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Treating Cannabis Use Disorder: Exploring a Treatment As Needed Model with 34-Month Follow-Up

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Abstract

Research has demonstrated that motivational enhancement (MET) and cognitive behavioral therapy (CBT) are some of the most effective interventions for adults with cannabis use disorder (CUD). As few as two sessions of combined MET and CBT has produced abstinence and reductions in cannabis use greater than delayed treatment controls. Despite their efficacy, outcomes in previous studies yielded abstinence rates from cannabis in the range of 20–30% at follow-ups of 6 to 12 months, and CUD remained a chronic condition for many. Additional models of providing treatment “as needed” (PRN), rather than as a single fixed-dose, are necessary to meet the different needs of adults with CUD and reengage those who do not respond to treatment initially or who relapse later. In the current study, 87 adults who met DSM-IV criteria for cannabis dependence were randomly assigned to receive either a fixed-dose of nine sessions of MET/CBT or to a PRN condition that provided a smaller initial dose of treatment, but allowed repeated access to treatment for 28 months. Cannabis use and associated problems were assessed every six months throughout a 34-month period. More than one-third of participants in the PRN condition accessed additional treatment episodes, but the total number of treatment sessions that participants utilized was comparable across conditions. Both treatments yielded significant reductions in cannabis use and associated problems at each follow-up. Contrary to hypotheses, the PRN condition did not yield better outcomes at the longer-term follow-ups. The fixed-dose condition produced greater rates of abstinence at the first follow-up, but otherwise there were no between group differences in outcomes. Future studies should test active approaches to reengaging participants with treatment when initial outcomes are less than optimal.

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Keywords

Cannabis Use Disorder; Marijuana treatment; Continuing care; Long-term follow-up

1. Introduction

Epidemiological studies indicate that about 3% of the U.S. population in the past year experienced cannabis use disorders (CUD), and about 30% of cannabis users developed a CUD in their lifetime (Hasin et al., 2015). The same studies indicate that the prevalence of CUD is increasing, likely because of an increase in the number of users. Heavy long-term cannabis use in adults has been linked to impairment in cognitive functioning, motivation, health, employment, and psychiatric functioning (Hall, 2015). Samples of adults seeking treatment for cannabis dependence have reported a similar profile of cannabis-related consequences (Budney, Radonovich, Higgins, & Wong, 1998; Stephens, Babor, Kadden, & Miller, & the MTPRG, 2002; Stephens, Roffman, & Simpson, 1994). Given the increasing prevalence of CUD and the adverse consequences associated with heavy long-term cannabis use, there is a clear need for efficacious treatments designed to reduce cannabis use.

Motivational enhancement therapy (MET) and cognitive behavioral therapy (CBT) have consistently demonstrated efficacy in randomized controlled trials (RCTs) with cannabis dependent adults (e.g., Budney, Higgins, Radonovich, & Novy, 2000; Copeland, Swift, Roffman & Stephens, 2001; Marijuana Treatment Project Group (MTPRG), 2004; Stephens, Roffman & Curtin, 2000), and reviews of the literature consider these psychosocial interventions to have the most empirical support (Chatters et al., 2016; Gates, Sabioni, Copeland, Le Foll, & Gowing, 2016). However, absolute treatment outcomes have been modest with only about 20–30% of those treated remaining abstinent or showing significant improvement at longer-term follow-ups. These findings suggest that a continuing care model may be useful to sustain initial treatment gains and reengage individuals who have relapsed in the treatment process (e.g., Dennis, Scott, & Funk, 2003).

Previous RCTs showed that as few as two treatment sessions could produce abstinence rates and reductions in cannabis use equivalent to much longer treatments (Stephens et al., 2000), indicating that a subset of treatment seekers can benefit from very brief treatments. However, other studies have shown an advantage to somewhat longer interventions with more sessions (Copeland et al., 2001; MTPRG, 2004). Typical RCTs test fixed doses of treatment (e.g., 2, 6, or 9 sessions) to standardize the treatment experience within a treatment condition and increase the internal validity of comparisons with other treatment conditions. However, these designs assume that all participants need the same amount and timing of treatment. Previous findings show that some individuals are successful in reducing use after only a few sessions of treatment and that others are unsuccessful after much longer treatments. Further, relapse rates following an initial dose of treatment suggest that some participants would benefit from later and possibly repeated episodes of brief treatment to re-establish motivation for change and acquire new strategies for making changes in their use. Fixed-dose treatments likely over-treat a subset of participants who could do well with a

brief intervention and under-treat another subset who need more intense or longer term intervention, resulting in less overall cost-efficient delivery of treatment.

The current study explored and tested a continuing care treatment model that allowed participants diagnosed with cannabis dependence to select additional episodes of treatment on an “as needed” or *pro re nata* (PRN) basis following an initial base set of four sessions. A fixed-dose intervention of nine MET/CBT treatment sessions, shown to be more efficacious than a brief intervention in the largest RCT to date (MTPRG, 2004) served as the comparison condition. A major goal of our study was to ascertain the proportion of PRN participants who would reengage with treatment and at what time points and intensities. Thus, we followed participants over 34 months. We expected that participants in the PRN condition would do as well at early follow-ups as those in the fixed-dose condition, and would do better at later follow-ups as they reengaged with treatment as needed.

2. Method

2.1 Participants

We recruited participants from the greater Seattle, WA, area with print and radio ads describing a study of treatments for cannabis users interested in quitting or reducing use. At the time of the study, cannabis use was illegal. We screened two hundred and four cannabis using adults to arrive at a final randomized sample of 87. Eligible participants were 18 years of age or older and met DSM-IV diagnostic criteria for cannabis dependence. Of those screened, 70 were ineligible for participation because they met dependence criteria for alcohol or other drug use ($n = 26$), were currently involved in other treatment ($n = 27$), had used cannabis on fewer than 50 of the past 90 days ($n = 21$), or failed to meet one of several inclusion criteria ($n = 15$; i.e., no evidence of psychosis/suicidality, fluent in English, available locally for the duration of the study). Another 47 of the screened participants were eligible but decided not to enroll in the study. Mean age of the randomized sample was 35.6 ($SD = 8.7$). The majority of participants were male (75%) and white (88%). They averaged 14.2 years of education and 49% were either married or living with a partner. At baseline they had used cannabis on 84% of the past 90 days, typically using 3.9 ($SD = 2.4$) times per day.

2.2 Design

Following screening and a baseline assessment, we randomly assigned participants to either the fixed-dose or the PRN treatment condition after blocking on sex and three stage of change categories (Precontemplation/Contemplation vs Preparation vs Action/Maintenance). We assessed stage of change during screening using a five category algorithm (Prochaska & DiClemente, 1983): Precontemplation—no plan to change; Contemplation—thinking about stopping or reducing but not in the next 30 days; Preparation—planning to stop or reduce in the next 30 days; Action—stopped or reduced within the last 6 months; Maintenance—stopped or reduced more than 6 months ago and have not returned to previous levels of use. We conducted follow-up assessments 4, 10, 16, 22, 28, and 34 months after baseline. Participants received \$50 for completing each follow-up assessment. The institutional review boards at the University of Washington and Virginia Tech approved the procedures.

2.3 Assessment and measures

Trained interviewers administered the Psychoactive Substance Use Disorders section of the Structured Clinical Interview for DSM-IV (SCID 2.; First, Spitzer, Gibbon, & Williams, 1995) at baseline to determine eligibility. We derived assessment of the percentage of days on which cannabis use occurred and abstinence from any use from an interviewer-administered timeline follow-back (TLFB) at each assessment (Sobell & Sobell, 1992). On days of any use, participants indicated the quarterly periods of the day during which use occurred (i.e., 6am to 12noon; 12noon to 6pm; 6pm to 12 midnight; 12 midnight to 6am), which we counted to provide a 1–4 index of the extent or duration of cannabis use each day. We assessed cannabis-related problems at each time point with the Marijuana Problems Scale (MPS; Stephens et al., 2000), a 19-item list of negative consequences associated with cannabis use. For each item, participants indicated if they had experienced the problem in the past 90 days on a 0–2 scale (0 = no problem, 1 = minor problem, 2 = major problem). We computed a weighted-total cannabis problems score by summing scores on the individual items (alphas = .88–.93). We administered additional self-report questionnaires at each assessment to measure psychosocial constructs and consequences related to cannabis use, but they are not the focus of the current paper.

We collected unobserved urine specimens from participants at each follow-up and assayed for cannabinoids (i.e., enzyme immunoassay tests followed by gas chromatography-mass spectrometry quantification). Across follow-ups there was 91% agreement between urine results and participants' reports of abstinence for the past 30 days (range = 86–98%).

2.4 Intervention conditions

We trained three therapists (2 male and 1 female) with extensive treatment experience in MET and CBT techniques using manuals and training principles from prior studies with cannabis dependent adults (see Steinberg et al., 2002; Steinberg et al., 2005). Therapists participated in weekly supervision with tape review of sessions and discussion to maintain treatment fidelity. The same therapists delivered both treatment conditions.

2.4.1 Fixed-dose condition.—The 9-session MET/CBT intervention found to be more efficacious than either a 2-session MET intervention or a Delayed Treatment Control Group in a multi-site RCT (MTPRG, 2004) served as the fixed-dose comparison condition. Participants in this condition met individually with a therapist on nine occasions over 12 weeks. We scheduled the first 8 sessions weekly and the 9th session was scheduled one-month after the 8th session (i.e., approximately week 12). In the first two sessions, the therapist reviewed a personalized feedback report with the participant and used motivational interviewing techniques (Miller & Rollnick, 2002) to build motivation and solidify commitment to change. Subsequent sessions drew on a menu of 5 core (i.e., identifying antecedents to use, coping with urges to use, managing thoughts about using, problem solving, and refusal skills) and 5 elective (i.e., coping with lapses, avoiding relapse situations, managing negative mood states, assertiveness training, and anger management) CBT skills-training modules. Therapists collaborated with participants in choosing the elective modules based on perceived need. Therapists recommended an abstinence goal but did not require one. Case management activities occurred throughout the nine sessions

starting with the identification of any social, economic, or physical barriers to change in cannabis use and then identifying resources, developing plans, and monitoring progress in addressing the barriers.

2.4.2 PRN condition.—We structured the PRN condition to allow participants to begin with a smaller, but likely effective, dose of treatment and then self-select additional treatment as needed. All participants in this condition began with 4 individual therapy sessions scheduled weekly that were similar to the fixed-dose condition sessions in content and process. The first two PRN sessions used the same MET processes to build motivation. The next two sessions included content selected from 2 of the 5 core CBT modules in the Fixed-dose condition. Therapists chose specific CBT modules collaboratively to meet the perceived needs of the participant. Case management occurred based on participant needs. Therapists gave participants in this condition the expectation that the 4 sessions would be sufficient to engender successful outcomes for many people, but that they could return for additional brief episodes of therapy as needed throughout the first 28 months of the follow-up period. Ending the availability of additional treatment at 28 months allowed for an assessment of durability of change during the six months between the 28-month and the final 34-month follow-up.

We scheduled additional episodes of treatment for participants in the PRN condition with the same therapist, and they were limited to 1–3 individual sessions in any one-month period. Therapist and participant decided collaboratively about the number of sessions during an episode. Additional episodes of treatment could not begin until at least one month following the initial four base sessions. Participants could initiate the next episode anytime within these constraints by contacting the research office, which facilitated scheduling of the next sessions with therapists. Therapists determined the content and process of PRN episode sessions based on the participant's goals and readiness for change. The therapist used motivational enhancement strategies when the participant's motivation for change had waned, whereas CBT and case management techniques were appropriate for targeting specific obstacles to change encountered since the last treatment session. Once a PRN episode was completed, the participant could not initiate another PRN episode for four more weeks. We designed the rules governing the limited number of sessions per episode (1–3) and the mandatory four-week break between episodes to keep treatment focused on cannabis use issues and avoid treatment turning into continuous, long-term therapy. A total of 15 additional treatment episodes, consisting of as many as 45 additional treatment sessions, over 28 months were possible.

3. Results

3.1 Data analyses

Checks on the success of random assignment revealed that those assigned to the fixed-dose condition were significantly older (37.50 vs 33.70) but had completed fewer years of education (13.70 vs 14.63) than those in the PRN condition ($p < .05$). We found no differences on any other sociodemographic variables or on any indicators of cannabis, alcohol, or drug use or related adverse consequences at baseline. Overall, follow-up rates

were very good at the 4-, 10-, 16-, 22-, 28-, and 34-month follow-ups (94%, 90%, 88%, 87%, 86%, and 80%, respectively). However, there was some evidence of differential attrition by condition at the 10-month (81% vs 97%), 16-month (81% vs 95%), 22-month (81% vs 93%), 28-month (79% vs 93%), and 34-month (70% vs. 91%) follow-ups, with a smaller proportion of participants in the PRN condition completing these assessments (p s < .1). Analyses examining the baseline sociodemographic and cannabis use characteristics of those present versus absent at each follow-up found few significant effects indicative of nonrandom attrition. There were small differences in age and years of education at early follow-ups that affected both treatment conditions similarly, but there were no significant differences in the baseline cannabis use characteristics of those attending versus not attending follow-ups either overall or by condition.

We tested the effects of the interventions with 2 (Condition) $\times$ 7 (Time) General Linear Model (GLM) analyses covarying for mean-centered age and mean-centered years of education. The original plan was to include both sex and stage of change as factors in the outcome analyses, but small cell sizes precluded meaningful analyses. There were only 11 women per condition and most participants (78%) classified themselves in the preparation stage of change at baseline, with only 6 participants in the precontemplation/contemplation and 11 in the action/maintenance strata. We replaced missing follow-up data using an expected-maximization algorithm conditional on observed values for treatment condition, cannabis use, dependence symptoms, and problem totals from all available assessment points (Schafer & Graham, 2002). We considered the primary outcome measure the percentage of days of cannabis use in the assessment period. Secondary analyses focused on periods of use per day and self-reported cannabis problems. We analyzed complete abstinence for the 30 days prior to each assessment as an additional outcome of interest and for comparison with previous treatment studies.

3.2 Treatment attendance

Table 1 shows initial treatment attendance by condition. Participants in the fixed-dose condition attended an average of 7.84 treatment sessions with 66% completing all 9 sessions. In the PRN condition, 77% completed the 4 base treatment sessions, with an average of 3.58 sessions attended. Sixteen PRN participants (37%) returned for more episodes of treatment ($M = 4.38$; $SD = 3.42$; range 1–13). These participants utilized an additional 8.50 ($SD = 8.63$; range 1–30) sessions on average. Six of the 16 participants used a single additional episode, five participants used 2 to 5 episodes, and 5 participants used 6 to 13 episodes. Across base treatment and episode use, the average number of sessions attended by PRN condition participants was 6.74. Table 2 shows the time periods when participants used additional episodes of treatment. Participants used more than half of the additional treatment episodes during the first ten months and only two participants initiated their first use of an episode after the 10-month follow-up.

3.3 Outcomes

A 2 (Condition) $\times$ 7 (Time) general linear model (GLM) analysis performed on the percentage of days of cannabis use at each assessment showed a significant effect of Time ($F(6, 498) = 34.76, p < .001$). Pairwise comparisons showed that cannabis use at each follow-

up was significantly reduced relative to baseline levels (all p s $< .001$; Table 3). The effects of Condition ($F(1, 83) = 0.42, p > .05$) and Condition $\times$ Time ($F(6, 498) = 1.03, p > .05$) were not significant. Between group effect sizes (d) at each follow-up assessment ranged from .31 at the 4-month assessment to 0.02 at the 28-month follow-up, with mean differences showing less cannabis use in the fixed-dose condition at earlier follow-ups (see Table 3).

The analysis performed on the daily periods of use and the cannabis problems measures showed the same patterns. The main effect of Time was significant for both quarters of use per day ($F(6, 498) = 13.39, p < .001$) and cannabis problems ($F(6, 498) = 31.15, p < .001$), but there were no significant effects of Condition or Condition $\times$ Time interactions (p s $> .05$). Periods of use per day and self-reported problems at each follow-up assessment were significantly reduced relative to baseline (all p s $< .05$; see Table 3). For periods of use per day, between groups effect sizes were smaller than for percentage days of use but still favored the fixed-dose condition at early follow-ups. Effect sizes for problem scores were closer to zero and did not show a consistent pattern favoring one condition over the other (Table 3).

The percentage of participants reporting complete abstinence from cannabis use for the 30 days prior to each follow-up assessment is shown in Table 4. At the 4-month follow-up a significantly higher percentage of participants in the fixed-dose condition reported abstinence (37%) compared to the PRN condition (15%), $X^2 = 4.96, p < .05$. There were no significant differences in abstinence rates between conditions at any other follow-up assessment, all p s $> .05$.

3.4 Additional treatment utilization outcomes and predictors

Exploratory analyses examining percentage days of cannabis use for PRN episode users versus nonusers did not find any significant differences across assessments. PRN episode users, PRN episode nonusers, and the fixed-dose condition also did not differ significantly in percentage days of cannabis use at any assessment (see Figure 1). Additional analyses attempted to identify characteristics of participants who used additional episodes of treatment in the PRN condition. PRN episode users did not differ from nonusers on baseline sociodemographic or cannabis use variables nor did they differ in the percentage of days using cannabis in the first month following the completion of the initial four base treatment sessions in the PRN condition.

4. Discussion

This is one of the first studies to evaluate a variable dose treatment for CUD in which participants could engage with treatment repeatedly over an extended period. Comparison with a nine-session, fixed-dose treatment condition previously shown to be efficacious provided a context in which to evaluate efficacy. Both treatment approaches were associated with significant reductions in cannabis use and associated problems over 34 months. Contrary to expectations, the PRN treatment approach did not result in superior cannabis use outcomes at later follow-ups, despite the availability of treatment for 28 months. Abstinence rates at the first follow-up were significantly higher in the nine-session, fixed dose condition. Similarly, although nonsignificant, effect sizes for between group differences in the

percentage of days of cannabis use and daily periods of use favored the fixed-dose treatment until the later follow-ups. In the long term, outcomes for the two different treatment approaches appeared comparable.

The failure of PRN participants to benefit from the availability of ongoing treatment is inconsistent with the premise that those in need of additional help with their cannabis use would seek additional treatment. The lack of differential outcomes may be, in part, the result of low utilization of PRN treatment episodes. Only slightly more than a third of PRN participants made use of additional treatment and only 10 (23%) utilized more than a single episode of additional sessions. Abstinence rates at the earliest follow-up were only 15% in the PRN condition, suggesting ample room for additional help reducing cannabis use. On the other hand, days and daily periods of cannabis use and associated problems were substantially reduced in the PRN group at the first follow-up. In the case of self-reported problems, reductions were roughly similar to the reductions seen in the longer fixed-dose condition. These improvements may have undermined motivation to pursue additional treatment sessions in the PRN condition.

Attempts to identify differences in those who used and did not use additional treatment failed to find predictors. Small sample sizes in these subgroups provided low power to detect differences. Further, the timing of reengagements with treatment naturally varied and made assessing cannabis use, problems, and motivations just prior to additional treatment episodes impossible. Future studies employing real-time assessment methods may be better suited to identifying the circumstances that promote treatment reengagement. In the current study, research staff reminded PRN participants of the availability of additional treatment sessions at each follow-up, but there was no ongoing contact with therapists unless the participants initiated it. Dennis and colleagues (Dennis et al., 2003; Scott & Dennis, 2009) have used recovery management checkups to motivate chronic substance abusers to reengage with treatment based on follow-up assessments. Those studies were successful in increasing treatment reengagement and long-term substance use outcomes. However, a study of adults with CUD, similar to those in the current trial, did not find an effect of maintenance check-ups in promoting additional treatment or better subsequent outcomes (Walker, Stephens, Towe, Banes, & Roffman, 2015). The short follow-up period in that study may not have allowed sufficient time for the maintenance check-ups to have an effect. It is also possible that adult cannabis users do not readily see the need for additional treatment following a substantial reduction in use and lessening of negative consequences.

Treatment design decisions regarding the duration and frequency of additional episodes of treatment in the PRN condition may have interfered with treatment reengagement and its overall effectiveness. The required gap between episodes of treatment and the restriction of episodes of treatment to no more than three meetings in a one-month period may have interrupted therapeutic relationships and processes. We limited treatment access in an attempt to bridge the gap between the tightly controlled provision of therapy in most efficacy studies and the less constrained implementation of therapies in real world effectiveness studies. We intended the gaps in treatment to allow participants time to try out new skills and strategies and then return with specific issues if they needed more help. We limited the number of sessions per episode to keep episodes of treatment focused specifically on either

motivational issues or cognitive-behavioral barriers to cannabis use reductions. Many adults with CUDs have comorbid conditions that are intertwined with daily cannabis use (e.g., Kerridge, Pickering, Chou, Saha, & Hasin, 2018). Our limiting the number of sessions per episode was intended to help therapists direct the process and content to specific cannabis use situations, associated cognitions, and needed behavior changes rather than trying to deal with broader therapeutic issues that may have dominated if treatment were allowed to be ongoing continuously. Future studies may test other models for delivering continuing care but will need to find ways to maintain treatment fidelity in the context of variable dose treatments.

This is the first RCT with cannabis dependent adults to assess outcomes more than 12 months after treatment. Abstinence rates and reductions in frequency of use were comparable to those in previous RCTs with shorter follow-up periods (e.g., Copeland et al., 2001; MTPRG, 2004), and participants maintained these changes for almost three years. Although long-term outcomes for both treatment conditions in the current study were essentially identical at 28 and 34 months, there appeared to be some advantage to the longer initial dose of treatment. The nine-session, fixed-dose group reported greater abstinence and lower rates of use at early follow-ups. Differences in frequency and daily duration of use were not statistically significant; but small effect sizes consistently favored the fixed-dose condition, suggesting that a study with greater power may have detected significant differences through the first 22 months of follow-up. If so, the findings may argue for recommending longer initial treatment episodes in future studies providing continuing care. We should note that the average number of treatment sessions that participants attended was similar in both conditions once we considered additional PRN sessions. Thus, there was no obvious savings in the cost of delivering treatment on a PRN basis in the current trial.

Limitations of the study include the predominantly white and male sample, which likely limits generalizability of the findings. The study was not adequately powered to detect small effect sizes and relied on self-reported cannabis use as the primary outcome. Concerns about the validity of self-reports were somewhat mitigated by comparisons with urine specimens that showed high agreement. There was some evidence of differential attrition in the proportion of participants available at follow-up by treatment condition. However, the baseline characteristics of those present or absent in each condition at each follow-up did not differ significantly. Despite these limitations, therapists delivered treatments with good fidelity, overall follow-up rates for participants were excellent, and participant outcomes were similar to those in previous RCTs with this population.

In conclusion, the study adds to the literature on the efficacy of a combined MET and CBT approach to the treatment of CUD in adults. Further, it extends the literature on the efficacy of these treatments to a much longer follow-up period than previously assessed. Participants' abstinence rates were modest, as in previous trials, but they maintained substantial reductions in cannabis use and associated problems for almost three years. However, our attempt to bolster long-term outcomes with ongoing availability of treatment was unsuccessful in producing better long-term outcomes. Future studies should focus on continuing care treatment models that actively encourage participants to reengage in treatment when initial outcomes are less than optimal.

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References

- Budney AJ, Higgins ST, Radonovich KJ, & Novy PL (2000). Adding voucher-based incentives to coping skills and motivational enhancement improves outcomes during treatment for marijuana dependence. *Journal of Consulting and Clinical Psychology*, 68(6), 1051–1061. doi:10.1037/0022-006x.68.6.1051 [PubMed: 11142539]
- Budney AJ, Radonovich KJ, Higgins ST, & Wong CJ (1998). Adults seeking treatment for marijuana dependence: A comparison with cocaine-dependent treatment seekers. *Experimental and Clinical Psychopharmacology*, 6(4), 419–426. doi:10.1037//1064-1297.6.4.419 [PubMed: 9861556]
- Chatters R, Cooper K, Day E, Knight M, Lagundoye O, Wong R et al. (2016). Psychological and psychosocial interventions for cannabis cessation in adults: A systematic review. *Addiction Research & Theory*, 24, 93–110. doi:10.3109/16066359.2015.1073719
- Copeland J, Swift W, Roffman R, & Stephens R. (2001). A randomized controlled trial of brief cognitive-behavioral interventions for cannabis use disorder. *Journal of Substance Abuse Treatment*, 21, 55–64. doi:10.1016/S0740-5472(01)00179-9 [PubMed: 11551733]
- Dennis M, Scott CK, & Funk R. (2003). An experimental evaluation of recovery management checkups (RMC) for people with chronic substance use disorders. *Evaluation and Program Planning*, 26(3), 339–352. doi:10.1016/S0149-7189(03)00037-5 [PubMed: 30034059]
- First MB, Spitzer RL, Gibbon M, & Williams JB (1996). *Structured Clinical Interview for DSM-IV Axis I Disorders, Clinician Version (SCID-CV)*. Washington, DC: American Psychiatric Press Inc.
- Gates PJ, Sabioni P, Copeland J, Le Foll B, & Gowing L. (2016). Psychosocial interventions for cannabis use disorder. *Cochrane Database of Systematic Reviews*, 5, doi: 10.1002/14651858.CD005336.pub4.
- Hall W. (2015). What has research over the past two decades revealed about the adverse health effects of recreational cannabis use? *Addiction*, 110, 19–35. doi:10.1111/add.12703
- Hasin DS, Tulshi DS, Kerridge BT, Goldstein RB, Chou SP, Zhang H et al. (2015). Prevalence of marijuana use disorders in the United States between 2001–2002 and 2012–2013. *JAMA Psychiatry*, 72, 1235–1242. doi:10.1001 [PubMed: 26502112]
- Kerridge BT, Pickering R, Chou P, Saha TD, & Hasin DS (2018). DSM-5 cannabis use disorder in the National Epidemiologic Survey on Alcohol and Related Conditions-III: Gender-specific profiles. *Addictive Behaviors*, 76, 52–60. [PubMed: 28755613]
- Marijuana Treatment Project Research Group (MTPRG; 2004). Brief treatments for cannabis dependence: Findings from a randomized multisite trial. *Journal of Consulting and Clinical Psychology*, 72(3), 455–466. doi:10.1037/0022-006X.72.3.455 [PubMed: 15279529]
- Miller WR & Rollnick S. (2002). *Motivational interviewing: Preparing people for change* (2nd ed.). New York: Guilford Press.
- Prochaska JO & DiClemente CC (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology*, 51, 390–395. [PubMed: 6863699]
- Schafer JL & Graham JW (2002). Missing data: Our view of the state of the art. *Psychological Methods*, 7, 147–177. [PubMed: 12090408]
- Scott CK & Dennis ML (2009). Results from two randomized clinical trials evaluating the impact of quarterly recovery management checkups with adult chronic substance users. *Addiction*, 104, 959–971. [PubMed: 19344441]
- Sobell LC, & Sobell MB (1992). Timeline followback: A technique for assessing self-reported ethanol consumption In Allen J & Litten R. z. (Eds.), *Measuring Alcohol Consumption: Psychosocial and Biological Methods* (pp. 41–72). Totowa, NJ: Humana Press.
- Steinberg KL, Roffman RA, Carroll KM, Kabela E, Kadden R, Miller M, et al. (2002). Tailoring cannabis dependence treatment for a diverse population. *Addiction*, 97, 135–142. [PubMed: 12460135]

- Steinberg KL, Babor TF, Miller M, Kadden R, Duresky D, & Stephens R. (2005). Brief counseling for marijuana dependence: A manual for treating adults Rockville, MD: Center for Substance Abuse Treatment, Substance Abuse and Mental Health Services Administration.
- Stephens RS, Babor TF, Kadden RA, Miller M & The Marijuana Treatment Project Research Group (MTPRG; 2002). The marijuana treatment project: Rationale, design, and participant characteristics. *Addiction*, 97, 109–124. [PubMed: 12460133]
- Stephens RS, Roffman RA, & Curtin L. (2000). Comparison of extended versus brief treatments for marijuana use. *Journal of Consulting and Clinical Psychology*, 68(5), 898–908. doi:10.1037/0022-006x.68.5.898 [PubMed: 11068976]
- Stephens RS, & Roffman RA, & Simpson EE (1993). Adult marijuana users seeking treatment. *Journal of Consulting and Clinical Psychology*, 61, 1100–1104. [PubMed: 8113490]
- Walker DD, Stephens RS, Towe S, Banes K, & Roffman R. (2015). Maintenance check-ups following treatment for cannabis dependence. *Journal of Substance Abuse Treatment*, 56, 11–15. [PubMed: 25922136]

Highlights

- MET/CBT treatments efficacious in reducing cannabis use and associated problems
- Reductions in cannabis use maintained for 34 months
- Availability of continuing care did not lead to better long-term outcomes

Figure 1.
Percentage days of marijuana use by condition and episode utilization.

Table 1:

Initial treatment attendance.

Initial Sessions Attended	Treatment Condition	
	PRN (n = 43)	Fixed (n =44)
0	1 (2%)	0 (0%)
1	0 (0%)	0 (0%)
2	5 (12%)	2 (5%)
3	4 (9%)	1 (2%)
4	33 (77%)	1 (2%)
5		2 (5%)
6		4 (9%)
7		1 (2%)
8		4 (9%)
9		29 (66%)
Mean (SD)	3.58 (0.88)	7.84 (2.02)

Table 2:

PRN episode use by follow-up period (n = 16).

Follow-Up Period	Number of Participants Using Episodes	Number of Episodes Used
< 4 Months	10	11
4 – 10 Months	12	29
10 – 16 Months	3	6
16 – 22 Months	3	11
22 – 28 Months	5	13

Table 3.

Cannabis use and problems.

Measure	Condition	Assessment						
		Baseline	4 Months	10 Months	16 Months	22 Months	28 Months	34 Months
Percent Days Cannabis Use	PRN n=43	85.76 (17.49)	44.91 (32.69)	51.48 (36.07)	51.66 (35.09)	57.88 (34.93)	46.83 (35.77)	47.64 (37.93)
	Fixed-dose n=44	82.85 (17.55)	34.83 (33.36)	40.99 (37.18)	44.24 (40.37)	49.67 (39.39)	45.94 (38.70)	45.24 (39.81)
	<i>d</i>		0.31	0.29	0.20	0.22	0.02	0.06
Periods of Use Per Day	PRN n=43	2.16	1.80 (0.72)	1.71 (0.82)	1.67 (0.79)	1.69 (0.81)	1.58 (0.82)	1.47 (0.92)
	Fixed dose n=44	2.32	1.61 (1.06)	1.62 (0.86)	1.51 (0.93)	1.61 (0.94)	1.47 (0.85)	1.61 (1.01)
	<i>d</i>		0.21	0.11	0.19	0.09	0.13	-0.15
Cannabis Problem Score	PRN n=43	11.37 (5.27)	6.69 (4.83)	6.16 (5.96)	6.77 (5.19)	6.46 (5.44)	5.44 (5.93)	4.81 (4.57)
	Fixed-dose n=44	13.11 (6.29)	6.75 (6.93)	7.48 (7.13)	6.02 (5.54)	6.58 (6.41)	6.26 (5.95)	4.88 (5.15)
	<i>d</i>		-0.01	-0.20	0.14	-0.02	-0.14	-0.01

Note. Parentheses indicate standard deviations. Missing data imputed. *d* = between groups effect size.

Table 4.

Percentage of participants abstinent for the 30 days preceding assessment.

Treatment Condition	Assessment					
	4 Months	10 Months	16 Months	22 Months	28 Months	34 Months
PRN	15% n=39	20% n=35	17% n=35	20% n=35	35% n=34	33% n=30
Fixed-dose	37% n=43	21% n=43	21% n=42	22% n=41	24% n=41	28% n=40