar) and social setting (e.g., alone, with others, with others who are drinking). Alcohol urges, alcohol/money availability, drinking start/stop time, recent drinking, expectancies, motivation for abstinence, and abstinence self-efficacy will also be assessed during random sampling. Random assessments will cease after 4 weeks.

Event Sampling will be available to participants on demand. Participants will be instructed to click the "Record Drink" button if/when they have their first drink of a day. Drinking assessments will include all items from the random assessments and will query about the reinforcing value of the drink(s) and causes of the drinking episode.

Geolocation. Consistent with previous work,[19,20,51] smartphones will collect geo-location coordinates about every 5 minutes. The aim of this study is to identify psychological, social, and contextual variables that predict drinking and heavy drinking days. Previous studies have found that continuous "breadcrumb" tracking can be used to identify important health risk factors.[19,20,58] We will remove all personal information from the phone once it is returned to us.

Alcohol Sensor

Biosensors can provide a continuous estimate of blood alcohol concentration (BAC) based on the concentration of alcohol in perspiration on the skin.[52-59] The device with the most extensive evaluation is the SCRAM bracelet (Alcohol Monitoring Systems, Littleton, CO), which is worn on the ankle. In Phase I, all participants will wear the SCRAM for 4 weeks. SCRAM has an electrochemical sensor that samples the vapor near the skin every 30 minutes for ethanol, and stores readings for later retrieval. Data from the SCRAM is downloaded to a computer via USB cable, using a 16-digit key and password-protected software. The SCRAM is water resistant and cannot be removed without cutting the strap. The SCRAM system provides alerts if the bracelet sensors detect an obstruction or other tampering. At the 2-week equipment check-in, our staff will review participant readings and any alerts and will address any malfunction or evidence of tampering. To mitigate any potential risk to subjects while wearing the SCRAM monitor:

a. Law enforcement officers cannot obtain the information even if subjects are taken to jail. SCRAM data are encrypted and need to be connected to the research computer in order to download the data.
b. The Certificate of Confidentiality (COC) protects investigators from having to disclose SCRAM data to law enforcement or anyone else.
c. Subjects can cover up the ankle monitor with their clothes and always decline participating in the study.
d. Subjects will be informed through the consent form that the SCRAM ankle bracelet may draw unwanted attention by law enforcement (and possibly others) to them.
e. Subjects will be provided with a laminated card that describes their participation as a research subject (they may also choose to carry a copy of the consent form with them).

App Testing (Phase III only)

The phone-based app that will be tested in Phase III will have multiple components including: 1) an on-demand "Tips" function/button; 2) a "Helpful Websites" function/button; 3) a "Call Staff" function/button; and 4) an algorithm that will use recent EMA responses and geolocation to assess current risk for alcohol use and automatically push relevant tailored messages to help them avoid drinking. The phone will record date/time when each of the above components is accessed. As the app is not yet designed, the IRB would need to approve the content of the app prior to Phase III testing.

Tips Function. Clicking this on-demand option will open a new window that will enable individuals to get useful tips related to: "Benefits of Sobriety," "Motivational Messages," "Alcohol Refusal Skills," and "Managing Urges." For instance, when the "Managing Urges" tips option is clicked, participants will receive a suggestion on how to cope with their current urge to drink. This function will enable participants to access tailored messages at any time. Participants may view additional tips by simply clicking the "Next" button. Type and number of tips viewed will be recorded by the smartphone. Other topics for tips will be identified via examination of Phase I participants' survey and EMA data.

Helpful Websites Function. Clicking this option will open a menu of potentially useful websites (e.g., Dallas public transit routes, Google maps, online support groups [e.g., Alcoholics Anonymous]).

Call Staff Function. Clicking this option will connect participants to study staff if they encounter problems with the study phone and for scheduling/rescheduling follow-up appointments.

Message Content. Smartphones will push tailored messages based on the risk algorithm score at the end of each EMA. We anticipate that participant responses that indicate low risk for imminent alcohol use (e.g., within the next 4 hours) will prompt delivery of level 1 messages that primarily focus on increasing motivation for abstinence, avoiding people/places/things that may trigger alcohol use, benefits of sobriety, advice on ways to escape high risk situations, and advice to seek support from others.[23] Level 2 messages will be delivered at the end of EMAs where the algorithm determines that there is heightened risk for imminent alcohol use (e.g., within the next 4-8 hours). These messages will focus on in-the-moment distraction, reframing, immediate help-seeking, planning, and other tools to reduce craving. Participants will receive level 3 messages when they report recent drinking. Level 3 messages will focus on reframing the drinking episode as a learning experience and considering strategies for handling the situation differently in the future.

Risk Algorithm. The algorithm used to guide the just-in-time treatment messages will be similar to the algorithm that was developed for the Smart-T smoking cessation app.[25] Specifically, the algorithm will estimate risk for alcohol use using variables identified in Phase I. Variables that predict alcohol use will be identified and, through an iterative process, will be weighted based upon their relation to lapse. We will also consider parameters (e.g., slopes and/or volatility of key variables) that are identified in the GLMMs described above as potential algorithm components. For instance, a pattern of increasing negative affect or stress over 8 hours may be a significant predictor of alcohol use. Finally, an innovative feature of this risk algorithm will be the inclusion of geolocation data. We anticipate that some locations will significantly increase an individual's risk for alcohol use (e.g., previously tagged drinking locations), and thus a person's "current location" will be an important part of the risk algorithm.

D. Statistical Analysis Plan

Acceptability of App (Phase III only)

A brief questionnaire will assess the initial feasibility and acceptability of the app. Specifically, in a final follow-up visit after participating in the EMA, participants will report on the helpfulness of the app and if the number of prompts on the app were appropriate. We will use statistical tests to determine if participants found the app to be helpful and if they would recommend it to others.

Effectiveness of App (Phase III only)

We will compare Phase III participants (i.e., those who received Metrocare, EMAs, and the app features including tailored treatment messages) to Phase I participants (i.e., those who received Metrocare and EMAs only) to examine the preliminary effectiveness of the app. Specifically, we will compare Phase I and Phase III participants' percent drinking days (PDD) and percent heavy drinking days (PHDD; >=5 drinks for men; >=4 drinks for women) using appropriate generalized linear models. We will consider the study phase as the parameter of interest estimating the treatment effect, adjusting for relevant covariates (e.g., gender, race, baseline AUD severity).

Phase I and Phase III

EMA data will be measured repeatedly and are thus correlated within subjects. Thus, our analytic approach will include generalized linear mixed model regression analysis (GLMM), a flexible analytic approach with wide use in health sciences research.[134] GLMM can handle fixed and random effect model parameters, nested designs, and repeated measures with various correlation structures.[135,136] GLMM can also handle normal and non-normal outcomes such as dichotomous alcohol use variables, different variance functions, as well as unbalanced designs where the number of observations varies across individuals. Examples of planned GLMM analyses include: 1) testing if random assessments of alcohol urges or measures of affect (each aggregated to one rating per day) predict daily drinking status after controlling for relevant covariates (e.g., gender, race/ethnicity, depression), 2) testing if protective factors (e.g., social support, positive interpersonal interactions, prosocial location) predict alcohol use, and 3) examine trends of number of drinks and drinking days over time, accounting for dependencies of within-person repeated measures.

In addition, EMA data will allow us to examine other important questions like: 1) agreement

between SCRAM, TLFB and EMA reports of alcohol use in this sample, and 2) the effect of episodic events (e.g., exposure to violence or other stressors) on self-efficacy and mood and what impact that has on alcohol use.