CONTINGENCY MANAGEMENT FOR THE TREATMENT OF STIMULANT USE DISORDERS

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CENTER OF EXCELLENCE

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Executive Summary

Background

Contingency Management (CM) is a behavioral treatment model rooted in operant conditioning, aiming to modify behavior through positive reinforcement. Initially popularized in the 1980s and 1990s, it was primarily used in the treatment of alcohol and cocaine use disorders. CM typically includes two reinforcement approaches: (1) voucher-based rewards and (2) prize-based rewards. Voucher-based CM rewards participants with vouchers of monetary value for achieving desired behaviors, often abstinence from substances. Similarly, prize-based CM offers participants the opportunity to draw prizes upon achieving specified goals. Additionally, the current review identified a third reinforcement approach—abstinence-based housing CM—designed for individuals experiencing homelessness. In this approach, participants are granted housing contingent upon meeting specific criteria for abstinence, with the opportunity to maintain housing by sustaining abstinence.

Methods

To understand and assess the effectiveness and utility of the CM, a literature review was conducted to investigate the outcomes associated with the model. Thirty-six articles met eligibility criteria for a full review. Reviewed studies were all experimental designs, with participants randomly assigned to either the CM or another form of treatment. Twenty-six studies were conducted in the U.S., five were conducted in Spain, four in Brazil, and one in Switzerland. The outcomes reviewed included drug use (e.g., abstinence and/or reduction in drug use), treatment retention (e.g., session attendance and/or treatment completion), and the risk for human immunodeficiency virus (HIV-risk) outcomes due to its prominence as a comorbid condition.

Findings

Voucher-based CM was more extensively investigated, followed by prize-based and abstinence-based housing among the studies that were identified for the review. CM was often combined with psychosocial treatments. Overall, the evidence strongly supports the effectiveness of CM in improving drug use outcomes and treatment retention. Studies show that treatment groups receiving CM had higher rates of abstinence, longer average treatment durations, and greater session attendance compared to their counterparts. Additionally, although not always statistically significant, several studies suggested the sustainability of CM-related improvements in drug use outcomes extending beyond the active treatment periods.

Conclusion

This review highlights the efficacy of CM in reducing drug use and enhancing treatment retention for individuals with stimulant use disorders, with voucher-based CM being the most extensively studied CM modality. Notably, all studies were experimental in design, with some including special populations, such as pregnant women, individuals experiencing homelessness, and gay and bisexual men, all showing promising outcomes. While most studies reinforced abstinence from stimulants, the question of how many substances to target for reinforcement incentives remains unanswered. Results did not appear to vary based on the number of substances targeted, suggesting implementation of the CM may be based on client needs and agency procedures. Additionally, studies recommend further exploration of CM's cost-effectiveness, with varying earnings per participant based on CM type and reinforced behavior. The Recovery Incentive Program in California exemplifies a leading state-level CM implementation model, offering valuable insights for future directions. Conducting

benchmarking interviews with this program may provide valuable insights and guidance to enhance Ohio's training and implementation efforts.

Stimulant Use Disorder Trends in the U.S. and Ohio

Substance misuse poses a significant challenge in the United States, particularly with increases in overdose deaths from stimulant use (Ahmad et al., 2024). The term "stimulants" refers to a class of drugs that includes "prescription drugs such as amphetamines, methylphenidate, diet aids, and other illicitly used drugs such as methamphetamine, cocaine, methcathinone, and other synthetic cathinones that are commonly sold under the guise of 'bath salts' that can come in multiple forms, such as 'pills, powders, rocks, and injectable liquids'" (U.S. Drug Enforcement Administration [DEA], 2020). While there are important therapeutic and medical uses for stimulants under the guidance and supervision of medical professionals, the misuse of these substances can lead to serious individual and public health consequences (U.S. DEA, 2020). The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM–5TR) defines stimulant use disorder as, "a pattern of amphetamine-type substance, cocaine, or other stimulant use leading to clinically significant impairment or distress" (American Psychiatric Association [APA], 2022).

The Centers for Disease Control and Prevention's National Vital Statistics System provides reported and provisional drug overdose death estimates every month from January 2015 through the present (Ahmad et al., 2024). Estimates represent the count of deaths that occurred over the last 12 months since the month of the estimate. Data are available at the national and state levels for several drug classes. Stimulant use drug classes available in these data include cocaine and psychostimulants with abuse potential, which includes methamphetamines. Figures

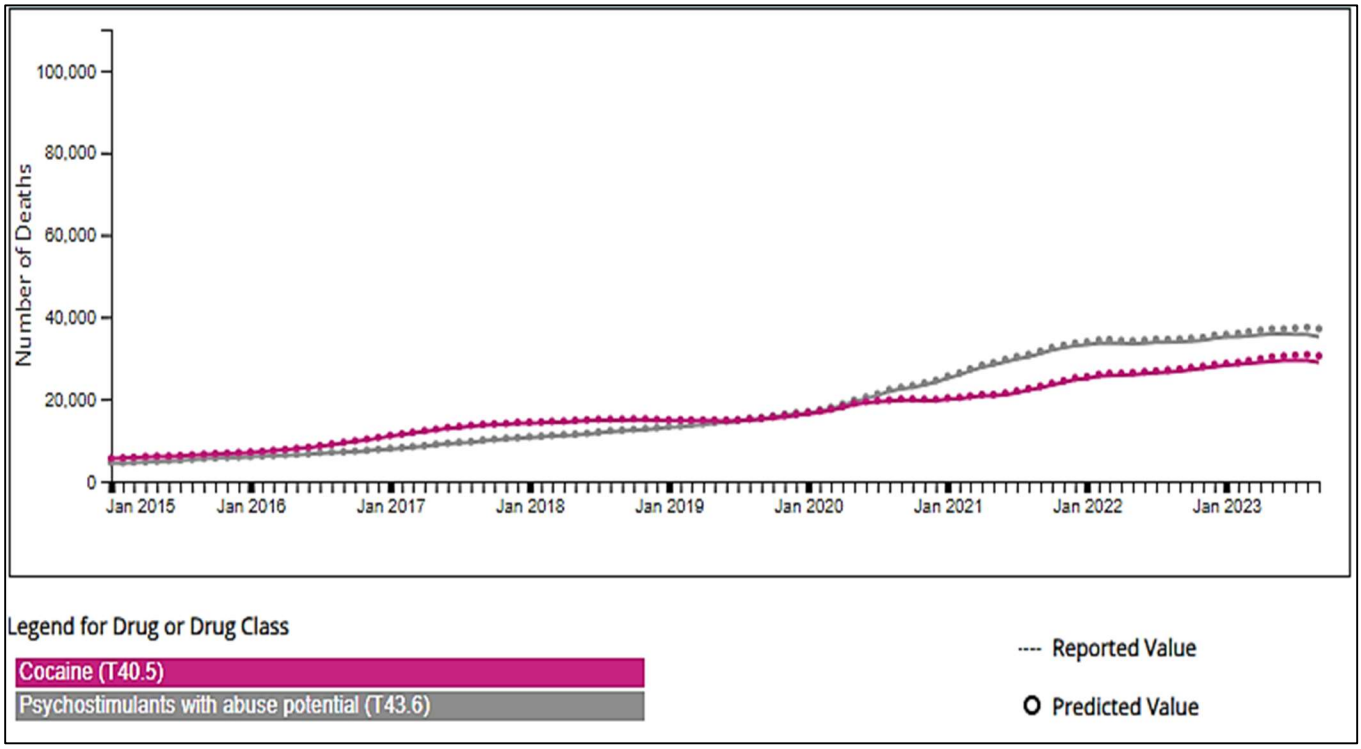
1 and 2 show trends in drug overdose deaths connected to stimulant use in the US and Ohio between 2015 and 2023 where data are available. The reported number of deaths from cocaine and psychostimulants with abuse potential has increased dramatically between January 2015 and September 2023 in the U.S. Cocaine-related deaths rose from 5,496 to 29,887, a five-fold increase, while deaths attributed to psychostimulants with abuse potential surged from 4,402 to 36,289, representing an eight-fold increase. Ohio has also witnessed a significant increase in overdose deaths due to these substances. From April 2015 to September 2023, cocaine overdose deaths in Ohio increased from 581 to 1,886, a three-fold increase, and overdose deaths related to psychostimulants with abuse potential rose from 77 to 1,433, representing more than an 18-fold increase (Ahmad et al., 2024).

According to the 2022 National Survey on Drug Use and Health (NSDUH), 1.8 million people over the age of 12 had methamphetamine use disorder, 1.4 million people had cocaine use disorder, and 1.8 million people had prescription stimulant use disorder in the U.S. (Substance Abuse and Mental Health Services Administration [SAMHSA], 2023).[1] Reports of the percentage of the population using cocaine and methamphetamines show variation from year to year. The latest data from the NSDUH show that the prevalence of methamphetamine use in Ohio had a sharper increase (83%) than the United States (9%) in 2017-2018 and 2018-2019 (SAMHSA, 2021). The prevalence of cocaine use in Ohio showed an increase of 8% for the same period, whereas there was a 5% decrease in the United States during that time frame (SAMHSA, 2021).

[1] These diagnoses are not necessarily mutually exclusive; therefore, these numbers cannot be added together because one person may have multiple diagnoses.

Figure 1

Provisional Number of Drug Overdose Deaths by Drug or Drug Class: United States[2]

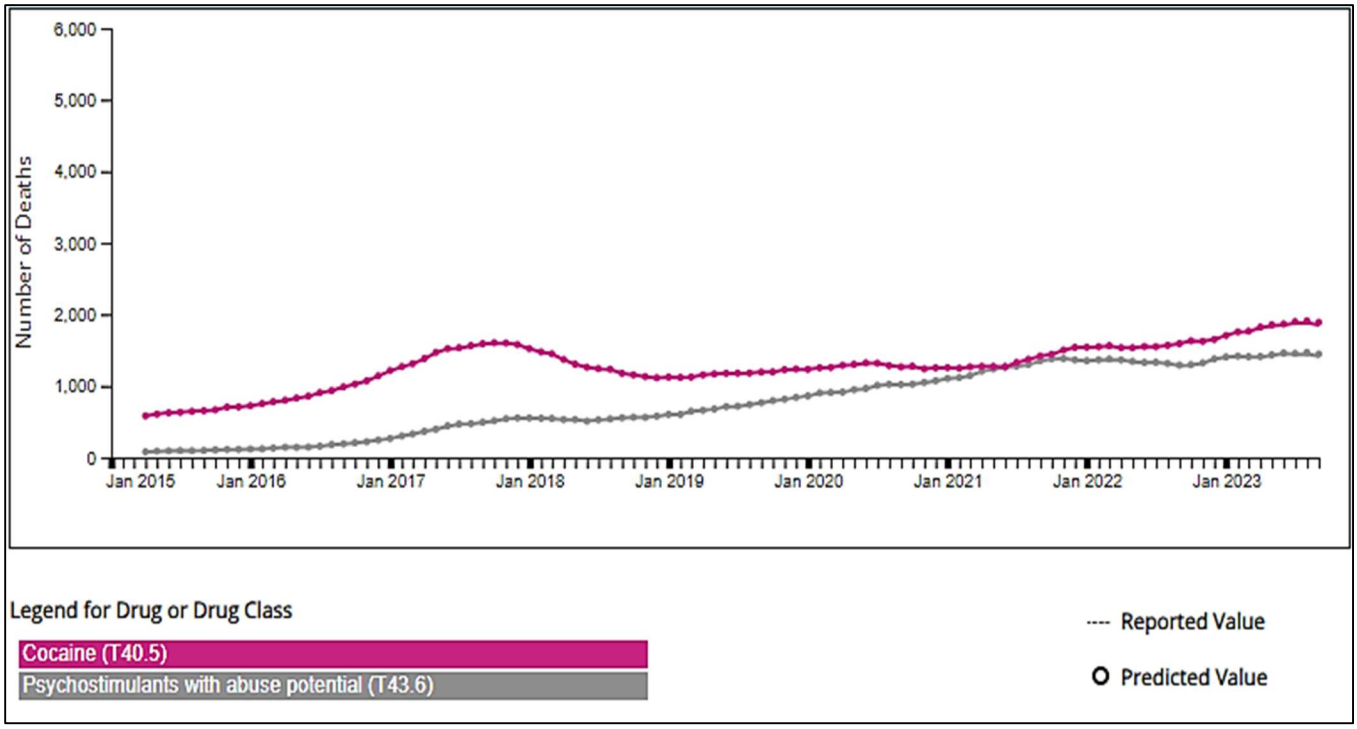


Source: Ahmad, F. B., Cisewski, J. A., Rossen, L. M., and Sutton, P. (2024). *Provisional drug overdose death counts.* National Center for Health Statistics.

[2] Ahmad et al. (2024) noted: "Reported provisional counts for 12-month ending periods are the number of deaths received and processed for the 12-month period ending in the month indicated. Provisional counts may not include all deaths that occurred during a given time period. Therefore, they should not be considered comparable with final data and are subject to change. Predicted provisional counts represent estimates of the number of deaths adjusted for incomplete reporting…Drug overdose deaths involving selected drug categories are identified by the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD–10) multiple cause-of-death codes." See https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm for more information.

Figure 2

Provisional Number of Drug Overdose Deaths by Drug or Drug Class: Ohio[1]



Source: Ahmad, F. B., Cisewski, J. A., Rossen, L. M., and Sutton, P. (2024). *Provisional drug overdose death counts.* National Center for Health Statistics.

This report describes the use of Contingency Management (CM) for addressing stimulant use disorder and preventing overdose deaths. The following sections define and describe CM and summarize the results of a literature review that was conducted to understand the effectiveness of CM in treating stimulant use disorder. The literature review focused on answering the following questions:

1. What are the substance use outcomes associated with the use of CM to address stimulant use disorders?
2. What are the treatment retention outcomes associated with the use of CM to address stimulant use disorders?

3. What other key morbidity and mortality stimulant use disorder outcomes are impacted by CM treatment?

A Response to Stimulant Use: Contingency Management

Contingency Management (CM) is an intervention grounded in operant conditioning, which is a learning process focused on behavioral modification through the association of stimuli with positive reinforcement or punishment (Higgins & Petry, 1999). The idea of providing motivational incentives for abstinence from alcohol and drugs was popularized in the 1980s and 1990s, first with the research on alcohol use and later cocaine dependence (Bigelow et al., 1981; Higgins et al., 1991, 1993, 1994, 2000).

Historically, the primary focus of CM has been the cessation of drug use, usually conceptualized through the longest period of continued abstinence, with treatment retention, and attendance introduced in more recent studies. Procedurally, the primary focus on a CM-based intervention is the use of positive reinforcement to help people choose abstinence over continued substance use. Typically, urine drug tests (UDTs) are administered multiple times each week (to detect brief periods of abstinence) and abstinence is reinforced each time a negative UDT is submitted. The reinforcers are monetary based and consist of vouchers which are exchangeable for goods, analogous to a clinic-managed bank account, or a prize draw with prizes usually ranging from US $1 to $100 in value. Missed or positive UDTs typically result in the reset in voucher magnitude or number of draws. Importantly, in effective CM interventions, the magnitude of reinforcement provided (voucher amounts or draws for prizes) increases with sustained periods of abstinence and resets upon non-compliance (Budney & Higgins, 1998; Petry, 2000; Petry & Stitzer, 2002).

Voucher-Based Reinforcement Therapy

In the early 1990's, Higgins and colleagues were among the first to apply the principles of operant behavioral learning to the understanding and modification of drug use behavior (Higgins et al., 1994; Higgins & Silverman, 1999). Given the lack of efficacious pharmacological treatment for cocaine use disorders at the time, Higgins and colleagues (1991, 1993, 1994) popularized the Voucher-Based Reinforcement Therapy (VBRT), which was initially developed as a strategy to help retain cocaine-dependent outpatients in treatment and to establish a period of initial abstinence (Higgins et al. 1991). The manualized 24-week intervention included a combination of counseling based on the Community Reinforcement Approach (CRA) and 12 weeks of voucher-based-CM contingent on cocaine abstinence. During the initial 12 weeks, participants were expected to attend counseling sessions twice a week and undergo urine toxicology testing for cocaine three times a week. During weeks 13-24, the schedule was reduced to one weekly counseling session and urinalysis twice a week. In their later work, Higgins and his colleagues (2019) clarified that allowing participants to earn vouchers for submitting negative cocaine urine drug samples during the initial 12 weeks of the intervention was designed to serves as an initial step in establishing naturalistic sources of reinforcement for a healthy lifestyle such that, vouchers exchangeable for retail items were provided, "to bridge that temporal gap between entering treatment and initiating cocaine abstinence and establishing natural sources of nondrug reinforcement in one's community that would be necessary to sustain longer-term abstinence" (Higgins et al., 2019, p. 504).

The key characteristic of the voucher system manualized by Budney & Higgins (1998) included (1) an escalating schedule, with (2) a bonus, and (3) a reset contingency. According to a recommended reinforcement schedule, participants could earn points for each negative UDT,

each worth approximately $0.25. During the initial 12 weeks of the intervention, the first negative UDT was worth 10 points ($2.50), with points per sample increasing by 5 points with each consecutive negative UDT, e.g., second negative UDT = 15 points (10 + 5) or $3.75 ($2.50 + $1.25). A $10 bonus was given for every three consecutive negative UDTs. Positive UDTs earned zero points and resulted in a reset. A reset implies that the subsequent negative UDT would revert to the starting value, which, in this instance, would be 10 points ($2.50). However, five consecutive negative UDTs following a reset would restore the voucher back to its value prior to the reset. During weeks 13-24, participants were eligible to receive one state lottery ticket for each cocaine-negative UDT (Budney & Higgins, 1998). In total, each patient could earn up to $997.50 in vouchers throughout the initial 12 weeks of treatment (Budney & Higgins, 1998; Higgins et al., 1993, 1994). Although quantified as cash values, the vouchers were only redeemable for retail items, previously approved and in support of a cocaine-free lifestyle (Budney & Higgins, 1998). Several more recent adaptations of the CRA-plus-voucher have used the original design proposed by Higgins and colleagues (1991, 1993, 1994) to promote continuous abstinence, while others have explored the effectiveness of varying reinforcement schedules (Roll et al., 2006).

Prize-Based Contingency Management

Another widely used technique, also known as the “fishbowl”, or simply prize-based CM, was developed and later manualized by Petry and Stitzer (2002) as part of the National Institute on Drug Abuse (NIDA) funding. The manual draws from earlier CM research (Petry et al., 2000, 2001, 2002) to propose low-cost clinical management strategies for a range of treatment settings (Petry & Stitzer, 2002).

As compared to the voucher-based CM, which rewarded abstinence with a predictable monetary value exchangeable for goods or services, the "fishbowl" technique is a probabilistic approach that reinforces abstinence with a chance of winning a prize. For every cocaine-negative UDT, which is provided twice a week, the patient would get one draw from the fishbowl and select a prize from the appropriate category if they drew a winning slip. The prizes usually range from small ($1) to jumbo ($100), but about half of the draws typically result in "non wins." Each consecutive negative UDT allows the participants to draw more prizes, including bonus rounds. Missed or positive samples typically result in the reset in the number of draws. Despite a relatively low probability of a patient winning a large or jumbo prize during the course of the intervention, Petry & Stitzer (2002) argued for allowing participants to select and suggest desired future prizes can not only motivate the patient to maintain his/her abstinence, but also prove to be cost effective. The authors estimated that even with a $5000 budget for prizes and 50 participants, the cost would be an average of $100 per patient. Figure 3 below is a sample fishbowl that would allow the patients to earn 20 draws per week.

Figure 3

Sample Fishbowl Schedule

	Number of Slips	Probabilities of Winning	Average Price/Prize	Cost per Draw
Non-winners	375	0.500		
Smalls	269	0.359	$ 0.70	$0.25
Mediums	75	0.100	3.50	0.35
Larges	30	0.040	14.00	0.56
Jumbo	1	0.001	70.00	0.09
TOTAL	750			$1.25

Source: Petry & Stitzer (2002). Contingency Management: *Using Motivational Incentives to Improve Drug Abuse Treatment.* Yale University Psychotherapy Development Center Training Series No. 6.

Statewide Implementation in California

Since 2023, the California Department of Health Care Service (DHCS) has been making considerable efforts to manualize and implement CM on a statewide level. The Recovery Incentive Program, a pilot 24-week outpatient treatment based on the principles of contingency management, is arguably the first implementation of CM approved to be covered under Medicaid (Peck et al., 2023). The DHCS is currently implementing contingency management services in 24 participating pilot counties covering 88% of the Medi-Cal (California's Medicaid health care program) population in outpatient, intensive outpatient, and Narcotic Treatment Program settings (Recovery Incentives Program, 2023). In parallel to the development of the program, the University of California, Los Angeles (UCLA) Integrated Substance Abuse Programs and the Promoting Research Initiatives in Substance Use and Mental Health (PRISM) Collaborative at Washington State University have made effort to manualize CM and make the information about the model available to the public. The following description of CM is based on the publicly available program manual available through the UCLA resource website (Peck et al., 2023; See Appendix A for a list of resources).

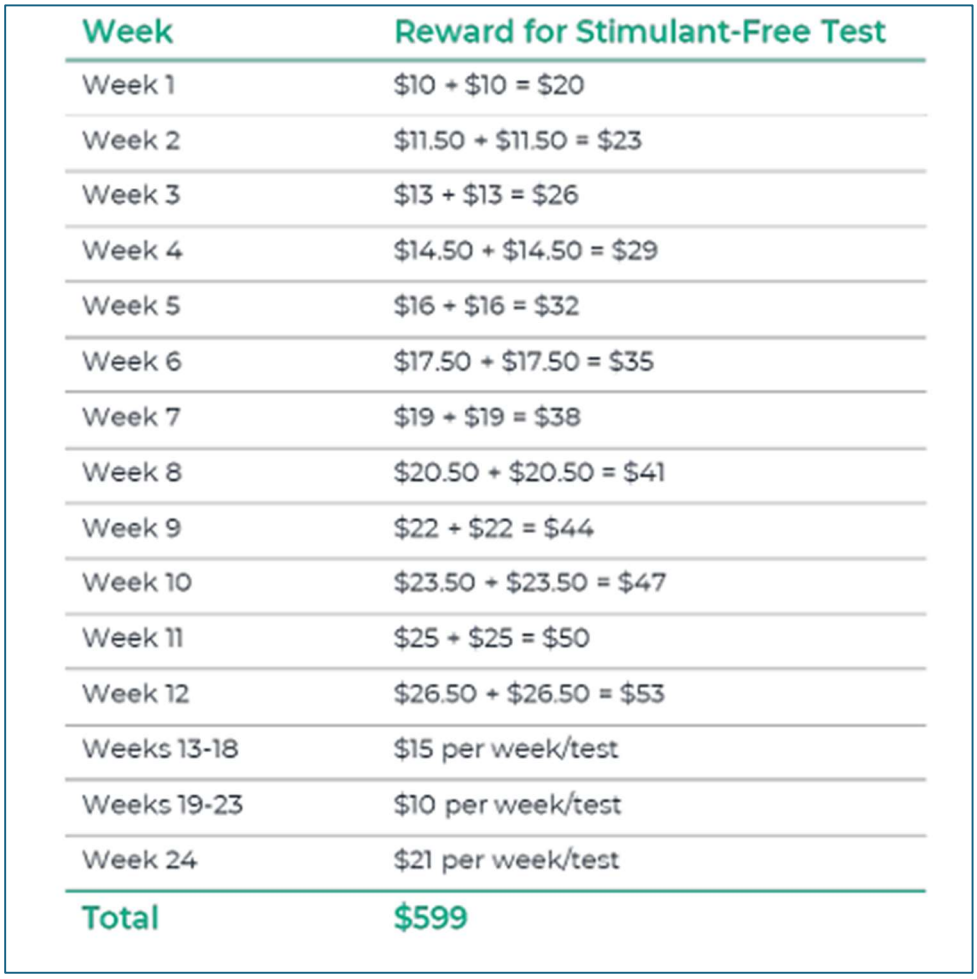
The Description of California's CM Treatment Program

The program is grounded in the theoretical principle of behavioral reinforcement and robust empirical evidence pointing to CM as the most effective evidence-based approach to treating stimulant use disorders, including reduction or cessation of drug use and longer retention in treatment (Peck et al., 2023). It uses an escalating schedule of reinforcement where the amount of reward (vendor-specific gift cards) increases the longer a person remains abstinent from stimulants (12 weeks of CM followed by 12 weeks of a stabilization period). Participants are subject to a UDT twice per week for the first 12 weeks and once per week for weeks 13-24.

During the initial 12 weeks, participants start at $10 for each stimulant-abstinent sample, escalating by $1.50 for each week of consecutive abstinence - assessed twice-weekly (e.g., a participant could earn $13/visit amounting to a total of $26 after third week of consecutive abstinence). In short, the longer the abstinence, the bigger the weekly rewards of continuous abstinence. During the weeks 13-24 (i.e., stabilization period), the UDTs are collected once per week and stimulant-free samples are rewarded with either a $10 or $15 gift card, with a final possible gift card worth $21 in week 24. A reset of the reward progression (referred to as “reset” hereafter) occurs when a participant submits a positive UDT or has an unexcused absence. The next time they submit a stimulant negative UDT, their reward level will “reset” to the initial incentive value (e.g., $10). After two consecutive stimulant-negative urine drug tests and the beneficiary will “recover” their previously earned incentive level plus the next escalation of $1.50. The Incentive Manager Portal is used to assess beneficiary-specific circumstances and calculate correct incentive amounts (Peck et al., 2023). Below is an example of the escalating schedule developed for the purpose of the Program (See Figure 4).

Figure 4

Sample Contingency Management Reward Schedule



Week	Reward for Stimulant-Free Test
Week 1	$10 + $10 = $20
Week 2	$11.50 + $11.50 = $23
Week 3	$13 + $13 = $26
Week 4	$14.50 + $14.50 = $29
Week 5	$16 + $16 = $32
Week 6	$17.50 + $17.50 = $35
Week 7	$19 + $19 = $38
Week 8	$20.50 + $20.50 = $41
Week 9	$22 + $22 = $44
Week 10	$23.50 + $23.50 = $47
Week 11	$25 + $25 = $50
Week 12	$26.50 + $26.50 = $53
Weeks 13-18	$15 per week/test
Weeks 19-23	$10 per week/test
Week 24	$21 per week/test
Total	**$599**

Source: Peck, J.A., Freese, T.E., Rutkowski, B.A., McDonell, M., Parent, S., & Hirchak, K. (2023). *Recovery Incentives Program: California's Contingency Management Benefit Program Manual.* UCLA Integrated Substance Abuse Programs.

Reward Delivery

The reward delivery program allows participants to earn vendor-specific gift cards, which can be redeemed immediately or accumulated and "banked". The rewards are delivered according to the preference of the participant (via text, email, or printed out in the clinic). Although the rewards should be desirable to the participant, they can only be used for goods and services that promote recovery and health. This prohibits any purchases of alcohol, tobacco, firearms, lottery tickets, and cannabis. The program manual also discusses ways of ensuring and achieving feasibility (Peck et al., 2023).

Literature Review Process

Literature reviews are often conducted to understand a topic in depth. The stages of a literature review involve creating a search strategy, identifying relevant sources, summarizing and organizing them around relevant themes, and synthesizing the information that is presented by the sources. The purpose of this literature review was to assess the effectiveness and utility of the Contingency Management (CM) by identifying and synthesizing relevant studies examining the outcomes of CM.

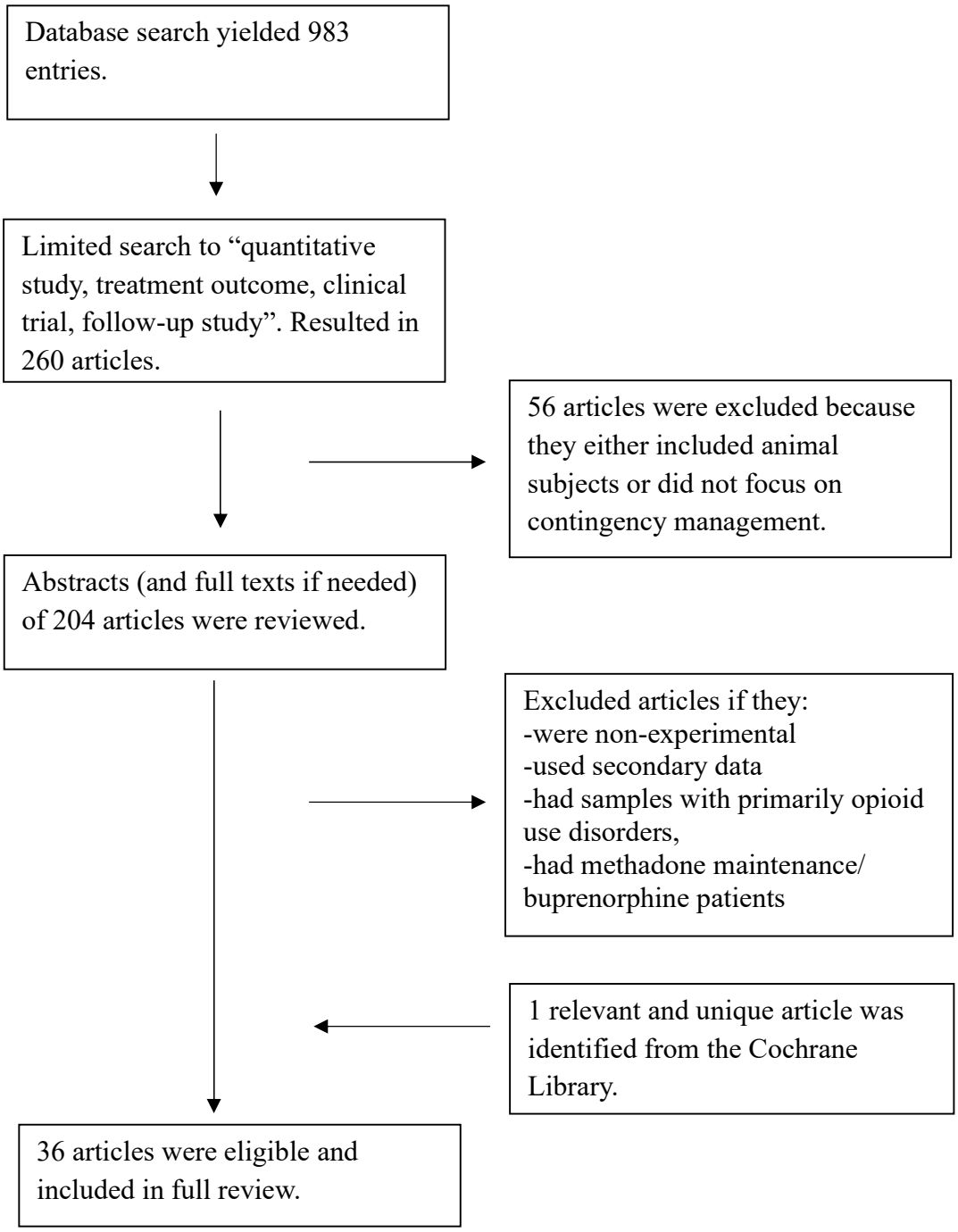
The first phase of the literature review included developing and refining relevant search phrases that represent the topic of interest and identifying key social and behavioral sciences research databases for use in the literature search. PsycINFO, MEDLINE, SocINDEX, Psychology and Behavioral Sciences Collection databases were searched using "(Contingency Management AND (cocaine OR methamphetamine OR amphetamine OR stimulant*)" phrases. The search was carried out in July 2023 and encompassed all existing literature up to that date. This search yielded a total of 983 results, which were then limited to "quantitative study,

treatment outcome, clinical trial, follow-up study" using limiters in the databases. This approach resulted in 260 articles. Fifty-six articles were excluded because they either included animal subjects or did not focus on CM. Abstracts and full texts of the articles were screened. Articles were included in full review if they were experimental in design, used primary data, and had samples primarily with stimulant use disorders. Articles were excluded if they were not experimental in design, used secondary data, had samples primarily with opioid disorders, and if the participants were methadone or buprenorphine maintenance patients. Thirty-five articles met the inclusion criteria.

The second phase included using the same search terms to conduct a similar search with the Cochrane Library, which is a well-reputed healthcare and medical research database that includes clinical trials, systematic reviews, and meta-analyses (Cochrane, 2023). This search yielded one unique and relevant article which was included for an in-depth review. The review included a total of 36 articles (see Appendix B for a full summary of the articles). All studies used experimental designs, where participants were randomly assigned to one of multiple treatment conditions/groups that were compared to identify statistically significant differences. Figure 5 illustrates the literature review process.

Figure 5

Literature Search Process Funnel for Identifying Contingency Management Outcome Studies



Summary of the Contingency Management Outcome Studies

Studies included in this review employed experimental designs where participants were randomly assigned to a CM condition or another treatment condition for comparison purposes. They often combined CM with another treatment when evaluating the outcomes of the CM. The type of CM studied across the articles varied. Twenty-four articles examined voucher-based CM, ten examined prize-based CM, and two examined abstinence-based housing CM.

The primary diagnosis of the participants across all studies was stimulant use disorder. Twenty-one studies had samples with concurrent substance or alcohol use disorders. All the studies focused on drug use outcomes. In addition, 33 studies examined treatment retention as an outcome and four focused on HIV-related outcomes. Twenty-six studies primarily incentivized abstinence from stimulants; whereas, nine incentivized abstinence from other drugs and/or alcohol in addition to stimulants. One study incentivized treatment attendance only. Twelve studies included participants from vulnerable populations such as individuals experiencing homelessness, pregnant women, individuals with severe mental illness, veterans, and men who have sex with men. Twenty-six studies were conducted in the U.S., five in Spain, four in Brazil, and one in Switzerland.

1. Voucher-based Contingency Management

The primary purpose of this section is to provide an overview of studies that have assessed the efficacy of voucher-based CM as a behavioral reinforcement technique that primarily rewards abstinence with a voucher which is exchangeable for goods or services. Across all studies under this review, 24 out of 36 implemented voucher-based CM. All the studies focused on stimulant use outcomes and 21 reported retention-related outcomes. Participants in the studies often earned vouchers for being abstinent from either one or a few types of

stimulants, or for other drugs and alcohol in addition to stimulants. Sample sizes ranged from 12 to 229 across studies. The duration of the treatment ranged from 12 to 24 weeks in general; however, one study with a sample of pregnant women did not report the treatment duration, instead it provided a range of treatment attendance (Elk et al 1998). The values of the vouchers in the escalating CM schedules ranged from $1.25 (Miguel et al., 2016) to $7.50 (Menza et al., 2010). Among studies reporting maximum potential earnings, these ranged from $185 (Miguel et al., 2022a) to $1,980 (Regnier et al., 2022). Also, six studies included samples from vulnerable populations including individuals experiencing homelessness, gay and bisexual men, and pregnant women.

1.1. Drug Use Outcomes

The outcomes related to drug use were primarily assessed as abstinence from stimulant-type drugs, verified through urinalysis. While some studies also incorporated self-report measures to assess substance use outcomes, only the results from urinalyses are reported in this section due to their greater reliability in providing an objective assessment of substance use. Studies often reported the longest duration of abstinence, percentage of participants with stimulant-negative UDTs and percentage of stimulant-negative UDTs. Some studies reported on the percentages of stimulant-positive UDTs.

CM was combined with other forms of treatment and was rarely used as a standalone treatment. Eight studies combined CM with community reinforcement approach (CRA), which is a community-based outpatient treatment approach designed to assist clients in gaining skills to avoid substance use and transform their lifestyle through the incorporation of new recreational activities (Budney & Higgins, 1998). It is a 24-week-long treatment program with a blend of individual and group sessions.

Nine studies combined CM with cognitive-behavioral therapy (CBT) or the Matrix Model. Some studies identified Matrix Model as a form CBT; therefore, both models are considered together when interpreting the findings and referred to as CBT. CBT in the studies often consisted of weekly manual-based group sessions aiming to increase coping skills to achieve and maintain abstinence. Two of the studies that incorporated CBT also involved pharmacotherapy, specifically sertraline (a type of selective serotonin reuptake inhibitor medication commonly used to treat depression and anxiety disorders) and levodopa-carbidopa (used primarily in the treatment of Parkinson's disease). The rest of the studies included usual care, standard treatment, or some other specific form of treatment such as low-intensity HIV prevention program. Usual care and standard treatment conditions were often weekly group sessions that are similar to CBT-based programs. One study from Brazil included a publicly funded program that assisted individuals with basic needs such as bathrooms and showers as well as special classes and self-help groups.

The drug use outcomes were organized by follow-up status in each study and then by CM comparison status (e.g., comparisons of different CM schedules or voucher value) and inclusion of a special population such as individuals experiencing homelessness. Eleven studies included a follow-up assessment while thirteen did not.

1.1.1. Studies with Follow-up Assessments

There were a total of eleven studies with a follow-up assessment. These studies compared both in-treatment and end of treatment drug use outcomes and included assessments extending beyond the treatment period to examine if the outcomes of CM were sustained. There was only one study that compared various CM schedules (Chudzynski et al., 2015). Four studies focused on special populations, including gay and bisexual men experiencing homelessness (Shoptaw et

al., 2005), men who have sex with men experiencing homelessness (Reback et al., 2010), pregnant women (Schottenfeld et al., 2011), and men who have sex with men (Menza et al., 2010).

Four studies compared CRA plus CM with CRA treatment alone. Higgins et al. (1995) reported follow-up findings for two experimental studies that were previously conducted. Both trial 1 (Higgins et al., 1993) and trial 2 (Higgins et al., 1994) were conducted at the same clinic and followed the same treatment schedules. Trial 1 compared CRA plus CM to drug abuse counseling, while trial 2 compared CRA plus CM to CRA alone, both having a treatment duration of 24 weeks. A total of 78 participants were tested for cocaine use via urinalysis three times a week for the first half of the treatment period, and twice a week for the second half. During the first half of the treatment, the first cocaine-negative UDT was rewarded with a voucher that was worth $2.50 and the value of the voucher each subsequent negative UDT increased by $1.25. An additional $10 bonus was awarded if three UDTs consecutively tested negative for cocaine. The value of the voucher was reset to its initial value of $2.50 when a positive UDT was submitted. In the second half of the treatment, participants received a $1 state lottery ticket for each cocaine-negative UDT. The maximum potential earnings for the first 12 weeks were $997.50. Information on fidelity and training for CM was not reported; however, the lead author for both studies was one of the developers of the CRA plus vouchers model. Higher percentages of those who received CM in both studies achieved at least 4, 8, and 16 weeks of continuous abstinence compared to the comparison groups, with a statistically significant difference. Post-treatment and follow-up assessment comparisons showed that even though abstinence levels were higher for the CM group, the difference between CM and comparison group was not significant. In trial 1, at the 6-month, 9-month, and 12-month

assessments, 72%, 88%, and 96% of participants in the CRA plus CM group were abstinent, respectively, compared to 67%, 69%, and 69% in the comparison group. In trial 2, at the same assessment points, 80%, 70%, and 65% of participants in the CRA plus CM group were abstinent, respectively, compared to 75%, 65%, and 60% in the comparison group.

Higgins et al. (2000) evaluated the effectiveness of CM on cocaine abstinence among 70 participants with cocaine use disorders. Participants were randomized into CRA plus CM (contingent on cocaine-negative UDTs) or CRA plus non-contingent incentives (incentives were provided regardless of the urinalysis results). Participants were tested for cocaine use via urinalysis three times a week for the first half of the treatment period, and twice a week for the second half. This study employed the same incentive system as described in Higgins et al. (1995) including the same voucher values and possible maximum earnings. Information on fidelity and training for CM was not reported, however the lead author for both studies was one of the developers of the CRA plus vouchers model. CRA plus CM group had better abstinence outcomes than the non-contingent incentives group. A higher percentage of the CRA plus CM group had 8 or more, 12 or more, and 16 or more weeks of abstinence compared to the non-contingent incentives group; however, only the difference for the 12 or more weeks of abstinence was statistically significant. The CM group showed statistically significantly higher levels of sustained continuous abstinence at follow-up compared to the non-contingent group. A higher percentage of participants in the CM group (19%) was abstinent throughout the entire posttreatment follow-up period compared to those in the non-contingent condition (6%); however, the difference was not statistically significant.

Secades-Villa et al. (2011) examined the effects of CRA plus CM on abstinence among individuals with cocaine use disorder in Spain. Sixty-four participants were randomized to CRA

plus CM or standard care (twice weekly group therapy for 24 weeks, followed by weekly group or individual sessions for the next 24 weeks). CRA plus CM consisted of twice-weekly group sessions for the initial 24 weeks, offering vouchers for cocaine-negative UDTs. This was followed by weekly group sessions for the subsequent 24 weeks, without vouchers. UDTs were collected three times a week for the first 12 weeks, then reduced to twice a week for the next 12 weeks. The initial negative UDT earned ten points, with a five-point increase for each subsequent negative UDT. Each point was valued at $0.36. Three consecutive negative UDTs earned a bonus of 40 points. The value of the voucher was reset to its initial value of ten points if the UDT was positive. In the following 12 weeks, half of the UDTs were randomly tested, and negative results earned points. Information on fidelity and training was not provided; however, the authors referred to the CRA plus vouchers treatment manual by Budney and Higgins (1998). At the 12-month assessment, approximately 59% of the participants in the CRA plus CM condition were abstinent, compared with about 26% in the standard care condition and the difference was statistically significant. Almost thirty five percent (34.5%) of the participants in the CRA plus CM group achieved twelve months of continuous cocaine abstinence, compared to 17% in the standard care group; however, the difference was not statistically significant.

García-Fernández et al. (2011) studied the effectiveness of the CRA plus CM treatment in a community setting in Spain at the 12-month follow-up. Fifty-eight individuals with cocaine use disorder were randomized to CRA plus CM or CRA-only groups. Information on fidelity and training was not provided; however, the authors referred to the CRA plus vouchers treatment manual by Budney and Higgins (1998), meaning they likely stayed true to the model. Participants in the CM group earned vouchers for submitting cocaine-negative urine samples (see Secades-Villa et al., 2011 for a detailed description of the voucher program). During the

treatment, CM group had a higher mean percentage of cocaine-negative UDTs compared to CRA-only group. Thirty-one percent of the participants in the CRA plus CM group remained abstinent throughout twelve months, compared with 28% in the CRA-only group; however, the difference was not statistically significant. Fifty-nine percent of the CM participants were abstinent at the 12-month assessment, compared to 38% of the CRA-only group, again with no statistically significant difference.

Rawson et al. (2006) compared CM, CBT, and CBT plus CM on abstinence among a sample of 171 participants with stimulant dependence. Treatment spanned 16 weeks and participants were tested for stimulant use (methamphetamine and cocaine) via urinalysis three times a week. Participants received a $2.5 voucher for each stimulant-negative UDT, with an increase of $1.25 for each consecutive negative UDT. They earned a $10 bonus for three consecutive stimulant-negative UDTs. The value of the voucher was reset to a lower level if the UDT was positive. Information on fidelity and training for CM was not reported. CM and CBT plus CM group had more stimulant-negative UDTs than did the CBT-only group. Sixty-nine percent of the CBT plus CM group, 60% of the CM group, and 34% of the CBT-only group achieved three weeks of abstinence during treatment, with the two CM-receiving groups demonstrating a statistically significant difference compared to the CBT-only group. At the 17-, 26- and 52-week follow-up assessments, the percentage of participants with stimulant-negative UDTs ranged from 67% to 79% for all the groups, and there were no statistically significant differences between the groups.

McKay et al. (2010) studied whether CM, cognitive-behavioral relapse prevention (RP), or CM plus RP would lead to better cocaine use outcomes among participants who had initially engaged in intensive outpatient treatment (IOP) as opposed to treatment as usual only (TAU; IOP

followed by one weekly group session). One hundred participants with cocaine use disorder were randomized to one of the four treatment conditions. Participants in the CM group underwent urinalysis for cocaine use three times a week and breath test for alcohol use. They earned vouchers for submitting cocaine-negative UDTs along with alcohol-free breath tests. The first cocaine-negative urine drug test (UDT) was rewarded with a $2.50 voucher, and the value of the voucher increased by $1.25 with each subsequent negative UDT. An additional $10 bonus was awarded if three UDTs consecutively tested negative for cocaine. The value of the voucher was reset to its initial value of $2.50 when a positive UDT was submitted. Abstaining from alcohol in addition to cocaine was mandatory to qualify for the rewards. The total possible maximum earnings for this study were $1,150. Information on fidelity and training for CM was not reported. The CM duration was 12 weeks, while for RP, it was 20 weeks. Data on UDTs were collected at 3-, 6-, 9-, 12-, 15-, and 18-month follow-up assessments. Compared to other groups, CM plus RP group had the lowest number of cocaine-positive UDTs across all follow-up points, followed by the CM group. Participants in both CM conditions had statistically significantly better cocaine use outcomes than those who did not receive CM. Paired comparisons of treatment groups showed that CM plus RP condition produced lower rates of cocaine-positive urines than did TAU and RP at 6- and 9-month follow-up assessments.

1.1.1.1. Studies with Comparisons of Different CM Schedules or Voucher Values

There was only one study with follow-up data that compared various CM schedules. Chudzynski et al. (2015) examined the different schedules of CM, in conjunction with CBT among a sample of individuals who had methamphetamine dependence. One-hundred and nineteen participants were randomized to 16 weeks of: (1) standard, (2) continuous CM, (3) intermittent predictable CM, and (4) intermittent unpredictable CM. All participants received

CBT based weekly group sessions (standard treatment) and those in the CM conditions earned rewards according to their assigned schedules for submitting methamphetamine-negative UDTs. Participants in the continuous CM condition earned vouchers for each negative UDT with an escalating and reset schedule, and bonuses for consecutive abstinence. The initial voucher value of $2.50 increased by $1.50 for each consecutive abstinence, with three consecutive abstinences resulting in a $10.00 bonus, along with a reset. Those in the intermittent predictable CM condition earned a voucher when they provided three consecutive methamphetamine-negative UDT with escalating schedules ($22 for the first set, with $13.50 increase with each consecutive negative UDT) along with reset, but without bonuses. The intermittent unpredictable CM schedule was similar to the predictable CM with the same voucher value; however, the timing of the voucher was random. As such, participants in this condition did not know when they would earn a voucher. Information on fidelity and training for CM was not reported. Analyses showed that compared to the standard treatment group, the continuous CM group was almost two times more likely, the intermittent predictable group was 2.4 times more likely, and the intermittent unpredictable CM group was 1.7 times more likely to submit a methamphetamine-negative urine sample. These findings were statistically significant. CM groups did not have statistically significant differences from each other on the likelihood of submitting a negative sample. Follow-up assessments for drug use outcomes did not show a statistically significant difference between the CM conditions and standard treatment. However, treatment completers (i.e., those who completed 16 weeks of treatment) were statistically significantly more likely to submit a methamphetamine-negative UDT.

1.1.1.2. Studies with Special Populations

Shoptaw et al. (2005) compared four treatment conditions on abstinence among a sample of gay and bisexual men with methamphetamine use disorder. One-hundred-sixty-two men were randomly assigned to one of the following treatment groups: (1) CBT alone, (2) CM alone, (3) CBT plus CM, or to (4) the culturally tailored CBT (GCBT) alone. The treatment spanned 16 weeks and the participants underwent urinalysis three times a week to detect methamphetamine and cocaine use. Those in the CM groups received $2.50 worth of vouchers for every negative UDT, with an additional $2.50 increment for each consecutive negative UDT. A $10 bonus was granted if all three UDTs in a given week tested negative for methamphetamine and cocaine. The value of the voucher was reset to its initial value if the UDT was positive. Participants could earn up to a total of $1,277.50 in vouchers. Fidelity to CM was monitored by audiotaped interactions with the participants and with supervision from the study coordinator. CBT consisted of three weekly group sessions that provided support for recovery. GCBT was a culturally adapted version of CBT, with a focus on the relevant behavioral and cultural characteristics of methamphetamine use by gay and bisexual men. The highest number of methamphetamine and cocaine-negative UDTs were observed for the CBT plus CM group, followed by the CM-only, GCBT, and CBT alone groups, respectively. The CM and CBT plus CM conditions showed a comparable trend regarding the duration of continuous abstinence. On average, the periods of continuous abstinence were over twice as long in the CM condition and three times as long in the CBT plus CM condition compared to CBT with a statistically significant difference. CBT plus CM group had the highest percentage of metabolite-negative urine samples by the end of the treatment (93%), followed by the CM only group (83%), GCBT (80%), and CBT alone (75%), respectively, with no statistically significant differences among the groups. Six-month and 12-

month follow-up analyses showed that the CBT alone group had highest percentage of metabolite-negative UDTs, followed by CBT plus CM, CM alone, and GCBT, respectively, with no statistically significant differences among the groups.

Reback et al. (2010) examined the effectiveness of CM for increasing health-promoting behaviors and reducing substance use among men having sex with men who experience homelessness, in a community-based, low-intensity HIV prevention program. A total of 131 men were randomized to HIV prevention program plus CM or HIV prevention program alone (control group) with a treatment period of 24 weeks. Participants in both conditions earned points for attending study visits and engaging in HIV prevention program activities. In the CM condition, points were also awarded for health-promoting behaviors and substance abstinence. Participants earned points for testing negative for all types of stimulants and alcohol (level 1; worth ten points) and more points if they also tested negative for opioid and marijuana (level 2; worth 20 points). Each point was worth $1. Three consecutive negative UDTs (20 points for level 1 and 30 points for level 2) and seven consecutive negative UDTs (40 points for level 1 and 60 points for level 2) earned bonus points. Points for each health-promoting behavior ranged from one to 50. Information on fidelity and training for CM was not reported. Over 24 weeks, the CM group had statistically significantly more drug metabolite-free UDTs per substance and overall compared to the control group. The likelihood of providing a level 1 metabolite-free UDT was nearly doubled in the CM group versus control. The authors were unable to assess the outcomes for level 2 substances due to fewer instances of opioid use, and instead they compared marijuana use outcomes between the two groups and found no significant differences. During the 9- and 12-month follow-up assessments, participants in the CM group were nearly twice as likely as control participants to be abstinent from stimulants and alcohol.

Schottenfeld et al. (2011) examined the effectiveness of CM, CRA, and twelve-step facilitation (TSF) for cocaine-dependent impoverished pregnant women or women with young children. A total of 145 women were randomized to 24 weeks of: (1) CRA combined with CM (monetary vouchers provided contingent on cocaine-negative urine tests); (2) CRA combined with voucher control (VC; vouchers were provided non-contingently); (3) TSF combined with CM; or (4) TSF combined with VC. UDTs were collected twice weekly. Participants in the CM group received a voucher for each cocaine-negative UDT. The first negative UDT earned $5, with an additional $2.50 increase for each consecutive negative UDT. An additional $10 bonus was awarded if three UDTs consecutively tested negative for cocaine. However, if a UDT was positive, the value of the voucher reset to its initial value. Participants could earn up to a total of $935 in vouchers. Information on fidelity and training for CM was not reported. Compared to VC, participants receiving CM achieved statistically significantly longer periods of abstinence from cocaine, higher proportion of cocaine-negative UDTs during treatment, and higher proportion of abstinences at 3-, 6-, 9- and 12-month assessments. CRA and TSF did not significantly differ from each other on these measures. However, all four groups had statistically significant reductions in cocaine use during treatment. Past 30-day abstinence during treatment and follow-up, which was based on self-report of no cocaine use in the past 30 days and a cocaine-negative UDT at the time of assessment, was statistically significantly higher for those who received CM compared to those who received VC. Past 30-day cocaine abstinence increased in all groups during treatment, then slightly decreased at the end of the treatment and remained stable at 9- and 12-month assessments. Women who achieved long-term abstinence during treatment were statistically significantly more likely to be abstinent at 12 months compared to those who did not.

Finally, Menza et al. (2010) examined the effectiveness of CM on abstinence from stimulants among men who have sex with men. The initial aim of the study was to provide insights for a trial to assess whether CM could effectively prevent HIV acquisition among methamphetamine-using individuals who were HIV-negative. A total of 127 men were randomly assigned to CM or control group (whereby the control group received referral to community resources). Participants in both groups were provided a printed list of local counseling, treatment, and outreach services at baseline and at each study visit. CM group was tested for stimulants (i.e., methamphetamine and cocaine) through urinalysis three times a week and received vouchers for submitting stimulant-negative UDTs for 12 weeks. The frequency of testing was later reduced from three to two times a week to lessen the burden on the participants. The initial value of the first negative UDT was raised from $2.50 to $7.50, and the maximum potential earnings increased from $453.75 to $476.25 due to the change in the frequency of testing. The voucher value for the each consecutive negative UDT increased by $1.25. A $20 bonus was awarded for two consecutive negative UDTs. Information on fidelity to CM was not provided; however, the authors mentioned that the study personnel followed a simple protocol when communicating the urinalysis results and providing vouchers by avoiding counseling around the results. All participants were tested for stimulants every six weeks for six months. Analyses showed that the CM group submitted more methamphetamine-positive UDTs than the control group, whereas the control group submitted more cocaine-positive UDTs throughout the study period, including treatment and follow-up periods. Sixty-three percent of CM participants versus 49% of control group participants submitted at least one methamphetamine-positive UDT. Thirty-three percent of CM group compared to 46% of control group submitted at least one cocaine-positive UDT; and 79% of CM group compared to 75% of control group submitted at

least one methamphetamine or cocaine-positive UDT. Also, while both CM and control participants exhibited similar likelihoods of submitting UDTs positive for methamphetamine during study visits within the treatment period, CM participants were somewhat more likely to submit a urine sample containing methamphetamine during the follow-up period, but it was not statistically significant.

1.1.2. Studies without Follow-up Assessments

There were a total of thirteen studies without a follow-up assessment. Those studies only compared drug use outcomes during treatment or at the end of the treatment. Four studies compared various CM schedules or voucher values (Roll et al., 2006; Roll & Shoptaw 2006; Garcia-Rodriguez et al., 2009; and Regnier et al., 2022). Three studies focused on special populations, including pregnant women (Elk et al., 1998) and those who experience homelessness (Miguel et al., 2022b).

Two studies from Spain compared CRA plus CM to CRA treatment alone. Secades-Villa et al. (2013) examined the effects of the CM and income on cocaine abstinence over 24 weeks at a community setting in Spain. A total of 118 participants were randomized into CRA plus CM treatment and CRA treatment alone. Therapists were trained in CRA and CM before the treatment and supervised throughout the treatment period. Participants were tested for cocaine use via urinalysis three times a week for the first half of the treatment period, and twice a week for the second half. Those in the CM group earned vouchers for each cocaine-negative urine sample (see Secades-Villa et al., 2011 for a detailed description of the voucher program). Participants in the CRA plus CM group remained abstinent for an average of 3 months compared to 2 months in the CRA group and the difference was statistically significant. Level of income

did not have an impact on the abstinence outcomes, indicating that CM was beneficial for any income status.

Another study from Spain (García-Fernández et al., 2013) examined the effectiveness of CM and the role of depressive symptoms on abstinence among individuals with cocaine use disorder. A total of 108 participants were randomized into CRA plus CM treatment and CRA treatment alone with a duration of 24 weeks. The authors mentioned that they adhered to the original treatment format during implementation, referencing Budney and Higgins (1998); however, they did not provide specific details on training and fidelity to the model. Participants were tested for cocaine use via urinalysis three times a week for the first half of the treatment period, and twice a week for the second half. Those in the CM group earned vouchers for each cocaine-negative UDT (see Secades-Villa et al., 2011 for a detailed description of the voucher program). Status in the CRA plus CM treatment group predicted better abstinence outcomes at the end of treatment and longest duration of abstinence during treatment regardless of the depressive symptoms. This finding was statistically significant.

Miguel and colleagues focused their attention on the feasibility of incorporating CM into public treatment settings. Miguel et al. (2016) studied the effectiveness of integrating CM into standard outpatient treatment for the treatment of crack cocaine dependence in Brazil. Standard treatment consisted of weekly group meetings on relapse prevention and coping skills training. The duration of the treatment period in the study spanned 12 weeks. There was no information on fidelity and training for CM. Sixty-five participants were randomized into standard treatment plus CM and standard treatment alone. The participants were tested for cocaine use via urinalysis three times a week and those in the CM group earned vouchers for each cocaine-negative UDT. Each voucher was valued at $1.25, with its worth increasing by approximately

$0.50 for each consecutive negative UDT, capped at a maximum of $3.75. Achieving three consecutive negative UDTs was rewarded with a bonus of $5. The value of the voucher was reset to its initial value if the UDT was positive. Participants were also tested for marijuana via urinalyses and alcohol use via breath analyses and those in the CM group earned vouchers for alcohol-free breath samples. They also earned additional bonuses if they were tested negative for all three substances. CM group members submitted a higher mean number of crack cocaine-negative UDT (mean=13.1) compared to the standard treatment alone group (mean=2.4). This translated to an average of 4.4 weeks of abstinence in the CM group and 0.8 weeks in the standard treatment group with a statistically significant difference. CM group was more likely to achieve continuous abstinence from crack cocaine than standard treatment only group. Depending on the type of analysis, there was also a statistically significant difference between the CM and standard treatment only group on the abstinence from other substances that were tested as well. The authors later conducted a crossover trial with some of the participants who were originally assigned to standard treatment only (Miguel et al., 2019). Six months after the end of the initial study, a total of 16 participants agreed to receive standard treatment plus CM for 12 weeks. The same CM protocol as the previous study was followed (e.g., identical voucher values), with the exception of testing for and incentivizing abstinence from marijuana and alcohol. The total possible maximum earnings for this study were $225. The outcomes of these participants were compared to their outcomes from the initial study when they received standard treatment only. Their drug use related outcomes improved when exposed to CM as they submitted statistically significantly higher rates of cocaine-negative UDTs, achieved longer mean duration of cocaine abstinence, and had increased likelihood of abstinence from cocaine compared to when they received standard treatment only.

Miguel et al. (2022a) studied the effectiveness of integrating CM into Unidade Recomeço Helvétia (URH), which is a public outpatient treatment program in Brazil for crack cocaine users. URH offers a diverse range of interventions, spanning from harm reduction to interventions promoting abstinence, tailored to individuals at various stages of recovery from crack use. The duration of the treatment period in the study spanned 12 weeks. Ninety-eight participants were randomized into URH plus CM treatment and URH treatment alone. Seventy-three percent of the participants also had polysubstance use and 88% had alcohol use disorders. The participants were tested for cocaine use via urinalysis twice a week and those in the CM group earned vouchers that were worth approximately $2 for each cocaine-negative UDT. The value of the voucher increased in value by $1 with the submission of negative subsequent UDT, capped by a maximum of $5. Achieving two consecutive negative UDTs was rewarded with a bonus of $5. The value of the voucher was reset to its initial value if the UDT was positive. The total possible maximum earnings for this study were $185. Treatment providers were trained in CM according to Petry's (2000) CM guidelines and model fidelity were monitored. Participants in the URH plus CM group were more likely to submit cocaine-negative UDTs, achieve three or more weeks of abstinence, achieve longer periods of continuous abstinence, and had a higher mean percentage of cocaine-negative UDTs compared to those in the URH alone.

Two studies included a type of medication to improve drug use outcomes along with CBT and CM. Shoptaw et al. (2006) examined the effectiveness of sertraline in the reduction of methamphetamine use over a 12-week period and the role of CM in this context. Participants in the study had methamphetamine use disorder and received CBT. A total of 229 participants were randomized into four treatment groups: (1) sertraline plus CM, (2) sertraline-only, (3) matching placebo plus CM, and (4) matching placebo only. The study did not include information on

fidelity and training for CM. Participants were tested for methamphetamine use via urinalysis three times a week and earned vouchers for each methamphetamine-negative UDT. The first methamphetamine-negative urine drug test (UDT) was rewarded with a $2.50 voucher, and the value of the voucher increased by $1.25 with each subsequent negative UDT. An additional $10 bonus was awarded if three UDTs consecutively tested negative for methamphetamine. The value of the voucher was reset to its initial value of $2.50 when a positive UDT was submitted. More participants in the sertraline plus CM (43%), placebo plus CM (52%), and placebo-only (42%) compared to sertraline-only group (25%) had at least three consecutive weeks of abstinence from methamphetamine and the difference was statistically significant. When aggregating participants who received CM versus those who did not, regardless of the medication/placebo usage, a statistically significant positive difference was found for those across CM groups. Specifically, a higher percentage of participants receiving CM (47.0%) achieved three consecutive weeks of abstinence compared to those not receiving CM (33.3%).

Schmitz et al. (2010) studied the effectiveness of levodopa-carbidopa in combination with CM for the treatment of cocaine use disorder over a 12-week period. A sample of 136 participants with cocaine use disorder were randomized into six treatment groups consisting of levodopa-carbidopa or placebo administered in combination with CM targeting one of three behaviors: (1) clinic attendance (CM-ATTEND); (2) medication compliance (CM-MEDICATION); (3) cocaine negative urine toxicology (CM- URINE). Participants in the CM-URINE group earned vouchers for submitting cocaine-negative UDTs; those in the CM-ATTEND earned vouchers for each scheduled clinic visit; and those in the CM-MEDICATION earned vouchers for taking levodopa-carbidopa pill as instructed. The value of the voucher started at $2.50 and escalated by $1.25 for each subsequent instance of the target behavior. A

bonus of $10 was awarded for three consecutive instances of the target behavior. The value of the voucher was reset to its initial value if the target behavior was not observed. Potential maximum earnings over 12 weeks amounted to $997.50. The study did not include information on fidelity and training for CM. All participants attended weekly brief clinical management and manual-driven CBT sessions. CM-URINE with levodopa-carbidopa treatment produced higher proportions of cocaine-negative UDTs compared to CM-URINE with placebo and the difference was statistically significant. In placebo conditions, CM-URINE did not significantly differ from CM-ATTEND and CM-MEDICATION on the proportion of cocaine-negative UDTs. In levodopa conditions, CM-URINE group had a significantly higher proportion of cocaine-negative UDTs, compared to CM-ATTEND and CM-MEDICATION.

1.1.2.1. Studies with Comparisons of Different CM Schedules or Voucher Values

Roll et al. (2006) compared five variations of CM on abstinence outcomes among participants with methamphetamine use disorders. A total of 83 participants were randomized into the following schedules: "(1) a flat magnitude of reinforcement schedule with no bonuses for continuous abstinence or resets for failure to abstain; (2) slowly escalating magnitude of reinforcement with large bonuses for blocks of abstinence and no resets for failure to abstain; (3) high initial magnitude of reinforcement with slow escalation of voucher magnitude and no bonuses for continuous abstinence or resets for failure to abstain; (4) high initial magnitude of reinforcement that decreased rapidly with moderate bonuses for blocks of abstinence and no resets for failure to abstain; (5) low initial magnitude of reinforcement, with moderate escalation, moderate bonuses for continuous abstinence and resets in voucher magnitude for failure to abstain" (p. 69). Each schedule had nearly identical maximum earnings ranging from $990.00 to $1,005.00. Participants in all groups also received CBT, which included three

weekly group sessions over 12 weeks. They underwent urinalysis for methamphetamine use three times a week and received rewards based on their assigned schedules. There was no information on fidelity and training for CM. However, the authors mentioned that schedules from 1 to 4 were developed by experienced clinicians; whereas, schedule 5 followed the guidelines from Higgins et al. (1994). On average, participants in the various schedules (from 1 to 5) earned the following amounts: $589.06, $476.08, $451.41, $614.17, and $402.09, respectively. There were no statistically significant differences in outcomes among the various monetary schedules. Schedule 5 generally outperformed other schedules on abstinence outcomes. It facilitated the onset of abstinence more quickly than Schedules 1 or 2 and showed similar effectiveness to Schedules 3 and 4 in this aspect. Regarding the length of abstinence, no notable differences were observed among the various schedules, although Schedule 5 yielded slightly longer periods of continuous abstinence compared to others.

Roll and Shoptaw (2006) compared two variations of CM on abstinence outcomes among participants with methamphetamine use disorders. A total of 18 participants were randomized into an escalating with reset CM condition and an escalating without reset CM condition. The voucher value increased with every methamphetamine-negative UDT in each condition. The first negative UDT was worth $2.50 with an increase by $1.50 for consecutive negative UDTs. In the escalating with reset condition, the value of the voucher reset to its initial value if the UDT was positive. In the escalating without reset condition, participants continued to earn increased value of the voucher without reset, meaning that the value of the voucher for the methamphetamine-negative UDT after a positive one continued to increase. Participants still needed to submit methamphetamine-negative UDTs to earn vouchers; however, the latter condition did not result in disruption of the escalating voucher magnitude. Participants in both

groups also received CBT, which included three weekly group sessions over 12 weeks. Eighty percent of the participants in the escalating with reset condition vs. 38% in the escalating without reset condition submitted methamphetamine-negative UDTs. Participants in the escalating with reset condition also achieved longer periods of abstinence (mean= 6.7 weeks) compared to the participants in the other condition (mean= 2.8 weeks). Both findings were statistically significant.

Garcia-Rodriguez et al. (2009) examined the effects of the CM voucher magnitude on cocaine abstinence over 24 weeks at a community setting in Spain. A total of 96 participants with cocaine use disorder were randomized into one of three groups: (1) CRA plus low monetary value vouchers (low-value CM), (2) CRA plus high monetary value vouchers (high-value CM), and (3) standard treatment, consisting of twice-weekly CBT-based group sessions. Therapists were trained in the specific treatment protocols for the study, however there was no information on fidelity. Participants were tested for cocaine use via urinalysis three times a week for the first half of the treatment period, and twice a week for the second half. Participants in the low- and high-value CM conditions earned points for each cocaine-negative UDT. Each point in the low-value CM was worth $0.18 and it was worth $0.36 in the high-value CM group. In each group, the first negative UDT was worth ten points with a five-point increase for each subsequent negative UDT. An additional 40 points were awarded as a bonus if three UDTs consecutively tested negative for cocaine. The mean percentage of the cocaine-negative UDTs in the high-value and low-value CM were higher (97% and 96%, respectively) compared to the standard treatment (88%) and the difference was statistically significant with a medium to large effect size. The high-value CM group had a significantly higher mean duration of continuous abstinence averaging four months compared to standard treatment averaging 2.5 months. The

low-value CM group had an average of 3.5 months of continuous abstinence. Only the difference between high-value CM and standard treatment was significant with a medium to large effect size. When looking at achieving abstinence for one to six months during treatment, percentages in both CM conditions were consistently higher than those in the standard treatment group. There was a statistically significant difference between high-value CM and standard treatment in the percentage of participants who achieved continuous abstinence for a duration of two months or more, three months or more, and four months or more. The only statistically significant difference between low-value and standard treatment was in four or more months of abstinence. All differences yielded medium effect sizes. Differences in the high-value and low-value CM group were not statistically significant. Lastly, 38% of the participants in the high-value CM group remained abstinent throughout the six months of the treatment, compared with low-value CM group (33%) and the standard treatment group (21%). It is unclear if those percentages were statistically different from one another.

Regnier et al. (2022) conducted two experiments to study the impact of varying CM schedules among participants with cocaine use disorder. Due to having small sample size in each experiment, the researchers did not conduct statistical analyses. In the first experiment, 17 participants were randomly assigned into a high paying CM (started with $5 voucher with $2.50 increase for each consecutive cocaine-negative UDT, and $20 bonus for three consecutive negative UDT), low paying CM (started with $1.25 voucher with $0.63 increase for each consecutive negative UDT, and $5 bonus for three consecutive negative samples), or a non-contingent condition ($13 per sample independent of the test results, without escalation of the value). The value of the voucher was reset to its initial amount if the UDT was positive. Participants in the high-value condition could earn a maximum of $1,980, whereas those in the

low-value and non-contingent condition could equally earn a maximum of $468 over a 12-week period. Participants in the high paying CM group provided an average of 21% cocaine-negative urine samples, followed by 18% in the noncontingent group and 6% in the low paying CM group. The second experiment also randomized participants into the same conditions but without an escalating schedule of the voucher magnitude. Instead, those participants in the high- and low-paying CM groups received vouchers with a fixed amount for each cocaine-negative UDT. The high-paying CM group received a fixed amount of $55 and the low-paying CM group received $13 for each cocaine-negative UDT. The noncontingent group also received $13 for any urine sample independent of the test results. The maximum amount each group could earn was identical to that of the groups in the first experiment. Participants in the high-paying CM group provided an average of 39% cocaine-negative UDTs, followed by 16% in the noncontingent group and 12% in the low-paying CM group. Both experiments showed that high-paying CM produced superior outcomes compared to low-paying CM and noncontingent groups.

1.1.2.2. CM Studies with Special Populations

Miguel et al. (2022b) studied the effectiveness of integrating CM into abstinent-contingent housing (ACH) treatment for the treatment of crack cocaine dependence in Brazil. ACH provides an alcohol and drug-free housing environment for individuals experiencing homelessness. It also requires individuals to receive standard outpatient treatment that includes individual and group sessions on relapse prevention and social skills, as well as other supportive therapies. Treatment providers were trained in CM according to Petry's (2000) CM guidelines and fidelity was monitored. The duration of the treatment period in the study spanned 12 weeks. Twenty-one participants were randomized into ACH plus CM and ACH alone. The participants

underwent urinalysis twice a week to detect cocaine use. Those in the CM group received $2 worth of vouchers for every cocaine-negative UDT, with an additional $1 increment for each consecutive negative UDT, up to a maximum of $5. An extra $5 bonus was granted if both UDTs in a given week tested negative for cocaine metabolites. The value of the voucher was reset to its initial value if the UDT was positive. The total possible maximum earnings for this study were $185. A larger percentage of the CM group submitted cocaine-negative UDTs and had three or more weeks of consecutive abstinence compared to the ACH alone group, with a medium to large effect size. The CM group also had the largest percentage of participants with the longest duration of abstinence, with a large effect size. All findings were statistically significant.

Elk et al. (1998) studied the effectiveness of CM on abstinence from cocaine among pregnant women who were receiving multifaceted treatment that included prenatal care, drug counseling, and HIV counseling. Twelve women were randomly assigned to multifaceted treatment alone or multifaceted treatment plus CM. The participants were tested for cocaine use via urinalysis three times a week and those who were in the CM group received monetary reinforcers based on their abstinence from cocaine, and attendance at counseling and prenatal care sessions. Each cocaine-negative UDT earned $18, with an additional $20 bonus granted if all three UDTs in a given week were negative for cocaine and if the participants attended all scheduled visits, including prenatal care. There was no information on fidelity and training for CM. Analyses showed that 100% of the UDTs in the CM group tested negative for cocaine compared to 98% in the non-CM group. There was no statistically significant difference in abstinence between the two groups.

1.1.3.Summary of Drug Use Outcomes

Most studies that examined the effectiveness of CRA plus CM compared to CRA alone or another form of treatment found statistically significant differences in abstinence between the two groups during treatment or at the end of the treatment, favoring CRA plus CM (Higgins et al., 1993, 1994, 2000; Schottenfeld et al., 2011; Secades-Villa et al., 2013; and García-Fernández et al., 2013). Most studies with follow-up assessments also provided support for the effectiveness of CRA plus CM on abstinence (Higgins et al., 2000; Schottenfeld et al., 2011; Secades-Villa et al., 2011). CRA plus CM groups showed significantly greater levels of sustained continuous abstinence (Higgins et al., 2000) and had higher proportions of individuals abstinent from stimulants (Schottenfeld et al., 2011; Secades-Villa et al., 2011) at follow-up assessments. In contrast, Higgins et al. (2000) and García-Fernández et al. (2013) did not find a statistically significant difference in the proportions of abstinent individuals at follow-up, even though CRA plus CM groups had a greater proportion of abstinent individuals. Two studies also examined being abstinent throughout the 12-month study period (García-Fernández et al., 2013; Secades-Villa et al., 2011), and even though CRA plus CM group had higher proportions of individuals who were abstinent the entire 12 months, the difference between the groups was not statistically significant.

Some of the studies combined CM with CBT and compared it to other forms of treatment such as CBT alone. All three studies provided support for the effectiveness of CM on abstinence (Rawson et al., 2006; McKay et al., 2010; Shoptaw et al., 2005). The CM and CBT plus CM groups had more stimulant-negative UDTs than did the CBT-only group and had a significantly higher percentage of individuals with at least three consecutive weeks of abstinence (Rawson et al., 2006). Also, the highest number of stimulant-negative UDTs was observed for the CBT plus

CM group, followed by the CM-only group, GCBT, and CBT alone group (Shoptaw et al., 2005). None of the three studies found a statistically significant difference in abstinence at follow-up assessments.

Two studies included a type of medication along with or without CM. Shoptaw et al. (2006) examined the effectiveness of sertraline and CM in the reduction of methamphetamine use. When participants were exposed to CM regardless of medication usage, better abstinence outcomes were observed for them. Schmitz et al. (2010) examined the role of levodopa-carbidopa along with CM for the treatment of cocaine use disorder. Participants that received both levodopa-carbidopa and CM had better abstinence outcomes compared to those who only received CM and a placebo.

Miguel and their colleagues (2016; 2019; 2022a; 2022b) conducted a series of studies with the integration of CM into the public treatment settings for crack cocaine users in Brazil. Their findings showed that the CM group had longer weeks of abstinence and was more likely to achieve continuous abstinence from crack cocaine (Miguel et al., 2016), had higher rates of cocaine-negative UDTs, achieved longer mean duration of cocaine abstinence, and had increased likelihood of abstinence from cocaine (Miguel et al., 2019). In addition, CM participants were more likely to submit cocaine-negative UDTs, achieve three or more weeks of abstinence, and had longer periods of continuous abstinence (Miguel et al., 2022a). Finally, the CM group had a larger percentage of individuals who were abstinent, had three or more weeks of consecutive abstinence, and had the longest duration of abstinence (Miguel et al., 2022b). All findings were statistically significant.

Some studies included elements of preventive strategies, such as encouraging health behaviors and decreasing HIV-risk (Reback et al., 2010), while others, like Elk et al. (1998),

incorporated CM along with prenatal care to enhance their impact. Reback et al. (2010) found a statistically significant support for the effectiveness of CM in increasing abstinence between those who were exposed to CM versus those who were not. These outcomes were sustained at follow-up as well. Both groups in Elk et al.'s (1998) study with pregnant women had nearly perfect abstinence outcomes, resulting in no statistically significant differences between the two groups.

One study (Menza et al., 2010) implemented CM as a standalone treatment. Menza et al. (2010) provided CM to men who have sex with men with an opportunity of referral to community resources for counseling or other support. In this study, contrary to expectations, a higher percentage of participants in the CM group compared to a community resources referral group submitted at least one stimulant-positive sample. CM participants were also more likely to submit methamphetamine-positive samples at follow-up. However, none of these findings were statistically significant. The authors concluded that CM as a standalone treatment may not be effective for the population they served.

Finally, five studies compared CM schedules or varying voucher magnitudes. Because each study focused on different CM delivery types, it is difficult to draw a definitive conclusion for the varying schedules. However, it was suggested that the way CM system is set up may have an impact on stimulant use outcomes. Two studies compared the impact of voucher magnitude on abstinence and only one of them (Garcia-Rodriguez et al., 2009) performed statistical analyses and found that those who were in the high-value CM condition had better abstinence outcomes. Regnier et al. (2022) reported better abstinence outcomes for those who were in high-paying CM conditions, however, it is not clear whether the difference was statistically significant due to the lack of statistical analyses.

In conclusion, most studies evaluated CM in conjunction with another type of treatment such as CRA or CBT. Most studies lend support for the utility of CM on reducing stimulant use and promoting abstinence. Only one study found outcomes that were contrary to expectations (Menza et al., 2010). This study did not utilize CM with a psychosocial treatment, indicating that CM may not be suitable as a standalone treatment approach. However, more research is needed to support or refute this finding.

1.2. Retention Outcomes

Twenty-one studies focused on retention in addition to drug use outcomes. Thirteen of them found statistically significant differences in retention when CM was compared to another form of treatment. Six did not find any significant differences in retention, two yielded mixed results, and one did not conduct statistical analyses. The following retention related outcomes were often measured across the studies: (1) treatment completion, (2) mean number of weeks in treatment, (3) mean number of sessions, (4) length of stay, and (5) session attendance. One study looked at the likelihood of appointment attendance and another looked at the likelihood of staying in treatment.

1.2.1. Statistically Significant Effects of CM on Retention

Three studies from Spain that compared CRA plus CM to standard treatment among samples of participants with cocaine use disorder found statistically significant differences in retention outcomes between the groups. Garcia-Rodriguez et al. (2009) found that CM group with high voucher value had a greater number of weeks in treatment on average (mean = 19 weeks) than the standard treatment (mean = 14 weeks) and the difference was statistically significant. However, the CM group with low voucher value (mean = 17 weeks) did not differ

significantly from the standard treatment group. Secades-Villa et al. (2011) found that a significantly higher percentage of CM group participants (65.5%) completed twelve months of treatment compared to standard treatment group participants (29%). Similarly, a later study by Secades-Villa et al. (2013) found that CRA plus CM group participants stayed in treatment significantly longer on average (mean = 18 weeks) compared to CRA treatment alone participants (mean = 14 weeks).

Four studies combined CM with CBT and examined treatment retention outcomes. Rawson et al. (2006) found a significant relationship between treatment type—which included CM, CBT, and CBT plus CM—and mean length of stay in treatment among a sample of participants with stimulant use disorder. Compared to the CBT-only group, participants in the CM and CBT plus CM groups had a significantly higher average length of stay in treatment (CBT-only mean= 9 weeks; CM mean=13 weeks; CBT mean=12 weeks). CM and CBT plus CM groups had significantly higher percentages of participants who completed the full 16 weeks of treatment compared to CBT-only group (63%, 59%, and 40%, respectively).

Shoptaw et al (2005) compared four treatment conditions (CBT alone, CM alone, CBT plus CM, or GCBT alone) on retention among a sample of gay and bisexual men with methamphetamine use disorder. Participants in all groups were retained in treatment for long periods; however, those who were in the CM and the CBT + CM groups remained in treatment for significantly longer periods than the CBT condition.

McKay et al. (2010) compared IOP session attendance among CM, CBT based RP, CM plus RP, and TAU with a sample of participants who had cocaine use disorder. The mean number of IOP session attendance was 38 in both TAU and CM plus RP, 37 in CM, and 25 in RP with CM plus RP having a statistically significant difference from the other groups. There was also a

significant difference in RP session attendance. Participants in the CM plus RP group attended a significantly higher number of sessions on average (mean =13 sessions), compared to those in the RP group (mean = 3 sessions).

One study used pharmacotherapy in conjunction with CM and a psychosocial treatment. Shoptaw et al. (2006) found a significant difference between CM plus medication versus medication only among a sample of participants with methamphetamine use disorder. They found that participants assigned to sertraline plus CM (mean = 19.5 sessions), placebo plus CM (mean = 20.9 sessions) and placebo-only groups (mean = 18.3) attended a significantly higher number of relapse prevention sessions than the sertraline-only group (mean = 13.5).

Three studies from Brazil focused on the integration of CM into the standard treatment and publicly funded treatment programs for individuals with crack cocaine use disorder. Miguel et al. (2016) found that participants who were exposed to CM attended a significantly higher number of treatment sessions on average and were significantly more likely to be retained in treatment at weeks 4, 8, and 12 compared to those who were in standard treatment. A subsequent crossover trial (Miguel et al., 2019) that recruited participants who only received standard treatment in the 2016 study provided standard care plus CM to those participants. The study found that participants were retained in treatment for a longer period when they received CM, compared to when they received standard treatment only. Another subsequent study by Miguel et al. (2022a) found that those who received a comprehensive publicly funded treatment program (URH) plus CM stayed in treatment for an average of seven weeks, whereas those in URH only stayed in the treatment for an average of 3 weeks - a statistically significant difference in outcomes.

Two studies compared different delivery schedules of CM on retention related outcomes among samples of participants with methamphetamine use disorders. In their comparisons of five variations of CM, Roll et al. (2006) found that session attendance was greater for Schedules 5 (low initial rewards, moderate increases, bonuses for abstinence, and resets) and 3 (high initial rewards, gradual increases, no bonuses, and no resets) compared to Schedule 1 (flat rewards, no bonuses, and no resets). Chudzynski et al. (2015) compared session attendance rates for each CM schedule group with standard treatment. The highest retention rate was for the intermittent predictable CM group (rewarded for three consecutive negative UDTs, escalating schedule with reset but no bonuses; 66%), followed by continuous (rewarded for each negative sample, with an escalating schedule with reset and bonuses; 64%), intermittent unpredictable (same as the predictable condition but the timing of the reward was random; 60%), and standard treatment group (no CM; 46%). Those in the intermittent predictable group were significantly more likely to attend treatment appointments than those in the standard treatment group.

1.2.2. Mixed Effects of CM on Retention

Two studies with samples that had cocaine use disorders showed mixed retention outcomes. Schmitz et al. (2010) studied the effectiveness of levodopa-carbidopa in combination with CM for the treatment of cocaine use disorder over a 12-week period. The study included six treatment groups consisting of levodopa-carbidopa or placebo administered in combination with CM targeting one of three behaviors: (1) clinic attendance (CM-ATTEND); (2) medication compliance (CM- MEDICATION); (3) cocaine negative urine toxicology (CM- URINE). The overall percentage of participants staying in treatment dropped from 51% at week 6 to 35% at week 12. While the CM-ATTEND group appeared to stay in treatment longer, there were no statistically significant differences between the groups. The number of clinic visits during

treatment decreased for all participants over time, but the decreases for the CM-MEDICATION and CM-URINE groups compared to the CM-ATTEND group were statistically significant. The CM-URINE and CM-MEDICATION groups had a decreased likelihood of attending a clinic visit, while for the CM-ATTEND group, the decrease was not statistically significant.

Schottenfeld et al. (2011) compared CRA plus CM, CRA plus voucher control (VC), twelve-step facilitation (TSF) combined with CM, and TSF plus VC, among impoverished pregnant women or women with young children and had cocaine use disorder. The proportion of participants who stayed in treatment did not significantly differ between CM and VC, or CRA and TSF. In contrast, CM participants attended more treatment sessions on average (mean = 25 sessions) than VC participants (mean = 20 sessions), and the difference was statistically significant.

In conclusion, both studies showed varying results depending on the measurement of retention. Both indicated no difference when the retention was measured based on the percentage of participants staying in treatment, however, statistically significant differences were observed when the session attendance (Schmitz et al., 2010) or the average number of sessions (Schottenfeld et al., 2011) were compared between the groups. Schmitz et al. (2010) also showed that rewarding attendance specifically may lead to better retention outcomes.

1.2.3. Non-Significant Effects of CM on Retention

Three studies compared CRA plus CM to CRA plus non-contingent incentives (Higgins et al., 2000) or CRA-only treatment (García-Fernández et al., 2011, 2013) among participants with cocaine use disorders. Higgins et al. (2000) compared treatment completion between CRA plus CM and CRA plus non-contingent incentives (i.e., provided incentives regardless of the

urinalysis results) groups. A slightly higher percentage of those in the non-contingent group (79%) completed 12 weeks of treatment compared to those in the CM group (72%), while a slightly higher percentage of participants in the CM group (56%) completed 24 weeks of treatment, compared to non-contingent group (53%). Both comparisons showed no statistically significant differences.

García-Fernández et al. (2011) compared CRA plus CM and CRA-only treatment groups on treatment completion and average number of weeks in treatment outcomes over a 12-month period of treatment. Sixty-five percent of the participants in the CM group versus 48% in the CRA-only group completed 12 months of treatment. The CM group stayed for an average of 36 weeks in treatment; whereas, the CRA-only group stayed for 29 weeks on average. The CM group showed better retention outcomes compared to the other group that did not receive CM, however, the findings were not statistically significant. A later study by García-Fernández et al. (2013) also did not find any statistically significant differences between CRA plus CM and CRA-only groups on retention. As such, treatment type did not predict length of stay in treatment among a sample of individuals with or without depressive symptoms.

Elk et al. (1998) found high retention rates for all the groups without a statistically significant difference among a sample of pregnant women with cocaine use disorders receiving a multifaceted treatment. Similarly, Reback et al. (2010) also did not find a difference between the attendance rates among men who had sex with men enrolled in HIV prevention program along with CM or without CM. Finally, Miguel et al. (2022b) did not find a statistically significant difference in average number of weeks in treatment between those who received abstinent-contingent housing (ACH) treatment plus CM versus those who received ACH-only.

One additional study reported retention outcomes, however, it did not conduct statistical analyses. Menza et al. (2010) compared CM with a control group on retention outcomes among a sample of men who have sex with men. The authors reported an overall attendance rate of 84% at the 24-week visit. The study did not involve a psychosocial treatment component. They also noted similar retention rates at the 6-week visit for both groups, although statistical analysis was not performed.

1.2.4. Summary of Retention Outcomes

Overall, the majority of the studies showed favorable retention outcomes for participants receiving CM. Most studies examining the average number of weeks in treatment or session attendance found that CM groups had better outcomes compared to the groups that did not receive CM. Even studies with no statistically significant findings favored CM over other types of treatment on retention. Studies with mixed findings varied in their results depending on the type of retention they examined. Among those studies that measured retention outcomes, the CM condition was generally superior.

Finally, some studies that compared different CM schedules varied in the types of schedules they compared and the way they compared treatment groups. Regardless of these variations, some important findings are worth noting. The study by Roll et al. (2006) found that CM utilizing an escalating schedule with bonuses led to better retention outcomes compared to flat rewards that did not offer any increase in incentives for consecutive abstinence. This finding indicates that clients may be more motivated to stay in treatment when they receive increased amounts of incentives and were acknowledged with tangible rewards for achieving consecutive periods of abstinence. Another study that compared different CM schedules to a standard treatment group found that those who were rewarded for consecutive abstinences rather than per

negative UDTs were more likely to attend their treatment sessions than those who did not receive any incentives (Chudzynski et al., 2015). The other CM schedules did not evidence statistically significant retention improvements compared to standard treatment. This finding illustrates how the scheduling and delivery of CM incentives may positively impact treatment retention outcomes.

1.3. HIV Related Outcomes

Among all the studies under the current review, four incorporated HIV-specific outcome measures among samples of pregnant women, individuals experiencing homelessness, and gay and bisexual men (Elk et al., 1998; Menza et al., 2010; Reback et al., 2010; Shoptaw et al., 2005), while an additional five provided HIV education as part of the standard or other treatment condition (Higgins et al., 2000; Milby et al., 2000, 2008; Schottenfeld et al., 2011; Shoptaw et al., 2006). A number of the remaining studies mentioned the link between drug use and the increased risk for HIV, especially among individuals who are experiencing homelessness, have co-occurring disorders, or engage in risky sexual behaviors (Miguel et al., 2016, 2019, 2022). Among the four studies that included HIV-related outcomes, Elk et al. (1998) did not provide results on HIV-related outcomes, and Shoptaw et al. (2005) only assessed outcomes for the group that did not receive CM. Thus, only the findings from the studies by Reback et al. (2010) and Menza et al. (2010) will be reported.

Reback et al. (2010) assessed the efficacy of CM for increasing health-promoting behaviors and reducing substance use among men who have sex with men (MSM) who are experiencing homelessness participating in a community-based, low-intensity HIV prevention program. Participants in both study conditions (HIV prevention + CM; HIV prevention only) earned points for attending scheduled study visits and participating in the HIV prevention

program activities. Authors found statistically significant reductions in stimulant use and greater increase in health-promoting behaviors among the CM group. In the CM condition, HIV-seropositive participants accomplished significantly more health-promoting behaviors than HIV-seronegative participants, but there were no differences based on HIV status in the control group. Based on the findings, authors concluded that CM is beneficial for this high-risk population and feasible to implement in a community-based HIV prevention program.

Menza et al. (2010) studied the effectiveness of CM on the prevention of HIV among MSM. The authors measured unprotected anal intercourse (UAI) with a partner of unknown or discordant HIV status (non-concordant UAI) in the past six weeks as a risk factor for HIV acquisition. During the 12-week treatment period, both the CM and control groups showed similar likelihoods of reporting non-concordant UAI. However, during the subsequent 12-week follow-up period, CM participants were less likely than control participants to report non-concordant UAI. Throughout both the treatment and follow-up periods, CM participants reported fewer non-concordant UAI partners compared to control participants. Despite these observed differences, none of them reached statistical significance.

2. Prize-Based Contingency Management

A number of studies have assessed the efficacy of prize-based CM as a behavioral reinforcement technique that rewards abstinence or attendance with a predictable monetary value exchangeable for goods or services. Across all studies under this review, ten out of 36 trials used the “fishbowl” technique, which provides a chance to draw from a bowl, and possibly win a prize after submitting a negative urine drug sample or attending a treatment session.

Three out of ten studies placed contingency on just one drug, cocaine (Carrol et al., 2016; Petitjean et al., 2014), or methamphetamine (Roll et al., 2013), while seven tested and reinforced abstinence from multiple substances, including methamphetamine, cocaine, amphetamine, alcohol, and opioids. One study rewarded attendance only (Petry et al., 2018). Although the duration of a CM protocol during which participants may earn incentives is likely to vary depending on clinical setting (Petry & Stitzer, 2002), the current review indicates that the 12- or 24-week protocols were adopted most frequently, and the overall treatment duration ranged from 4 weeks to 6 months. All studies have used an escalating schedule with bonus and reset features, meaning that the number of draws (usually twice weekly) or bonuses increases with successive abstinence or attendance and resets upon lack of compliance with the desired behavior such as unexcused absence from group sessions (Petry et al., 2018). Across all studies, around 50% of cards, chips, or slips were associated with prizes of varying magnitude ranging from small (value up to $1) to jumbo (value up to $100). Based on the monetary value, each prize was exchanged for varied goods, including food items, toiletries, bus tickets, watches, TVs, etc. Depending on the duration of the intervention and the frequency of monitoring abstinence (cocaine, amphetamine, methamphetamine, or alcohol), or attendance, an average maximum earning per participant ranged from $103 (Hagedorn et al. 2013) to $190 in prizes (Petry et al., 2018). Eight studies provided usual care as a control, while two studies used CBT in conjunction with CM, placebo, or disulfiram[3] (Carroll et al., 2016), or as a control (Petitjean et al., 2014).

The majority of the studies under the current review were conducted in the United States except for one study conducted in Switzerland (Petitjean et al., 2014). All studies sampled individuals in community outpatient programs, while four studies focusing on special

[3] A type of medication used in the treatment of alcohol use disorder to deter people from drinking alcohol.

populations, including patients with high psychiatric comorbidity (Petitjean et al., 2014), patients with serious mental illness (McDonell et al., 2013), veterans (Hagedorn et al., 2013), and individuals with co-occurring psychiatric disorders and experiencing homelessness (Tracy et al., 2007). Sample sizes ranged from 30 (Tracy et al., 2007) to 442 (Petry et al., 2012) participants, predominantly White with an age range between 30 and 50 years. Three large-scale studies had predominantly female samples. Many studies had some proxy or indicator of fidelity (e.g., implementing and adhering to schedules or procedure used in prior literature or having qualified staff implement and oversee procedures).

2.1. Drug Use Outcomes

Similar to previously discussed voucher-based CM, substance use reduction is one of the primary outcomes measured across trials using prize-based CM. Typically, drug use was measured using urinalysis, while reductions in use were operationalized through the longest duration of sustained abstinence from stimulant drugs (weeks), and the proportion of drug-negative samples submitted throughout the duration of treatment (Hagedorn et al., 2013; Petry et al., 2004, 2005, 2013, 2018; Petitjean et al., 2014; Roll et al., 2013). Alternatively, some studies focused on the percentage of days without stimulant use and the number of positive urinalysis samples (Carroll et al., 2016; Tracy et al., 2007), or estimating the likelihood of a participant submitting a negative urinalysis sample during the treatment period. All studies included a control group, usually consisting of standard treatment procedures, but only few studies included indicators of fidelity.

2.1.1. Studies with Follow-up Assessments

There was a total of seven studies with a follow-up assessment. These studies compared both in-treatment and end of treatment drug use outcomes and included assessments extending beyond the treatment period to examine if the outcomes of CM were sustained. Three studies explored variations in types, schedules, and values of CM (Petry et al., 2012, 2018; Roll et al., 2013). Three studies focused on special populations, including patients with high psychiatric comorbidity (Petitjean et al., 2014), serious mental illness (McDonell et al., 2013), and veterans with polysubstance use disorders (Hagedorn et al., 2013).

Carroll et al. (2016) evaluated the extent to which outcomes from CBT treatment of individuals with cocaine use disorder could be enhanced by adding CM, disulfiram, and the combination of CM and disulfiram by comparing the effectiveness of 12-weeks of four conditions: (1) contingency management (CM) + disulfiram + CBT, (2) CM + placebo + CBT, (3) disulfiram + CBT, and (4) placebo + CBT among a sample of 99 individuals with a cocaine use disorder. Participants earned chances to draw prizes from a bowl contingent on two independent behaviors (i.e., medication adherence and cocaine negative urine samples). The bowl contained 750 plastic coins: 75 small prizes ($1 value), 20 medium prizes ($5 value), 15 large prizes (up to $20 value), and three jumbo prizes (up to $100 value). The number of draws increased when a participant demonstrated a desired behavior, while a failure to comply with the conditions resulted in a reset. Authors ensured fidelity by scheduling and logging all study procedures, and by using standardized instruments to measure outcomes. Despite no main effects of CM for percent days of self-reported cocaine abstinence, through statistically significant interactions, the researchers found that CM enhances outcomes for the treatment of cocaine use disorder with the best cocaine outcomes for the combination of CM and placebo. CM was

associated with a statistically significantly higher percentage of abstinent days for participants assigned to placebo (91%), as compared to 79% of participants with no CM. In the disulfiram group, the effects of CM were less pronounced with 69% of abstinent participants, as compared to 79% of participants who received disulfiram and CBT but no CM. The results also indicated a statistically significant effect of CM on percent of cocaine-negative urine drug samples (no CM 36.6% negative; CM 55.9% negative). One year follow-up data indicated sustained treatment effects across conditions.

2.1.1.1. Studies with Comparisons of Different CM Schedules or Voucher Values

Petry et al. (2012) explored the efficacy of varying magnitudes of reinforcement on drug use outcomes in individuals with cocaine use disorder. Depending on their initial abstinence status, 442 participants were randomized to one of the six study conditions. A total of 333 initially participants with cocaine-negative UDT were randomized to one of the three conditions: (1) standard care (SC), (2) SC+CM reinforcing submission of negative samples with $250 in prizes ($250Abs), or (3) SC+CM reinforcing attendance ($250Att). One-hundred-nine initially participants with cocaine-positive UDT were randomized to one of the three conditions: (1) SC, (2) $250 abstinence-based CM ($250Abs), or (3) higher magnitude abstinence-based CM ($560Abs). Participants in all six groups submitted urine (screened for cocaine and opioids) and alcohol breath samples, which were collected throughout 12 weeks following a tempering schedule. The authors found that the group with cocaine-negative UDT had a significantly higher proportion of negative samples (89%) as compared to the group with cocaine-positive UDT (47%). For participants with initially cocaine-negative UDT, both CM conditions significantly increased proportions of negative UDTs submitted relative to SC, and the two CM conditions did not differ when missing UDTs were not considered in the denominator. At the same time, the two

CM conditions were equally efficacious to SC in enhancing longest duration of abstinence (LDA). In initially cocaine-positive patients, both CM conditions increased proportions of negative urine drug samples relative to SC. When expected samples were used in the denominator, only patients in the $560Abs condition demonstrated increased proportions of negative urine drug samples compared with those in SC. Patients assigned to $560Abs also achieved significantly longer durations of abstinence than those assigned to SC and those assigned to $250Abs achieved intermediary periods of abstinence, which did not differ from either of the other conditions. Follow-ups revealed no differences among groups, but LDA was consistently associated with abstinence at 9 months. About half the patients relapsed to substance use during the post-treatment period.

Roll et al. (2013) assessed whether different durations of CM in conjunction with psychosocial treatment produce divergent rates of abstinence among individuals with methamphetamine use disorder. A total of 118 participants were randomized to one of the four 16-week treatment conditions: (1) standard psychosocial treatment (SPT) or (2) psychosocial treatment plus one of the three durations of CM (one-month, two-month, or four-month). The standard psychosocial treatment consisted of a manualized protocol based on the Matrix Model. UDTs were collected three times per week during attended sessions throughout the course of treatment. Having a methamphetamine-negative UDT earned draws from the prize bowl. Fifty percent of tokens in the bowl conveyed "good job" without tangible rewards, while the other half were linked to tangible prizes ranging from small ($1.00 value) to jumbo ($80.00 value). Extra draws were given for each consecutive week of abstinence. A positive UDT resulted in not earning a draw and the number of draws for the next negative UDT was reset to one. The researchers found significant differences across treatment conditions for number of consecutive

days of methamphetamine abstinence with participants more likely to remain abstinent through the 16-week trial as CM duration increased. Follow-up at 6, 8, 10, and 12 months revealed a statistically significant effect of treatment condition and time on abstinence over time with those in the 4-month CM condition about 7.25 times more likely to submit a negative UDT as compared to the standard treatment condition (SPT=24.1% vs 4-month CM=75.9%).

Petry et al. (2018) explored the impact of CM on treatment attendance and cocaine use outcomes over a twelve-week period of treatment. Using an adaptive research design, a total of 360 participants were randomized to either usual care (UC) or attendance-based CM at treatment initiation. Six weeks later, they were re-randomized to UC or CM. Both groups submitted up to 24 UDTs and breath samples, but prizes were contingent on successive attendance as opposed to the submission of a drug-free UDT. Half of the cards in the prize bowl were associated with a tangible prize, including small (e.g., toiletries, food items, or bus tokens), large (e.g., gift cards; worth up to $20), and jumbo (e.g., TV; worth up to $100). Extra draws were given for attending each subsequent scheduled session since the last draw. An unexcused absence resulted in not earning a draw and the number of draws was reset to one. All study procedures were delivered by trained and qualified staff, and ongoing supervision consisted of regular review of treatment protocols as well as an independent of adherence to study procedures. The authors found that the CM group reported a significantly longest duration of time in which patients submitted all negative samples and a higher proportion of UDTs testing negative. As compared to UC, later CM patients had improved drug use outcomes. Patients randomized to CM twice (during both six-week periods or 12 consecutive weeks of CM) achieved longer durations of abstinence and had higher proportions of negative UDTs with small to medium effect sizes as compared to those who received CM for 6 weeks. At 6-month follow-up, the percentage of negative UDTs for each

group ranged from 49% to 54%, but the assignment to UC or CM was not a significant predictor of abstinence.

2.1.1.2. Studies with Special Populations

Three out of four studies with special populations included follow-up assessments. The primary objective of a randomized control trial conducted by McDonell et al. (2013) was to determine whether contingency management was associated with increased abstinence from drug use in stimulant-dependent patients with serious mental illness treated in a community mental health center. The authors compared the effectiveness of 24 weeks of treatment as usual (TAU) to TAU plus CM among a sample of 176 participants. Those randomized to the CM group were allowed to draw from a bowl each time they provided a negative urine drug sample for all stimulants (amphetamine, methamphetamine, and cocaine). Fifty percent of tokens in the bowl conveyed "good job" without tangible rewards, while the other half were linked to physical prizes ranging from small ($1.00 value) to jumbo ($80.00 value). Extra draws were given for each consecutive week of abstinence. A positive UDT resulted in not earning a draw and the number of draws for the next negative UDT was reset to one. Information on fidelity and training for CM was not provided. The authors found that participants in the CM group were two times more likely to submit a stimulant-negative urine drug sample during the treatment period (3 urine tests submitted per week, for 12 weeks), and reported significantly fewer days of stimulant use during the treatment period relative to participants in the TAU group. During the three-month follow-up period, participants in the CM group were more likely to submit a urine drug test negative for stimulants and have statistically significantly fewer days of stimulant use during the treatment period when compared to those in the TAU group.

Hagedorn et al. (2013) assessed the efficacy of adding CM to the standard Veterans Health Administration substance use disorders treatment for veterans with alcohol use disorder only or stimulant use disorder. A total of 330 participants were randomly assigned to eight weeks of usual care (UC) or UC + CM and then subdivided into an alcohol (n =191) and stimulant (n =139) subgroups at intake. All participants were screened for cocaine, amphetamine, methamphetamine, and alcohol twice weekly, but only the CM group earned chances to win vouchers when their urine and breath test results were negative for all targeted substances. Fifty percent of tokens in the bowl conveyed "good job" without tangible rewards, while the other half were linked to physical prizes ranging from small ($1.00 value) to jumbo ($80.00 value). Extra draws were given for each consecutive week of abstinence. A positive UDT resulted in not earning a draw and the number of draws for the next negative UDT was reset to one. Information on fidelity and training for CM was not provided. The results showed that the majority of samples (92.9 – 100%) submitted by participants in both groups were free of target substances. The authors found that the subgroup with alcohol use disorder that received UC + CM submitted significantly more negative urine drug samples, achieved significantly longer median durations of abstinence, and submitted significantly more negative samples at follow-ups as compared to UC participants. These differences were associated with medium effect sizes. There were no statistically significant intervention effects for the subgroup with stimulant use disorder assigned to either UC or UC + CM. There were also no statistically significant differences between the mean number of submitted negative urine drug samples between alcohol and stimulant subgroups that received CM. At two, six, and twelve-month follow-ups, the subgroup with stimulant use disorder submitted comparable percentages of positive UDTs despite treatment group assignment, but the differences were not reported as statistically significant. There was,

however, a significant linear trend showing an increase in the proportion of both alcohol and stimulant positive UDTs across the three follow-up time points.

Petitjean et al. (2014) assessed the efficacy of combining CBT and prize-based CM in treating cocaine use disorder in an outpatient unit in Switzerland. The study compared 24 weeks of CBT plus CM to CM alone with a sample of 60 participants. After group allocation, participants received a 12-week intervention phase (CBT + CM or CBT alone, week 1–12) followed by a 12-week maintenance phase (CBT + CM or CBT alone, week 13–24). During the intervention phase, CM group had a chance to earn prizes twice a week, and then once a week during the maintenance phase for submitting cocaine-negative UDTs. Fifty percent of tokens in the bowl conveyed "good job" without tangible rewards, while the other half were linked to physical prizes ranging from small ($2.00 value) to jumbo ($500.00 value). Extra draws were given for each consecutive week of abstinence and a positive UDT resulted in a reset of the draws. CBT group had 60-minute group sessions once a week during the intervention phase and then once every other week during the maintenance phase. All procedures were performed by qualified psychologists and psychiatrists trained in the CBT manual for cocaine use disorder videotaped, and in accordance with the protocol by Petry (2000) for the entire 24 weeks. The authors found a statistically significant reduction in cocaine use over time for participants in both groups. There were no statistically significant differences between groups in the proportion of cocaine-free urine drug samples submitted during the intervention, except at weeks 8, 9, 10, 17 and 21 when the CBT + CM group reported significantly higher proportion of negative urinalysis as compared to the CM only group. At 6-month follow-up, the percentage of cocaine-negative urine drug samples was higher in the CBT + CM group (66%) as compared to CM only (45%), but the difference was not statistically significant. Despite the lack of statistically significant

differences between groups, researchers reported a highly significant decrease in frequency of cocaine use over time, and a statistically significant reduction in the amount of cocaine use in favor of the CBT + CM group.

2.1.2. Studies without Follow-up Assessments

There were three older studies without a follow-up assessment. After the publication of the manualized version of the prize-based CM (Petry & Stitzer, 2002), Petry and colleagues (2004) conducted a randomized control trial that compared the effects of 12 weeks of (1) standard care (SC), (2) SC plus low-magnitude CM (average of $80 in reinforcement), and (2) SC plus high-magnitude CM (up to $240 in reinforcement) on drug use for 120 intensive outpatient treatment-initiating individuals who were diagnosed with cocaine use disorder. Standard treatment comprised group sessions that included 12-Step oriented treatment, CBT, health education and HIV prevention and life skills training. Information on fidelity and training for CM was not provided. Participants in all three study conditions submitted weekly urine drug samples, but only those in the two CM-based conditions had the opportunity to draw a reward from the fishbowl for submitting UDTs that were negative for cocaine, opioid and alcohol, as well as for completing tasks related to their treatment goals. For both CM groups, half of the 250 slips of paper in the bowl were non-winning and conveyed “good job” and the other half were winning slips. The low-magnitude group had a chance to earn mini prizes worth about $0.33, medium prizes worth $5, and a jumbo prize worth up to $100. The high-magnitude group had a chance to earn small prizes worth up to $1, large prizes worth up to $20, and a jumbo prize worth up to $100. The researchers found statistically significant differences between the three groups with participants in the high-magnitude ($240) CM condition achieving longer periods of continuous abstinence and submitting the highest percentage of drug-free specimens.

A consecutive study by Petry et al. (2005) evaluated the efficacy of 12 weeks of usual care (UC) in comparison to UC plus abstinence-based CM for 415 drug abusing patients in community treatment settings. The UC condition included group and possibly some individual and family counseling, while the CM condition provided participants with a chance of winning a prize contingent on a negative UDT (i.e., cocaine, amphetamine, methamphetamine) and alcohol test. Half of the chips in the bowl conveyed "good job" without tangible rewards, while the other half were linked to tangible prizes ranging from small ($1.00 value) to jumbo (up to $100.00 value). Extra draws were given for each consecutive week of abstinence and a positive UDT resulted in a reset of the draws. Participants also earned bonus draws if they were abstinent from opioids and marijuana. Information on fidelity and training for CM was not provided. In line with their primary hypothesis, the authors found that proportion of negative UDTs in the CM condition was statistically higher than the usual care condition. The CM group had almost four times the number of participants who achieved 12 weeks of abstinence, with an overall adjusted mean of 8.4 weeks for CM participants and 4.8 weeks for usual care participants.

2.1.2.1. Studies with Special Populations

There was only one study involving a special population without a follow-up assessment. Tracy et al. (2007) evaluated the feasibility and efficacy of low-cost CM on substance use outcomes among individuals with co-occurring disorders and experiencing homelessness. A total of 30 participants were randomized to two 4-week conditions: (1) assessment-only treatment condition and (2) CM. Access to all shelter services was provided to both groups for the duration of the study. Information on fidelity and training for CM was not provided. Authors measured drug use through self-reported percentage of days with no cocaine or alcohol use and the objective number of positive urine drug screens and breathalyzer specimens. Each participant in

the CM group who demonstrated abstinence was given a chance to draw from the prize bowl ($1-$100 prizes with a maximum expected value of $81.60 in prizes). Overall, authors reported that substance use was low during the 4-week trial with participants in both groups averaging 85% days with no cocaine use (CM = 96%, assessment-only = 75%) with similar percentages for days with no alcohol use. Participants in the CM group reported significantly fewer days of cocaine use and made greater reductions in the frequency of cocaine use over time, as compared to the assessment-only group.

2.1.3. Summary of Drug Use Outcomes

Overall, the studies under the current review supported the effectiveness of CM in reducing abstinence from drugs (i.e., cocaine, methamphetamine, and amphetamine). Drug use was measured utilizing self-report as well as urinalysis screenings. All but one study, which was conducted in with a sample of veterans that used self-reported cocaine use as the primary outcome (Hagedorn et al., 2013), indicated a statistically significant effect of CM on the number of drug-free samples submitted throughout the study, days of use, or consecutive days/weeks of abstinence. One study also explored the efficacy of CM in relation to the initial abstinence status to find that participants in the cocaine-negative arm submitted a higher proportion of drug free samples as compared to the cocaine-positive arm. However, both CM conditions significantly increased proportions of negative urine drug samples submitted relative to SC regardless of initial abstinence status (Petry et al., 2012). The authors found that the cocaine-negative arm had a significantly higher proportion of negative urine drug samples (89%) as compared to the cocaine-positive-arm (47%).

Seven out of the ten studies conducted follow-up assessments. One study that focused on attendance-based CM found that reinforcing attendance at treatment did not yield benefits with

respect to long-term substance use outcomes (Petry et al., 2018). An earlier study that compared abstinence to attendance-based CM also did not find statistically significant differences in percentages of negative urine drug samples submitted at the nine-month follow-up (Petry et al., 2012). One year follow-up data indicated sustained treatment effects across conditions with CM enhancing the outcomes for CBT treatment of participants with cocaine use disorder. Participants who received the combination of CM and placebo treatment reported the best outcomes (Carroll et al., 2016). Another study reported a highly significant decrease in frequency of cocaine use over time, and a statistically significant reduction in the amount of cocaine use in favor of the CBT + CM group at the six-month follow-up (Petitjean et al., 2014). Similarly, follow-up analysis revealed that participants in the longest (4-month) CM condition were more likely to submit methamphetamine-negative urine drug samples than participants in the standard treatment condition (Roll et al., 2013). The effects of CM were also sustained among patients with drug-dependency who also were diagnosed with serious mental illness. At the three-month follow-up period, participants in the CM group were more likely to submit a stimulant negative urine drug test (i.e., amphetamine, methamphetamine, and cocaine) and have significantly fewer days of stimulant use during the treatment period when compared to those in the TAU group (McDonell et al., 2013). Lastly, after finding no statistically significant differences between treatment as usual and CM on drug use, researchers reported a significant linear trend showing an increase in the proportion of both alcohol and stimulant positive urine drug samples across the three follow-up time points at two, six, and 12 months (Hagedorn et al., 2013).

2.2. Retention Outcomes

In addition to focusing on drug use outcomes, all ten studies included retention outcomes, typically operationalized through the number of weeks an individual remained in treatment, or the overall percentage of individuals who completed the treatment. Given often divergent nature of the studies and the selection of primary and secondary outcomes, and the lack of uniformity in operationalizing retention outcomes, there is a noticeable variation in the depth, breadth, and statistical significance of reported findings.

2.2.1. Statistically Significant Effects of CM on Retention

Starting with the most methodologically robust studies, Petry et al. (2018) hypothesized that 12 weeks of CM would improve attendance at treatment as compared to usual care. The authors reported that patients who received 12 weeks of attendance CM came to treatment more days, attended a higher proportion of scheduled groups, and stayed in treatment for a longer consecutive period than patients who were never randomized to CM, with effect sizes ranging from medium to large. Despite reporting low overall retention, Roll and colleagues (2013) found statistically significant differences in retention rates across the four treatment conditions (SPT, SPT + one-month CM, SPT + two-month CM, SPT + four-month CM) with 37% of the SPT and 76% of the four-month CM groups retained at follow-up. The overall treatment attendance rate was 64.3%.

Petry et al. (2005) reported on treatment retention and completion through the number of weeks in the study and the percentage of participants who completed all 12 weeks of treatment. The authors found that participants assigned to the CM condition were significantly more likely to be retained than those assigned to usual care. By the end of 12 weeks, 49% of CM participants

were still retained vs 35% of the usual care participants. On average, participants in the CM condition (mean=19.2) attended significantly more counseling sessions on average during the 12-week study period compared with the participants in the usual care condition (mean=15.7).

Petry et al. (2012) conducted a randomized trial adapting CM targets based on initial abstinence status of patient with cocaine-use disorder. The study compared the effects of abstinence and attendance-based CM among two study groups (i.e., initially cocaine positive or negative). The authors found that participants with initially negative UDTs in both abstinence and attendance CM groups attended more sessions than those in the standard treatment group. The authors found no differences in weeks retained in treatment in either study arm or number of sessions attended across groups in the cocaine-positive arm.

2.2.2. Mixed Effects of CM on Retention

Petitjean et al. (2014) hypothesized that participants in the CBT plus CM group would show better retention in treatment compared to CBT alone during active treatment and at 6-month follow-up. Overall, 38 (63.3%) of 60 participants completed the 24-week trial with no group differences in the overall decline in study retention over time. Patients in the CM group stayed in treatment for an average of 19 weeks and those in the control group for 17 weeks. Two baseline variables were statistically significant predictors of dropout. Patients with more cocaine-using days were 1.2-fold more likely to drop out, and patients having debts were 4.5-fold more likely to drop out. Petry et al. (2004) were interested in exploring both retention (i.e., number of days that elapsed between when the first and last study urine samples were submitted) and participation (number of counseling sessions attended during the 12-week study, including individual, group, and family counseling sessions). The authors reported that mean number of weeks in the study was 6.2, 6.2, and 6.7 for the standard, $80 CM, and $240 CM conditions,

respectively. There were no statistically significant differences in retention across groups. However, patients in the $240 CM condition had the highest treatment completion rate (31.6%) in relation to other groups, including the standard condition (13.5%) and the $80 CM condition (20.0%). Lastly, Tracy et al. (2007) focused on a small sample of individuals with co-occurring disorders experiencing homelessness and reported that of those who were randomized to the CM condition, 86.6% (26) completed the post treatment assessment and 13.3% (4) did not complete the study. All participants who did not complete the study were in the assessment-only condition.

2.2.3. No Effects of CM on Retention

Carroll et al. (2016) reported no statistically significant differences across treatment group, medication (disulfiram versus placebo), or contingency management (CM versus no CM) in terms of days retained in the 84-day treatment protocol, number of scheduled CBT sessions completed, percentage of study days the participant reported taking their study medication as prescribed, or number of urine specimens collected. Interestingly, McDonnell et al. (2013) found that significantly fewer participants in the CM group (42%) were retained throughout treatment compared with those in the control group (65%). CM participants were also retained for fewer weeks (mean = 7.25) than participants in the non-contingent control group (mean = 9.33). This unexpected outcome may be attributed to the fact that the non-contingent group was being rewarded independently from UDT results.

Dropout typically occurred during the first 4 weeks with 64% in the CM group and 63% in the control group. Lastly, Hagedorn et al. (2013) found that only the alcohol use disorder subgroup that received UC + CM were retained significantly longer (7 versus 6 weeks) with a medium effect size compared to the usual care participants.

2.2.4. Summary of Retention Outcomes

Overall, there were mixed findings on the effectiveness of CM in improving treatment retention among individuals with stimulant use disorders. Although most of the studies found differences in retention-related outcomes for CM groups compared to groups receiving other treatments, there was not enough statistically significant evidence to suggest that exposure to longer and higher-magnitude CM generally improved retention outcomes. The nature, breadth, and depth of reported findings varied across studies, but in general retention rates for participants in CM groups spanned between an average of 32% (Petry et al., 2012) and 87% (Tracy et al., 2007). Among the studies that reported positive effect, the CM groups generally stayed longer in treatment and attended more sessions (Petitjean et al., 2014; Petry et al., 2005, 2012, 2018; Roll et al., 2013). Some key factors that appear to have differentially impacted retention outcomes included initial abstinence status (Petry et al., 2012), cocaine-using days, and having debt (Petitjean et al., 2014).

2.3. HIV Related Outcomes

Two out of the ten studies incorporated HIV-specific outcomes measures, while an additional two provided AIDS education as part of the standard treatment. The remainder of the studies either mentioned the link between drug use and increased risk for HIV, especially among individuals with co-occurring disorders, or did not address the importance of these potential causal mechanisms. Among the two studies that included HIV-related outcomes, Petry et al. (2004) tested whether the participant was HIV positive at baseline (part of demographic data) to find no statistical differences between the three study conditions (Standard treatment = 8.3%, CM ($80) = 9.5%, CM ($240) = 8.1%). In addition to baseline HIV assessment, health education and AIDS prevention was part of the standard treatment. In a study conducted by McDonell et al.

(2013), participants completed the HIV risk behavior (the HIV Risk Behavior Scale) at weeks 4, 8, 12, 16, 20, and 24. Despite study limitations, results provided evidence that CM is an effective technique for reducing drug and alcohol use, HIV risk behavior (injection drug use), psychiatric symptoms, and rates of inpatient hospitalization in seriously mentally ill adults.

3. Abstinent Contingent Housing

Another less explored form of CM incentivizes abstinence with housing. Within this review, two studies were identified to investigate the effects of abstinent contingent housing on drug use and retention outcomes among individuals experiencing homelessness.

3.1. Drug Use Outcomes

Milby et al. (2000) studied the effectiveness of abstinent contingent housing on drug use and retention outcomes among a sample of dually diagnosed individuals with cocaine use disorder and who were experiencing homelessness. A total of 110 participants were randomized to behavioral day treatment alone (DT) or behavioral day treatment plus abstinent contingent housing and work therapy (DT+). DT spanned two months and included transportation from and to shelter along with lunch. It was comprised of individual counseling, psychological evaluation and "participant governed morning meeting, process group, AIDS education, relapse prevention training, goal development, goal review, assertiveness training, role play, weekend planning, reinforcement exposure and planning, recreation outing group, 12 Steps, relaxation, recreation goal development and recreation goal review" (Milby et al., p. 57). Both DT and DT+ groups were tested for drugs and alcohol twice a week via urinalysis. DT+ group received the same intervention but also included formulation of housing and work goals as part of CM. Participants in this group moved to rent-free, furnished apartment or unit in a group house when they

achieved two consecutive weeks of abstinence from cocaine, marijuana, and alcohol. Testing positive for drug (i.e., cocaine and marijuana) and alcohol use resulted in removal from the group house and return to a shelter. Once a participant re-established abstinence, they were able to return to the group house. During the second phase of the program (months 3-6), participants had to pay a modest rent, or if they participated in work therapy, the rent fee was deducted from their paycheck. At the second phase of the programs, both groups received aftercare, consisting of weekly group sessions and continued psychoeducation content from the first phase. Information on fidelity and training for CM was not provided. Analyses showed that DT+ group had statistically significantly higher percentage of days abstinent at 2 and 6 months (71% and 41%, respectively) compared to DT alone group (41% and 15%, respectively). There was also a statistically significant difference in the length of abstinence between the two groups at two- and six-month assessments. The DT+ group averaged about five consecutive weeks of abstinence at two months and 9.5 weeks at six months, whereas the DT alone group averaged about three consecutive weeks of abstinence at two months and four weeks at six months.

In their subsequent study, Milby et al. (2008) formulated a cost-effective version of abstinent contingent housing with an 18-month (one-year after the treatment ended) follow-up assessment. They extracted the following CM components of the treatment model from the study by Milby et al. (2000): contingency-managed housing, job training, and work with transportation services. All these components together were labeled as CM in the study. A total of 206 individuals experiencing homelessness and had cocaine use disorder were randomized to (1) behavioral day treatment and CM (CM+), or (2) CM alone (CM). All participants received a furnished apartment with food and work training/employment contingent on negative UDTs. CM+ also received CBT, therapeutic goal management, and other intervention components. For

both groups, housing was contingent on abstinence from cocaine, marijuana and alcohol which were tested via urinalysis three times a week. Treatment spanned 24 weeks and information on fidelity and training for CM was not provided. Analyses showed that during the active treatment phase (24 weeks), CM+ group had slightly higher abstinence levels than CM-only group, but the difference was not statistically significant. Both groups showed high abstinence with more than 50% of the participants in each group being abstinent on a weekly basis. During the active treatment phase, CM+ had a mean of about 13 weeks of consecutive abstinence whereas CM-only group had a mean of about 11 weeks of consecutive abstinence. Even though CM+ group had longer consecutive weeks of abstinence on average, the difference was not significant. When the consecutive weeks of abstinence was examined for 52-week (includes with and without treatment periods), CM+ group had statistically significantly higher consecutive weeks of abstinence on average (mean = 19 weeks) compared to CM-only (mean = 14 weeks) group. Level of treatment attendance had a statistically significant relationship with abstinence in each group. As such, greater attendance was associated with longer weeks of consecutive abstinence and a higher percentage of drug-free urine samples.

3.2. Retention Outcomes

Milby et al. (2000) examined the retention outcomes for DT and DT+ groups in their study by comparing treatment exposure. In Phase I, treatment exposure was defined as attending at least four morning treatment sessions and in Phase II it was defined as attending two or more aftercare sessions. Among the total of N=110 participants, 80.9% were identified as Phase I treatment exposed (89.3% for DT+ and 72.2% for DT), and 40% were identified as Phase II treatment exposed (53.6% for DT+ and 25.9% for DT). An analysis of the numbers of treatment-

exposed individuals in each group at 2 and 6 months revealed significant differences favoring DT+.

Milby et al. (2008) examined the average retention for CM and CM+ groups. CM group had an average retention of 19.7 weeks and CM+ group had an average retention of 20.4 weeks. The two groups showed nearly identical retention lengths, with no statistically significant difference.

Overall, the earlier study by Milby et al. (2000) found a significant difference between the groups whereas the subsequent one (Milby et al., 2008) found that both groups were similar in their retention rates. The later study had CM components for both groups, which might have contributed to similar rates of retention.

Limitations

One limitation identified in the literature is the inconsistent use of fidelity measures. Of the 36 studies reviewed, two reported use of clearly defined fidelity measures. Some studies had a proxy or an indicator without explicitly mentioning fidelity such as implementing and adhering to schedules or procedure used in prior literature, referring to a CM manual or having qualified staff implement and oversee procedures. Moreover, ten studies were completed outside of the United States, which limits generalizability to the U.S. population due to cultural differences and attitudes about substance use.

While the inclusion/exclusion criteria for the study selection process used in this review helped ensure inclusion of strong research designs and kept the focus primarily on stimulant use disorders, it's worth noting that this approach might have left out some important insights from the less rigorous studies. Given the extensive volume of research in this field, it was not feasible

to expand the range of research designs and samples considered for inclusion in this review. Nevertheless, twenty-one studies had samples with concurrent substance or alcohol use disorders, while some studies did not specify this information. Only a handful of studies had exclusion criteria for certain substance use disorders when recruiting participants. It is highly possible that most of the studies had samples with multiple substance use disorders. Consequently, even though the purpose of the review was to address treatment of stimulant use disorders, it is important to note the presence of overlaps with other substance use conditions within the analyzed literature.

Although none of the studies directly explore the link between stimulant use and mortality or morbidity, several of them point to an association between use and engaging in risky sexual behaviors, and heightened risk of contracting HIV (McDonell et al., 2013; Reback et al., 2010; Menza et al., 2010). Given this link, it's worth pointing out that a handful of reviewed studies provide some type of HIV education as part of standard care or other treatment modality, which is either a control condition or used in combination with CM.

Conclusion

Studies included in this review support the effectiveness of CM in reducing drug use and improving treatment retention for individuals with stimulant use disorders. Across various CM modalities—voucher-based, prize-based, and abstinence-based—positive outcomes are evident, with voucher-based CM being the most extensively investigated. Moreover, promising evidence indicates that the benefits of CM extend beyond the treatment duration, highlighting its potential for long-lasting impact.

Studies included in this review all employed experimental designs, considered the most rigorous research design. Furthermore, twelve of the studies included special populations such as pregnant women, individuals experiencing homelessness, veterans, individuals with severe mental illness, or gay and bisexual men, whose substance use profiles are often distinctively different than those of the general population. Notably, the majority of studies yielded promising drug use and retention outcomes for these diverse groups.

Across studies, the majority reinforced abstinence from stimulants, while some also incentivized participants for abstaining from multiple substances, such as cocaine, methamphetamine, amphetamine, opioids, alcohol, and marijuana. Few studies offered bonuses for abstinence from additional substances or alcohol. This finding raises a question about the number of substances that should be targeted for the CM procedures, especially because twenty-one articles (and perhaps more) had samples with multiple substance use conditions in this review. Rash (2023) argues that even though targeting multiple substances is effective, targeting one substance or one class of substances may yield to stronger outcomes. Results from the current review did not indicate distinct variations in drug use outcomes based on the number of substances targeted as part of the CM protocol. Hence, the decision regarding the number of substances to target in CM interventions might vary based on the specific needs of the client population and the operational procedures of the substance use treatment agency.

In addition to exploring the efficacy of CM in treating various form of stimulant use disorders, several studies recommended further inquiry into cost-effectiveness. The total amount of earnings per participant also differed based on the type of CM (voucher or prize) and the desired behavior that was reinforced (e.g., abstinence, attendance, housing or employment goals, or medication compliance). Miguel and colleagues (2019) argue that the average monthly cost of

CM per patient is insignificant compared to the social and economic burden of cocaine use. In addition, Murphy and colleagues (2015) posit that CM appears to be a wise investment for both the provider and the payer with regard to the clinical outcome of time free from stimulants. On average, participants in the US could earn between $476.25 and $1,980, while those in Brazil between $185 and $235.50 throughout the treatment. However, this range is limited to studies that reported this information, but also subject to geographic or economic factors and their likely fluctuations over time. In the current review, a few studies that compared lower value versus higher value CM protocols favored higher value CM protocol in drug use outcomes (e.g., Garcia-Rodriguez et al., 2009; Petry et al., 2004). Rash (2023) suggested increasing the amount of the incentive based on the number of behaviors or substances being targeted, severity of the population, and treatment duration.

The Recovery Incentive Program in California is one of the first implementations of CM at the state level. The California Department of Health Care Service (DHCS) has been working on the implementation of voucher-based CM. Conducting a benchmarking interview with the Recovery Incentive Program could offer valuable training and implementation insights that may benefit Ohio efforts.

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