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Feasibility of a Mobile Messaging-Enhanced Brief Intervention for High Risk Heavy Drinking MSM: A Pre-Pilot Study

Kathryn Chavez, MA*, Tibor P. Palfai, PhD

Boston University, Psychological and Brain Science, 900 Commonwealth Avenue 2nd Floor, Boston, 02215, MA, USA

Abstract

The purpose of this project was to assess the feasibility of an in-person session + mobile messaging intervention approach to reduce heavy drinking and condomless anal intercourse among heavy drinking men who have sex with men at high risk for HIV. Participant ($n = 8$) engagement rates, retention and satisfaction ratings were used to measure feasibility and acceptability of the 4-week intervention. Paired t-tests were used to assess additional secondary outcomes. Results support the feasibility and acceptability of this novel treatment approach among this population. Pre-post intervention effect sizes on alcohol, sex risk and process variable secondary outcomes are discussed.

Keywords

men who have sex with men; MSM; HIV; alcohol; mhealth; mobile messaging

1. Introduction

Men who have sex with men (MSM) are the population most at risk for HIV infection within the US, accounting for 67% of new HIV diagnoses in 2016 (Centers for Disease Control [CDC], 2018b). Although pharmacological prevention approaches have become available (CDC, 2019b), behavioral approaches continue to be critical for the prevention HIV transmission among MSM (CDC, 2018a). Efforts to develop effective prevention approaches must include a focus on prevalent factors associated with transmission among this group. Among the various correlates of sexual risk behavior (for review see Mustanski, Newcomb, Du Bois, Garcia & Grove, 2011), alcohol use may be especially significant in its relationship to sexual risk taking among this high-risk population (Maisto & Simons, 2016, Wray et al., 2016). Heavy episodic drinking has been identified as a critical risk factor for HIV among MSM (e.g., Hess et al, 2015; Maisto & Simons, 2016). Defined as the consumption of five or more drinks on one occasion for men, this pattern of alcohol consumption has been significantly associated with multiple HIV risk behaviors across global, situational and event-level studies (Maisto & Simons, 2016; Woolf & Maisto, 2009). Heavy drinking prior

*Corresponding Author: kathryn.eve.chavez@gmail.com.

Declaration of Interests

There are no conflicts of interests to be declared.

to a sexual episode has been associated with increased likelihood of condomless anal intercourse (CAI; e.g., Colfax et al., 2004; Venable et al., 2004). Furthermore, more frequent binge drinking is associated with heightened frequency of sexual risk behaviors among MSM (Hess et al., 2015).

Given the association between heavy drinking and sexual risk, the National Institute on Alcohol Abuse and Alcoholism (NIAA) has suggested that interventions that target alcohol should be part of HIV prevention strategies (NIAAA, 2002). Indeed, recent research has supported the idea that HIV prevention interventions may demonstrate increased efficacy by targeting both alcohol use and sexual risk behavior using college student and emergency department patient samples (Celio et al., 2019; Lewis et al., 2014). Among the few existing efficacious HIV prevention interventions that have been adapted to include alcohol use as a treatment target, Personalized Cognitive Counseling (PCC; Dilley et al., 2002) and Motivational Interviewing (MI; Miller & Rollnick, 1991) have shown promise for efficacy among MSM samples (Wray et al., 2016). PCC is recognized as an evidence-based intervention for HIV prevention among MSM by the Centers for Disease Control and Prevention (2019a). Advantages of PCC as a treatment approach include its single session face-to-face treatment design, capacity to be easily taught and successfully delivered by paraprofessional counselors, and its high acceptability ratings among MSM (Dilley et al., 2011). Evidence for PCC as an effective alcohol use treatment however is limited. An adaptation of PCC for substance-using MSM populations has shown positive preliminary results for overall reductions in any alcohol use, however no significant treatment effects have been found for number of binge drinking days, number of CAI events, number of CAI events while intoxicated or number of CAI partners (Coffin et al., 2014; Santos et al., 2014). MI has been well-established as an effective treatment for alcohol use across a range of samples including MSM (Morgenstern et al., 2007; Vasilaki, Hosier & Cox, 2006; Wray et al., 2016). Strengths of MI include its brief treatment duration, emphasis on internal motivation for change, focus on client-selected treatment goals, and its ability to be integrated with other treatments (Flowers et al., 2017; Vasilaki et al., 2006). Previously, MI has been found to be effective in reducing heavy episodic drinking and number of standard drinks per week among substance using MSM in a number of studies, however positive results have been short in duration (Morgenstern et al., 2007; Vasilaki et al., 2006; Velasquez et al., 2009) and the effects of MI on number of CAI has been limited (Morgenstern et al., 2009; Velasquez et al., 2009). PCC and MI have proven to be effective in reducing sexual risk taking and alcohol use among MSM respectively, however, whether elements of each of these approaches might be integrated to reduce HIV-risk behaviors among MSM is largely unknown.

One of the primary challenges of developing a secondary prevention approach is that participants may not be initially interested in participating in a sustained intervention for behaviors that they do not identify as problematic. The use of mobile health (mhealth) technologies may be especially helpful in this regard. Research has shown that mobile phone technologies can greatly increase engagement with intervention content by providing numerous, brief contact opportunities throughout the day (Anderson-Lewis, Darville, Mercado, Howell & Maggio, 2018; Suffoletto, 2016). Mobile phone messages are delivered in a convenient and discreet fashion, providing greater access to care while reducing

concerns over stigmatization and confidentiality (Schnall, Travers, Rojas & Carballo-Diéguez, 2014; Suffoletto, 2016; Suffoletto & Chung, 2016). Through interactive messaging capabilities, messages can easily be personalized in real-time at the individual level providing tailored content based on patient-entered data (Head et al., 2013; Suffoletto, 2016). Moreover, message delivery can be scheduled during times when risk behavior is most likely serving as a cue to consider potential consequences of HIV risk behaviors during periods of increased vulnerability (Freeman, 2016; Suffoletto et al., 2015). With the addition of mobile messaging, positive effects for traditional alcohol and HIV prevention treatment may be magnified and sustained for longer durations to produce lasting health behavior change among MSM.

Previous research suggests that for an mhealth approach to be efficacious, the end-user must perceive the intervention as personally relevant and useful (Bock et al., 2015; Talley, 2013). Therefore, it is advantageous to include members of the target population during the intervention development process. The purpose of this project was to conduct an intervention development pre-pilot study of a single in-person session combined with a mobile messaging component designed to reduce frequency of heavy drinking and CAI among heavy drinking MSM. The aims of this study were to (1) develop a semi-structured intervention manual for the single treatment session combining elements of PCC and MI to reduce heavy drinking and sexual risk behavior, (2) create a series of interactive mobile messages to deliver intervention content enhanced with PCC and MI behavior change strategies, (3) conduct a small pre-pilot test of the combination intervention to gather information on the feasibility and acceptability of the intervention. An additional exploratory aim of the study was to examine the impact of the intervention on heavy drinking frequency, CAI, cognitive-motivational processes related to change and condom use attitudes. The objective was to utilize results from this pre-pilot study to refine the intervention for a subsequent randomized controlled pilot study to provide an initial test of the efficacy of this approach.

2. Methods

2.1. Participants

Participants were moderate to heavy drinking MSM ($n = 8$). Eligibility requirements for the study included (1) age 21–50, (2) at least one episode of heavy drinking in the past thirty-days, (3) sexual intercourse with other men at least once per month in the past ninety-days, and (4) no involvement in a monogamous relationship.

2.2 Intervention

2.2.1. In-Person Brief Intervention Session—The intervention included one brief in-person session that combined features of MI and PCC followed by four weeks of interactive mobile messages. The goals of the brief in-person session were to (1) increase awareness of the influence of heavy alcohol use and risky sexual behaviors on important goals and values of the participant, (2) explore and resolve ambivalence about behavior change regarding alcohol use and CAI, (3) increase motivation and confidence for change and (4) provide options to assist participants begin to change their behaviors if they so

choose. A semi-structured treatment manual was created to provide a framework from which to conduct the brief intervention. The intervention was delivered using an MI-style (Miller & Rollnick, 1991) throughout which included a collaborative, nondirective approach guided by participant responses, reflective listening, and a focus on the elaboration of personal goals that may be inconsistent with risky sexual behavior and heavy drinking. The in-person component of the intervention was divided into four parts: exploring the role of alcohol in the participant's life, understanding the patient's perspective on the association between alcohol and sexual behaviors, the retelling and examination of a recent CAI and related self-justifications for the risky sexual behavior, and personal goal selection and monitoring using mobile messages. A series of questionnaires regarding alcohol use, alcohol use consequences, readiness to change, recent HIV sex risk behaviors and self-justification for CAI were administered and reviewed by the interviewer before the in-person treatment session and were referenced throughout the interview to personalize the intervention. Throughout the first three parts of the session, the interviewer elicited goals related to alcohol use and sexual risk taking from the participant to be integrated into the final part of the session.

2.2.2 Mobile Messaging Component—The mobile messaging component was introduced to participants as a tool to help them reach their own personal goals for alcohol use and safe sex. To extend the brief in-person treatment, message content was grounded in PCC and MI as well as self-regulation theory and referenced topics discussed during the face-to-face session. As self-monitoring behavior has been associated with improved behavior change outcomes in previous research (e.g., Harkin et al., 2016), this self-regulatory strategy was a key component of the mobile messaging component to motivate and sustain behavior change towards self-selected goals. The mobile messages provided information regarding safe sex and harm reduction for alcohol use, and included strategies related to planning and identification of specific barriers to change. Messages related to motivation to change, important goals and values discrepant with use, self-efficacy, key change-talk statements and self-justifications for CAI were also featured. Messages were sent every Thursday-Monday for four consecutive weeks following the brief treatment session.

Given the challenges of maintaining participation in mhealth interventions over time (Alkhaldi et al., 2016; Bidargaddi, Pituch, Maaieh, Short & Stretcher, 2018; Brouwer et al., 2008), a number of strategies were utilized to increase and maintain user engagement with the mobile messages for the duration of the study. Previous work has found that interactivity or two-way communication within mobile messages is one method to increase user engagement (Armanasco, Miller, Fjeldsoe & Marshall, 2017). Message tailoring and personalization have also been recognized as strategies associated with increased user engagement and mhealth intervention efficacy (Bidargaddi et al., 2018; Head et al., 2013). As such, ninety percent of the mobile messages included in the mhealth component included between one and seven questions requiring a participant response. To decrease any perception of repetitiveness, questions were formatted as multiple choice, free response or Likert scale. Fifty-five percent of messages required a response to multiple questions and sixty-five percent of messages sent were personalized with a follow up message that was

based on the participant's response to the previous question. Notifications of a new mobile message included the name of each participant (e.g., "Dan – Your survey is ready!"). Moreover, strategies were used to increase the participants' sense of autonomy and choice in the mobile messages. Although all mobile messages were programmed before enrollment, to enhance the perception of autonomy and choice, each participant was asked to rate each mobile message domain (planning, safe sex, self-efficacy, core-values, motivational messages, and barriers to change) according to their preference for which they would like most to receive.

A major strength of mhealth interventions are their ability to reach and engage users at the most opportune times (Bidargaddi et al., 2018; Head et al., 2013). With this in mind, every Thursday-Sunday at 7 p.m. one brief message was sent containing intervention content. This time was selected as it was considered a point in the evening prior to typical high-risk drinking hours (e.g., pre-gaming). Prompting engagement in treatment at this time was a strategy to increase the salience of participants' self-selected alcohol and safe sex goals and integrate these goals into their evening plans. Each Monday at 9 a.m., participants were sent a message allowing them to choose a goal for the next seven days regarding alcohol use or safe sex. To encourage self-monitoring, every following Monday, participants reported whether they were able to reach their goal then set a new goal for the next seven days. If participants reported not reaching their goal, follow up messages guided participants through the identification of barriers that prevented them from reaching their goal and encouraged planning to make changes to be more successful in the following week.

2.2.3. Mobile Messaging Platform—Messages were delivered via a free mobile app (Metricwire) downloaded to each participant's personal smartphone. The decision to deliver intervention content messages via an app follows recent research highlighting the enhanced user experience, programming capabilities and personalization features available with app-based messaging (Muessig et al., 2013; Suffoletto, 2016). Before enrolling participants, a research assistant programmed messages into the Metricwire online platform, selected message format (i.e., multiple choice, free response, Likert scale), created branching and piping designs to automatically send the appropriate tailored follow up message to participants based on their response to the previous message, and scheduled message delivery and participant response reminders.

Application (app) push notifications alerted each participant when a new message was available in the Metricwire app. A push-notification is a short message alert that appears on the screen of a smartphone, often paired with a sound. These notifications appear regardless if or how the device is being used. Tapping on a push-notification will automatically open the associated app. In the context of this study, receipt of a Metricwire app push-notification on their device exposed each participant to the intervention. Each notification served as a reminder of the brief in-person treatment session and increased the salience of the discussion regarding their alcohol and safe sex goals. Previous studies have shown that the use of push-notifications is a promising method to increase engagement and sustained use of smartphone-based applications (Alkhaldi et al., 2016; Bidargaddi et al., 2018) but must be used judiciously as a high frequency of push notifications can overwhelm and discourage

use (Head et al., 2013). For this study, one reminder push-notification was sent to participants who had not responded to the new message after fifteen minutes.

2.3. Measures

Eligibility for enrollment was assessed during telephone screening and confirmed during an in-person screening prior to the baseline session. Assessment was conducted with both paper and computer-based self-report measures. Inclusion criteria were as follows: 21–50 years of age, one episode of heavy drinking in the past thirty-days, one episode of CAI in the past ninety-days, no involvement in an exclusive, monogamous relationship and a Kinsey Scale (Kinsey, Pomeroy & Martin, 1948; Kinsey, Pomeroy, Martin & Gebhard, 1953) score of 3 or higher. The Kinsey Scale is a 7-point scale used to assess self-identified sexual orientation, with 0 representing exclusive heterosexuality and 6 representing exclusive homosexuality. Exclusion criteria were as follows: a positive HIV status, past (previous 3 years) or current treatment for alcohol use, a diagnosis of bipolar disorder or schizophrenia, current psychological treatment, a substance specific ASSIST (Alcohol, Smoking, and Substance Involvement Screening Test; World Health Organization [WHO], 2002) score of 27 or above and a Brief MAST (Brief Michigan Alcoholism Screening Test; Pokorny, Miller & Kaplan, 1972) score of 5 or above. Both the ASSIST and the Brief MAST have been previously found reliable as screening measures for drug use and alcohol use respectively (WHO, 2002; Connor, Grier, Feeney & Young, 2007).

2.3.1 Primary Outcomes—Feasibility for the intervention was determined by mobile message response rate and retention in the mobile message intervention. Individual rates of opening a message and submitting a response were calculated. A modified version of the Client Satisfaction Questionnaire (Larsen, Attkisson, Hargreaves & Nguyen, 1979) was used to assess intervention acceptability. Scale descriptors ranged from 1 (very dissatisfied) to 5 (very satisfied). Additional information about the acceptability of the intervention was elicited during debriefing interviews during a follow up visit five to six weeks after baseline. Questions posed to participants during the interview included “Did you find the mobile messages helpful, and if so, in what ways?”, “How would you modify the mobile messages?” and “How did the mobile messages influence your behavior?”.

2.3.2 Secondary Outcomes—Self-report measures of alcohol use, sexual behaviors and cognitive-motivational processes were administered in the lab at baseline and during the follow up visit five to six weeks after baseline. Responses to alcohol use and sexual risk behavior measures were referenced during the brief treatment session. The heavy drinking item from the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Barbor, de la Fuente, & Grant; 1993) was used to measure heavy drinking. The AUDIT has demonstrated good internal reliability and validity as a screening measure for risky or harmful alcohol consumption (de Meneses-Gaya, Zuardi, Loureiro & Crippa, 2009; Reinert & Allen, 2002). Item 3 from the AUDIT (“How often do you have six or more drinks on one occasion?”) was used to assess heavy drinking frequency. Response options included “never”, “less than monthly”, “monthly”, “weekly”, and “daily or almost daily”. Sexual Behavior Survey-Extended (Gordon, Carey & Carey, 1997) was used to assess the number of CAI episodes in the past ninety-days. Two versions of the Goal Systems Assessment Battery

(GSAB; Karoly & Ruehlmen, 1995) were used to measure self-regulation processes related to the goals of (1) “CURBING/LIMITING the amount of ALCOHOL that you consume per occasion” and (2) “USING CONDOMS every time you have sex [with a partner of unknown status for sexually transmitted infections]”, respectively. The GSAB includes four subscales (i.e., Value, Planning, Self-Efficacy and Self-Monitoring), each comprised of 4-items, and has demonstrated good internal consistency and test-retest reliability among various populations (Karoly et al., 2005; Lutz, Karoly & Okun, 2008). Scale descriptions for each item ranged from 0 (“not at all accurate description of how I think about this goal”) to 3 (“extremely accurate description of how I think about this goal”).

2.3.3 Exploratory Outcomes—Prior to the discussion portion of the intervention, participants completed the Self-Justification Elicitation Instrument (SJEI) adapted for substance-using MSM (Coffin et al., 2014; Knight et al., 2014). This measure is used to bring to mind the “heat-of-the-moment” thoughts, attitudes and beliefs before, during and after a recent episode of CAI (Gold & Rosenthal, 1995; Knight et al., 2014). Items within the SJEI are divided into nine themes: (1) Substance Use as a Facilitator of Sex, (2) Transmission Risk Calculus, (3) Assumptions Regarding Partner’s HIV Status, (4) Cognitive Escape, (5) Sensation Seeking/Spontaneity, (6) Condom-Related Issues, (7) Opportunities for Sex, (8) Expectation or Obligation, and (9) Invincibility. Participants were asked to rate how strongly each self-justification had occurred to them at the time that they decided to engage in CAI on a 5-point scale, ranging from 1 (“I had this thought STRONGLY [in the forefront of my mind]”) to 4 (“I did not have this thought at all”). A response indicating “I can’t REMEMBER at all if I had this thought or not” was also included and was scored as 0. Responses to this measure were used to help guide the discussion regarding the retelling of a recent CAI. Individual rankings for each mobile-message content domain were also explored to identify any trends in preference among the study sample. Rating of mobile messages were based on a 6-point scale ranging from message type participants would most prefer to receive (1) to message types they would least prefer to receive (6).

2.4. Procedures

The study was approved by the Boston University Institutional Review Board. Informed consent was obtained from all individuals before completion of the baseline assessment. Participants were recruited through various digital media outlets (e.g., Facebook, Grindr) for a study to assess alcohol use and sexual behavior through experience sampling (R01-AA022301–01A1). From this database, individuals between the age of 21–50 who reported at least one heavy drinking episode in the past thirty-days, one episode of CAI in the past ninety-days, and no involvement in an exclusive, monogamous relationship were recruited to participate in the study. Participants were screened by phone for eligibility which was confirmed at an in-person screening.

Following baseline assessments, participants engaged in a brief in-person intervention session regarding their alcohol use and sexual risk behaviors and were then enrolled in the mobile messaging component. Mobile messages were sent (as described above) over the following four weeks. Five to six weeks after baseline, participants returned to the lab to complete a follow up assessment and engage in a discussion regarding the acceptability of

the mobile messages and satisfaction with the intervention approach. Measures of heavy drinking frequency, CAI and cognitive-motivational processes were collected during the follow up assessment.

2.5. Data Analytic Strategy

Message response rates for the twenty mobile messages delivered over the course of the four-week intervention served as an indicator of engagement and a measure of feasibility for the mobile messaging component of the intervention. An index of acceptability for the mhealth approach consisted of the median and mean scores of the Likert-scale satisfaction item. Additional information regarding the acceptability of the messaging component was gathered through participant responses during a debriefing interview. The baseline measure of past ninety-day CAI frequency was divided by three to derive an average past thirty-day CAI frequency to parallel the time-period measured at follow up. Hypothesized health behavior change processes were also assessed during these two periods. A series of paired sample t-tests were used to measure differences in secondary outcomes between baseline and follow up. Given the small sample, effect size estimates were used to provide initial information about the potential impact of the intervention on outcomes. Endorsement rates for individual items of the SJEI and mean ratings of mobile message content preferences were calculated to explore any trends in self-justification endorsements and self-selected message personalization among the study sample. One participant was lost to follow up after completing the four-week mobile messaging intervention component and was therefore excluded from analysis involving follow up data.

3. Results

3.1. Descriptive Statistics

The overall study sample ($n = 8$) was 50% Caucasian ($n = 4$) and 12.5% Asian ($n = 1$). 12.5% ($n = 1$) of participants endorsed “Other” race, 12.5% ($n = 2$) endorsed being Multicultural and 25% ($n = 2$) were Hispanic or Latino. The mean age of the sample was 24 ($SD = 2.80$). At baseline, the mean frequency of heavy drinking in the past thirty-days from AUDIT item 3 was 2.60 ($SD = 0.55$) and the mean number of CAI in the past thirty-days among the sample was 2.67 ($SD = 3.00$).

3.2 Feasibility and Acceptability of Mobile Messaging Component

3.2.1 Text Messaging Engagement—Over the course of the four-week mhealth intervention component, participants opened a median of 92.50% ($M = 86.25\%$, $SD = 0.15$) and submitted a median of 90% ($M = 83.75\%$, $SD = 0.14$) responses to the twenty mobile messages. Two participants opened one message without submitting a response and one additional participant opened two messages without submitting a response. All remaining participants opened and submitted responses to every message.

3.2.2 Satisfaction—The median satisfaction rating for the overall intervention was 4.00 ($M = 4.25$, $SD = 0.05$). The median response to the questions “Has this intervention helped you with decisions about your alcohol use?” and “Has this intervention helped you with decisions about your sexual behavior?” were both 2.00 ($M = 1.67$, $SD = 1.53$, and $M = 2.00$,

$SD = 1.00$, respectively). These ratings support the view that the intervention was readily adopted by participants and that they experienced high levels of satisfaction in its use.

3.2.3 Post-Intervention Debriefing Information Related to Intervention

Content—During the debriefing interview, participants were asked a series of questions regarding their experiences of mobile messaging intervention and their perspectives on how to modify the mobile messages for future iterations of the study. Consensus among the sample emerged for three aspects of the smartphone portion of the intervention. Specifically, five of seven participants reported that goal-setting and reminders were what they found most helpful about the mobile messages. For example, one participant shared “It [the mobile messages] made me think about the goals I set, reminded me of those goals and how alcohol can get in the way of those goals”. Another participant noted that they “learned to make goals more realistic, start smaller”. These opinions are in line with recent research finding interest among MSM in tracking and receiving feedback on personal behaviors including sexual risk taking and alcohol/drug use within a mobile-based HIV prevention intervention (Goldenberg, McDougal, Sullivan, Stekler & Stephenson, 2014; Ventuneac, John, Whitfield, Mustanski & Parsons, 2018). Another shared opinion among the study sample was that they felt the mhealth intervention helped them to moderate their drinking utilizing a variety of strategies. Drinking water while consuming alcohol, having less alcohol in one sitting, and monitoring the number of drinks consumed were among the strategies all seven participants reported adopting during the mhealth portion of the intervention. Mirroring this perceived utility of the mobile messages, Wray, Kahler, Simpanen & Operario (2019) highlighted the need for a harm reduction section within user-centered health risk mhealth interventions for MSM. Lastly, when asked how they would modify the mobile messaging portion of the intervention, four of seven participants advised that adding an additional goal-reminder message mid-week would be helpful to keep the self-selected goal they set on Monday stay on their mind throughout the weekend. Participants also suggested including their goal to be piped into this reminder message to make it more personalized.

3.3. Impact of Intervention on Secondary Outcomes

Results of intervention effects on secondary outcomes are presented in Table 1. These results showed a large pre-post effect on the heavy drinking item from the AUDIT which was statistically significant. Due to a data collection error, only 5 participants have pre and post data on this secondary outcome. Results indicated a medium effect on CAI at follow up compared to baseline but this was not statistically significant.

Among the various cognitive-process variables examined, results indicated that several Goal Systems Assessment Battery subscales related to alcohol and to condom use were positively influenced by the intervention. Results suggested changes from baseline to follow up on a number of self-regulatory processes related to drinking including the GSAB-Alcohol Value and Planning subscales. Likewise, significant changes in self-regulatory processes related to condom use were seen including the GSAB-Condom Self-Efficacy, Self-Monitoring, and Planning subscales. By the end of the intervention period, participants self-reported level of self-efficacy, self-monitoring and planning behaviors in relation to the goal of “using condoms every time they had sex with a person of unknown STI status” had increased.

Positive changes in planning behaviors related to condom use and condom use negotiation between baseline and follow up were also found. Results showed a significant mean difference in these planning behaviors indicating that participant self-reported planning for condom use and condom-use negotiation increased over the course of the intervention. Full results of all secondary outcomes assessed can be found in Table 1.

3.4 Post-Hoc Analysis: Intervention Self-Justification Content

To better understand the motivations and context of unprotected sexual episodes among the study sample, we examined endorsement rates of the SJEI scale. The items with the highest frequency of being endorsed at least slightly or greater can be found in Table 2. Before enrolling in the mobile intervention component, participants were asked to rank order their preferred mobile-messaging domains from 1 – 6, 1 representing the message domain they'd most prefer to receive, 6 representing the message domain they'd least prefer to receive. The three highest ranked mobile message domains among the study sample were planning messages ($M = 2.37$, $SD = 1.77$), motivational messages ($M = 2.87$, $SD = 1.81$), and self-efficacy messages ($M = 3.63$, $SD = 1.69$). Data regarding the most endorsed SJEI self-justification items and mobile message domain preferences offers valuable information for subsequent iterations of this intervention. As engagement and retention rates are improved by tailoring intervention content and focus to fit the experiences of the target population, these results will provide guidance to improve both the in-person treatment session and the mobile messages in future research.

4. Discussion

This study sought to test the feasibility and acceptability of a novel mhealth-enhanced intervention incorporating interactive mobile messaging with a brief in-person session to reduce the frequency of heavy drinking and condomless anal intercourse among heavy drinking men who have sex with men. The development of efficacious and innovative interventions and delivery methods is critically needed to increase access to care and improve treatment engagement among men who have sex with men, the group at most risk for HIV infection within the US (CDC, 2018b). Results from this study provide support for the acceptability and feasibility of this approach among a sample of heavy drinking men that have sex with men at risk for HIV. Participants were engaged with the interactive mobile messages as evidenced by a submission rate of 90% and the retainment of the full study sample for the duration of the four-week intervention. Satisfaction ratings of the overall intervention and feedback regarding the acceptability of the intervention during debriefing interviews suggest this intervention approach may be a potentially efficacious treatment design to address heavy episodic drinking and sexual risk behavior among heavy drinking men that have sex with men.

Findings from this pilot study also highlight the impact of the intervention on heavy drinking frequency as well as several processes of change over a four-week period. Results from this study showed that the combination intervention had a strong effect on frequency of heavy drinking at follow up. A number of self-regulatory processes related to both the goal of alcohol use reduction and the goal of always using condoms with partners of unknown STI

status were also significantly influenced by the intervention. Specifically, increases in the valuation and planning behaviors related to that goal of reducing or curbing alcohol use were found. Increases in personal self-efficacy, self-monitoring and planning behaviors for the goal of practicing safe sex were also shown. Moreover, increases in planning for condom use and condom use negotiation were evidenced at follow up. The preliminary findings regarding the changes in heavy drinking frequency and various processes examined in this study lend support for mhealth-enhanced interventions as a promising approach to improve treatment outcomes.

Limitations of this study should be considered in future work. First, this preliminary study consisted of only 8 participants in a pre-post design. Future work must utilize a larger sample size to provide more confidence about the generalizability of results found in this preliminary study and to provide a suitable comparison group to account for assessment effects and change over time. Future work should also include a more precise measurement of secondary outcomes including heavy drinking frequency and sexual risk behaviors to provide an improved investigation of intervention effects. Including multiple indices of alcohol and sexual risk behaviors would also allow for more nuanced understanding of intervention effects. Finally, although results regarding intervention effects on cognitive-process variables within this study point to specific variables that warrant further examination, a formal mediational analysis utilizing a larger sample size is needed to accurately assess potential mechanisms of change underlying treatment effects. These limitations may be addressed in a subsequent randomized pilot trial guided by the results of the present study.

Despite the limitations discussed, this study provides preliminary support for the feasibility of a mhealth-enhanced alcohol and sexual risk behavior intervention for heavy drinking men who have sex with men. Results of this pre-pilot show that this combination in-person + mobile messaging intervention approach is acceptable to participants and holds potential to reduce risky drinking, condomless anal intercourse, and enhance self-regulatory processes related to these behaviors in this population.

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Figure 1.
CONSORT Flow Diagram

Table 1.

Secondary Outcomes

		<i>M</i> (<i>SD</i>)	<i>M</i> difference	95% CI	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
Heavy drinking frequency (past 30 days)	BL	2.60 (0.55)						
	FU	1.60 (0.55)	−1 (0.71)	−1.88, −0.12	−3.16	4	0.03*	−1.41
CAI(past 30 days)	BL	2.67 (3.00)						
	FU	1.29 (1.38)	−1.62 (3.20)	−4.58, 1.34	−1.34	6	0.23	−0.51
GSAB-A Value	BL	5.71 (2.69)						
	FU	10 (3.61)	4.29 (3.09)	1.42, 7.15	3.67	6	0.01 ⁺	1.39
GSAB-A Self-Efficacy	BL	12.14 (2.48)						
	FU	13 (2.71)	0.86 (1.68)	−0.69, 2.41	1.35	6	0.23	0.51
GSAB-A Self-Monitoring	BL	6.14 (4.14)						
	FU	9.71 (2.63)	3.57 (4.43)	−0.53, 7.67	2.13	6	0.08	0.81
GSAB-A Planning	BL	4.86 (4.26)						
	FU	8.14 (3.24)	3.29 (3.09)	0.42, 6.15	2.81	6	0.03*	1.06
GSAB-C Value	BL	11.14 (5.52)						
	FU	13.71 (2.21)	2.57 (3.55)	−0.71, 5.86	1.92	6	0.1	0.72
GSAB-C Self-Efficacy	BL	11.57 (3.36)						
	FU	13.43 (2.70)	1.86 (1.68)	0.31, 3.41	2.93	6	0.03*	1.11
GSAB-C Self-Monitoring	BL	7.29 (4.96)						
	FU	11.14 (3.85)	3.86 (3.08)	1.01, 6.70	3.32	6	0.02*	1.25
GSAB-C Planning	BL	7.43 (5.38)						
	FU	11.43 (3.64)	4 (3.56)	0.71, 7.29	2.97	6	0.03*	1.12
Condom Use Intentions	BL	9.57 (4.69)						
	FU	12.43 (2.64)	2.86 (4.78)	−1.56, 7.27	1.58	6	0.17	0.60
Condom Use Self-Efficacy	BL	15.29 (7.5)						
	FU	18 (5.03)	2.71 (4.46)	−1.41, 6.84	1.61	6	0.16	0.61
Condom Use Planning	BL	11.86 (5.15)						
	FU	14.71 (4.19)	2.86 (2.34)	0.69, 5.02	3.23	6	0.02*	1.22

Note: Heavy drinking frequency in the past 30 days was measured using item 3 from the AUDIT, CAI = episodes of condomless anal intercourse in the past thirty-days, GSAB-A = Goal Systems Assessment Battery-Alcohol, GSAB-C = Goal Systems Assessment Battery-Condom, Condom Use Intentions refers to intentions to use condoms over the next ninety-days, Condom Use Planning refers to planning behaviors related to condom use over the next ninety-days.

* $p < 0.05$;

⁺ $p < 0.01$

Table 2.Sample of the highest endorsed statements from the Self-Justification Elicitation Instrument ($n = 8$)

Self-Justification Statement	% (n) endorsed slightly or greater	% (n) endorsed strongly
"Alcohol and/or drugs make it easier to have sex (or different kinds of sex)"	87.5 (7)	25 (2)
"He said he was negative, and I have been tested. So it must be safe"	87.5 (7)	12.5 (1)
"Sex is better when I am drunk or high"	87.5 (7)	0
"He would have told me if he were positive"	87.5 (7)	0
"This feels more natural. Sex is just better without a condom"	75 (6)	50 (4)
"I know enough about this guy, I figure I can trust him"	75 (6)	37.5 (3)
"We've both had the HIV test, and the tests were both negative, so neither of us is infected"	75 (6)	37.5 (3)
"This guy is really into me. It feels good to be wanted so much"	75 (6)	25 (2)
"The two of us have had sex without a condom before, not so long ago, so there is no point in stopping now"	75 (6)	25 (2)
"I want to have unprotected sex because it feels good"	75 (6)	25 (2)
"Condoms take all the feeling away"	62.5 (5)	25 (2)
"Topping isn't that risky"	50 (4)	25 (2)
"I want to show him that I trust him"	50 (4)	25 (2)
"A condom would spoil the romance. I can't have a condom separating me from the man I care about. I can't have a condom coming between us"	37.5 (3)	25 (2)

Note. Measure scored on a 5-point Likert scale, 1=I had this thought STRONGLY (in the forefront of my mind), 4=I DIDN'T have this thought at all, with 0=I CAN'T REMEMBER at all if I had this thought or not.