A Comparison Between Low-Magnitude Voucher and Buprenorphine Medication Contingencies in Promoting Abstinence From Opioids and Cocaine

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This study compared the relative efficacy of low-magnitude, contingent monetary vouchers, contingent buprenorphine medication, and standard counseling in promoting abstinence from illicit opioids and cocaine among opioid-dependent adults. Following an 8-week baseline period during which participants received buprenorphine maintenance treatment with no contingencies in place, 60 participants were randomly assigned to one of 3 treatment groups for 12 weeks: (a) Participants in the voucher group earned vouchers for each opioid- and cocaine-negative urine sample, in accordance with an escalating schedule. Continuous abstinence resulted in voucher earnings equivalent to a total of $269, which participants could exchange for material reinforcers of their choice. (b) Participants in the medication contingency group received half their scheduled buprenorphine dose for clinic attendance and the other half for remaining abstinent from opiates and cocaine. Thus, they received only half of their scheduled dose on submission of an opioid- and/or cocaine-positive urine sample. (c) Participants in standard treatment did not receive programmed consequences contingent on urinalysis results. All participants were maintained with buprenorphine according to a 3-times-per-week dosing regimen and participated in behavioral drug counseling. Retention rate did not significantly differ across the groups; however, participants in the medication contingency group achieved significantly more weeks of continuous abstinence from opiates and cocaine compared with participants in the voucher group ($M_s = 5.95$ and $2.90$, respectively). Results suggest that the use of medication-based contingencies in combination with behavioral therapy in promoting drug abstinence may have clinical utility. Limitations of the study are discussed.

Keywords: contingency management, buprenorphine, opioid abstinence, cocaine abstinence, behavioral therapy

Empirical research has demonstrated that contingency management procedures can be effective in targeting a variety of problematic behaviors among substance abusers (for reviews, see Higgins & Silverman, 1999; Petry, 2000). Based on the principle of operant conditioning, contingency management strategies in substance abuse treatment involve a contract detailing the consequences of demonstrating or failing to demonstrate a desired target behavior (e.g., drug abstinence, clinic attendance) over a specific period of time. Dependent on the contract, the patient receives positive reinforcers or rewards for abstinence (e.g., restaurant gift certificates, movie theater tickets, clothing, sports equipment) and negative consequences or punishments for evidence of drug use. Higgins et al. (1991) developed a contingency management intervention that uses a monetary voucher-based reinforcer. This strategy has been used successfully in the treatment of cocaine dependence (Higgins et al., 1991, 1993, 1994), in the treatment of cocaine-abusing methadone-maintenance patients (Silverman, Bigelow, & Stitzer, 1998; Silverman, Higgins, et al., 1996), and as an adjunct to methadone maintenance in opioid-dependent individuals (Silverman, Wong, et al., 1996).

One criticism of voucher programs, however, is that they are expensive to use and to manage in clinical settings. In the above-mentioned studies, each patient could earn up to

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$1,000 worth of goods during treatment. In addition to the cost of the vouchers themselves, the cost of staff time to purchase items and transportation costs to obtain requested items must be considered. Therefore, pragmatic concerns exist over how clinics can raise the necessary funds to support such interventions. Still, even if these procedures have proven to be efficacious in research, public opinion may be opposed to spending money to support such programs.

One potential approach to addressing these concerns is to decrease the cost of delivering these treatments. There are several possible methods to reduce the cost of contingency management procedures. One method is to seek community donations of goods and services to be used in contingency management interventions (Amass & Kamien, 2004), although the cost-effectiveness of such procedures has not been systematically studied. Another method is to decrease the value of the vouchers. Several studies conducted by Petry and colleagues have examined this issue by evaluating the efficacy of using a variable-magnitude reinforcement procedure targeting drug abstinence. Specifically, participants can earn the opportunity to draw a slip of paper from a fishbowl, which can result in a prize of small, medium, or large magnitude for providing a drug-negative urine sample. This lottery-based prize-drawing procedure has been shown to be an efficacious and cost-effective contingency management procedure in several studies with drug-dependent individuals (Petry & Martin, 2002; Petry, Martin, Cooney, & Kranzler, 2000; Petry, Martin, & Finocche, 2001; Petry et al., 2004). Less research, however, has focused on the efficacy of lower magnitude, fixed-interval schedules of reinforcement whereby a patient earns a reinforcer for each occasion that he or she exhibits the desired behavior (drug-free urine sample; Jones, Haug, Stitzer, & Svikis, 2000). Better understanding the relationship between incentive values used in fixed-interval schedules of reinforcement and treatment outcome is a largely unexplored but important research endeavor.

A second approach to decreasing the cost of delivering contingency management procedures in a clinic setting is to examine the efficacy of incentives intrinsic to a clinic, such as medication. Given that buprenorphine can function as a reinforcer (Bickel & Amass, 1995), the pharmacotherapy itself could be used as an incentive inherent to the clinic to improve outcome. In several studies, positive reinforcers intrinsic to clinics—such as take-home doses of methadone, increases in methadone dose, and other clinic privileges—have been provided to methadone patients contingent on their abstinence from illicit drugs (e.g., Bickel et al., 1989; Chutuape, Silverman, & Stitzer, 1998; Higgins, Stitzer, Bigelow, & Liebson, 1986; Rowan-Szal, Joe, Chatham, & Simpson, 1994; Schmitz et al., 1998; Stitzer, Bickel, Bigelow, & Liebson, 1986). In addition, aversive consequences—such as methadone dose reductions, treatment discharge, rapid detoxification, and split dosing—have been used as consequences for illicit drug use (e.g., Kidor & Stitzer, 1996; McCarthy & Borders, 1985). Finally, various combinations of positive and aversive consequences for drug abstinence and drug use, respectively, have been used (Iguchi, Stitzer, Bigelow, & Liebson, 1988; Saxon, Calsyn, Kivlahan, & Roszell, 1993; for a review, see Leal & Galanter, 1995). To our knowledge, virtually no research has examined the efficacy of buprenorphine-related contingencies.

Typically, contingency management procedures have targeted one drug of dependence. However, many opiate abusers also use other illicit drugs (Kosten, 1991; Stitzer & Kirby, 1991). For example, cocaine use is often prevalent among treatment-seeking opiate abusers (Black, Dolan, Penk, Robinowitz, & DeFord, 1987; Stitzer & Kirby, 1991). Cocaine abuse among methadone patients is associated with poor retention, increased rates of HIV infection, unemployment, and criminal activity (Magura, Nwakeze, & Dzemsky, 1998; Silverman et al., 1998). Although most contingency management interventions during methadone treatment target illicit drug use, targeting more than one drug for contingency management has been infrequently evaluated in randomized, clinical trials, with varying degrees of success (e.g., Carroll et al., 2001; Carroll, Sinha, Nich, Babuscio, & Rounsaville, 2002; Downey, Helmus, & Schuster, 2000; Piotrowski et al., 1999; Silverman et al., 1998; Silverman, Higgins, et al., 1996; Silverman, Wong, et al., 1996). To further develop efficient contingency management approaches in treating heroin addicts, it is timely to seek reinforcement strategies that effectively target more than one illicit drug.

The aim of the present study was to compare the relative efficacy of low-magnitude monetary vouchers delivered contingent on each instance of drug-abstinent urine samples versus contingent buprenorphine dose reductions contingent on each instance of drug-positive urine samples. The maximum amount of vouchers that participants could earn via this fixed schedule of reinforcement was similar to the amounts that have been evaluated in the lottery-based, prize-drawing procedure (e.g., Petry et al., 2004). In this study, the scope of the contingency was expanded to target cocaine abstinence as well as opioid abstinence. That is, contingent on having a urine sample that was negative for both opiates and cocaine, participants received either monetary vouchers or full doses of buprenorphine. To our knowledge, the efficacy of contingency management programs using negative reinforcers intrinsic to a clinic (e.g., buprenorphine medication) has not been directly compared with the efficacy of programs using reinforcers extrinsic to a clinic (e.g., monetary vouchers).

We hypothesized that the negative-reinforcement medication contingency strategy would exert greater control over abstinence and treatment retention because of the loss-aversion phenomenon described in the behavioral economic literature. According to this literature, which examines how organisms allocate their behavior under constrained systems (Bickel, Green, & Vuchinich, 1995), aversive outcomes (losses) may have a greater effect on behavior than do comparable positive reinforcing events (gains; Baker, Johnson, & Bickel, 2003; Simpson & Vuchinich, 2000; Thaler, 1981). Additionally, little research has examined the efficacy of low-magnitude vouchers delivered contingent on each instance of drug-abstinent urine samples (in accordance with a nonprobabilistic schedule). Thus, the present
study provides what is likely a novel contribution to the scientific literature on contingency management.

Materials and Method

Participants

This study was conducted from April 1999 to September 2001. Participants were 18 years of age or older, in good health, met Diagnostic and Statistical Manual of Mental Disorders (4th ed.; American Psychiatric Association, 1994) criteria for opioid dependence and Federal Drug Administration (FDA) qualification criteria for methadone treatment (i.e., a history of opioid dependence and either objective evidence of current opioid use or signs of opioid withdrawal). Participants were recruited via a variety of advertisements to participate in a research study with buprenorphine. Health status was determined by medical history, physical exam, and laboratory evaluation (including electrocardiogram, complete blood-cell count, clinical chemistry profiles, and urinalysis). Evidence of acute psychosis or serious medical illness was an exclusion criterion. Codependence on cocaine, ethanol, or sedative-hypnotics did not exclude patients from participation in the study. Pregnant female participants were excluded from study participation. The study was approved by the Institutional Review Board, and all participants provided written informed consent prior to participation.

Ninety-five individuals signed consent to participate in this study, and 60 were randomly assigned to a treatment condition. Thirty-five participants were excluded because they did not complete the 8-week baseline condition required to be randomly assigned to a study condition. The 60 opioid-dependent individuals (33 male, 27 female) who participated in this outpatient study using a parallel-groups design had a mean age of 32.5 years (SD = 9.8; see Table 1 for participant characteristics). On completion of an 8-week baseline period, participants were randomly assigned to one of three treatment groups (contingent voucher, contingent medication, or standard counseling group) using minimum-likelihood allocation (Aickin, 1982). This method of randomization was designed to achieve balance between treatment groups on patient characteristics likely to influence treatment outcome. Five characteristics were used to stratify patients to one of the three treatments: (a) buprenorphine maintenance dose (i.e., 4 or 8 mg/70 kg; to ensure dose was balanced across conditions), (b) history of injection use during the past year (because intranasal and injection users may have had different durations of opiate use and may have differential treatment outcomes; e.g., Carpenter, Chutu-

Table 1

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>Statistic</th>
<th>Voucher (n = 20)</th>
<th>Med. contingency (n = 20)</th>
<th>Control (n = 20)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>%</td>
<td>95</td>
<td>100</td>
<td>80</td>
<td>.06</td>
</tr>
<tr>
<td>Male</td>
<td>%</td>
<td>50</td>
<td>55</td>
<td>60</td>
<td>.82</td>
</tr>
<tr>
<td>Never married</td>
<td>%</td>
<td>45</td>
<td>60</td>
<td>45</td>
<td>.55</td>
</tr>
<tr>
<td>High school education</td>
<td>%</td>
<td>60</td>
<td>85</td>
<td>75</td>
<td>.20</td>
</tr>
<tr>
<td>Employed full-time</td>
<td>%</td>
<td>35</td>
<td>40</td>
<td>65</td>
<td>.13</td>
</tr>
<tr>
<td>Age (years)</td>
<td>M ± SD</td>
<td>33.71 ± 9.66</td>
<td>29.20 ± 8.91</td>
<td>34.63 ± 10.41</td>
<td>.17</td>
</tr>
<tr>
<td>Monthly income (dollars)*</td>
<td></td>
<td>682 (395–1,250)</td>
<td>704 (300–1,600)</td>
<td>1,200 (925–2,527)</td>
<td>.07</td>
</tr>
<tr>
<td>Opioid use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior treatment</td>
<td>%</td>
<td>70</td>
<td>60</td>
<td>85</td>
<td>.21</td>
</tr>
<tr>
<td>Regular use (years)</td>
<td>M ± SD</td>
<td>9.34 ± 5.71</td>
<td>7.16 ± 6.41</td>
<td>12.39 ± 9.81</td>
<td>.10</td>
</tr>
<tr>
<td>Age of first use (years)</td>
<td>M ± SD</td>
<td>21.40 ± 8.85</td>
<td>19.32 ± 5.84</td>
<td>20.25 ± 6.88</td>
<td>.67</td>
</tr>
<tr>
<td>Weekly spending on opioids (dollars)*</td>
<td></td>
<td>455 (175–678)</td>
<td>292 (128–716)</td>
<td>467 (327–817)</td>
<td>.80</td>
</tr>
<tr>
<td>Preferred route</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intravenous</td>
<td>%</td>
<td>55</td>
<td>80</td>
<td>85</td>
<td>.85</td>
</tr>
<tr>
<td>Intranasal</td>
<td>%</td>
<td>40</td>
<td>10</td>
<td>5</td>
<td>.73</td>
</tr>
<tr>
<td>Oral</td>
<td>%</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Other drug dependence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>%</td>
<td>30</td>
<td>15</td>
<td>25</td>
<td>.52</td>
</tr>
<tr>
<td>Cocaine</td>
<td>%</td>
<td>25</td>
<td>40</td>
<td>25</td>
<td>.49</td>
</tr>
<tr>
<td>Sedative</td>
<td>%</td>
<td>20</td>
<td>15</td>
<td>25</td>
<td>.73</td>
</tr>
<tr>
<td>Cannabis</td>
<td>%</td>
<td>30</td>
<td>40</td>
<td>30</td>
<td>.74</td>
</tr>
<tr>
<td>Duration of cocaine use (years)</td>
<td>M ± SD</td>
<td>7.15 ± 8.11</td>
<td>3.81 ± 3.77</td>
<td>5.55 ± 6.65</td>
<td>.27</td>
</tr>
<tr>
<td>Scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASI composite scales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td>M ± SD</td>
<td>.16 ± .31</td>
<td>.23 ± .32</td>
<td>.28 ± .36</td>
<td>.50</td>
</tr>
<tr>
<td>Employment</td>
<td>M ± SD</td>
<td>.64 ± .31</td>
<td>.53 ± .32</td>
<td>.54 ± .37</td>
<td>.50</td>
</tr>
<tr>
<td>Alcohol</td>
<td>M ± SD</td>
<td>.07 ± .17</td>
<td>.06 ± .13</td>
<td>.08 ± .17</td>
<td>.98</td>
</tr>
<tr>
<td>Drug</td>
<td>M ± SD</td>
<td>.38 ± .13</td>
<td>.38 ± .10</td>
<td>.37 ± .08</td>
<td>.99</td>
</tr>
<tr>
<td>Psychiatric</td>
<td>M ± SD</td>
<td>.32 ± .22</td>
<td>.30 ± .25</td>
<td>.30 ± .27</td>
<td>.97</td>
</tr>
<tr>
<td>Legal</td>
<td>M ± SD</td>
<td>.26 ± .31</td>
<td>.34 ± .32</td>
<td>.13 ± .16</td>
<td>.07</td>
</tr>
<tr>
<td>Family–social</td>
<td>M ± SD</td>
<td>.23 ± .24</td>
<td>.25 ± .25</td>
<td>.22 ± .22</td>
<td>.93</td>
</tr>
<tr>
<td>BDI</td>
<td>M ± SD</td>
<td>20.80 ± 12.85</td>
<td>21.60 ± 12.27</td>
<td>18.95 ± 12.09</td>
<td>.79</td>
</tr>
<tr>
<td>MAST</td>
<td>M ± SD</td>
<td>12.55 ± 13.23</td>
<td>8.45 ± 10.07</td>
<td>12.45 ± 15.89</td>
<td>.54</td>
</tr>
</tbody>
</table>

Note. ASI = Addiction Severity Index (McLennan et al., 1985); BDI = Beck Depression Inventory (Beck, 1978); MAST = Michigan Alcoholism Screening Test (Selzer, 1971).

* Median (interquartile range).
ape, & Sitzer, 1998), (c) gender (because men and women have sometimes been shown to have differing clinical presentations on entry into opioid treatment and differential outcomes during treatment; e.g., Chatham, Hiller, Rowan-Szal, Joe, & Simpson, 1999), (d) prior history of buprenorphine treatment (because individuals with prior treatment episodes may have better treatment outcomes; e.g., Nurco, Kinlock, & Hanlon, 1994), and (e) presence versus absence of illicit cocaine use during the 8-week baseline period (because individuals who achieve abstinence early in treatment may have better treatment outcomes; e.g., Higgins, Badger, & Budney, 2000). This method of group assignment successfully allocated patients to the two experimental groups and the control group without any significant differences on any measured baseline characteristics.

**Buprenorphine Induction and Stabilization**

Participants’ maintenance dose of buprenorphine was determined during the first 2 weeks of participation. On Day 1, participants were initially placed on a 2 mg/70 kg dose. The dose was then increased on Day 2 to a 4 mg/70 kg dose, and participants remained on this dose through the end of the 1st week. If a participant was still experiencing withdrawal symptoms or displayed a significant opioid habit at intake, their dose was increased to 8 mg/70 kg starting at the beginning of Week 2. Thus, participants were maintained on either 4 mg/70 kg or 8 mg/70 kg for the duration of the study (note that these doses translate to approximately 8–16 mg of the FDA-approved buprenorphine sublingual tablet, because the tablets are about half as bioavailable as the buprenorphine solution; see Mendelson et al., 1996; Nath et al., 1999). The dosing schedule was similar to induction procedures described previously from our research group (Bickel, Amass, Crean, & Badger, 1999; Bickel, Amass, Higgins, Badger, & Esch, 1997), although more rapid induction procedures have also been shown to be safe and effective (Johnson, Cone, Henningfield, & Fudala, 1989; Substance Abuse and Mental Health Services Administration, 2004).

Following the 2-week buprenorphine dose stabilization, participants began an 8-week baseline period during which they received a stable maintenance dose of buprenorphine with no contingencies in place for opioid or cocaine use. During this 8-week baseline period, participants received their maintenance dose on an alternate-day schedule. That is, participants attended the clinic three times a week, receiving a double of their daily maintenance dose on each dosing day. They were told that the first half dose was provided for abstinence. Thus, the participant would receive the scheduled half dose if and only if the participant was stillexperiencing withdrawal symptoms or dis
crate violations (i.e., 1 mg decrease every 4 days) or were referred to other studies or appropriate treatment programs.

**Treatment Groups**

On completion of the 8-week baseline condition, participants were assigned to one of three treatment groups: contingent vouchers, contingent medication, or standard drug counseling. Treatment conditions were in effect for 12 weeks. During this experimental phase of the study, participants continued to receive their maintenance dose of buprenorphine thrice weekly (on Mondays, Wednesdays, and Fridays).

**Contingent voucher condition.** The voucher system involved systematically reinforcing abstinence, as indicated by urinalysis results. Staff informed patients of their urinalysis results immediately after testing. Specimens that were negative for opioids (opiates, propoxyphene, and methadone) earned points that were recorded on vouchers and given to patients. Each point was worth $0.125. The first negative specimen was worth 29 points at $0.125 per point, or $3.63. Each subsequent consecutive negative specimen increased the value of the voucher by 1 point (e.g., 30 points for the second, 31 points for the third, etc.). As an additional incentive for continuous opioid abstinence, a $5 bonus was provided to patients for each set of three consecutive negative samples. Continuous abstinence throughout the 12-week period (Weeks 9–20) during which these contingencies were imposed resulted in a patient receiving vouchers equivalent to a total of $269. Participants never received money directly. Instead, the cash equivalent of the points earned by patients were used by staff members to buy material reinforcements requested by patients (e.g., fishing licenses, restaurant gift certificates, automobile parts). These material reinforcements could be obtained at any time during treatment and were selected by the patient with the counselor, who retained veto power over any item that was deemed to be inconsistent with promoting a drug-free lifestyle. Submission of an opioid- and/or cocaine-positive urine sample or failing to submit a scheduled specimen was counted as positive, and the next negative sample for both drugs reset the value of vouchers to the initial $3.63 level. Submission of five consecutive opioid- and/or cocaine-negative specimens returned the value of the vouchers to the level obtained before the reset. Points, once earned, could not be lost.

**Medication contingency condition.** Participants in the medication contingency group were told that they would receive two half doses on each dosing day. They were told that the first half dose was for attending the clinic and the second was for remaining abstinent from opiates and cocaine. If a participant in the medication contingency condition provided an opiate- and/or cocaine-positive urine sample, he or she received only half of the scheduled dose. That is, the participant would receive the scheduled half dose for “attendance” for that day and the next day (given at once) but would not receive the other half dose that would have also been provided for abstinence. Thus, the participant lost the equivalent of one maintenance dose per positive sample. Because dosing was done every Monday, Wednesday, and Friday, this meant that if a participant submitted a positive sample on a Monday or Wednesday, he or she only received a single daily maintenance dose on that day for that 2-day period instead of a double maintenance dose. On Fridays, participants received a double dose rather than a triple dose if they submitted an opiate- and/or cocaine-positive sample.
Standard treatment condition. Participants in this group did not receive programmed consequences contingent on urinalysis results. Thus, these participants did not receive voucher points on submission of an opioid- and/or cocaine-free urine sample, nor did they receive dose reductions on submission of an opioid- or cocaine-positive urine sample. Participants in this condition continued to receive thrice-weekly dosing with buprenorphine and behavioral counseling (described below) as they had during the baseline period.

Behavioral Treatment

All participants received behavioral drug counseling, originally developed for outpatient treatment of cocaine dependence (Higgins, et al., 1991, 1993, 1994). These procedures were implemented in one 1-hr individual counseling session per week. During therapy sessions, participants were provided with relationship and employment counseling, instruction on antecedents and consequences of their opioid use, and assistance in developing new or reinitiating old recreational activities. Participants also received HIV/AIDS education. Counselors also assisted participants with finding a job, securing stable housing, and meeting other treatment goals. This behavioral approach has been shown to be more effective than standard methadone drug counseling (Bickel et al., 1997).

Urinalysis Procedures

Urine specimens were collected under staff observation from all patients on Mondays, Wednesdays, and Fridays and screened immediately on-site with the enzyme-multiplied immunoassay technique (Syva Corp., San Jose, CA). All specimens were screened for methadone, opiates, propoxyphene, and cocaine, with one randomly selected specimen per week also screened for benzodiazepines (positive results determined at >300 ng/mL). Breath alcohol samples were analyzed at the time that urine specimens were collected. Breath alcohol levels had to be less than or equal to .05 g/μL of air for participants to receive scheduled medication.

Statistical Methods

Comparisons between treatment groups on baseline characteristics were performed using either analyses of variance (ANOVAs) or Kruskal–Wallis tests for continuous measures and chi-square tests for categorical variables. ANOVA was also used to compare treatment groups with respect to mean duration of continuous abstinence, total number of weeks abstinent (noncontinuous), and number of missing visits. For each participant, continuous abstinence was defined as the longest continuous period of abstinence (in weeks) from both opioids and cocaine documented by negative urine toxicology tests during the 12-week experimental phase. Missing urine specimens were treated as opioid positive, as recommended in substance abuse treatment research (Nathan & Lanksy, 1978). Pairwise comparisons among the three treatment groups on mean continuous abstinence were performed using Fisher’s least significant difference (LSD). We used time-to-event analysis, using a log rank test, to compare treatment groups on retention time. Additionally, a chi-square test was used to compare groups on the percentage of participants retained through the 12-week experimental phase. Repeated measures ANOVAs were used for treatment comparisons corresponding to Addiction Severity Index (ASI; McLellan et al., 1985) composite scores collected at intake, at the end of the 8-week baseline phase prior to randomization, and at the end of the 12-week experimental phase. Treatment means presented below for each assessment are least-square means, which are adjusted for missing data resulting from incomplete follow-up. Statistical analyses were performed using SAS statistical software (SAS Institute, Cary, NC).

Results

Participant Retention

There was no significant difference in weeks retained in treatment across the three experimental groups, log rank test $\chi^2(N = 2) = 2.4, p = .29$. Average retention times were 10.4 weeks ($SD = 3.2$), 11.3 weeks ($SD = 1.8$), and 11.8 weeks ($SD = 0.4$) for participants in the contingent medication, voucher, and control groups, respectively. There were also no significant differences in the percentages of participants among the three treatments who completed the experimental phase of the study, $\chi^2(N = 2) = 1.6, p = .49$. Sixteen out of 20 (80%) participants in the voucher group, 16 of the 20 (80%) participants in the control group, and 13 of the 20 (65%) participants in the medication contingency group completed the 12-week experimental phase of the study. Of the 15 participants who failed to complete the experimental phase, 12 were in the 8 mg/70 kg dosing group, and 3 were in the 4 mg/70 kg dosing group. These participants represented 26% and 22% of participants in their respective dosing groups. There was no significant difference in the mean number of missed visits while participants were retained in treatment, $F(2, 57) = 0.01, p = .99$. The average numbers of missed visits were 1.1 ($SD = 1.7$), 1.2 ($SD = 1.9$), and 1.2 ($SD = 2.3$) in the contingent medication, voucher, and control groups, respectively.

Opioid and Cocaine Abstinence

ANOVA revealed significant differences in mean weeks of continuous abstinence across the three treatment groups, $F(2, 57) = 3.33, p = .04$. Pairwise comparisons indicated that the participants randomized to the contingent medication group achieved significantly greater durations of continuous abstinence from opioids and cocaine ($M = 5.9$ weeks, $SD = 4.6$) than did participants in the voucher group ($M = 2.9$ weeks, $SD = 3.3$; Fisher’s LSD, $p < .05$). Participants receiving standard counseling did not differ significantly from participants in either of the other two groups ($M = 4.0$ weeks, $SD = 3.2$). When total (i.e., not continuous) weeks of abstinence was examined, similar results were observed, though these differences were not statistically significant, $F(2, 57) = 2.80, p = .07$. Mean total weeks of abstinence for the contingent medication, standard counseling, and voucher groups were 6.9 ($SD = 4.7$), 5.8 ($SD = 3.8$), and 3.9 ($SD = 3.7$), respectively. Participants randomized to the voucher condition earned an average of $\$91$ (interquartile range = $\$24–$146) of the $\$269$ possible. Participants assigned to the medication contingency group received an average of 5.5 (interquartile range = 0–9.5) reduced doses.
ASI Composite Scores

ASI composite scores at intake were highest for employment \( (M = .57, SD = .33) \) and drug problems \( (M = .38, SD = .10) \); moderate for psychiatric \( (M = .31, SD = .24) \), legal \( (M = .24, SD = .28) \), and family problems \( (M = .23, SD = .23) \); and lowest for alcohol problems \( (M = .07, SD = .15) \). There were no significant differences across the three treatment conditions at intake, nor was there evidence of differential change across conditions from intake to the end of the experimental phase on any of the seven ASI composite scores \( (p > .05 \text{ for all main effects of treatment and all Treatment } \times \text{Time interactions}) \). However, significant decreases over time were observed in three domains independent of treatment condition—drug problems, \( F(2, 91) = 69.13, p < .001 \); legal problems, \( F(2, 91) = 10.50, p < .001 \); and employment problems, \( F(2, 91) = 4.67, p = .01 \)—indicating that participants improved during treatment on these measures. Much of the reduction in composite scores in each of these three domains occurred by Week 8 and before random assignment to the treatment conditions.

Discussion

The goal of this study was to expand knowledge regarding cost-effective contingency management strategies in promoting drug abstinence. Using a contingency management paradigm, we evaluated the efficacy of a reinforcer that was intrinsic to a clinic (medication) and compared it with an extrinsic reinforcer (low-magnitude voucher incentives). To our knowledge, this study is the first to use buprenorphine for this purpose.

Community-based substance abuse treatment clinics may often be unable to use voucher-based schedules of high magnitude in their clinical setting because of the prohibitive costs. We hypothesized that if fixed-interval, lower magnitude voucher schedules were shown to be efficacious, clinics might use them more readily. Prior research has already supported the effectiveness of contingent vouchers in comparison with a noncontingent- (yoked-) reinforcement comparison group \( \text{e.g., Preston et al., 1999; Silverman, Higgins, et al., 1996} \). For this reason, we omitted a noncontingent reinforcement comparison group in our design. Although contingent versus noncontingent buprenorphine doses have not been systematically compared, we know from this prior research that contingencies are important—and most important, we wanted our comparison group to reflect the standard of care in buprenorphine treatment (which does not include noncontingent reinforcement) to increase external validity of our findings.

Our results demonstrate that the efficacy of the low-magnitude, voucher-based reinforcement intervention used in the present study did not significantly differ from that of the standard counseling control condition. The lack of a statistical difference between these groups may have been a result of the small number of participants, and/or the selected duration of the intervention may have been too short to detect group differences. In an earlier trial, Bickel et al. \( (1997) \) demonstrated the efficacy of a voucher incentive program that used voucher points that increased at the same rate as in the current study; however, the contingencies in this prior study were implemented for 23 weeks, unlike the 12-week intervention used in the current study. Thus, continuous abstinence throughout the 23 weeks resulted in a patient receiving vouchers equivalent to a maximum of $658.38, compared with a maximum of $269 that participants could earn in this study. A longer time interval in which contingencies were imposed and/or a higher voucher magnitude might have allowed for higher abstinence rates in the present study.

Indeed, prior research has demonstrated that higher magnitude vouchers are efficacious. In a recent study by Silverman et al. \( (1998) \), an escalating reinforcement schedule was shown to be effective in treating cocaine abuse among methadone patients. Patients exposed to this intervention were able to earn approximately $1,000 in vouchers for providing cocaine-free urine samples over a 12-week period. Another study by Chutuape et al. \( (1999) \), which examined poly-drug use in methadone-maintained patients, provided participants in a contingency management treatment group with up to $900 worth of goods during the 12-week intervention. Also, unlike other studies, in which the value of the voucher usually begins low (usually about $2.50) and increases with each consecutive drug-free urine sample, in the study by Chutuape et al. \( (1999) \), a fixed value of $25 was chosen for each voucher to promote sufficient reinforcement early on in treatment. Providing larger magnitude reinforcers early in the voucher schedule may be important for promoting early initiation of abstinence during treatment. Moreover, the use of variable-interval schedules of reinforcement has been shown to be efficacious and may be more cost-effective than fixed-interval schedules that use high-magnitude vouchers \( \text{Petry & Martin, 2002; Petry et al., 2000, 2001} \). As previously noted, the maximum amount of vouchers participants could earn in the present study was similar to average earnings in some variable-interval, prize drawing (“fishbowl”) schedules that have been evaluated \( \text{e.g., Petry et al., 2004} \). The absence of a significant effect in the present study, unlike with the fishbowl procedure, could thus be attributable to the use of fixed, low-magnitude reinforcers rather than the lottery-based procedure, in which one can earn rewards of varying magnitude. Finally, the contingency management procedures used in the present study targeted two drugs of abuse simultaneously. Thus, the lower magnitude voucher schedule may have been inefficacious because participants were required to perform two behaviors (abstinence from both opiates and cocaine) to receive a voucher reinforcer.

We also examined the efficacy of using the pharmacotherapy itself to function as a reinforcer, because it is inherent to a treatment clinic and does not require additional cost to deliver in a treatment setting. This approach has been previously examined with methadone in various combinations \( \text{Bickel et al.,1989; Dolan, Black, Penk, Robinowitz, & DeFord, 1985; McCarthy & Borders, 1985; for an overview, see Leal & Galanter, 1995} \). Participants in the contingent medication group showed significantly longer continuous abstinence from opiates and cocaine than did par-
participants in the voucher group. Unfortunately, although it was not significant, there was a trend for the aversive contingency to cause higher attrition rates compared with those in the voucher group. These findings are consistent with research from Iguchi et al. (1988) and Nolimal and Crowley (1990), who reported retention rates of approximately 60% in their programs that used negative-incentive contingencies. Thus, although medication-based contingencies appear to contribute to greater participant attrition, those who experience this contingency appear to have better treatment outcomes. Future research may focus on those subpopulations of drug-dependent individuals who may be more likely to remain in treatment and have better treatment outcomes under such conditions.

The finding that a negative-reinforcement strategy (reduction in medication dose contingent on drug-positive results) produced greater control over participants’ drug abstinence relative to a positive-reinforcement strategy (delivery of voucher reinforcement contingent on drug-negative results) is consistent with findings in the behavioral economics literature. Specifically, this literature, which examines how organisms allocate their behavior under constrained systems (Bickel et al., 1995), has demonstrated that aversive outcomes (losses) may have a greater effect on behavior relative to comparable positive reinforcing events (gains; Baker et al., 2003; Simpson & Vuchinich, 2000; Thaler, 1981). For example, the value of a $100 reward delivered in 1 week is discounted more than the value of a $100 fine collected in 1 week. This loss-aversion phenomenon has been demonstrated in unimpaired human populations as well as drug-dependent groups (Baker et al., 2003; Chapman, 1996), and it was demonstrated in the present study for continuous abstinence but not for retention.

Differences between the interventions evaluated in this study may have been obscured by the efficacy of the intensive and demonstrably efficacious behavioral treatment each participant received. Indeed, this may also account for the positive results observed in the standard treatment group. In addition, buprenorphine itself is a very effective drug, which might have rendered the detection of differences between the groups difficult. Thus, a larger number of patients may be needed to detect significant differences on more measures when such an effective behavioral and pharmacological treatment is provided.

If one views substance abuse treatment as a multifaceted intervention for addressing and minimizing the social problem of substance use, then varying treatment interventions to achieve optimal treatment outcomes may be appropriate. Contingency management procedures—including the use of pharmacotherapy as a reinforcer contingent on abstinence—represent an empirically based intervention for enhancing treatment outcomes among substance-abusing populations. These procedures are based on a substantive scientific literature demonstrating that substance use is highly sensitive to systematically applied environmental consequences. Indeed, these interventions are designed to arrange for the systematic application of behavioral consequences for substance use and abstinence as well as other therapeutic behavior to help motivate substance users to initiate new, substance-free behavioral patterns.

In conclusion, the pursuit of finding less costly and readily applicable contingency strategies in promoting drug abstinence is an important focus of research. Although treatment programs may experience several barriers when trying to adopt evidence-based contingency management procedures to clinical settings (e.g., reliable urinalysis testing), the cost of adopting science-based contingency management interventions may represent a significant barrier to adoption of such interventions. In this respect, results from the present study suggest two findings: (a) a low-magnitude, fixed-interval voucher reinforcer may not be efficacious when targeting abstinence from more than one drug, and (b) the moderate use of aversive consequences via medication-based contingencies may be useful for some individuals in promoting drug abstinence in a manner that does not introduce additional costs but, rather, can be readily implemented in treatment programs.

References


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