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Randomized clinical trial examining duration of voucher-based reinforcement therapy for cocaine abstinence

Kimberly C. Kirby[a,b,*], Carolyn M. Carpenedo[a], Karen L. Dugosh[a,b], Beth J. Rosenwasser[a], Lois A. Benishek[a,b], Alicia Janik[a], Rachel Keashen[a], Elena Bresani[a], Kenneth Silverman[c]

[a] Treatment Research Institute, 600 Public Ledger Building, 150 South Independence Mall West, Philadelphia, PA 19106, USA
[b] Center for Studies of Addiction, Department of Psychiatry, University of Pennsylvania School of Medicine, 3900 Chestnut Street, Philadelphia, PA 19104, USA
[c] Johns Hopkins University School of Medicine, 5200 Eastern Avenue, Mason F. Lord, Suite 142, West Baltimore, MD 21224, USA

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ABSTRACT

Background: This is the first study to systematically manipulate duration of voucher-based reinforcement therapy (VBRT) to see if extending the duration increases abstinence during and following VBRT.
Methods: We randomized cocaine-dependent methadone-maintained adults to Standard (12 weeks; $n = 62$) or Extended (36 weeks; $n = 68$) VBRT and provided escalating voucher amounts contingent upon urinalysis verification of cocaine abstinence. Urinalysis was scheduled at least every 2 weeks during the 48-week study and more frequently during VBRT (3/week) and 12 weeks of Aftercare (2/week).
Results: Extended VBRT produced longer durations of continuous cocaine abstinence during weeks 1–24 (5.7 vs 2.7 weeks; $p = 0.003$) and proportionally more abstinence during weeks 24–36 ($X^2 = 4.57$, $p = .03$, OR = 2.18) compared to Standard VBRT. Duration of VBRT did not directly predict after-VBRT abstinence; but longer continuous abstinence during VBRT predicted abstinence during Aftercare ($p = 0.001$) and during the last 12 weeks of the study ($p < 0.001$). Extended VBRT averaged higher monthly voucher costs compared to Standard VBRT ($96 vs $43, $p < .001$); however, the average cost per week of abstinence attained was higher in the Standard group ($8.06 vs $5.88, $p < .001$). Participants in the Extended group with voucher costs exceeding $25 monthly averaged 20 weeks of continuous abstinence.
Conclusions: Greater abstinence occurred during Extended VBRT, but providing a longer duration was not by itself sufficient to maintain abstinence after VBRT. However, if abstinence can be captured and sustained during VBRT, then providing longer durations may help increase the continuous abstinence that predicts better long-term outcomes.

1. Introduction

Contingency management (CM) interventions, including voucher-based reinforcement therapy (VBRT), are among the most efficacious methods for improving drug abstinence during drug abuse treatment and have been identified as an empirically-based treatment approach for both opiate and cocaine drug use disorders (Chambless et al., 1998; Chambless and Ollendick, 2001). Meta-analyses of CM yield small to medium overall effect sizes for reducing opiate use during methadone treatment ($r = .25$; Griffith et al., 2000) and VBRT yields moderate effect sizes for outpatient treatment of cocaine use ($r = .35$; Lussier et al., 2006).

In VBRT, each time patients provide a urine sample testing negative for specified drugs, they are given a voucher that can be exchanged for a range of goods and services. Typically, the value of the voucher increases gradually with each consecutive drug-free urine sample provided. A drug positive sample or failure to provide a scheduled sample results in the voucher value being reset to the initial value from which it can again escalate according to the same rules. The majority of VBRT studies addressing illicit drug use have implemented a 12-week escalating schedule of voucher delivery.

In surveys of community-based treatment providers, 15–22% of respondents indicate they believe that the effects of CM disappear after the intervention ends (Kirby et al., 2012). This belief is not unfounded; animal research has repeatedly demonstrated that behavior reverses toward baseline after reinforcement is terminated (Skinner, 1938). However, these studies are conducted in operant chambers that minimize extraneous variables, producing an environmental vacuum. In applied research, reinforcement may occur in a social context where individuals are exposed to

* Corresponding author at: Treatment Research Institute, 600 Public Ledger Building, 150 South Independence Mall West, Philadelphia, PA 19106, USA.
Tel.: +1 215 399 0980x120; fax: +1 215 399 0987.
E-mail address: kkirby@tresearch.org (K.C. Kirby).

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many factors that can function as naturally-occurring reinforcers (see Baer, 1982) for both drug use and abstinence. In drug abuse treatment research, drug use often returns toward pretreatment levels when CM is abruptly terminated, suggesting that naturally-occurring reinforcers for abstinence are not present (e.g., Silverman et al., 1996, 1999). However, 12 weeks may be too short for changes in the surrounding environment to occur that will reinforce and maintain abstinence.

Silverman et al. (2004) provided support for the view that delivering a longer CM intervention may result in better maintenance of abstinence. Relative to usual care with or without contingent take-home doses, patients receiving contingent methadone take-home doses and VBRT for a full year did not show precipitous decreases in abstinence during the 8 weeks after VBRT was terminated. Also, Higgins et al. (2000) reported that maximum duration of continuous cocaine abstinence during treatment predicted longer-term cocaine abstinence at 6, 9, and 12 months after treatment entry, suggesting that there is no fixed amount of abstinence needed to increase the odds of longer-term abstinence: the odds continue to increase as a function of the amount of during-treatment abstinence achieved.

Although previous studies have provided VBRT for longer than a12-week duration (e.g., Preston et al., 2001; Silverman et al., 2004), this is the first study to systematically manipulate duration of VBRT in a 48-week randomized controlled trial conducted in a community-based methadone treatment program (also see Carpenedo et al., 2010). The purposes of the study were to compare a standard duration (12 weeks) of VBRT to an extended duration (36 weeks) to test the following hypotheses: (1) Compared to Standard VBRT, Extended VBRT will result in (a) longer durations of continuous cocaine abstinence and (b) increased proportions of cocaine-negative urine samples; (2) Extended VBRT participants will show less cocaine use than Standard VBRT participants during (a) a 12-week Aftercare period following VBRT and (b) during the last 12 weeks of the study (i.e., weeks 37–48); and (3) The longest duration of continuous abstinence achieved during VBRT will predict (a) the percent of cocaine-negative samples provided during Aftercare and (b) during the last 12 study weeks.

2. Method

2.1. Participants

Participants were recruited from patients enrolled in a large urban methadone treatment program. Eligibility criteria included: receiving a minimum stable 40 mg methadone maintenance dose at intake, meeting DSM-IV criteria for current cocaine abuse or dependence, providing biologically-verified evidence of cocaine use during the past 30 days, ability to participate in study protocol (e.g., provide urine specimens; remain in geographical area for study duration), no history of gambling problems, no spouse or significant other enrolled in study, and ability to provide valid contact information and informed consent.

Potential participants were referred to study staff by treatment program counselors. We assessed 233 referred patients for eligibility; 58 (25%) did not meet the basic inclusion criteria (e.g., no current cocaine use; undergoing methadone detoxification). Four of the 175 remaining potential participants declined participation, three were discharged from the treatment program or entered inpatient treatment before enrollment, and 37 were excluded because they did not complete the intake assessment. The resulting 131 patients were urn randomized (controlling for cocaine and opiate intake urinalysis result) to either Standard VBRT ($n = 63$) or Extended VBRT ($n = 68$). One participant assigned to Standard VBRT reported having a kidney problem and was deemed ineligible because he was not able to reliably deliver urine specimens. As such, data from 130 participants were included in the final analyses (Fig. 1). The study was approved and overseen by the Institutional Review Boards for the Treatment Research Institute and the Philadelphia Department of Health.

2.2. Procedures

Fig. 2 provides a schematic summarizing the research design and the procedures described below.

2.2.1. Treatment-as-usual (TAU). The outpatient methadone treatment program scheduled all participants to receive daily methadone doses ($M = 171$ mg; range = 40–340 mg), thrice weekly 3-h group treatment sessions, and urinalysis once monthly. As is the case in most community methadone clinics where it is recommended that clinicians do not respond immediately to a single urinalysis result (Batki et al., 2005), there were no systematic consequences for positive tests (also see Benishek et al., 2010; McGovern et al., 2004).

2.2.2. Weekly urinalysis. All participants were scheduled to provide urine samples three times weekly (Monday, Wednesday, Friday) during VBRT phases of the study and twice weekly (Monday/Thursday or Tuesday/Friday) during the Aftercare phase. If a participant failed to provide a sample, research staff attempted to collect one on the following clinic day. To ensure veracity, all samples were collected under direct observation, temperature tested, and checked for adulteration via Teco Diagnostics Drug Adulteration test strips. Samples that did not pass the veracity check were not tested, but participants could provide another sample. Valid samples were tested for the cocaine metabolite benzoylecgonine using *ACON* One Step Test Strips, which return a negative result when concentrations are below 300 ng/mL. Urinalysis results were entered into a database that calculated the value of the voucher that was delivered.

2.2.3. Biweekly urinalysis. In addition to weekly tests, participants provided a urine sample that was tested for benzoylecgonine every other week during the 48-week study. If a participant completed a bimonthly assessment on the same day that a weekly test was scheduled, one sample was used for both purposes. Participants received $10 for each biweekly assessment and a $25 bonus for every three consecutive biweekly assessments.

2.2.4. Standard VBRT. Upon delivery of the first cocaine-negative urine sample, participants received a $2.50 voucher. The value of the voucher escalated by $1.25 with each consecutive cocaine-negative sample (e.g., $3.75, $5.00, $6.25, etc.) up to a maximum value of $40. A bonus voucher value of $10.00 was provided after each delivery of 3 consecutive cocaine-negative samples. If a cocaine-positive sample was provided, participants did not receive a voucher on that day, and escalating voucher values were reset back to the original value of $2.50 for the next cocaine-negative sample provided. Voucher values were also reset if a participant failed to provide a scheduled urine sample. Samples collected on the following day did not prevent resets or earn vouchers. When 5 consecutive cocaine-negative samples were provided following a reset, voucher values were restored to the highest amount earned prior to the reset. VBRT remained in effect for 12 weeks. This voucher schedule is consistent with Higgins et al.'s (1994) original schedule.

2.2.5. Extended VBRT. The Extended VBRT schedule was identical to the Standard schedule except that it remained in effect for 36 weeks. As with the Standard schedule, the escalating voucher value