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Impact of Behavioral Drug Abuse Treatment on Sexual Risk Behaviors: An Integrative Data Analysis of Eight Trials Conducted within the National Drug Abuse Treatment Clinical Trials Network

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Abstract

Background—The extent to which behavioral drug abuse treatments affect sexual risk behaviors is largely unknown. This study examined the impact of behavioral drug abuse treatments on sexual risk behaviors using an integrative data analysis approach across eight trials conducted within the National Drug Abuse Treatment Clinical Trials Network (CTN).

Methods—Participants ($N = 1,305$) from eight randomized controlled trials who were sexually active at baseline were included in the pooled dataset; 48.7% were female, 64.1% self-identified as a racial/ethnic minority, with M (SD) age of 34.9 (9.6). Longitudinal logistic regression estimated the probability of risky sexual behavior (i.e., inconsistent condom use and/or >1 sexual partner in past 30 days) post-intervention with an indicator variable (1 for post-intervention), study condition (control, intervention), and their interaction as predictors; the analysis employed random effects for each trial and included relevant control variables. Time-varying differences in effects based on weeks post-intervention were incorporated using interacted linear and quadratic terms with condition status.

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Compliance with Ethical Standards

Disclosure of Potential Conflicts of Interest: None of the authors has any conflict of interest regarding this manuscript.

Research Involving Human Participants and/or Animals: All procedures performed in studies involving human subjects were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent: Informed consent was obtained in all of the original clinical trials included in this secondary data analysis.

Results—Approximately 84.2% reported risky sexual behaviors at baseline. The control and intervention conditions were 18.5 and 17.3 percentage points less likely to report risky sexual behavior post-intervention, respectively. Results suggest decreasing rates of risky sex engagement until eight weeks (control) or nine weeks (intervention) post-intervention; risky sexual behavior subsequently increased.

Conclusions—Behavioral CTN trial participation was associated with decreased sexual risk behaviors in both the intervention and control trial conditions. Participation in behavioral substance use treatment may result in secondary benefits of sexual risk behavior reductions.

Keywords

Integrative data analysis; behavioral drug treatment; sexual risk behaviors

Rates of new human immunodeficiency virus (HIV) infections remain relatively stable, with an estimated 47,500 incident infections in the United States (US) in 2013 (CDC, 2014). While estimates vary, it has been suggested that as many as one-third of incident HIV infections are related to drug use, highlighting the intertwined relationship between the HIV and drug abuse epidemics (Sorensen & Copeland, 2000). Risk of HIV acquisition and transmission is elevated among individuals who abuse drugs, due in part to specific drug use behaviors (e.g., injection drug use [IDU], needle sharing, CDC, 2015; Mathers et al., 2008). Drug abuse is also associated with high risk sexual behaviors that may co-occur with drug use including inconsistent condom use (Khan et al., 2013; King, Nguyen, Kosterman, Bailey, & Hawkins, 2012; Leigh, Ames, & Stacy, 2008; NIDA, 2012b) and multiple or concurrent sexual partners (Khan et al., 2013).

Behavioral drug abuse interventions used alone or in conjunction with medication assisted treatment modalities (e.g., methadone, buprenorphine) offer the potential to reduce both substance use and HIV risk behaviors among at-risk populations (Shoptaw & Frosch, 2000; Shoptaw et al., 2005; Sorensen & Copeland, 2000; Tross et al., 2011). In a narrative review of 20 drug abuse treatment studies published between 1988 and 1998, HIV risk behavior engagement decreased over the course of drug abuse treatment (Sorensen & Copeland, 2000). Specifically, 16 of 17 studies demonstrated reductions in IDU; 11 of 12 studies reported sexual risk behavior reductions (Sorensen & Copeland, 2000). Additionally, individuals engaged in drug abuse treatment reported less HIV risk behavior engagement relative to individuals who were not engaged in treatment (Sorensen & Copeland, 2000). Thus, there is evidence to suggest that drug abuse treatment may produce secondary HIV risk reduction benefits.

The National Drug Abuse Treatment Clinical Trials Network (CTN) aims to advance drug abuse treatment in the US via conducting large-scale, multi-site effectiveness trials of drug abuse treatments (Greenfield et al., 2011; NIDA, 2012a; Tross et al., 2011). Across completed CTN trials, there is diversity in the treatments evaluated, with a focus on pharmacological treatments, behavioral treatments, or a combination of these approaches. Analyses from a limited number of individual CTN trials have investigated the extent to which drug abuse treatment results in reduction of HIV transmission risk behaviors (Tross et al., 2011). For example, secondary analyses from a trial of trauma-focused cognitive-

behavioral group therapy for women with victimization histories (CTN-0015) demonstrated reductions in unprotected sexual encounters (Hien et al., 2010). CTN trials assess a variety of domains including drug use and HIV risk behaviors using common assessment measures, and CTN provides an online Data Share with access to data from completed CTN trials (NIDA, 2012a). The CTN is an optimal platform to integrate data from multiple completed behavioral drug abuse treatment trials to evaluate potential secondary benefits of HIV risk behavior reductions utilizing pooled original data sets.

Integrative data analysis (IDA) facilitates examination of combined original datasets and provides advantages relative to other data analytic approaches. An IDA approach allows for analysis of multiple original data sets that have been pooled into one using harmonized variables (Brown et al., 2013; Curran & Hussong, 2009; Hussong, Curran, & Bauer, 2013). In contrast, meta-analytic approaches utilizing aggregate study data are limited by reliance on summary statistics from published studies (Curran & Hussong, 2009). IDA offers a number of advantages including increased statistical power, the ability to examine low base-rate behaviors, and the opportunity to test novel hypotheses in data pooled across trials (Curran & Hussong, 2009; Hussong et al., 2013; Perrino et al., 2013). When identical measures do not exist, variables can be harmonized by transforming the original items to have logically equivalent response scales in order to combine variables for pooled data analyses (Hussong et al., 2013; Shrout, 2009).

However, IDA poses potential challenges including the collection of original data sets from researchers and inconsistency in assessment outcome measurement between trials (Brown et al., 2013). CTN trial data are optimally suited to address the key challenges associated with an IDA approach. First, the CTN provides for the sharing of original study data in a publicly available format. Second, CTN trials employ common assessment measures across trials. For example, there are two primary measures of HIV transmission risk behaviors (HIV Risk-Taking Behavior, Risk Behavior Survey) that are used in the majority of CTN trials. The creation of harmonized variables from these measures using recommended IDA approaches for nonidentical items also addresses this challenge.

The aim of this study was to examine the impact of behavioral drug abuse treatments on sexual risk behavior engagement (i.e., inconsistent condom use, having multiple sexual partners) using an IDA approach across eight randomized controlled trials conducted within the National Drug Abuse Treatment CTN. It was hypothesized that participants, regardless of randomized trial condition, would demonstrate reductions in sexual risk behaviors at the follow-up assessment period. Further, it was hypothesized that participants randomized to the intervention conditions would demonstrate greater reductions in sexual risk behaviors relative to the control conditions. Last, we predicted that the greatest sexual risk behavior reductions would occur more immediately following the trial and decrease over time (a pattern of findings demonstrated in behavioral HIV risk-reduction interventions; see DiClemente, Brown, Sales, & Rose, 2013), particularly in the control conditions.

Methods

Participants

Participants were adults currently using substances engaged in outpatient substance abuse treatment who were enrolled in one of eight CTN randomized controlled behavioral drug abuse treatment trials (CTN-0004, 0005, 0006, 0007, 0009, 0013, 0015, 0021; see Table 1). Analyses were limited to the subset of participants with at least one post-assessment who reported recent vaginal sexual activity (past 30 days) at the baseline assessment ($N = 1,305$).

Procedures

Trial inclusion and exclusion criteria—CTN trials were included in the pooled dataset if they met the following criteria: (a) the CTN trial evaluated a behavioral treatment targeting drug abuse delivered via an in-person format for adults; and (b) the CTN trial included either the HIV Risk-Taking Behavior Scale or the Risk Behaviors Survey to assess HIV transmission risk behaviors. Three trials (CTN-0031, 0037, 0047) were excluded due to not including either of the HIV transmission risk behavior assessments. CTN trials evaluating only pharmacological interventions were not included ($n=11$; CTN-0001, 0002, 0003, 0010, 0027, 0028, 0029, 0030, 0046, 0048, 0052). Additionally, trials providing process evaluations of drug treatment services ($n=2$; CTN-0008, 0012), those evaluating interventions for clinicians providing drug treatment services ($n=1$; CTN-0016) or to increase employment ($n=1$; CTN-0020), trials delivered by phone or the computer ($n=2$; CTN-0011, 0044), trials with an adolescent sample ($n=1$; CTN-0014), and trials evaluating behavioral treatments directly targeting reductions in HIV or sexual risk behaviors ($n=4$; CTN-0017, 0018, 0019, 0032) were excluded.

Summary of trials' methodology and overview of primary trial findings—Table 1 provides an overview of the eight CTN behavioral drug abuse intervention trials' methodologies included in the pooled dataset (CTN-0004, 0005, 0006, 0007, 0009, 0013, 0015, 0021). As shown in Table 1, all of the CTN trials represent a multi-site effectiveness trial with the number of study sites ranging from 4 to 8. Table 1 also provides the primary intervention modality delivered in each trial, highlighting the heterogeneity of treatment approaches employed. The primary intervention approach employed was Motivational Interviewing or Motivation Enhancement Therapy ($n=4$) with additional intervention approaches including Contingency Management ($n=2$) and Cognitive Behavioral Therapy approaches ($n=2$). The intervention trials also varied in the substance(s) targeted by the behavioral intervention and whether the intervention was implemented among patients also receiving medication assisted treatment modalities (e.g., CTN-0007 recruited participants currently using cocaine or methamphetamine from methadone maintenance treatment programs). All the intervention conditions were evaluated relative to a comparison condition that included substance use treatment as usual. Thus, all participants included in the analysis were receiving some form of behavioral substance abuse treatment. None of the trials included intervention content designed to reduce sexual risk behaviors. Table 1 also demonstrates heterogeneity in the follow-up assessments, with between 2 to 4 post-intervention assessments ranging from 0 to 48 weeks post-intervention.

Measures

Demographic characteristics—Participants reported their age, gender (male, female), race (White, Black, Other), and ethnicity (Hispanic, not Hispanic).

Sexual risk behaviors—Two measures were used across trials to assess engagement in sexual risk behaviors: (a) HIV Risk-Taking Behavior Scale (CTN-0004, 0005, 0006, 0007, 0021) and (b) Risk Behavior Survey (CTN-0009, 0013, 0015). The primary sexual risk behaviors of interest were number of vaginal sexual partners and condom use in the past 30 days. Table 2 presents the original questionnaire items and corresponding response options for each of the two assessments employed across trials. Since identical measures for number of vaginal sexual partners and consistent condom use did not exist across trials, variables were first harmonized by transforming the original items to have logically equivalent response scales (see Table 2; Hussong et al., 2013; Shrout, 2009). For the number of vaginal sexual partners in the past 30 days, the HIV Risk-Taking Scale employed discrete response options (e.g., none, one person, two people, etc.), while the Risk Behavior Survey had a free response option. The harmonized number of vaginal sexual partners' variable had response options of: 0 partners, 1 partner, and >1 partner. Next, for frequency of condom use in the past 30 days, response options were harmonized to indicate either consistent condom use (i.e., every time or always used condoms) or inconsistent condom use. Last, a composite variable was created from the two harmonized variables to indicate engagement in either or both of the sexual risk behaviors (i.e., inconsistent condom use and/or >1 vaginal sexual partner in the past 30 days).

Data Analytic Approach

All analyses were conducted in Stata Version 14 (StataCorp, 2015). Analyses were limited to participants who: (a) completed baseline and 1 post-treatment assessment(s); and (b) reported baseline vaginal sexual activity (i.e., 1 vaginal sexual partner in the past 30 days; 67.8% of sample; $N = 1,305$). The low prevalence of anal sexual activity precluded separate analyses examining anal sex behavioral engagement. Trial condition was coded to reflect whether a participant was randomized to the trial's intervention condition (coded as 1) or comparison condition (coded as 0). To harmonize time across trials, the length of each follow-up assessment was coded as the number of weeks post-intervention completion (see Table 1).

Descriptive statistics were calculated to characterize participant demographic characteristics, baseline condom use, and number of sexual partners. Longitudinal logistic regression using Stata's `xtlogit` command estimated the probability of sexual risk behavior engagement (i.e., inconsistent condom use and/or >1 vaginal sexual partner in the past 30 days) through 13-weeks post-intervention with an indicator variable that takes on a value of 1 for post-intervention and 0 otherwise, study condition, and their interaction as predictors. The analysis employed a normally-distributed random effect for each of the 8 study trials to account for common heterogeneity and standard errors were calculated allowing for heteroscedasticity between and serial correlation in errors within participants.¹ The analysis controlled for relevant demographic characteristics (age, gender, race/ethnicity) and baseline condom use and number of vaginal sexual partners. Marginal effects were calculated to

estimate the percentage point (pp) change in sexual risk behavior engagement overall and by condition post-intervention. Time-varying differences in effects based on weeks since intervention were incorporated using interacted linear and quadratic terms with condition status. A Wald Test was used to assess the statistical significance of linear combinations of estimated marginal effects.

Results

Sample Demographic Characteristics

Table 3 displays participants' demographic characteristics by trial and for the full sample of participants across trials. A majority of participants was male (51.3%). Participants identified their race as Black (26.5%), White (35.8%), or other racial background (19.8%); a minority were Hispanic (17.5%). The mean (SD) age of participants was 34.9 years (9.6).

Baseline Sexual Risk Behavior Engagement

Table 4 presents descriptive statistics for baseline sexual risk behavior engagement by trial and across all trials. At baseline, most participants reported inconsistent condom use (79.2%). A majority (85.9%) endorsed having one vaginal sex partner, with 14.1% endorsing two or more partners in the past 30 days. At baseline, 84.2% of the sample reported inconsistent condom use and/or >1 vaginal sexual partners in the past 30 days (i.e., sexual risk behavior engagement). Participants in the intervention condition were slightly less likely (3.2 percentage points; pp) to engage in risky sexual behavior at baseline relative to the comparison condition, although a t-test indicated the unadjusted difference was not statistically different ($p = .11$).

Longitudinal Logistic Regression Estimating the Probability of Risky Sexual Behavior

On average, 67.4% of participants in the intervention condition engaged in risky sexual behavior between week 1 and 13, as compared to 66.7% of those in the comparison condition. Table 5 displays the estimated marginal effects from the longitudinal logistic regression analysis estimating the probability of sexual risk behavior engagement (i.e., inconsistent condom use and/or >1 vaginal sexual partner in the past 30 days) through 13-weeks post-intervention. Those reporting inconsistent condom use at baseline were 37.4 percentage points (pp) more likely to engage in continued risky sexual behavior ($p < .001$) as compared to 11.2pp with more than 1 sexual partner at baseline ($p = .01$). Of demographic control variables, only those identifying as Hispanic had a statistically different likelihood to engage in a risky sexual behavior ($p = 0.01$).² Those in the comparison condition were 18.5pp less likely to engage in a risky sexual behavior post-intervention ($p < .001$) conditional upon included control variables. Those receiving the intervention condition were 2.7pp less likely to engage risky sexual behavior overall ($p = .068$), but 3.9pp more likely post-intervention ($p = .009$). The overall marginal effect for intervention condition

¹This analytic approach is equivalent to estimating a two-way generalized linear mixed model with a constant and independent random effect. Possible serial correlation within participants was accounted for by estimating clustered Huber-White sandwich estimators for each participant independently as suggested by Stock and Watson (2008).

²Female and older participants were only slightly less likely to engage in a risky sexual behavior, although neither difference were statistically relevant.

participants post-intervention is recovered by a linear combination of the three above marginal effects, and was 17.3pp ($p < .001$).

Table 6 presents results allowing the estimated effects to vary by week post-intervention and condition.³ Participants in the comparison condition were 5.6pp less likely to engage in a risky sexual behavior each additional week ($p < .001$), but at a decreasing rate, as indicated by the positive marginal effect on the quadratic term (0.3pp, $p < .001$). Relative to comparison participants, those in the intervention condition were slightly less likely to initially engage in a risky sexual behavior ($p = .115$), but were estimated to not experience as large of decline in such behaviors at each additional week ($p < .001$).

Figure 1 illustrates the predictive margins for the intervention and comparison conditions by week setting the estimated random effect for each study equal to 0. The lowest probability of engaging in risky sexual behavior was estimated to occur at 8 weeks for the comparison condition (58.9%), and 9 weeks for the intervention condition (64.7%). The likelihood of engagement in risky sexual behavior after 13 weeks was almost identical for the comparison and intervention conditions at 67.9% and 68.5%, respectively.

Discussion

Individuals with substance use disorders experience elevated HIV prevalence (Sorensen & Copeland, 2000). Efficacious substance use treatment approaches that reduce drug use may also decrease drug-related behaviors (e.g., use of unclean needles for injecting drugs) associated with HIV transmission and acquisition (CDC, 2015; Mathers et al., 2008). Cross-sectional and longitudinal studies demonstrate associations between drug use and increased engagement in sexual risk behaviors including trading sex for money or drugs (Marshall et al., 2011), multiple or concurrent sexual partners (Khan et al., 2013), and inconsistent condom use (Khan et al., 2013; Leigh et al., 2008). Thus, reduced drug use may also produce secondary HIV risk reduction benefits via decreased sexual risk engagement. This study investigated whether participation in one of eight CTN trials evaluating a diverse set of behaviorally-focused treatments (not directly targeting HIV outcomes) resulted in changes in sexual risk practices.

Among sexually active participants, the majority endorsed either inconsistent condom use and/or multiple recent sexual partners upon entering the trial. Regardless of assigned trial condition, behavioral CTN trial participation was associated with decreased engagement in the sexual risk behaviors of inconsistent condom use and/or reporting more than one sexual partner in the past 30 days. Indeed, across both conditions there was a decrease in sexual risk behaviors at the follow-up assessments, with greater reductions in sexual risk behavior observed in the comparison conditions relative to the intervention conditions. Findings echo previous research demonstrating HIV risk reductions among individuals engaged in substance use treatment (Shoptaw et al., 2005; Sorensen & Copeland, 2000). However, the greater reduction in sexual risk behaviors observed among the comparison condition

³Akaike Information Criterion (1977) indicated a superior fit of the above effects interacted with both a linear and quadratic term of weeks since intervention as compared to a strictly linear effect.

participants (where all were receiving some form of outpatient substance use treatment) highlights the need to better understand which components or forms of drug treatment are most efficacious to reduce HIV risk behaviors.

The use of an integrative data analysis (IDA) approach allowed for analysis of multiple original CTN trial data sets that were pooled into one (Brown et al., 2013; Curran & Hussong, 2009; Hussong et al., 2013). Since identical measures of sexual risk behaviors did not exist across trials, variables were harmonized by transforming the original items to have logically equivalent response scales in order to combine variables for pooled data analyses (Hussong et al., 2013; Shrout, 2009). This approach allowed for an examination of the potential impact of behavioral substance use treatment approaches on sexual risk behaviors. Our pooled dataset provided increased statistical power to assess secondary outcomes not planned in the individual trials (i.e., sexual risk engagement) across trials with differing methodological designs evaluating diverse treatment approaches. This study along with recent investigations employing an IDA approach (e.g., Walsh, Weinhardt, Kalichman, & Carey, 2016), highlight the potential utility of IDA for investigating novel hypotheses not previously considered in the original trials (Hofer & Piccinin, 2009; Hussong et al., 2013; Perrino et al., 2013).

Various pathways may underlie the association between substance use treatment engagement and sexual risk reductions. Associations between drug use and sexual risk may be due to the co-occurrence of these behaviors, as posited by the Theory of Problem Behavior (Donovan & Jessor, 1985). Thus, reduced substance use may also affect sexual behaviors that occur within the context of substance use. Future research to examine the extent to which reduced substance use accounts for decreased sexual risk behavior is warranted. Further, drug use may influence sexual risk taking through disinhibition or by impairing cognitive processing and decision-making in sexual situations (Bryan, Schmiede, & Broaddus, 2009). Additional factors that may underlie both substance use and sexual risk behavior include impulsivity or sensation seeking (Charnigo et al., 2013; Cooper, Agocha, & Sheldon, 2000; Hayaki, Anderson, & Stein, 2006), elevated stress or depression (Mazzaferro et al., 2006), and victimization histories (Silverman, Raj, Mucci, & Hathaway, 2001), among other factors. Substance use treatment, particularly treatment approaches that address co-occurring psychiatric illness and psychosocial adjustment, may also address these mediating factors. Thus, while findings from this study suggest that participation in behavioral substance use treatments may reduce engagement in sexual risk behaviors, future research would benefit from examining specific pathways or mechanisms that may underlie this association.

There is a growing literature examining strategies to integrate HIV prevention approaches within substance use treatment. For example, a meta-analysis examined the effectiveness of HIV risk reduction interventions for individuals in drug abuse treatment programs (Prendergast, Urada, & Podus, 2001). Results indicated improvements in HIV-related knowledge, attitudes and beliefs, reductions in sexual risk behaviors, improved HIV risk reduction skills, and reduced IDU practices; this study further highlights the promise of incorporating HIV risk reduction within drug abuse treatment settings (Prendergast et al., 2001). A subset of CTN trials has tested the effectiveness of behavioral HIV risk reduction interventions among drug using populations (Tross et al., 2011). For example, two trials

(CTN-0017, 0032) examined the effectiveness of HIV testing and brief HIV risk reduction counseling with encouraging results (Metsch et al., 2012). Additional research to investigate best practices to integrate additional HIV prevention approaches within substance use treatment may further bolster sexual risk reduction engagement.

Strengths and Limitations

Strengths of the study include the integration of data from eight multi-site randomized controlled behavioral drug abuse intervention trials utilizing an IDA approach with harmonized variables. We were able to examine potential changes in sexual risk behaviors across a diverse set of trials employing a range of intervention approaches, some of which were utilized in conjunction with medication assisted treatment approaches (e.g., methadone, nicotine replacement patch). Further, participants across trials were seeking outpatient treatment for a variety of substances in community based treatment facilities. Limitations include a reliance on a relative frequency measure of condom use and an exclusive focus on vaginal sex among individuals who were sexually active entering the trial. Further, the final categorization of risky sex required a relatively low level of risk to be included in the category. The limited number of men who have sex with men enrolled across trials precluded an examination of sexual risk engagement in this HIV at-risk population. Additional information regarding other facets that may influence HIV risk including partner characteristics (e.g., HIV serostatus, relationship type, marital status), frequency of sexual activity, and the co-occurrence of substance use and sexual activity was not included in the trials' HIV risk assessments. Given that some trials recruited participants who were also receiving medication assisted treatments (e.g., methadone), we were not able to examine the effect of the behavioral intervention independent from other treatment components. Furthermore, trials employed differing lengths of post-intervention follow-up periods and we limited analyses to participants who completed at least one follow-up assessment. Thus, the sample is biased towards individuals who were retained in the trials.

Conclusions

This study further advances the field by examining the extent to which behavioral drug abuse treatments impact HIV transmission risk across a diverse population engaged in a variety of intervention approaches. Given the heterogeneity of treatment approaches employed across the eight NIDA CTN trials, results point to the effectiveness of behavioral drug abuse treatment to reduce sexual risk behaviors. To bolster further reductions in HIV risk behavior engagement, there is a need to identify HIV risk reduction interventions that can best be integrated within existing resource-limited outpatient substance use treatment programs. Future research to examine mechanisms that may underlie this association are also needed.

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Figure 1.
Predicted Probability of Engaging in Risky Sexual Behaviors by Week and Study Condition

Table 1
Summary of Included CTN Trials' Methodology and Overview of Primary Trial Findings

CTN Trial	Study Citation	N	# of Sites	Sample Characteristics	Trial Conditions (E: Experimental intervention condition; C: Comparison/control condition)	Number (Length) of Intervention Sessions	Assmt. Time Points (Wks)	Overview of Primary Trial Findings
0004	(Ball et al., 2007)	461	5	Current substance and/or alcohol users (use in past 28 days) entering outpatient substance abuse treatment	E: Individual MET to enhance treatment engagement and retention, reduce substance use C: Individual substance use counseling as usual	E: 3 (45–55 min) C: 3 (45–55 min)	BL, 4, 8, 16	-No difference in treatment retention between conditions -No difference in substance use (self-reported; urine drug screen) at 16 weeks between conditions
0005	(Carroll et al., 2006)	423	5	Current substance and/or alcohol users (use in past 28 days) entering outpatient substance abuse treatment	E: Individual intake evaluation integrated with MI to enhance treatment engagement and retention, reduce substance use C: Individual intake evaluation as usual	E: 1 (120 min) C: 1 (120 min)	BL, 4, 12	-Greater retention at 4 weeks in E condition -No difference in treatment retention at 12 weeks between conditions -No difference in substance use (self-reported) at 4 or 12 weeks between conditions
0006	(Petty et al., 2005)	415	8	Current cocaine or methamphetamine users entering outpatient substance abuse treatment	E: Contingency management for drug and alcohol abstinence for 12 weeks + Substance use treatment as usual C: Substance use treatment as usual	N/A	BL, 4, 12, 24	-Greater treatment retention and engagement in E condition -Greater number of drug negative urine samples in E condition -Greater sustained drug abstinence in E condition
0007	(Peirce et al., 2006)	388	6	Current cocaine or methamphetamine users engaged in methadone maintenance for at least 4 weeks	E: Contingency management for drug and alcohol abstinence + Substance use treatment as usual C: Substance use treatment as usual	N/A	BL, 4, 12, 24	-Greater likelihood of drug and alcohol negative samples in E condition -No difference in study retention or treatment engagement between conditions
0009	(Reid et al., 2011)	225	7	Current cigarette smokers (10 cigarettes per day) engaged in methadone maintenance or outpatient substance abuse treatment for at least 30 days	E: Group CBT smoking cessation counseling, transdermal nicotine replacement patch + substance use treatment as usual C: Substance use treatment as usual	E: 9 (NR) C: N/A	BL, 13, 26	-Greater reductions in: cigarettes smoked per day, exhaled carbon dioxide levels, cigarette craving, nicotine withdrawal in E condition -No difference in treatment retention by condition -No difference in use or cravings for primary substance of abuse between conditions
0013	(Winhusen et al., 2008)	200	4	Current substance using pregnant women engaged in outpatient substance use	E: MET for pregnant substance users to enhance	E: 3 (Session 1: 90–120 min;	BL, 4, 12	-No difference in treatment engagement between conditions

CTN Trial	Study Citation	N	# of Sites	Sample Characteristics	Trial Conditions (E: Experimental intervention condition; C: Comparison/control condition)	Number (Length) of Intervention Sessions	Assmt. Time Points (Wks)	Overview of Primary Trial Findings
					treatment engagement and reduce substance use C: Substance use treatment as usual	Sessions 2–3: 60 min C: 3 (Session 1: 90–120 min; Sessions 2–3: 60 min)		-No difference in substance use (self-reported, urine drug screen) between conditions
0015	(Hien et al., 2010)	353	7	Women engaged in outpatient substance abuse treatment with PTSD diagnosis and substance use in past 6 months	E: Group-delivered Seeking Safety—CBT for substance use disorders and PTSD to reduce PTSD symptoms and substance use + substance use treatment as usual C: Group-delivered, manualized health educational information sessions + substance use treatment as usual	E: 12 (75–90 min) C: 12 (75–90 min)	BL, 0, 12, 24, 48	-No difference in PTSD related symptoms between conditions -No difference in substance use (self-reported) between conditions
0021	(Carroll et al., 2009)	405	5	Spanish-speaking, current substance users (use in past 28 days) entering outpatient substance abuse treatment	E: Individual MET to enhance treatment engagement and retention, reduce substance use C: Individual substance use counseling as usual	E: 3 (45–55 min) C: 3 (45–55 min)	BL, 0, 4, 12	-No difference in treatment retention between conditions -No difference in substance use (self-reported; urine drug screen) at 4 or 12 weeks between conditions

Notes: E: Experimental intervention condition; C: Comparison/control condition; Assmt.: Assessment; Wks: Weeks post-intervention completion; MET: Motivational enhancement therapy; min: Minutes; MI: Motivational Interviewing; BL: Baseline, pre-intervention assessment; N/A: Not applicable; NR: Not Reported; CBT: Cognitive Behavioral Therapy; PTSD: Post-traumatic stress disorder.

Table 2

Harmonization of Sexual Risk Behavior Variables Across Trials

Number of Vaginal Sexual Partners (Past 30 days)			
CTN Trial	Questionnaire Item	Response Options	Harmonized Response Options
0004 0005 0006 0007 0021	How many people, including regular partners, casual acquaintances and clients have you had sex with in the last 30 days?	-None -One person -Two people -3–5 people -6–10 people -More than 10 people	-0 partners -1 partner -2 or more partners
0009 0013 0015	How many (women/men) did you have vaginal sex with? [past 30 days]	Free Response	
Condom Use for Vaginal Sex (Past 30 days)			
CTN Trial	Questionnaire Item	Response Options	Harmonized Response Options
0004 0005 0006 0007 0021	How often, in the last 30 days, have you used condoms when you have sex with your (regular, casual) partner(s)?	-No partner/no penetrative sex -Every time -Often -Sometimes -Rarely -Never	-Consistent condom use (Every time or Always) -Inconsistent condom use (Often, Sometimes, Rarely, Never & Never, Less than ½ the time, About ½ the time, More than ½ the time)
0009 0013 0015	How often did you use a condom? [past 30 days]	-Never -Less than ½ the time -About ½ the time -More than ½ the time -Always -Don't know/unsure * -Refused *	

Note.

* Across the included trials no participants endorsed response options of 'don't know/unsure' or 'refused.' As such, these response options were not included in the final variable harmonization approach.

Table 3

Demographic Characteristics by Trial and Across Trials for Participants Endorsing Recent

Study (Sample size)	Female	Race/Ethnicity				Age: (SD)
		Black	White	Hispanic	Other	
CTN-0004 (N=146)	52(35.6%)	64(43.8%)	54(36.9%)	18(12.3%)	9(6.2%)	36.6(8.9)
CTN-0005 (N=231)	93(40.3%)	21(9.1%)	161(69.7%)	7(3.0%)	42(18.2%)	32.2(9.6)
CTN-0006 (N=155)	76(49.0%)	61(39.4%)	57(36.8%)	28(18.1%)	9(5.8%)	35.2(8.9)
CTN-0007 (N=178)	81(45.5%)	92(51.7%)	39(21.9%)	35(19.7%)	10(5.6%)	40.6(8.4) ^a
CTN-0009 (N=93)	44(44.1%)	16(17.2%)	37(39.8%)	30(32.3%)	10(10.8%)	40.4(9.1)
CTN-0013 (N=120)	120(100.0%)	35(29.2%)	48(40.0%)	18(15.0%)	19(15.8%)	26.1(5.5)
CTN-0015 (N=151)	151(100%)	57(37.8%)	72(47.7%)	0(0%)	22(14.6%)	38.9(8.5)
CTN-0021 (N=231)	22(9.5%)	0(0%)	0(0%)	93(40.3%)	138(59.7%)	31.7(8.3)
Total (N=1305)	636(48.7%)	346(26.5%)	468(35.8%)	229(17.5%)	259(19.8%)	34.9(9.6) ^b

Vaginal Sexual Activity at Baseline (N=1,305).

Note. Unless otherwise stated, values represent frequency and corresponding percent.^a N=176 reporting;^b N=1303 reporting

Table 4

Baseline Sexual Risk Behaviors in the Past 30 Days by Trial and Across All Trials (N=1,305)

Study (Sample size)	Inconsistent Condom Use	>1 Vaginal Sexual Partner	Inconsistent Condom Use and/or >1 Vaginal Sexual Partner
CTN-0004 (N=146)	102(69.9%)	38(26.0%)	119(81.5%)
CTN-0005 (N=231)	193(83.6%)	28(12.1%)	200(86.6%)
CTN-0006 (N=155)	118(76.1%)	32(20.7%)	128(82.6%)
CTN-0007 (N=178)	123(69.1%)	25(14.0%)	139(78.1%)
CTN-0009 (N=93)	75(80.7%)	7(7.5%)	77(82.8%)
CTN-0013 (N=120)	108(90.0%)	6(5.0%)	108(90.0%)
CTN-0015 (N=151)	128(84.8%)	29(19.2%)	134(88.7%)
CTN-0021 (N=231)	186(80.5%)	18(7.8%)	194(83.9%)
Total (N=1305)	1033(79.2%)	183(14.0%)	1099(84.2%)

Table 5
Marginal Effects Estimating the Probability of Sexual Risk Engagement across the Post-Intervention Period

	Marginal Effect	SE	z	p	95% CI
Post-intervention	-.19	.03	-5.84	<.001	-.25, -.12
Study condition	-.03	.01	-1.83	.068	-.06, .002
Post-intervention by Study condition interaction	.04	.01	2.61	.009	.009, .07
Baseline inconsistent condom use	.37	.02	20.38	<.001	.34, .41
Baseline >1 vaginal sexual partner	.11	.04	2.58	.01	.03, .19
Age	0	.001	-.25	.81	-.002, .002
Female	-.009	.02	-.41	.68	-.05, .04
Black	-.02	.02	-1.29	.19	-.06, .01
Hispanic	-.06	.02	-2.57	.01	-.11, -.01
Other race	-.02	.02	-.75	.45	-.06, .03

Notes: Post-intervention takes on a value of 1 for post-intervention and 0 otherwise; control/comparison condition coded as 0, intervention condition coded as 1.

Marginal Effects Estimating the Probability of Sexual Risk Engagement with a Quadratic Time Function

Table 6

	Marginal Effect	SE	z	p	95% CI
Weeks post-intervention	-.06	.01	-5.19	<.001	-.08, -.03
Weeks post-intervention squared	.003	.001	4.65	<.001	.001, .004
Study condition	-.03	.02	-1.58	.12	-.06, .006
Weeks post-intervention by study condition	.02	.01	3.52	<.001	.01, .03
Weeks post-intervention squared by study condition	-.001	0	-3.83	<.001	-.002, 0
Baseline inconsistent condom use	.37	.02	23.45	<.001	.34, .40
Baseline >1 vaginal sexual partner	.11	.04	2.54	.01	.03, .19
Age	0	0	-.33	.74	-.002, .002
Female	-.01	.02	-.48	.64	-.06, .04
Black	-.02	.02	-1.2	.23	-.05, .01
Hispanic	-.06	.02	-2.71	.007	-.11, -.02
Other race	-.02	.02	-.85	.39	-.06, .03