CONTINGENCY MANAGEMENT FOR TREATMENT OF SUBSTANCE ABUSE

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Abstract Clinical research trials demonstrate the efficacy of contingency management procedures in treating substance use disorders. Usually, reinforcement, in the form of vouchers exchangeable for retail goods and services, is provided for drug abstinence in patients treated in psychosocial or methadone maintenance clinics. Recently, the types of reinforcers have been adapted to include lower cost alternatives, and reinforcement is being expanded to alter other target behaviors such as attendance at treatment, adherence to treatment goals, and compliance with medication. This chapter provides an overview of the populations and behaviors to which contingency management approaches have been applied. It also reviews design features that appear critical in the successful adaptation of the techniques. In addition, areas for future research are described.

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INTRODUCTION TO CONTINGENCY MANAGEMENT

Contingency management (CM) treatments are derived from basic behavioral principles, particularly the principle that reinforced behaviors will increase in frequency. In the drug abuse treatment field, therapies must compete with the potent and immediate reinforcement provided by the abused drug itself. The application of CM in drug abuse treatment is based on providing tangible and immediate reinforcement that can effectively compete with drug reinforcement to promote abstinence and alternative nondrug-related behaviors. From their origins in animal operant conditioning research, these interventions have been adopted by clinicians who typically provide a tangible reinforcer, such as a voucher exchangeable for retail goods and services, each time patients provide objective verification of a desired behavior such as drug abstinence. Although drug abstinence is of central interest as an outcome in drug abuse treatment, growing evidence suggests that CM therapies can be expanded to behaviors beyond abstinence, and that a variety of reinforcers can be used. The efficacy of CM interventions for retaining substance abusers in treatment and enhancing abstinence has been demonstrated in numerous clinical trials (Petry 2000). Nevertheless, some basic procedures must be incorporated in the design of these interventions for them to be efficacious.

In this chapter, we provide an overview of CM and review evidence of its efficacy. We detail the use of reinforcement for drug abstinence in a variety of settings and populations, and discuss how these techniques can be expanded to other behaviors. We also describe issues central to the design of an effective CM intervention and areas for future research.

Target Behaviors

The primary goal of drug abuse treatment in general, and of CM in particular, is to reduce or eliminate drug use behaviors. In CM interventions, the behavior targeted for change must be measured frequently, and only reports that are objective, as opposed to subjective, can be usefully considered. Thus, when abstinence is the target behavior for reinforcement, drug use is generally monitored several times (e.g., three times) weekly because most urine monitoring systems can detect only drug use that has occurred over the prior 48–72 hours. Frequent testing is ideal because it provides little opportunity for patients to use drugs without the test denoting a positive sample, while at the same time, it provides patients with frequent
opportunities to earn reinforcement if they are able to refrain from substance use for a relatively short, 2–3 day period.

**Reinforcers**

Each time a patient tests negative for the targeted substance, the clinician provides the patient with the reinforcer. The reinforcers used in CM interventions have varied from money (Shaner et al. 1997), to vouchers exchangeable for retail goods and services (Higgins et al. 1994), to the opportunity to win prizes of different magnitudes (Petry et al. 2000). In some settings, clinic privileges, such as take-home doses of methadone, are provided (Stitzer et al. 1992). Each of these types of reinforcers has efficacy in reducing drug use, most likely because similar behavioral principles are employed in their design, including the contingent nature of the reinforcement.

**Contingent Link**

Learning occurs most rapidly whenever a desired behavior is immediately followed by its consequence. Thus, in teaching a young child to make his bed, a reinforcer (money, candy) would ideally be provided each day immediately after the child makes the bed. If the bed is not made, no money or candy are given. Once a new behavioral pattern is established, the parent may move to a more intermittent reinforcement schedule, such as awarding more money, or a day out at the movies, after about a week if the bed is made continuously during that period. Research in behavior analysis demonstrates that behaviors that are ultimately reinforced under variable schedules are less likely to extinguish if reinforcement is omitted. Descriptions of rats lever-pressing thousands of times without reinforcement, for example, are noted (Ferster & Skinner 1957), as are descriptions of humans working for many hours for a single drug reinforcer (McLeod & Griffiths 1983).

In CM interventions for substance abusers, the situation becomes a bit more complicated because reinforcement may not be provided for a behavior per se, but instead for the lack of one (nondrug use). Therapists certainly cannot follow patients around in the community and give vouchers continuously during times they successfully refrain from using drugs. Instead, the submission of drug-negative specimens is reinforced, a proxy for refraining from drug use for a several-day period. As described below, these procedures are efficacious in reducing drug use in a number of settings.

**REINFORCEMENT OF DRUG ABSTINENCE**

Abstinence is a primary behavioral outcome in drug abuse treatment, since periods of abstinence are associated with positive benefits both to the individual and to society. Controlled research reviewed below shows that CM procedures providing external reinforcement for evidence of drug abstinence can be highly effective for
promoting sustained periods of abstinence, particularly while the interventions are in place. Natural recovery processes that take place during periods of sustained abstinence, including gradual diminution of response to drug-related cues and lifestyle changes that provide alternative competing reinforcers, may then form the mechanisms for longer-term recovery of addicted individuals. Reinforcement principles have been applied both in outpatient psychosocial counseling programs that treat alcohol, marijuana, and stimulant abusers and in methadone maintenance programs that treat opioid abusers. The following sections review studies that have targeted drug abstinence in these two types of settings.

### Psychosocial Counseling Programs

Psychosocial counseling programs refer to clinics providing counseling and psychotherapy without methadone or other agonist pharmacotherapies. They typically offer individual and group counseling of either a structured format (e.g., cognitive-behavioral therapy) or an eclectic approach.

**STIMULANT TARGET; VOUCHER REINFORCERS** Psychosocial counseling programs have been the focus of a number of CM studies, including one of the first voucher CM studies conducted at the University of Vermont. Higgins et al. (1994) treated all cocaine-dependent patients with community reinforcement approach (CRA) therapy (Budney & Higgins 1998), an individualized and intensive intervention in which therapists may go out into the community to engage patients in treatment and facilitate expansion of their nondrug-using networks. All patients left urine samples twice weekly, which were screened for the presence of cocaine. Half of the patients \((N = 20)\) were randomly assigned to receive CRA alone, and the other half \((N = 20)\) received CRA plus vouchers for every specimen that tested cocaine-negative. Voucher amounts escalated for each consecutive negative specimen, such that the first negative sample resulted in $2.50 in vouchers, the next sample $3.75, then $5.00 and so on. Over a 12-week period, patients could earn about $1000 if they provided all negative specimens. Vouchers could be spent upon retail goods and services that were consistent with a drug-negative lifestyle, and were typically used for gift certificates, clothing, electronics, etc.

Patients who were randomly assigned to the voucher + CRA condition remained in treatment significantly longer and achieved greater durations of abstinence from cocaine than did those assigned to receive CRA alone (Higgins et al. 1994). Three-quarters of patients receiving CM completed the study, compared with 40% receiving CRA alone. Over half of those in the CM condition achieved at least two months of continuous cocaine abstinence versus only 15% in the non-CM condition.

Higgins et al. (2000a) subsequently found that it was not just the availability of vouchers, but rather the contingent delivery of them, that improved outcomes. In that study, all cocaine-dependent patients again received CRA as the platform therapy, but they also all received up to $1000 in vouchers. In one condition, the
vouchers were contingent upon cocaine abstinence (N = 36), but in the other (noncontingent) condition (N = 34), patients received vouchers regardless of the outcomes of their sample results. Provision of noncontingent vouchers resulted in similar proportions of patients remaining in treatment for six months (56% versus 53% in contingent and noncontingent, respectively). However, a higher proportion of those in the contingent versus the noncontingent condition achieved 12 weeks of continuous abstinence during treatment. Thus, a longer period of sustained abstinence was seen when vouchers were contingent upon providing negative samples.

CM is also effective when used by other investigators and in different treatment models. Jones et al. (2004) tested the efficacy of abstinence-contingent vouchers for preventing relapse to cocaine use. After a brief residential stay, cocaine-dependent patients were randomly assigned to conditions in which they could earn up to $1155 in abstinence-contingent (N = 103) or noncontingent (n = 96) vouchers during a 12-week, once weekly outpatient phase. Significant benefits of contingent vouchers were found for the number of cocaine negative samples submitted and days of continuous cocaine abstinence in this commonly used treatment model, in which detoxification is followed by aftercare.

STIMULANT TARGET; PRIZE REINFORCERS Other types of reinforcers have also been investigated for reducing stimulant use in psychosocial treatment programs. This research extends beyond the university setting to community-based clinics, with an aim of reducing costs of the vouchers. Rather than earning escalating amounts of vouchers for successive negative specimens, patients earn the chance to draw a slip of paper from an urn, and each draw is associated with the chance of winning a prize. Only about half the slips result in a prize, as about 50% state, “Good job!” When prize slips are drawn, they are associated with three prize categories, in decreasing probabilities: small $1 prizes (e.g., choice of fast food gift certificates, bus tokens), large $20 prizes (e.g., watches, Walkmans), and jumbo $100 prizes (e.g., TVs, DVD players, boom boxes). The overall cost of prizes per patient using this technique ranges from approximately $240 to $400 during a 12-week treatment period.

Several studies of this approach have been conducted with cocaine-abusing patients (Petry et al. 2004), including one comparing it to traditional voucher CM. Petry et al. (2006) randomly assigned 142 patients at three community-based psychosocial treatment programs to standard care as usual, standard care plus prize bowl reinforcement, or standard care plus voucher reinforcement. Patients in the two CM conditions remained in treatment significantly longer and achieved greater durations of abstinence compared with those in standard treatment alone. Although no statistically significant differences between the two CM conditions were noted, there was a trend toward greater improvements in the prize CM condition relative to the voucher CM condition.

In an even larger, multisite trial conducted at eight clinics throughout the country as part of the Clinical Trials Network (CTN; Petry et al. 2005), 415 stimulant
users were randomly assigned to standard care or standard care plus the chance to win prizes for submission of stimulant-negative specimens. About 35% of patients in standard care remained in treatment throughout the 12-week study period, compared with 50% in the contingent condition. Only 12% of those in standard care versus 26% in the CM condition achieved at least eight weeks of continuous abstinence. No differences in the percentages of negative samples were found, as more than 88% of specimens in both conditions tested negative for stimulants. Thus, most patients were abstinent while they remained in treatment.

Higgins and colleagues have investigated the longer-term posttreatment effects of voucher reinforcement targeted on cocaine abstinence. In one study (Higgins et al. 2000a), the benefits of contingent versus noncontingent voucher reinforcement were apparent for up to 12 months after treatment ended, resulting in higher rates and longer durations of cocaine abstinence for those treated with contingent vouchers. Importantly, Higgins and colleagues (Higgins et al. 2000b) have shown that the likelihood of posttreatment abstinence is directly related to duration of abstinence achieved during treatment. This observation emphasizes the importance of during-treatment abstinence as a primary treatment goal. It also supports the speculation that mechanisms for long-term beneficial effects of CM lie in natural recovery processes and lifestyle changes that take place during periods of prolonged abstinence.

ALCOHOL TARGET Alcohol is the most common substance for which patients seek treatment at psychosocial counseling programs, but few studies of CM have been conducted in this population. The primary reason for the paucity of CM trials in alcohol-dependent patients relates to technological limitations in objectively verifying abstinence. Breath, urine, and blood tests can only detect alcohol use over a brief period, such as four to eight hours. To accurately gauge (and reinforce) alcohol abstinence would require testing two to three times daily, a schedule that is unfeasible in most settings.

Only a few studies have evaluated the efficacy of CM in primarily alcohol-abusing populations (e.g., Miller 1975, Petry et al. 2000). Miller (1975) randomly assigned 20 individuals with multiple public drunkenness offenses either to standard care or to a CM intervention that provided basic goods and services contingent upon sobriety. This intervention resulted in substantial reductions in public drunkenness arrests and alcohol consumption. In a larger trial of 42 patients, Petry et al. (2000) applied the prize-CM approach to alcohol-dependent veterans receiving intensive outpatient treatment at a Veterans Administration hospital. More than 80% of those assigned to the CM condition remained in treatment throughout the eight-week study period versus 22% of those in the standard care condition. Further, as shown in Figure 1, 69% of those in the CM versus 39% in the standard care condition reported no alcohol use through the end of treatment.

MARIJUANA TARGET Detection of marijuana abstinence suffers from the opposite problem as alcohol: In chronic marijuana users, samples can test positive for several
Figure 1  Relapse to alcohol use during an eight-week treatment period. Abstinence survival data are shown for patients who received a prize-draw contingency management (CM) intervention based on negative breath-alcohol readings in an outpatient psychosocial counseling program (N = 19) and those who received usual-care counseling without the CM intervention (N = 23). (From Petry et al. 2000)

weeks after use ceases. Thus, reinforcing patients for initial efforts at abstinence is much more difficult. Despite these technical issues, CM interventions can be efficacious in reducing marijuana use. Budney et al. (2000) randomly assigned 60 marijuana abusers to motivational enhancement therapy (MET) alone, MET in combination with cognitive-behavioral therapy (CBT), or the two psychotherapies plus voucher CM (maximum of $570 over 12 weeks). To address the potentially long latency to achieve negative urine tests, vouchers did not begin until week 3 of the 14-week study. Results were striking: Those in the CM condition achieved an average of 4.8 weeks of continuous abstinence versus 2.3 and 1.6 weeks in the two non-CM conditions. Thus, even with substantial modifications such as reduced earnings and delay in start of reinforcement, CM was highly efficacious in reducing marijuana use.

CIGARETTE SMOKING TARGET  Offering payments contingently for evidence of smoking reduction (i.e., reduced breath carbon monoxide readings) is an effective method to alter cigarette-smoking behavior in general samples of smokers who are not trying to quit (Stitzer & Bigelow 1983, 1984). More recently, CM approaches
have been used to engender periods of smoking abstinence in nonquitters (Alessi et al. 2004, Heil et al. 2003). Contingent reinforcement techniques could be used in smoking cessation programs as well, and recently the technique has been applied to substance abusers who wish to quit smoking (Shoptaw et al. 2002).

These studies suggest that CM holds promise as an aid to smoking cessation treatment. However, technical issues need to be worked out, including identification of feasible and appropriate biological markers for verifying smoking abstinence. Breath carbon monoxide is convenient to measure, but it requires frequent monitoring due to its very short half-life. Cotinine, nicotine’s major metabolite, can be measured in urine or saliva, has a longer (20-hour) half-life and is a highly sensitive index of nicotine intake (Benowitz 1996). Previously, this metabolic by-product required specialized laboratory technology to measure, but new dipstick technologies (Gariti et al. 2002) hold promise for improving feasibility and may have useful application in CM for smoking cessation.

Methadone Maintenance Programs

Methadone is a long-acting, orally effective opioid medication that can be used to treat opioid dependence. It relieves withdrawal symptoms and attenuates effects of short-acting opioids through cross-tolerance. Although methadone is a highly efficacious treatment for opioid users, the continuing use of other drugs during treatment is a serious problem, but one that can be addressed with CM.

Some of the initial studies of voucher reinforcement were conducted within methadone clinics because many methadone patients abuse stimulants in addition to opioids. For example, Silverman et al. (1996) utilized a yoked-control design similar to that of Higgins et al. (2000a). All 40 patients in this study received standard methadone therapy, but half were randomly assigned to a condition in which vouchers (maximum of $1155 over 12 weeks) were contingent upon cocaine abstinence, while the other half were assigned to a noncontingent voucher condition. More than 80% of the patients in both groups remained in treatment for the entire 12-week trial. About half of the patients in the voucher condition were able to achieve eight or more weeks of continuous cocaine abstinence compared with none who achieved this duration of abstinence when vouchers were delivered independent of behavior.

Other studies add considerable weight to the evidence that CM is efficacious in reducing stimulant use during methadone treatment and also have tried to identify improved intervention parameters. One study (Silverman et al. 1998) replicated prior observations that vouchers could significantly reduce cocaine use during treatment, but found that adding up to twelve $50 bonuses during the first six weeks of treatment based on early abstinence initiation did not improve outcomes.

More recently, Silverman and colleagues (2004) examined the additive benefits of abstinence-contingent take-homes and voucher reinforcers in a study that extended the intervention duration to 52 weeks. Methadone patients (N = 78) with
Figure 2  Percent cocaine-negative samples submitted during a 10-week baseline period and a 52-week intervention. Methadone-maintained patients with evidence of ongoing cocaine use were randomly assigned in week 10 to receive one of three interventions: (a) take-homes contingent on opioid- and cocaine-negative samples plus vouchers contingent on cocaine negative samples, (b) contingent take-home reinforcers only, or (c) usual-care methadone maintenance with no contingent reinforcers (N = 26 per group). (Adapted from Silverman et al. 2004)

Evidence of ongoing cocaine use were randomly assigned to conditions where they could (a) earn methadone take-homes (three per week) for providing opioid- and cocaine-free urines, (b) earn take-homes as above and also vouchers (maximum of $5500 over 52 weeks) for cocaine-free urines, or (c) participate in usual care without the opportunity to earn abstinence-contingent incentives. As illustrated in Figure 2, results were impressive, with significant between-group differences in overall rates of cocaine-negative urines submitted. In addition, 42% of participants were continuously abstinent from stimulants for six months or more in the take-home plus voucher group as compared with 8% in the take-home only and 0% in the standard-care groups. Further, initiation of long periods of sustained abstinence was observed across the first nine months of the trial. These data suggest a benefit of long-term implementation of CM with methadone patients.

The prize CM technique is also efficacious in cocaine-using methadone patients. Petry et al. (2005) randomly assigned 77 cocaine-abusing methadone patients to standard treatment or standard treatment plus prize CM. Patients receiving CM had about twice the rate of cocaine abstinence as those in the standard condition.
A similar study was conducted in six methadone clinics throughout the country as part of the National Drug Abuse Treatment Clinical Trials Network. Peirce et al. (2006) randomly assigned 388 cocaine-using methadone patients to standard treatment alone or with prize CM. Patients could earn up to $400 during a 12-week study if their samples tested negative. The overall proportion of cocaine-negative samples submitted in the CM group (54%) was significantly greater than in the standard group (37%), and the odds that a stimulant-negative sample would be submitted during treatment were doubled by the CM intervention.

Other CM studies have focused explicitly on opioid use during methadone treatment. Some of these studies were conducted prior to the advent of vouchers and utilized cash or clinic privileges such as take-home methadone doses as reinforcers. For example, Stitzer et al. (1980) showed that patients submitted fewer opioid-positive samples during periods when they could earn money or take-homes for negative samples. Silverman et al. (1996b) showed that opioid use could be dramatically suppressed by a voucher CM program (maximum of $1155 over 12 weeks), and Preston et al. (2000) investigated the separate and combined benefits of higher methadone doses and CM in 120 methadone patients. Contingent vouchers (maximum of $554 over eight weeks) and higher methadone dose (70 mg versus 50 gm) each significantly increased the percentage of opioid-negative specimens, but the combined intervention did not have additive benefits.

Because of the high rates of polydrug use observed in methadone patients, some studies have applied contingencies to abstinence from multiple drugs concurrently. Generally, these procedures are not as efficacious as when reinforcement is provided for abstinence from one drug at a time (Downey et al. 2000, Griffith et al. 2000, Piotrowski et al. 1999). Most likely, reduced efficacy is related to the difficulty of abstaining from several drugs simultaneously among those individuals who use many types of drugs concurrently. Even when cocaine abstinence alone is reinforced in methadone patients, over half the sample may be unable to provide even a single cocaine-free sample (Dallery et al. 2001, Silverman et al. 1996a). This situation is likely exacerbated in those who use multiple drugs.

Nevertheless, there have been some successful demonstrations of CM application to polydrug use targets in methadone patients. Stitzer et al. (1992) showed that abstinent-contingent, as compared with noncontingent, methadone take-home privileges resulted in more patients showing sustained reductions in drug use even though the contingency involved multiple drugs (opioids, cocaine, benzodiazepines) and required a relatively long (two-week) period of abstinence prior to receipt of the reinforcer. Some schedules that use bonuses to reinforce multdrug abstinence have also been successful. Petry & Martin (2002) devised a CM schedule in which patients earned a single draw if their samples tested negative for either cocaine or opioids, and bonus draws when they were abstinent from both drugs concurrently. This intervention was successful in simultaneously reducing use of
both drugs. In the CTN study of prize CM (Peirce et al. 2006), methadone patients were required to be abstinent from both alcohol and stimulants to earn prizes, with concurrent opioid abstinence resulting in additional bonus draws. Both stimulant and opioid abstinence increased in the CM relative to the non-CM condition.

Several studies have shown that reductions in nontargeted drugs can be observed when reinforcement is directed toward a single drug. Thus, opioid use may decline when cocaine is the target of intervention (e.g., Silverman et al. 1996a, 2004), and cocaine use has declined when opioids are targeted (Robles et al. 2002). Additional research is needed to determine whether bonuses further reduce use of secondary drugs beyond the spontaneous reductions seen when a single drug is targeted.

### Detoxification Programs

While methadone maintenance is considered the optimal treatment for most opioid-dependent patients, short-term medically supervised detoxifications are used clinically to ameliorate withdrawal during the initial stage of abstinence. Several studies have demonstrated the efficacy of CM procedures for improving outcomes during (though not necessarily after) detoxification. In one early study (Higgins et al. 1986), opioid-dependent patients (N = 58) in a 13-week methadone taper were randomly assigned to one of three conditions, two of which involved the opportunity to request and receive up to 20-mg daily dose increases during the taper period. Relapse was seen in both those who could not request the dose increase and in those who could request an increase independent of their urine test results. In contrast, those who could request the increase only if their sample tested negative for opioids had significantly fewer opioid-positive samples during treatment and showed little evidence of relapse. This study suggests an inexpensive strategy for suppressing relapse during a methadone dose taper while potentially tailoring the speed of the taper to the ability of patients to maintain abstinence.

Another study (Robles et al. 2002) utilized vouchers to reduce relapse during a 10-week methadone dose taper. Vouchers (maximum of $2232 over 22 weeks) for opioid-free samples were available both before, during, and after the taper. Although the intervention by no means eliminated relapse, rates of opioid-negative urines were significantly higher among those who received vouchers contingent on opioid abstinence than among those who received noncontingent vouchers (74% versus 35% negative samples, respectively). Bickel et al. (1997) also found that voucher CM for opioid abstinence (maximum earnings of about $660) improved outcomes during a 23-week buprenorphine detoxification. Both retention and during-treatment abstinence were significantly increased by CM. Finally, Katz et al. (2004) offered a one-time $100 bonus for completion of a one-week outpatient detox with an opioid- and cocaine-negative urine result; they showed a small but statistically significant effect of CM in terms of percent negative samples submitted on the last day of the detoxification.

Although therapeutic benefits of detoxification are generally limited in the absence of some kind of continuing treatment, the studies reviewed here provide
support for the potential utility of CM approaches in helping more patients to successfully complete detoxification protocols.

REINFORCEMENT OF OTHER TARGET BEHAVIORS

Abstinence from illicit drugs and alcohol may be considered the most important goal of drug abuse treatment. However, many other behaviors are legitimate targets of interventions. These behaviors, many of which are critical for long-term health and psychosocial outcomes, can be positively influenced by CM interventions, as reviewed in the following section.

Therapy Attendance

As noted earlier, CM procedures that reinforce abstinence in psychosocial counseling programs also tend to have beneficial effects in improving retention, most likely because the requirement of leaving samples necessitates attendance. However, simply reinforcing attendance alone can have benefits. In methadone patients, Stitzer et al. (1977) and Kidorf et al. (1994) successfully used take-home methadone doses to reinforce therapy attendance. Similarly, Rhodes et al. (2003) found that prize-based CM improved on-time counseling session attendance in methadone patients. However, CM procedures are not always effective in enhancing attendance, and attendance may not necessarily be associated with reduction in drug use (Kidorf et al. 1994). In a CM study with pregnant substance abusers, Svikis et al. (1997) noted a modest improvement in attendance of women enrolled in a psychosocial counseling modality when $5 or $10 per day was offered but not when $0 or $1 was available. Jones et al. (2000) found little benefit of a low-magnitude voucher system ($5 per day on the first seven days of outpatient treatment), regardless of whether vouchers were contingent upon attendance alone or abstinence. In a later study, however, Jones et al. (2001) found better attendance and drug use outcomes when pregnant women were offered reinforcement under an escalating voucher schedule (maximum earnings of $525) during their first two weeks of treatment. The less favorable outcomes in some studies may relate to the low magnitudes of reinforcement provided.

Treatment Plans

Because of the array of problems encountered by drug-abusing patients, some studies have applied reinforcement contingent upon completion of goal-related activities (Bickel et al. 1997, Iguchi et al. 1997). For example, patients may decide upon three activities each week that are related to their treatment goals. These activities could include attending a medical appointment if the goal is to improve health, going to the library with their child if the goal is to improve parenting, or filling out a job application if the goal is to obtain employment. If patients successfully accomplish these activities and provide objective
documentation of their completion, they would earn vouchers or draws from a fishbowl.

Some data suggest that involvement in these activities may reduce drug use. In a study of polydrug-using methadone patients, Iguchi et al. (1997) found that a condition in which vouchers were provided contingent only upon compliance with activities was more effective in reducing drug use than a condition in which abstinence alone was reinforced. However, the basic design of that study was recently replicated in a psychosocial counseling program, with different results (N.M. Petry, S.M. Alessi, K.M. Carroll, T. Hanson, S. McKinnon, et al., under review). In this study, 131 patients were randomly assigned to treatment as usual, prize CM for submission of drug-negative samples, or prize CM for completion of goal-related activities. The total number of draws and magnitudes of expected prizes were equivalent in the two CM conditions. Although both CM interventions improved outcomes relative to standard treatment alone, the CM-abstinence condition resulted in greater retention and more abstinence than did the CM-activity condition. Thus, in this study, reinforcing abstinence was the better method for improving outcomes. Nevertheless, future research should explore interventions that combine use of different behavioral targets to see whether additive or synergistic effects might be achieved. This is particularly relevant in light of the hypothesized role that may be played by competing reinforcers derived from a nondrug lifestyle in supporting long-term abstinence.

Medication Adherence

Another class of therapeutically important behaviors that can be improved through CM is medication adherence. Adherence to medication regimens is particularly poor among substance abusers (e.g., Cox et al. 1996). For example, an individual who consistently ingests the opioid antagonist naltrexone cannot experience opioid effects or relapse to dependence, but adherence to naltrexone is poor (Natl. Res. Counc. 1978). Several studies have shown that reinforcing naltrexone consumption can greatly increase adherence. Preston et al. (1999) compared retention and opioid drug use among 57 recently detoxified opioid-dependent patients who received voucher reinforcers (maximum of $1155 over 12 weeks) for ingesting naltrexone three times per week under observation at the clinic with those who received yoked vouchers independent of their naltrexone ingestion or who received a naltrexone prescription after their detoxification with no contingencies (usual care). The mean number of naltrexone doses ingested was significantly greater for the contingent reinforcement (21.4 doses) than for noncontingent (11.3 doses) or usual-care (4.4 doses) groups, and drug use outcomes were closely tied to whether or not naltrexone had been ingested. As shown in Figure 3, retention to the end of treatment, at 50%, 25%, and 5% for the three groups, respectively, was related to the amount of naltrexone ingested rather than to the amount of voucher money received, which was equated for the contingent and noncontingent voucher groups.
Similarly, Carroll et al. (2001) randomized patients to two groups that could earn vouchers (maximum of $561) for ingesting naltrexone and providing opioid-negative urines (N = 85). These patients had significantly better retention and drug-use outcomes than patients (N = 44) who received standard supervised naltrexone. In a follow-up study, Carroll et al. (2002) found doubling voucher values did not further improve outcomes.

CM techniques may also be useful for improving adherence to HIV regimes. Rigsby and colleagues (2000) found that contingent monetary reinforcement combined with a personalized cue reminder plan resulted in better adherence to an HIV pharmacotherapy regimen than did the cue reminder plan alone or nondirective inquiries about medication ingestion. Seal et al. (2003) compared the effectiveness of clinical outreach versus monetary incentives ($20/month) for adherence to a three-dose hepatitis B vaccine regimen. Only 23% in the outreach group completed the vaccine regimen compared with 69% in the CM condition.

In sum, CM can be effective for reinforcing medication adherence, and this in turn may assist patients in achieving and maintaining drug abstinence and/or improving medical and psychiatric conditions. However, some technical issues need to be addressed before this approach is implemented widely, especially for
medications that require doses be ingested away from the clinic such that ingestion cannot be directly monitored and immediately reinforced.

INTERVENTION PARAMETERS

The preceding sections have documented the wide array of behaviors that can be modified using CM techniques and have noted that a number of different reinforcers are efficacious in altering behaviors of substance abusers. Despite this heterogeneity, several technical commonalities are noted in successful CM interventions, as detailed below.

Schedules of Reinforcement: Escalating and Reset Features

Both voucher and prize CM studies have applied escalating schedules of reinforcement with resets back to low levels of reinforcement following a lapse to inappropriate behavior, a strategy designed to reinforce sustained behavior change. Specifically, as patients achieve longer periods of abstinence, the value of the vouchers or number of draws increases. By the end of the 12-week treatment period in Higgins’s studies (1994, 2000, 2003), for example, patients could earn over $30 for each drug-free urine specimen. Similarly, in the prize CM procedure, patients can earn up to 10–15 draws. If a sample is positive, refused, or missed (e.g., unexcused absence), the next negative sample provided results in a reset to $2.50 in vouchers or one draw from the fishbowl.

Eliminating the escalation feature and delivering a constant rate of reinforcement may make the voucher system less expensive and easier to implement. A study by Roll et al. (1996) compared in cigarette smokers the escalating approach to one that provided a constant rate of reinforcement, with both procedures providing equivalent total amounts of reinforcement. Although both schedules engendered similar amounts of overall abstinence, the escalating system resulted in longer periods of continuous abstinence, which in turn have been associated with good long-term outcomes (Higgins et al. 2000b, Petry et al. 2006). These results suggest that an escalating system may be necessary for inducing significant periods of sustained abstinence, at least initially. Once behavior change has occurred, and sustained abstinence is ongoing, the value of the reinforcer may be reduced (e.g., $1 lottery ticket) without a detrimental impact on outcomes.

The importance of engendering stable initial abstinence was highlighted in a study by Kirby et al. (1998), where few cocaine-dependent patients initiated abstinence under a traditional escalating schedule. However, much better outcomes were achieved in this population with a schedule that provided higher-valued reinforcers initially for each negative sample and then tapered the density of reinforcement using a fixed ratio schedule (i.e., requiring an increasing number of consecutive negative urines to receive the reinforcer). Future studies should evaluate systematically and in a variety of populations the reinforcement parameters.
that can engender abstinence in the largest number of patients as well as when, and by how much, reinforcer magnitudes can be reduced without compromising efficacy after stable abstinence is achieved.

**Reinforcer Immediacy and Magnitude**

Learning occurs best when each time the target behavior is exhibited it is followed by its consequence without delay (e.g., Zeiler 1977). Voucher programs use this behavioral principal by providing vouchers right after submission of a negative specimen. Moreover, samples are screened within minutes of collection, and data suggest that onsite testing systems engender greater abstinence than sending samples offsite for testing (Schwartz et al. 1987). Similarly, draws from the fishbowl or exchange of vouchers for retail items occur with minimal delay, 2–3 days from request. Meta-analyses demonstrate that immediacy of reinforcement appears to be linked to effect sizes in CM studies (Griffith et al. 2000).

Behavior is determined not only by the rate of reinforcement but also by its magnitude (Catania 1966), and studies of CM likewise find that magnitude of reinforcement affects outcomes. Stitzer & Bigelow (1983, 1984) found that nicotine abstinence increased as a function of the magnitude of the reinforcer, ranging from $0 to $12 per day. Silverman et al. (1999) found that some cocaine-using methadone patients who were “treatment resistant” at standard voucher amounts achieved abstinence if amounts were increased threefold. Dallery et al. (2001) noted a direct relationship between voucher amounts and abstinence in another study of methadone patients. These studies all suggest that larger-magnitude reinforcers may improve outcomes. Yet, some studies employing low-magnitude reinforcers have demonstrated positive effects. Rowan-Szal et al. (1994) found that stars exchangeable for $5 items reduced drug use. Petry et al. (2000, 2002, 2004, 2005, 2006) found that prize systems based on intermittent reinforcement reduced alcohol, cocaine, and opioid use despite relatively low overall cost. Thus, when principles associated with learning are applied, positive outcomes may be achieved with lower-magnitude reinforcers. However, more research is needed to identify characteristics of patients who can benefit from low-magnitude reinforcers versus those that require higher-magnitude reinforcers for effective behavior change. For example, there is currently no evidence to indicate that individuals with lower versus higher income levels differentially benefit from CM interventions. However, it may be the case that income status could influence the reinforcer magnitude that is effective with a given individual.

**Shaping**

Another principle central to establishing new behavioral patterns is to reinforce successive approximations, or shaping. For example, in teaching lever-press behavior, a rat may be reinforced initially for sniffing the lever. As the rat begins to sniff the lever more frequently, eventually he will lean on it and press it. Each gradual approximation toward the lever-press response is reinforced. Similarly, in establishing a pattern of drug abstinence, substance abuse clients can be
reinforced for approximations of abstinence. Preston et al. (2001) showed that an initial “shaping” procedure that reinforced reductions in urinary cocaine metabolite during the first three weeks of an eight-week intervention led to higher rates of abstinence during a subsequent abstinence-based reinforcement phase, possibly because the shaping procedure allowed more participants to earn reinforcers and thus come into contact with the benefits of the incentive program.

Shaping procedures may be particularly efficacious in difficult-to-treat patients. Robles et al. (2000) developed the “brief abstinence test,” which provides a $100 voucher contingent upon quantitative urinalysis evidence of recent (two-day) cocaine abstinence. Decrease in urinary benzoylecgonine concentration over the two-day test was seen in 94% of patients when the reinforcer was available, compared with 46% and 48% with decreasing concentrations during a comparable period in the weeks preceding and following the abstinence test. Similarly, urinalysis criteria for cocaine abstinence was met by 84% of study participants when the reinforcer was available compared with only 36% and 32% meeting abstinence criteria during the weeks preceding and following the test. Although this procedure appears useful for initiating abstinence in cocaine users, its clinical utility has yet to be demonstrated (Katz et al. 2002, Sigmon et al. 2004).

COMBINATION THERAPIES

One new direction in the field of CM research is to examine how CM may additively or synergistically improve outcomes when combined with pharmacotherapies or other psychotherapies. Higgins’s original voucher reinforcement studies combined CM with an intensive behavioral therapy based on the Community Reinforcement Approach (Budney & Higgins 1998). Higgins has now examined the separate and combined efficacy of these major components of his multicomponent treatment. One recent study (Higgins et al. 2003) showed that combined treatment with voucher reinforcers and CRA therapy produced better outcomes both during and after treatment than the voucher reinforcement alone. For example, six-month treatment retention rates were 65% with the combined treatment versus 33% with vouchers alone. Cocaine use was lower during (but not after) treatment with the combined therapy compared with vouchers alone, and other outcomes including alcohol use and employment were also superior both during and after treatment with the combined approach. Thus, the study provides evidence of an additive benefit for combining CM with an intensive behavioral counseling program. However, studies in methadone populations that used a different type of counseling have not reached the same conclusion.

Rawson et al. (2002) examined the separate and combined effects of voucher reinforcement and cognitive-behavioral therapy (CBT) for improving cocaine abstinence outcomes in methadone-maintenance patients. The CM intervention was more effective than CBT for reducing cocaine use during treatment, but both interventions were equally effective (and superior to no treatment control) at 6- and 12-month follow-ups, with no additive effects of the interventions noted.
A similar study by Epstein et al. (2003), also conducted in cocaine-using methadone-maintenance patients, also found significantly better during-treatment results when CM was implemented than when it was not, but the combination of CM and CBT produced better outcomes than did other treatments at some posttreatment evaluation time-points. More research is needed to resolve these discrepant results across studies, and this is an important area of investigation for understanding the mechanisms of behavior change underlying long-term abstinence outcomes when external reinforcers are used during CM interventions to promote periods of sustained abstinence.

Voucher incentives can also be used as a behavioral platform in pharmacotherapy studies (e.g., Jones et al. 2004). This strategy has the advantage of stabilizing and equating external motivation for abstinence across all treated patients. Kosten et al. (2003), for example, used a four-cell design to examine desipramine (DMI; 150 mg/day) versus placebo combined with contingent (CM; maximum of $738 over 12 weeks for opioid- and cocaine-negative urines) versus noncontingent vouchers as treatments to reduce opioid and cocaine use in buprenorphine-maintained outpatients. An additive effect was found in that participants receiving the combined treatment (DMI + CM) submitted significantly more opioid- and cocaine-free urines during treatment than did members of any other treatment group. This suggests that combining CM with medication treatments may be a good strategy for enhanced treatment effectiveness. However, additional research would be needed in order to identify conditions under which the beneficial effects of various combined therapies are or are not apparent.

NOVEL APPLICATIONS OF CONTINGENCY MANAGEMENT

As the principles of CM have become more widely accepted within both the research and treatment communities, novel applications have emerged that are designed to translate these principles into programs that can be integrated with ongoing community treatment models and community resources. Milby et al. (1996, 2000) have developed and tested a comprehensive treatment program that incorporates principles of CM while addressing basic needs of homeless cocaine abusers. In the comprehensive program, all patients can participate in an intensive day-treatment program that focuses on skills training and goal setting. In addition, patients may be able to receive program-supported housing and employment in the community, with the latter benefits contingent upon evidence of drug abstinence. Two randomized evaluation studies have been conducted. One study (Milby et al. 1996) showed that day treatment with contingent housing and work produced better outcomes on measures of both drug use and homelessness than did usual care delivered in a different program that provided twice weekly counseling and referral services. A second study, as shown in Figure 4, revealed that the program including contingent housing and work produced better outcomes than did the intensive day-treatment program alone (Milby et al. 2000).
Figure 4  Percentage of patients drug abstinence at two and six months after treatment enrollment. Data are shown for those who received intensive day treatment only (N = 54) versus day treatment with contingent access to program-sponsored housing and employment (N = 56). Drug abstinence was defined as urines testing negative for cocaine, marijuana, alcohol, amphetamine, morphine, and benzodiazepines. (Adapted from Milby et al. 2000)

Another variation on the theme of intensive day treatment with contingent access to community resources is a medication-free outpatient treatment program (reinforcement-based therapy) for inner-city heroin abusers developed at Johns Hopkins University School of Medicine. This program provides individual counseling based on the community reinforcement approach (Budney & Higgins 1998). Those who remain drug-free can also receive rent for community recovery housing, help with finding a job, and access to a daily recreation program designed to expose participants to alternative sources of nondrug reinforcement in the community. This treatment, implemented with heroin abusers exiting medically supported detoxification, produced significantly better outcomes compared with a usual care intervention in which patients exiting detox are referred to community treatment programs for aftercare (Gruber et al. 2000, Jones et al. 2005).

Finally, Silverman and colleagues have developed a novel and innovative application of CM in which drug abusers are allowed to participate in paid job training or to work in a program-operated data entry business, but can only earn salary for work on days when they have delivered opioid and cocaine-free urine samples at the program. In this novel conceptualization of CM, earned salary is used as the contingent benefit, with the opportunity to work and earn salary being closely
tied to and contingent upon abstinence. The program has demonstrated efficacy for sustaining both attendance and abstinence at six-month (Silverman et al. 2001) and three-year (Silverman et al. 2002) evaluations. The idea of integrating abstinence requirements into employment could be incorporated into employment or training programs operated by treatment systems. Importantly, it is also an approach that may be acceptable for adoption by community-based employers.

SUMMARY AND CONCLUSIONS

CM interventions continue to demonstrate efficacy and utility for improving drug abuse treatment outcomes. Their ability to promote periods of sustained abstinence has been documented for stimulants, alcohol, and marijuana when delivered in the context of psychosocial counseling treatment programs and for stimulants, opioids, tobacco, and polydrug use when delivered in the context of methadone treatment programs. Further, methodologies that employ principles of intermittent reinforcement have now been developed and tested that can reduce the cost of CM interventions, and the effectiveness of these lower-cost interventions has been documented in large multisite clinical trials implemented in community treatment programs. The principles of CM have been effectively applied to other therapeutic behaviors such as attendance, goal performance, and medication adherence. Further, novel applications have been developed that integrate CM into community treatment and employment-based models, thus expanding their potential therapeutic application.

Overall, the application of CM principles to the treatment of drug abuse has altered the landscape and conceptualization of treatment intervention. Research on CM interventions continues to grow and thrive. Future research will no doubt improve the efficacy and reach of these interventions by clarifying optimal intervention parameters, by continuing to develop models tailored to the needs of special populations, by translating contingency management principles into programs feasible for adoption by community treatment providers and other agencies, and by better understanding the underlying mechanisms of short- and long-term behavior change associated with the use of CM.

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