RBTCC Revista Brasileira de Terapia Comportamental e Cognitiva
e-ISSN: 1982-3541

Contingency Management Banking: Reducing Costs and Increasing the Efficacy of Contingency Management Treatment for Substance Use Disorders

Manejo de Contingência Bancário: Reduzindo Custos e Aumentando a Eficácia do Manejo de Contingência no Tratamento dos Transtornos por Uso de Substância

Manejo de Contingencia Bancario: Reducción de Costos y Aumento de la Efectividad del Manejo de Contingencia en el Tratamiento de los Trastornos por uso de Sustancia

ABSTRACT: Contingency Management (CM) is among the most effective behavioral interventions for cocaine use disorders, yet the dissemination of CM to community treatment settings has been limited and slow due partially to costs. Leveraging evidence-based behavioral science principles, we developed a modified version of CM termed CM Banking, designed to reduce costs related to screening, reinforce attendance and acknowledgement of recent cocaine use, and increase abstinence rates and long-term engagement in treatment. CM Banking provides an additional contingency where participants can increase the amount of vouchers earned consequent to abstinence by attending treatment and acknowledging recent cocaine use, while reducing costs related to screening as participants that acknowledge recent cocaine use are not required to submit a urine specimen. We provide a detailed description of this procedure and present its scientific, clinical and practical rationale to stimulate discussion about its utility across a diverse array of low-resource treatment settings. We also discuss why CM Banking may reduce costs, enhance treatment engagement and promote cocaine abstinence.

Keywords: Cocaine use disorder; Contingency Management; Crack cocaine; Psychosocial interventions.

RESUMO: O Manejo de Contingência (MC) é um dos tratamentos mais eficazes para os transtornos por uso de cocaína, no entanto sua disseminação tem sido limitada em parte devido ao seu custo. Baseados em princípios da ciência comportamental, desenvolvemos uma versão modificada do MC chamada MC Bancário, desenvolvida com o intuito de reduzir custos ligados a triagem de uso de cocaína, reforçar os comportamentos de adesão e admissão de uso de cocaí-

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Dados do Artigo

DOI: 10.31505/rbtcc.v22i1.1424

Recebido: 03 de Abril de 2020
Revisado: 25 de Junho de 2020
Aprovado: 16 de Julho de 2020

Como citar este documento

Miguel, A. Q. C., Simões, V., Yamauchi, R., Madruga, C. S., Da Silva, C. J., Laranjeira, R. R., Roll, J. M., Mari, J. J., McPherson, S. (2020). Contingency Management Banking: Reducing Costs and Increasing the Efficacy of Contingency Management Treatment for Substance Use Disorders. *Revista Brasileira de Terapia Comportamental e Cognitiva*, 22. https://doi.org/10.31505/rbtcc.v22i1.1424

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na recente, e aumentar a taxa de abstinência e adesão ao tratamento. O MC Bancário fornece uma contingência adicional onde participantes podem aumentar o valor recebido em *vouchers* consequente a abstinência ao frequentarem o tratamento e admitirem o uso recente de cocaína e, ao mesmo tempo, reduz custos relacionados à triagem já que participantes que reconhecem o uso recente de cocaína não precisam submeter uma amostra de urina. Neste artigo, fornecemos uma descrição detalhada desse procedimento e apresentamos sua lógica científica, clínica e prática e seus eventuais benefícios. Também argumentamos porque o MC Bancário pode reduzir custos, aumentar a eficácia do MC e promover a sua aplicação em serviços de tratamento com recursos financeiros limitados.
Palavras-Chave: Transtorno por uso de cocaína; Manejo de Contingência; Crack; Tratamento psicossocial.

RESUMEN: El Manejo de Contingencia (CM) es uno de los tratamientos más efectivos para los trastornos por uso de cocaína, sin embargo, su propagación ha sido limitada en parte debido a su costo. Con base en los principios de la ciencia del comportamiento, desarrollamos una versión modificada del MC llamada MC Bancario, diseñada para reducir los costos relacionados con la detección de consumo de cocaína, reforzar el comportamiento de adherencia e admisión del consumo reciente de cocaína, y aumentar la tasa de abstinencia y adherencia al tratamiento. O MC Bancario proporciona una contingencia adicional en la cual los participantes pueden aumentar la cantidad ganada en *vouchers* consiguiente a la abstinencia asistiendo al tratamiento y reconociendo el uso reciente de cocaína, mientras, reduce los costos relacionados con la detección una vez que los participantes que reconocen el uso reciente de cocaína no necesitan someter muestras de orina. En este artículo, proporcionamos una deserción detallada de este procedimiento, presentamos la lógica científica, clínica y práctica que lo respalda, y presentamos sus posibles beneficios. Además, discutimos por qué MC Bancario puede reducir costos, aumentar la efectividad de MC, y promover su aplicación en servicios de tratamiento con recursos financieros limitados.
Palabras Clave: Trastorno por uso de cocaína; Manejo de Contingencia; Crack; Tratamiento psicosocial.

During the last 30 years, Contingency Management (CM) has emerged as one of the most effective psychosocial interventions for cocaine use disorders (CUD) (Higgins & Budney, 1993; Higgins, Budney, & Bickel, 1994; Peirce et al., 2006; Petry et al., 2005). CM is based on operant conditioning principles that espouse that a specific behavioral response will have an increased likelihood of occurring if it is immediately followed by a reinforcing consequence (Bickel, DeGrandpre, Hughes, & Higgins, 1991; Higgins, 1997). Within this framework, CM delivers reinforcers (i.e., vouchers with monetary value) contingent upon desirable responses incompatible with substance use such as objective verification of abstinence (Petry, 2000). Several meta-analyses, conducted with rigorous methodology, offer robust evidence of the efficacy of CM in promoting prolonged periods of abstinence (e.g., 4-week, 8-week periods of abstinence), longest duration of abstinence, reduction in cocaine use and retention to treatment (Higgins, Heil, & Lussier, 2004; Lussier, Heil,

Mongeon, Badger, & Higgins, 2006; Prendergast, Podus, Finney, Greenwell, & Roll, 2006). In fact, compared to other evidence-based psychosocial interventions CM shows the highest effect size (Cohen's $d = .58$) in preventing cocaine use during treatment (Dutra et al., 2008).

Yet, despite the substantial evidence in support of this procedure, the dissemination of CM to community treatment settings has been limited due to costs (Carroll, 2014; Petry, 2010). Indeed, the incremental total cost of incorporating 12-weeks of CM in community treatment programs range from $225 to $438 per participant (Olmstead, Sindelar, & Petry, 2007; Sindelar, Olmstead, & Peirce, 2007), which can be a limiting factor for many under-resourced treatment programs. As such, strategies to reduce costs and increase the cost-effectiveness of CM are paramount to the dissemination of this intervention.

Recently, our group published the first Brazilian CM treatment trial for CUD using the classic vouchers-based, escalating reinforcement type of approach for the application of CM (Miguel et al., 2016, 2017, 2018, 2019). Despite our positive results, we observed specific components of the CM approach that could be generating unnecessary costs and limiting the efficacy and treatment engagement potential of CM. Prompted by this experience, we developed a modified version of CM designed to reduce costs and increase the efficacy of CM. This modified version of CM is currently being evaluated in a randomized clinical trial (RCT) for treatment seeking crack cocaine users in São Paulo, Brazil (ClinicalTrials.gov nº NCT03345394).

Aims

This paper has three objectives. First, informed by operant conditioning theory and a myriad of clinical research findings, we describe the three components present in classic CM procedures that were considered in the development of this novel CM procedure. Second, we provide a full description of the new CM procedure and characterize how it differs from classic CM procedures. Third, we argue why this approach can reduce costs and improve the efficacy of CM.

Screening Substance Use

One of the key elements of abstinence-based CM involves the objective verification of abstinence via the submission of negative urine specimens (Petry, 2000). In the USA, on-site screening kits cost about $2.00 per reagent, while in developing countries, such as Brazil, screening kits cost around $4.00 per reagent. As a result, costs for screening can account for more than 40% of all CM's expenses. Although drug screening is a necessary component of CM, costs related to screening have no direct impact on the effectiveness of the intervention as it is not used to reinforce targeted responses. As such, any attempt to reduce costs with the screening procedure shouldn't impact the efficacy of CM and only improve the cost-effectiveness and feasibility of CM.

Reinforcing Desirable Treatment Responses Other Than Abstinence

Desirable treatment responses other than objective verification of abstinence are usually not reinforced in abstinence-based CM interventions and may be limiting the efficacy of CM. For example, a participant that is unable to submit a negative cocaine urine specimen but still comes to treatment and admits recent cocaine use to treatment staff. Coming to treatment and telling the truth about recent drug use are two important and desirable treatment responses. However, in a classic abstinence-based CM intervention, no form of reinforcer would be given in this circumstance.

Not only that but having to be exposed to the urine screening procedure (which is at least minimally invasive) after admitting recent cocaine use might also have a negative effect on attendance and retention. Previous research has shown that CM interventions that also reinforce attendance are more effective at increasing abstinence, promoting attendance and reducing dropout compared to CM interventions targeting abstinence alone (Ledgerwood, Alessi, Hanson, Godley, & Petry, 2008; Petry et al., 2004). However, pairing this component to an abstinence-based CM intervention tends to also increase the overall costs. Furthermore, an intervention that gives vouchers to participants independent of their cocaine use tend to suffer resistance from treatment services and staff. As a result, reinforcing attendance only might undermine both the feasibility and dissemination of CM to community treatment settings. Hence, a CM approach designed to target desirable treatment responses other than abstinence without increasing costs or creating resistance should increase CM's efficacy without undermining its dissemination to community treatment settings.

Magnitude of Reinforcement

Although effective, most CM trials for CUD show that a substantial number of participants (30 to 50%) do not respond to CM, i.e., participants are unable to submit a single negative cocaine urine specimen (Petry et al., 2004). From an operant perspective, the inability to submit a cocaine negative urine specimen can be partially explained by magnitude of reinforcement (Stitzer & Bigelow, 1984; Vuchinich & Tucker, 1983, 1988). According to this principle, in order to promote abstinence, the magnitude of reinforcers contingent on abstinence (submission of a negative urine specimen) need to be high enough to compete with the magnitude of reinforcement associated with cocaine use (Higgins, 1997; Higgins et al., 2007). Therefore, some individuals may not respond to CM because the magnitude of reinforcement used in the CM intervention (e.g., ordinarily a voucher or prize worth roughly $2.50 for the first negative specimen) is too small to compete with the magnitude of the reinforcing effects contingent to cocaine use. This hypothesis is strongly supported by clinical studies showing that CM with higher reinforcing magnitude is associated with higher rates of abstinence and longer duration of continuous abstinence (Dallery, Silverman, Chutuape, Bigelow, & Stitzer, 2001; Higgins et al., 2007), as well as a study that found that a high magnitude CM was effective in promoting abstinence among participants previously non-responsive to a low magnitude CM intervention (Silverman, Chutuape, Bigelow, & Stitzer, 1999). Unfortunately, although higher magnitude reinforcers tend to be more effective, it also results in a significant increase in costs, undermining its feasibility in less resourceful treatment programs. As so, any procedure that can increase the magnitude of reinforcer (e.g., increase voucher's value) without increasing the cost of the intervention might improve CM's effectiveness and feasibility combined.

CM Banking

CM Banking is currently being evaluated in a 12-week RCT comparing CM to usual care for the treatment of CUD in São Paulo, Brazil. Like most classic CM procedures for CUD, this modified CM intervention consists of reinforcing cocaine abstinence by giving participants vouchers with monetary value after the submission of a negative cocaine urine specimen. In this protocol, urine specimens are collected two times a week (Mondays and Thursdays or Tuesdays and Fridays). Vouchers' value starts at ≅ US$2.50 (as of January 2020, one US dollar was approximately four Brazilian reals) and increase by ≅ US$1.25 for every consecutive

negative cocaine specimen submitted to a maximum of ≅ US$6.00. An additional ≅ US$6.00 bonus is given if both specimens collected in a given week are negative for cocaine. Vouchers' value is reset to its initial value if participants fail to submit a urine specimen or test positive for cocaine. Up to this point, our procedure in this RCT is the same as most voucher-based CM procedures. However, prior to submitting the urine specimen, participants are asked if they have used cocaine in the last four days or since their last study visit (e.g., if this occurred less than four days prior to the current visit). If participants state that they have been abstinent during this period, they are encouraged to submit the urine specimen to confirm abstinence (same as any classical CM procedure). However, if a participant discloses recent cocaine use, they are not asked to submit the urine specimen. Instead, they are congratulated for coming to treatment and for disclosing recent cocaine use (meanwhile urine result is codded as positive by research or treatment staff). In order to reinforce these responses, they also receive a token with a value of ≅ US$0.75. This token however cannot be used to make any form of purchase. Instead, it is added to the *future voucher's value* contingent on the submission of a future negative cocaine urine specimen. Thus, it is banked for future access to the reinforcer. Hence, every time a participant comes to treatment and discloses recent cocaine use, the initial voucher's value contingent on cocaine abstinence increases by US$0.75.

Anticipated Effects of CM Banking

First, by not conducting urine screenings when participants disclose recent cocaine use, this modified version of CM tend to reduce costs with screening. In fact, every time a participant discloses recent cocaine use, this CM intervention will save roughly US$3.25 per participant per visit in trials conducted in underdeveloped countries like Brazil (US$4.00 from the urine screening kits minus US$0.75 given as token) and US$1.25 in the USA. In a trial of n=120 where 25% of the urine specimens test positive this could total as much as US$2,340.00 across an entire RCT.

Second, this procedure will also provide reinforcement for (1) attendance, (2) retention and (3) disclosure of recent use by giving tokens when participants come to treatment and disclose recent cocaine use; all of which are desirable treatment outcomes for substance using patients. As a result, this procedure should, in theory, increase CM's efficacy in promoting these treatment outcomes.

Third, this procedure may also enhance CM's efficacy among non-treatment responders without increasing the costs of the intervention. As mentioned, for some individuals the initial voucher's value may not be strong enough to compete with the reinforcing effects of cocaine use, while a voucher with a higher value might. In this CM Banking procedure, the initial voucher's value increases by US$0.75 every time an individual comes to treatment and discloses recent use. At a certain point, this cumulative voucher's value may become potent enough to compete with the reinforcing effects of cocaine use, thus effectively promoting cocaine abstinence among these individuals.

In other words, by allowing the initial voucher's value to escalate upon attendance and admission of cocaine use, the CM Banking procedure may prompt several individuals who require reinforcers of higher magnitude to achieve abstinence, to make the transition from being a non-treatment responder to a late treatment responder. Furthermore, since all additional voucher monetary value coming from the token acquisition are smaller than the amount saved by not conducting the urine screening, this procedure will still result in lower costs than a traditional voucher-based CM procedure. Finally, since the tokens contingent upon

coming to treatment and admitting recent cocaine use will only acquire monetary value if it promotes objective verification of cocaine abstinence in the future, this procedure is ultimately reinforcing abstinence while also reinforcing attendance and retention outcomes and thus, shouldn't suffer resistance from community treatment services and staff.

Fourth, based on previous findings, CM Banking may not only increase the effectiveness but also the cost-effectiveness of CM. In a study where the cost-effectiveness of two CM conditions with the same reinforcing schedule but different magnitudes of reinforcement were compared to standard treatment, it was observed that the total incremental cost of applying CM to lengthen abstinence by 1 week was US$67 for the higher magnitude CM condition compared to US$84 for the lower magnitude CM condition (Sindelar, Elbel, & Petry, 2007). In other words, the higher magnitude CM condition was more cost-effective in promoting this outcome. In accordance, it is plausible to hypothesize that, because CM Banking creates an additional contingency that can increase the magnitude of reinforcement delivered upon the submission of a negative cocaine specimen, it may also lead to an increase in the cost-effectiveness of this procedure. Furthermore, because CM Banking has the ability to reduce costs related to screening while guarantying the availability of at least the same magnitude of reinforcers of a traditional CM procedure, CM Banking should, in theory, be at least as effective as a traditional CM procedure. Thus, rendering it more cost-effective due to the lower costs of its screening procedure.

It's important to acknowledge, however, that some characteristics present in CM Banking may hinder its ability to be more effective than a traditional CM procedure. One possible limitation of CM Banking may be related to delay discounting (Odum, 2011). It is well stablished that the reinforcing effect that a reinforcer has over a specific response is also dependent on the time elapsed between the emission of that response and the access to that reinforcer. The longer the time elapsed between the emission of the response and access to the reinforcer, smaller the reinforcing effect of that reinforcer will be (Ainslie, 1974). It is also known that individual factors influence the degree in which delays are discounted (Odum et al., 2020) and that steep delay discounting is an important risk factor for substance use and abuse (Amlung, Vedelago, Acker, Balodis, & MacKillop, 2017). Cocaine users in particular show high levels of delay discounting (Heil, Johnson, Higgins, & Bickel, 2006). Therefore, because in CM Banking tokens given contingent to attendance and acknowledgment of recent cocaine use do not have an immediate reinforcing value but may only acquire a reinforcing value contingent to the submission of a future negative urine specimen (available at least three days after a token is acquired), it is possible that this population may be relatively insensitive to this particular contingency due to the delay between the emission of the targeted response (i.e., attendance and acknowledgment of recent cocaine use) and access to the reinforcer (i.e., higher amount of vouchers). In other words, it is possible that this contingency does not increase the frequency of attendance and acknowledgment of recent cocaine use responses due to the delay between the emission of these responses and access to the reinforcer.

Another factor that may limit the efficacy of CM Banking is that reinforcers contingent to attendance and acknowledgment of recent cocaine use are not only delayed, but also of a small magnitude (≅ US$0.75). It is possible that these two factors combined (delayed access to a reinforcer of small magnitude) may render this contingency not strong enough to reinforce the attendance and acknowledgment of recent cocaine use responses, and consequently have no effect over the future submission of a neg-

ative cocaine specimen response. In this case, CM Banking would not be more effective in promoting attendance, acknowledgment of recent cocaine use and cocaine abstinence compared to a traditional CM procedure.

It's important to note, however, that delay discounting is dependent on the type of reinforcer being discounted (Madden, Petry, Badger, & Bickel, 1997), where generalized unperishable reinforcers such as money and vouchers are discounted less steeply when compared to reinforcers such as drug and food (Odum & Rainaud, 2003). Thus, although the delay in the reinforcement contingency present in CM Banking may limit its efficacy to some degree, it may still exert some reinforcing effect on the emission of the targeted response due to the nature of the reinforcer being used. Furthermore, it's expected that when patients' come to treatment and acknowledge recent cocaine use (targeted responses) they will be immediately exposed to social reinforcers provided by treatment staff. As such, it's possible that these immediate social reinforcers may increase the strength of this contingency, thus increasing the effectiveness of CM Banking.

Conclusion

CM is among the most effective interventions for CUD, yet the dissemination of CM has been limited primarily due to costs related to this intervention. In this study we present a novel CM procedure termed CM Banking and, based in operant conditioning theory and clinical research findings, argue why it can increase the effectiveness and cost-effectiveness of CM. CM Banking was primarily developed to: (1) reduce costs related to screening; (2) reinforce desirable treatment responses other than abstinence; and (3) increase the effectiveness of CM by increasing vouchers values without generating additional costs. If proven effective, CM Banking has the potential to reduce costs and enhance the effectiveness and feasibility of CM. Experimental studies conducted in controlled settings as well as clinical trials conducted in natural treatment settings are necessary to determine the potential benefits of CM Banking compared to traditional CM procedures.

Author Note

All authors have no conflicts of interest to disclose.

This study was supported by the Research and Innovation grant for Prevention of Mental Disorders and Abuse use of Alcohol and Other Drugs (Pesquisas e Inovações em Prevenção de Transtornos Mentais e Uso de Álcool e Outras Drogas) funded by the Brazilian Ministry of Health (TED #176/2017). Dr. Miguel was supported by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) with the postdoctoral fellowship process nº 2017-05371-8 and 2017-22004-9. Dr. McPherson was also supported by NIH/NIAAA R41 AA026793 (MPI: McPherson, McDonnell and Johnson).The Ministry of Health, FAPESP and NIH/NIAAA had had no further role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

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