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1 **Feasibility and acceptability of mobile phone self-monitoring and automated feedback to**
2 **enhance telephone coaching for people with risky substance use: The QUIT-Mobile Pilot**
3 **Study**

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ABSTRACT

Objectives: This study evaluates the feasibility, acceptability, and perceived benefits of mobile-phone delivered self-monitoring queries and feedback integrated into the evidence-based QUIT screening and brief telephone health coaching intervention to prevent progression from risky drug use to addiction as the QUIT-Mobile intervention.

Methods: Participants (n=20) were primarily Black/African American and Latino men in Los Angeles with risky substance use. Self-monitoring surveys were sent by text-message twice-weekly for 6 weeks and once-weekly from 6 to 12-weeks. Surveys consisted of 10 questions regarding drug and alcohol use (i.e., # days of use) and cravings, quality of life, and medication adherence. Feedback messages praised or encouraged drug use reductions. Coaches monitored patient responses and discussed them in QUIT's telephone coaching sessions. Participants' experiences were assessed qualitatively at 3-month follow-up.

Results: 19 out of 20 participants that completed the evaluation qualitative feedback from the 12-week follow-up reported: 1) self-monitoring surveys helped them adhere to drug use reduction goals and reflect on associations between self-monitoring domains; 2) preference for higher frequency (twice-weekly) self-monitoring during the 6-week coaching period, and then weekly surveys thereafter but not monthly; and 3) self-monitoring and coaching were mutually reinforcing for their drug use reduction goals.

Conclusion: Results are consistent with prior similar research suggesting that mobile phone self-monitoring of drug use and related factors is feasible and acceptable among diverse adults with risky drug use. Findings also suggest the potential benefits of integrating electronic self-monitoring and feedback into substance use reduction interventions such as QUIT to enhance patient self-management and coaching or counseling intervention components.

53 **Keywords:** Risky drug use; mobile phone; self-monitoring; automated feedback; SBIRT

INTRODUCTION

Substance use is a pervasive problem in the United States. Substance use and substance use disorders have resulted in serious economic consequences, costing more than \$400 billion annually in physical and mental health care costs and other indirect costs (i.e., loss of productivity, increased motor vehicle crashes, spread of infectious disease) (National Drug Intelligence Center 2011, Substance Abuse and Mental Health Services Administration (US) and Office of the Surgeon General 2016). According to the 2016 National Survey on Drug Use and Health, approximately 29 million people aged 12 or older reported using any illicit drug in the past 30 days, with 24 million reported as marijuana, and the remainder reported as misusing prescription pain relievers and stimulants, cocaine, hallucinogens, methamphetamine, and inhalants (Center for Behavioral Health Statistics and Quality 2016). Substance use disorders (SUDs) are associated with a range of medical, mental health, academic, workplace, safety, violence and criminal justice problems. It is typically easier to intervene early in substance use trajectories before they develop into SUDs and addiction, yet, our current healthcare and prevention systems miss many opportunities for prevention and early intervention and specialty treatment initiation and engagement is low (Loveland and Driscoll 2014, National Institute on Drug Use (NIDA) 2019, Liu et al. 2020). Thus, in addition to implementation of treatment services, more effort is needed to implement comprehensive prevention programs to reduce substance use among people who are not yet addicted to prevent development of substance use disorders and addiction.

The QUIT (Quit Using Drugs Intervention Trial) screening and brief intervention (SBI) is one of the only SBIs for risky drug use in health care settings that has exhibited efficacy for drug use reductions among U.S. adults (Baumeister et al. 2014, Padwa et al. 2014, Gelberg et al. 2015, Gelberg et al. 2017). QUIT's 1/3 to 1/2 reduction in drug use could have significant public health impact for the 20-million people with risky substance use in the U.S. who could be

prevented from progression to a serious substance use disorder (SUD) (The National Center on Addiction and Substance Use at Columbia University (CASA Columbia) 2012, U.S. Department of Health and Human Services (HHS) Office of the Surgeon General 2016). Major challenges for behavioral interventions such as QUIT are patients' low engagement in active self-management during a) their daily routines, b) during the periods between intervention contacts (e.g., primary care visits, counseling session), and c) sustaining drug use reduction after the brief interventions end. Mobile phones and their integration into daily routines offers innovative and potentially cost-effective opportunities to enhance and sustain the effects of brief interventions, such as QUIT, by facilitating patient engagement and activation between coaching sessions during daily routines (Barlow et al. 2002, Bodenheimer et al. 2002, Rotheram-Borus et al. 2012a) and sustaining changes after coaching ends (Fjeldsoe et al. 2009, Reback et al. 2012, Finitsis et al. 2014).

Self-monitoring and feedback are two behavior change intervention core elements that may enhance patient activation (i.e., their willingness and ability to take actions to reduce their substance use) during daily routines and may be scalable, disruptive innovations in which even small effects can have significant impacts at scale (Rotheram-Borus et al. 2012b). Self-monitoring is a core element of self-regulation and self-management (Kanfer 1970, Bandura 1991, Kanfer and Gaelick-Buys 1991a) applied in a range of chronic conditions (Chorpita et al. 2005, Michie et al. 2013). Short message service (SMS) text-messaging enable self-monitoring and automated feedback to be cheaply implemented and scaled. The theoretical bases underlying QUIT's cognitive behavioral (Kanfer 1970, Bandura 1991, Kanfer and Gaelick-Buys 1991a) and motivational interviewing (Miller and Rollnick 2002, Miller and Rollnick 2013) strategies emphasize that self-monitoring and feedback are integral to self-regulation and self-management through self-observation, reflection, self-correction, and reinforcement via self-

reward, critique, and feedback (Kanfer 1970, Bandura 1991, Kanfer and Gaelick-Buys 1991a, Prochaska and Velicer 1997, Rotheram-Borus et al. 2012b).

Feasibility, acceptability, and theory-based mechanisms underlying mobile self-monitoring and feedback for drug use and related factors (e.g., triggers, craving, physical and mental health symptoms) have been examined in several studies with substance using patients (Ramanathan et al. 2012, Swendeman 2014, Comulada et al. 2015, Swendeman et al. 2015a, Swendeman et al. 2015c, Swendeman et al. 2015d, Swendeman et al. 2016, Reback et al. 2019) and outpatient drug use disorder treatment clients (Comulada et al. 2015) but rarely in conjunction with counseling or coaching. Only a few pilot studies published to date examined mobile self-monitoring to enhance motivational interviewing and other interventions for clinic patients to reduce substance use (Copeland and Martin 2004, Simpson et al. 2005, Lightfoot et al. 2007, Sinadinovic et al. 2010). Coach dashboards displaying patient self-monitoring data have demonstrated acceptability and perceived benefits (i.e., to counseling activities) when used by counselors in an outpatient methamphetamine treatment program in conjunction with substance abuse counseling (Swendeman et al. 2015d).

This study aimed to assess the feasibility, acceptability, and perceived benefits of enhancing the QUIT intervention with three key functions (QUIT-Mobile): 1) patient self-monitoring of drug use and related factors (i.e., cravings, physical and mental health symptoms/QoL) by SMS twice weekly through 6 weeks during QUIT coaching, and then weekly from 6-12 weeks; 2) weekly automated feedback on goal progress for reducing drug use; and 3) dashboards for coach monitoring to use in coaching sessions and to follow-up if drug use increases. This feasibility study also incorporated medication adherence monitoring and coaching, building upon QUIT's health and wellness orientation, in order to explore expanding the scope of the QUIT intervention to address medication non-adherence that has been linked to substance use and SUD and for potential application in specialty care settings such as HIV

clinics (Gonzalez et al. 2011). We hypothesized that mobile self-monitoring will be feasible, acceptable, and useful for participants in self-managing and adhering to their drug use reduction goals, linked quality of life and health self-management factors, and for coaches to facilitate coaching sessions.

METHODS

Participants were recruited from a longitudinal cohort study of people who use drugs in Los Angeles, more specifically, a cohort of minority men who have sex with men recruited through federally qualified health center (FQHC) primary care and HIV specialty care clinics (<http://themstudy.org/>) (Okafor et al. 2017, Gorbach et al. 2019, Javanbakht et al. 2019). As part of the secondary aim of the study, this cohort contributed to the original QUIT study intervention by exploring its application and tailoring for more diverse populations, and within HIV specialty care settings. A recruitment letter was emailed to cohort participants who reported substance use in the past three months in a prior cohort assessment interview. The study was referred to as the “Living Well Study,” per the QUIT intervention protocol. The protocol for this study was approved by the Institutional Review Board of the University of California, Los Angeles. All study participation was conducted remotely by email, telephone, text-messaging, and internet.

Eligibility criteria included: 1) being 18 years and older; 2) have a working phone number; 3) English-speaking; 4) ASSIST score between 4 and 26 indicating risky (moderate) drug use during eligibility screening, and used the “highest scoring drug” (HSD) on the ASSIST in the past 30 days; and 5) not enrolled in a substance use treatment program in past three months, which indicates recent SUD and an exclusion criteria for the QUIT intervention.

Incentives. Participants earned up to \$100 in Amazon electronic gift cards. Participants earned \$40 for completing the baseline assessment, \$10 for a 2-week follow-up assessment, \$10 for a 6-week follow-up assessment, and \$40 for a 3-month assessment and interview. Gift

cards codes were emailed to participants upon completion of each study activity. Incentives were not provided for responding to self-monitoring surveys.

WHO ASSIST Screening. Risky drug use was assessed with the World Health Organization Alcohol Substance Involvement Screening Test (ASSIST) (Who Assist Working Group. 2002, World Health Organization. 2010), which identifies risky drug using patients as “at risky of health and other problems because of their drug use” or “at high risk of severe health and other problems because of their drug use.” The ASSIST asks about tobacco, alcohol, marijuana, crack/cocaine, opioids, methamphetamine/amphetamine type stimulants, inhalants, sedatives, and hallucinogens. Its ability to classify patients based on degree of illicit drug use has been validated (Humeniuk et al. 2008). Participants’ use of each drug category (excluding alcohol and tobacco) were coded as: no or low use (score 0-3); risky (moderate) use (score 4-16); or high use (score 17-26). Scores of 27+ indicate SUD warranting referral to treatment rather than the QUIT SUD prevention intervention.

After screening, the research assistant (RA) sent participants a web-link to an online consent form via text or email. Enrolled participants completed a baseline questionnaire querying about demographic characteristics, past 30-day drug and alcohol use, and medication adherence (for participants taking medications). Participants were also asked if they preferred to use a code name for their HSD in text-message surveys and coaching sessions. The RA then sent participants a link to a video doctor who gave brief clinician advice (<4 minutes), per the original QUIT protocol.

Of the 120 participants who were invited to participate, 39 replied and were screened for risky drug use. Of the 39 participants who were screened, 22 were eligible and consented to participate. One withdrew from the study and one was lost to follow-up immediately after the baseline resulting in 20 participants in this study (see Figure 1).

-- Figure 1 here--

QUIT-Mobile Intervention Description

The QUIT-Mobile intervention described in this study uses the original QUIT screening and brief telephone coaching intervention protocol with the addition of the mobile self-monitoring, automated feedback and coach dashboards showing participant self-monitoring responses. The coach dashboard was not the focus of this study but is an important note because it makes the individual self-monitoring data visible and actionable by coaches to use in the QUIT telephone coaching sessions. These intervention components are described briefly below, including the QUIT intervention and how the mobile elements were incorporated into the telephone coaching.

Self-monitoring surveys. Participants received self-monitoring surveys by SMS twice weekly for the first 6-weeks after enrollment, coinciding with QUIT's two telephone coaching sessions at weeks 2 and 6 (described below), and then self-monitoring once-weekly from 6-weeks to 12-weeks. Surveys consisted of 10 questions, taking less than four minutes to complete, on alcohol and drug use (i.e., # days of use), cravings for their HSD, Quality of Life (QoL; i.e., fatigue, energy, activity limitation, depression/sadness, anxiety/worry, perceived stress, sleep) and medication adherence (see Table 1). The QoL questions were adapted from the SF-12 measure (Life Data 2018, RAND Health Care 2019) and used in prior mobile self-monitoring studies, which found that participants were highly engaged with questions on their physical and mental health symptoms/QoL (Swendeman et al. 2015a, Swendeman et al. 2015b, Swendeman et al. 2015c, Swendeman et al. 2018) . Similarly, the QUIT intervention trials demonstrated improvements in perceived QoL in patients, since QoL and drug use are associated in terms of both triggers and consequences of drug use (Baumeister et al. 2014). The twice weekly surveys were sent on Monday to assess weekends and Fridays to assess weekdays.

--Table 1 here--

SMS Feedback Messages. Participants received SMS feedback messages upon completion of the SMS survey. Coaches scheduled the delivery of feedback messages to mimic automated delivery that would occur through a large-scale program. Messages were tailored to the participant's self-monitoring responses on their HSD use based on reducing, no change, or increasing number of days used in reference to the prior week's response: 1) a reward message (e.g., "great job meeting your goal this week"); 2) encouragement message (e.g., "some weeks are harder than others, stay focused on your goal, you can do it!"). In cases of non-response, a follow-up message was sent (e.g., "We haven't heard from you this week. Hope you are well. Please check-in to let us know"). To be consistent with the QUIT intervention's simultaneous focus on drug use and QoL, feedback was also provided on responses to SMS questions on QoL, depression, anxiety, and medication adherence questions (e.g., "You felt healthy and full of energy this week and were able to get more rest/sleep! Keep it up!").

Phone Coaching. QUIT-Mobile includes the QUIT intervention's video doctor (as noted above) and two 30-minute telephone coaching sessions delivered by paraprofessionals at two- and six-weeks after enrollment. This study integrated discussion of self-monitoring data into the coaching sessions. At the two-week coaching session, after introductions and ground rules, coaches first briefly recapped (3 minutes) the patient's self-monitoring data that were displayed on the coach's dashboard as follows: 1) HSD use assessment by first commenting on available self-monitoring data (e.g., "Your mobile data showed that you used your HSD # days in the past week), and then eliciting a confirmatory response (i.e., per QUIT standard protocol for HSD assessment); 2) asking if the patient had any new insights about their HSD use and associated factors from the self-monitoring or in general; 3) coach acknowledgement of the patient's observations, and then brief mention of any trends evident to the coach on the dashboard data on HSD use and other self-monitoring questions (i.e., "Use seemed to occur more on days you

were feeling [sad, anxious, worried, etc.]"; and 4) stressing the importance of self-monitoring to enhance and maintain drug use reductions.

Coaching session content, per the QUIT protocol, also includes discussing barriers and facilitators to reducing/quitting risky drug use, rating willingness to reduce/quit use of HSD on a scale of one to ten, and referring participants to indicated resources and services. The session concludes with the coach assisting the patient in setting a concrete and tangible goal to reduce use of their HSD. Examples of goals included: 1) Change morning routine to include exercise and stretching to reduce urge to smoke marijuana, 2) Reduce use of amphetamines to only the weekends, and 3) Continue sobriety by focusing on school and eating a healthy diet. The mobile component in this study also added a query to the patient about whether they wanted to change automated feedback message content, timing of self-monitoring prompts, or day of week of the weekly survey and feedback message.

The six-week QUIT coaching call served as a check-in call to assess if there were changes with the participants' risky drug use, quality of life factors, and need for referrals. This study incorporated review of self-monitoring responses as described for the 2-week coaching call above. The coach adjusted the "plan" goal if deemed necessary by the participant.

Assessment Interviews

6-week and 12-week Assessments. At the study mid-point at 6-weeks and at the 12-week end-point, RAs conducted assessment interviews consisting of a brief survey of past 30-day drug use and 15 qualitative and quantitative questions about participant satisfaction, experiences, and feedback about self-monitoring survey content and frequency, and coaching sessions. Initial questions were non-directive followed up by specific probes. Qualitative examples included: 1) Please tell me about your experiences and thoughts regarding the cell phone text message surveys you received; 2) Do you have suggestions for changing the cell

phone survey content, the words we used, or the topics we asked about?; 3) In what ways do you think the cell phone surveys benefitted you in addition to the telephone coaching you received at 2- and 6-weeks?; 4) Did you notice any trends or patterns in your drug and/or alcohol use from the cell phone surveys, including triggers, feelings, and/or cravings for your [HSD]?; 5) What are your thoughts on how frequently we sent the cell phone surveys? (i.e., twice-weekly versus once-weekly); 6) What are your thoughts on the content and topics of the cell phone surveys? Responses were typed verbatim.

Data Analyses

Qualitative data on patient-experiences related to feasibility, acceptability, feedback, and suggestions were analyzed. Qualitative content analysis was used to generate substantive codes and subthemes that emerged from the data. The primary domains were predetermined based on the semi-structured interview guide and study aims, while the sub-theme code identification was informed by a grounded theory approach. The responses were coded in iterative rounds by the two research assistants (RAs) and by the lead investigators. Two RAs coded the data independently, with the lead investigators reviewing the results to resolve any discrepancies. The code themes from the evaluation interviews were: feasibility, acceptability, self-reflection, self-monitoring and motivation, and timing and frequency of SMS surveys. Descriptive analyses for demographic characteristics were conducted with simple frequency distribution statistics (e.g., mean, range).

RESULTS

Baseline Participant Characteristics. A majority of the sample identified as Black/African American (55%), followed by Latino/Hispanic (30%), White (5%), Asian or Pacific Islander (5%), and Other (5%). Approximately 60% of the sample was HIV-positive. Approximately 75% of the sample identified as gay, 15% bisexual, 5% queer, and 5% heterosexual. The mean age was 34

years old with a range of 26 to 45 years. The HSD on the baseline ASSIST that were the primary targets for substance use reduction in the QUIT coaching sessions were marijuana (65%), amphetamine type stimulants (25%), cocaine/crack (5%), and inhalants (5%).

QUIT-Mobile Intervention Participation and Satisfaction. Participants responded to 96% of the self-monitoring surveys sent to them (i.e., completing at least one question for 336 of 349 prompts) and completed all ten questions for 88% of surveys sent (309 of 349). Figure 2 shows details of messages sent and completion. Primary reasons why some weekly surveys were not sent was due to the participant receiving their first survey on a Friday, rather than a Monday, resulting in a lapse of their first twice-weekly survey, one participant opting to receive surveys only once a week instead of twice during the first 6 weeks of the intervention, temporary suspension of mobile phone service until a bill was paid, or a participant traveling internationally and unable to use their cell phone SMS service (see Figure 2). Overall, 95% of participants that completed the survey were also sent automated feedback (294 of 309) and 47% that received the feedback responded to it (147 of 294). Participants responded to about half of the automated feedback to either thank the sender or acknowledge receipt of the message even though this was not instructed per the protocol.

--Figure 2 here--

There was also high telephone coaching participation with 93% of sessions completed (2 per participant). There was also high satisfaction with the intervention. At the mid-point evaluation, which was incorporated into the 6-week coaching session, 19 of 20 participants (95%) stated that they would recommend the QUIT-Mobile intervention to family and friends (see Table 2). About 70% of participants reported being very satisfied or extremely satisfied with the intervention (35% each). When the participants were asked about which of the components of the intervention motivated them to continue participating, 80% (16 of 20) reported that the self-monitoring surveys were the primary motivating component. Lastly, 60% reported no issues

that prevented them from participating in the intervention. Almost all (19 of 20) also completed the 12-week end-point assessment, with responses highly consistent with the mid-point evaluation (see Table 2).

--Table 2 here--

Evaluation Interview Qualitative Feedback of the QUIT-Mobile Intervention. Table 3 shows example quotes from participant feedback on their experience with the QUIT-Mobile intervention in the following domains: feasibility; acceptability; self-reflection, awareness, and reminders; self-monitoring with coaching to support motivation; and timing and frequency of self-monitoring surveys. For feasibility, participants reported how easy and discrete the self-monitoring surveys were, indicating the feasibility of self-monitoring. For acceptability, participants also expressed positive thoughts and feedback about their experiences with the self-monitoring survey questions and the intervention overall. A common theme of self-reflection and awareness regarding their drug use emerged as participants reflected on their weekly behaviors while completing SMS self-monitoring responses, and reinforced during coaching calls when they were prompted to identify associations between their substance use and their quality of life. Participants also noted how the SMS texts and their responses also functioned as reminders for their goals. Participants were asked what components of the intervention motivated them to continue participating in the intervention, with several noting that rapport with the coach in conjunction with self-monitoring surveys helped them feel connected, supported, and motivated. Participants also reported on their perceptions of the coach presence in the simulated automated feedback messages with several participants reporting that they liked that the coach was perceived to be present behind the automated feedback (even though coaches did not respond to participants' responses to feedback). Several participants were also more engaged and responsive to the automated feedback pertaining to their quality of life or mental health relative to feedback on their drug use. Finally, in terms of timing and frequency of self-

monitoring surveys, participant feedback was consistent in supporting the twice-weekly during the 6 week coaching period with weekday and weekend reporting was optimal, but not daily, while during the post-coaching period weekly monitoring was best and that monthly would be too infrequent.

--Table 3 here--

Participant Drug Use Reduction. Cannabis was the most commonly used drug, with 17 of 20 participants reporting use in the past 30 days. Of the 17 participants who reported past 30 day cannabis use, 11 had reductions at 3-months follow-up, with a mean of 3.82 days less use [range 1-10 days]. In terms of HSD use as primary target of intervention, 8 of 13 participants had reductions in cannabis use, with a mean of 4.38 days less use [range 1-10 days]. HSD data for methamphetamine, cocaine, and prescription stimulants were combined into a “stimulants” category; of the 5 participants who had stimulants as a HSD, one had reductions in use by 2 days [methamphetamine], which is consistent with the prior QUIT trials indicate less effectiveness for stimulant use relative to other drugs including opioids.

DISCUSSION

This study suggests that QUIT-Mobile’s twice-weekly (for 6 weeks) and once-weekly (from 6 to 12-weeks) self-monitoring of drug use and quality of life to enhance a brief telehealth coaching intervention to reduce risky drug use may be feasible and acceptable among people with risky substance use, thus warranting further studies. The portability and convenience of mobile phone integration into daily routines is creating innovative and novel ways to engage patients between routine care visits. Participants in this study reported the mobile self-monitoring increased awareness of their daily and weekly drug use and linked quality of life factors, as well as motivation and intervention engagement. Self-monitoring and the self-reflection and the paraprofessional coach-mediated discussion of self-monitoring data is consistent with the

motivational interviewing intervention developed by Miller and Rollnick (Huffman 2009), theories of self-regulation and self-management (Bandura 1991, Kanfer and Gaelick-Buys 1991b), and cognitive-behavioral strategies that are common core elements of evidence-based behavioral interventions (Chorpita et al. 2005), all of which underpin the QUIT screening and brief intervention (Gelberg et al. 2015). The purpose of health coaching is to motivate participants to achieve goals that enhance their health behavior-related quality of life. A coach's role is to assist patients with weighing options, planning and identifying challenges, goal-setting, listening, facilitating, motivating, and providing feedback (Hayes et al. 2008). Participants in this study noted that reviewing and discussing their self-monitoring survey responses with coaches helped to keep them motivated and accountable to achieve their drug use reduction goals and to remain engaged in the intervention.

The findings of this study are consistent with another similar pilot study that used a smartphone app for self-monitoring to augment an outpatient methamphetamine treatment program involving three group sessions a week and two 30-minute counseling sessions over 8 weeks (Swendeman et al. 2015d). In that study, participants were prompted to complete more extensive self-monitoring five times a day, which was found to be acceptable given the substance use disorder criteria for enrollment, intensiveness of the treatment program, and the high levels of motivation from people enrolling in the treatment program. Participants in that study noted feeling more "connected" to the counselor, and increased motivation and accountability because they perceived monitoring by the counselor via dashboards. The current study confirms that people with risky of substance use also find self-monitoring to be acceptable and useful in supporting their drug use reduction goal attainment, but with lower frequency of self-monitoring commensurate with the lower frequency of their drug use.

This study is not without limitations. First, this study was exploratory in nature, focused on novel intervention component feasibility and acceptability, and the small sample of 20

participants was not powered for statistical analyses. Generalizability of our findings are limited by lack of inclusion of women and heterosexual men, however, this limitation may be less of a concern because other similar pilot studies have demonstrate feasibility and acceptability of mobile self-monitoring of substance use with more diverse populations (Ramanathan et al. 2012, Swendeman 2014, Comulada et al. 2015, Swendeman et al. 2015a, Swendeman et al. 2015c). The rationale for the population included in this study was to address secondary aims of exploring use of the QUIT intervention for HIV-positive and at-risk populations for potential application in specialty care clinics, and to incorporate a medication adherence component as substance use had been linked to medication non-adherence. Alcohol and tobacco use data were not included in the analyses because the QUIT intervention focuses on risky drug use reduction of the HSD; while it does not focus on alcohol or tobacco use, it does recommend reduction of use of other substances in the risky range. Another limitation is that drug use was self-reported by participants to the research assistants and was not validated with biomarkers as was done in the prior QUIT randomized controlled trials and the future trial proposed for the QUIT-Mobile intervention. Another factor worth noting is that none of the 120 screened individuals were positive for opioid use and non-medical use. The opioid epidemic has swept across the United States with nearly 12.5 million individuals reporting use of opioid pain relievers in 2015 (Center for Behavioral Health Statistics and Quality 2016). Individuals who misuse prescription opioids may face comorbid behavioral and mental health disorders and physical health concerns (Becker et al. 2008). This intervention may function differently among participants with opioid use and non-medical use as their HSD. The last limitation refers to Table 2 and the motivating factors that participants had in completing the intervention, in which an increased response to financial incentives (42.1%) was indicated during 12-week follow-up. Incentives may be a limitation to widespread generalizability for scaling the intervention, and future studies or evaluations should consider a randomized design with a non-incentivized arm.

CONCLUSION

Supplementing the QUIT intervention, and other behavioral interventions, with mobile self-monitoring and feedback could offer a promising modality for engaging participants between and beyond coaching sessions to enhance intervention efficacy. Further, incorporating mobile technology into substance use prevention interventions may improve the reach, flexibility, and communication with participants compared to being limited to in-person interventions. Future research is needed to determine the effectiveness of integrating mobile self-monitoring and feedback into behavioral interventions for reducing substance use. The results and participant feedback from this study will guide a recently funded larger randomized controlled trial to test the effectiveness of QUIT and QUIT-Mobile for drug use reduction over 3-months and 12-months.

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Figure 1. QUIT-Mobile Feasibility Study Design and Sampling Plan

Figure 2. QUIT-Mobile Pilot's Text Message Surveys and Automated Feedback Response Flow

Table 1. Self-Monitoring Survey Questions of the QUIT-Mobile Pilot

Survey Prompts	<p>Weeks 1 to 6:</p> <p><u>Monday Surveys:</u> The following questions are about the past weekend, from Friday to Sunday. Respond 0, 1, 2, or 3 for the number of days for each question.</p> <p><u>Friday Surveys:</u> The following questions are about this week, from Monday to Thursday. Respond 0, 1, 2, 3, or 4 for the number of days for each question.</p> <p>Weeks 7- to 12:</p> <p><u>Weekly Surveys:</u> The following questions are about the past 7 days. Respond 0 to 7 for the number of days for each question.</p>
Drug Use/ Cravings	<ol style="list-style-type: none">1. How many days did you use [HSD]?2. How many days did you have cravings for [HSD]?3. How many days did you use other drugs or alcohol?4. How many days did you crave other drugs or alcohol?
QoL	<ol style="list-style-type: none">5. How many days did you feel sad, blue, or depressed?6. How many days did you feel worried, tense, or anxious?7. How many days did you not get enough rest or sleep?8. How many days did you feel very healthy and full of energy?9. How many days were usual activities hard to do?
Medication Adherence	<ol style="list-style-type: none">10. How many days did you skip, miss, or forget taking your medications?

Table 2. Intervention Evaluation Survey Responses of the QUIT-Mobile Pilot

	6-weeks	12-weeks
Question	N (%) n=20	N (%) n=19
(1) How satisfied are you with the intervention of the Living Well Study so far? [1-5] (Mean) “Not at all satisfied” to “Extremely satisfied”	3.95 (SD=1.05)	4.15 (SD=0.60)
(2) What components of the intervention motivated you to continue participating until now? (Mark all that apply)		
Twice-weekly cell phone surveys	7 (35.0%)	1 (5.3%)
Once-weekly cell phone surveys	2 (10.0%)	2 (10.5%)
Follow-up calls with Coach feedback	4 (20.0%)	5 (26.3%)
Getting cash for answering survey questions and follow-up calls	3 (15.0%)	8 (42.1%)
All the components	7 (35.0%)	10 (52.6%)
None of the components	2 (10.0%)	0 (0.0%)
(3) What are problems that prevented you from participating fully in this study? (Mark all that apply)		
Lack of time	5 (25.0%)	8 (42.1%)
Lack of interest in completing the text message surveys	1 (5.0%)	1 (5.3%)
There were no problems that prevented you from participating	12 (60.0%)	7 (36.8%)
Other problem(s)	3 (15.0%)	3 (15.7%)
(4) Would you recommend this intervention to your family and friends?		
Yes	19 (95.0%)	18 (94.7%)

Table 3. Qualitative Feedback of Self-Monitoring Surveys and Telephone Coaching of the QUIT-Mobile Pilot

Feasibility

Participant 1812: Everything is easily read and easily answered. The questions are as simple as they can get. I wouldn't change anything about the text-message surveys. They aren't interfering with anything I'm doing.

Participant 1803: They [self-monitoring surveys] were easy to answer. I like how you can start and stop later in the day in case something happens. No one can tell you're doing it.

Participant 1805: I like it because the other day I was on the bus answering those questions. It's more private.

Acceptability

Participant 1811: They're [self-monitoring surveys] well targeted. I wouldn't cut any of the questions.

Participant 1804: That interaction throughout the week was helpful. It's useful to have someone looking after me.

Participant 1801: It helped me so much to be honest. It made me think about all of my [problems]. Thank you for that.

Self-Reflection, Awareness, and Reminders

Participant 1814: I've been much more aware and cognizant of how much I smoke [marijuana]. I feel like I'm holding balance now.

Participant 1813: The whole benefit [of the surveys] is you are asking yourself the questions and reflecting, which is something people should do anyways.

Participant 1813: I think the best part of the study is it puts it [substance use] in your consciousness. It makes you think about substance use like you wouldn't normally, so it's an easy way to keep it on your mind.

Participant 1819: It's a reminder to myself to think back on my day-to-day behaviors. It gives me an opportunity to think about myself.

Participant 1822: It [self-monitoring] helps keep me on track of where I am at the week. It's every Monday and Friday, I have to look at my cell phone of how many times I used. It's a memory game of taking care of myself. I like it though.

Participant 1820: Can't believe I said 6 days anxious!.... I do think it has to do with marijuana to a degree, because the day I was anxious or depressed, I didn't feel like doing anything. It must have been after my birthday, so I felt tired from excessive use.

Self-Monitoring with Coaching to Support Motivation

Participant 1819: The twice-weekly texting was my motivation to continue in the study because it's convenient and the questions are easy to read. Also the coaching calls. I can really just talk about anything without feeling judged, which is important to me. I like the way you [the coach] communicate with me. I appreciate it. It makes me feel safe.

Participant 1801: The whole interaction made me feel like I'm not alone.

Timing and Frequency of Self-Monitoring Surveys

Twice-weekly for first 6 weeks, weekly for weeks 6-12

Participant 1801: I think once weekly wasn't enough. I would forget completely about the study.

Participant 1814: I think it's just right. Checking on me after a weekend and before.

Participant 1810: I like that that they [surveys] are consistent. Same time on same day. It didn't come out on the blue. When I don't get it when I'm driving. I like the sign off message. Sometimes it seems if the survey just ended. Officially having sign off question to know that I finished.

Participant 1819: Twice-weekly is better than once-weekly. You have nuances, like your mood, that happen in the week that may not be clearly remembered after a full week. It's hard to give accurate answers.

Thoughts on doing surveys once a month after second coaching session

Participant 1805: Once a week. In my case, I need someone to be coaching me. Seeing that I am doing okay. I am following goals I have. Because I may forget or lose interest, but I see that you are trying to help me by calling and sending text message that would be better for me.

Participant 1811: Once a week is okay. Thinking back on 30 days would be hard to remember. My answers would be less accurate, kind of like guestimating

Thoughts on doing surveys daily for first two weeks

Participant 1804: It's overkill, but if you did it for the first 2 weeks it depends on the person. For example, if someone that has a bigger problem with Christina [methamphetamine] might need it more frequently

Participant 1805: That could be a lot. It depends on people's usage. If someone is trying to quit that could be helpful. If contemplative on quitting that could be overwhelming. Also, if they are not using. I think the first two week are better.

Participant 1819: Every day is only okay if you limit the questions to 2 or 3. Any more than 5 is too much for every day.