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Review

Contingency Management interventions for non-prescribed drug use during treatment for opiate addiction: A systematic review and meta-analysis

Tom S. Ainscough[a,b,*], Ann McNeill[a,b], John Strang[a], Robert Calder[a], Leonie S. Brose[a,b]

[a] Addictions Department, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, UK
[b] UK Centre for Tobacco and Alcohol Studies, UK

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ABSTRACT

Background and aims: Use of non-prescribed drugs during treatment for opiate addiction reduces treatment success, creating a need for effective interventions. This review aimed to assess the efficacy of contingency management, a behavioural treatment that uses rewards to encourage desired behaviours, for treating non-prescribed drug use during opiate addiction treatment.

Methods: A systematic search of the databases Embase, PsychInfo, PsychArticles and Medline from inception to March 2015 was performed. Random effects meta-analysis tested the use of contingency management to treat the use of drugs during opiate addiction treatment, using either longest duration of abstinence (LDA) or percentage of negative samples (PNS). Random effects moderator analyses were performed for six potential moderators: drug targeted for intervention, decade in which the study was carried out, study quality, intervention duration, type of reinforcer, and form of opiate treatment.

Results: The search returned 3860 papers; 22 studies met inclusion criteria and were meta-analysed. Follow-up data was only available for three studies, so all analyses used end of treatment data. Contingency management performed significantly better than control in reducing drug use measured using LDA (d = 0.57, 95% CI: 0.42–0.72) or PNS (d = 0.41) (95% CI: 0.28–0.54). This was true for all drugs other than opiates. The only significant moderator was drug targeted (LDA: Q = 10.75, p = 0.03).

Conclusion: Contingency management appears to be efficacious for treating most drug use during treatment for opiate addiction. Further research is required to ascertain the full effects of moderating variables, and longer term effects.

1. Introduction

Amongst those in treatment for opiate addiction, use of non-prescribed drugs is very common. Hair samples from 99 recently deceased opiate addiction patients identified a range of 21 different drugs being used during treatment, including cocaine, amphetamine, morphine and diazepam (Nielsen et al., 2015). Other studies have observed that over a third of patients entering opiate addiction treatment were also DSM-IV dependent on a drug other than heroin (not including nicotine) (Puigdollers et al., 2009), and poly drug use has been reported to be as high as 68% (Taylor, 2015). These high levels of drug use are not limited to illicit substances. Tobacco smoking is highly prevalent in drug treatment in general (Cookson et al., 2014), with prevalence rates of over 90% observed in individuals undergoing methadone treatment for opiate addiction (Best et al., 2009; Clemmey et al., 1997). Methadone itself has been linked to increased tobacco cigarette consumption, smoke intake and self-reported satisfaction of cigarette smoking (Chait and Griffiths, 1984), and to increased alcohol consumption compared with heroin use (Backmund et al., 2003).

Use of non-prescribed drugs during methadone treatment for opiate addiction has been associated with a range of adverse effects such as poor treatment retention and outcomes (Magura et al., 1998). Use of a single drug during opiate addiction treatment is associated with a threefold greater risk of dropping out of treatment, and use of multiple drugs quadruples the risk of dropping out (White et al., 2014). For example, cocaine use during methadone treatment has been linked to persistence of heroin use (Hartel et al., 2011). Similarly, tobacco smoking during opiate detoxification results in significantly greater opiate craving and significantly lower rates of detoxification completion (Mannelli et al., 2013) and is associated with higher levels of illicit drug use (Frosch et al., 2000).

High prevalence rates and the links to adverse treatment outcomes indicate a need for effective interventions for non-prescribed drug use during opiate addiction treatment. One of the most widely used

* Corresponding author at: Addiction Sciences Building, 4 Windsor Walk, Denmark Hill, London, SE5 8BB, UK.
E-mail address: thomas.ainscough@kcl.ac.uk (T.S. Ainscough).

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behavioural interventions is contingency management (CM). CM is based on the theory of operant conditioning (Skinner, 1938), which states that the administering of a reward for a particular behaviour increases the likelihood of that behaviour being repeated. In the current context, CM uses rewards (vouchers, clinical privileges or desirable items to be won as prizes for example) to positively reinforce abstinence from or reduced use of drugs during treatment for opiate addiction. CM differs from other common psychological interventions in that the focus of treatment is not on introspective analysis of discrepancies between goals and behaviour (as in motivational interviewing) or modification of flawed cognitive processing (as in CBT), but instead on directly influencing the reinforcement mechanisms involved in addiction (Jhanjee, 2014). Previous reviews have shown CM to be moderately effective in treating substance use (illicit drugs, alcohol and tobacco) disorders in general (Benishek et al., 2014; Davis et al., 2016; Dutra et al., 2008; Lussier et al., 2006; Prendergast et al., 2006), particularly so for opiate addiction (Prendergast et al., 2006). Despite a number of recent reviews assessing the efficacy of CM for substance use in general, very little is known about the use of CM for treating use of non-prescribed drugs in the context of opiate addiction treatment, where treatment outcomes may differ.

Whilst some of these reviews included studies assessing the use of CM in this context (Benishek et al., 2014; Castells et al., 2009; Davis et al., 2016; Lussier et al., 2006), none directly addressed the efficacy of CM for substance use during opiate addiction treatment. The most recent review of this specific use of CM is a meta-analysis published over 16 years ago (Griffith et al., 2000). CM was observed to perform better overall than control, and the effects of CM for drug use during opiate addiction treatment were observed to be moderated by five factors (type of reinforcer, time to reinforcement delivery, targeted CM drug(s), number of urine specimens collected per week and type of subject assignment). However, this review did not search the literature systematically, increasing the risk of bias in the selection of study data. Similarly, it did not assess the effects of different drugs targeted with CM, instead only assessing the moderating effects of targeting single or poly drug use. The aim of the present review was to assess the efficacy of CM for treating the use of different non-prescribed drugs during treatment for opiate addiction, by systematically searching the literature and assessing the effects of potentially moderating variables.

2. Method

A protocol for the current review is available online (see appendix of Supplementary file).

2.1. Search strategy

The review was carried out in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher, 2009). Studies were identified using a keyword search of the online databases Embase; PsychInfo; PsychArticles using the Ovid SP interface and a MeSH search of Medline using the PubMed interface; with the following search terms: "Contingency Management" **or** "Reward" **or** "Payment" **or** "Incentive" **or** Prize" **and** "Substance" **or** "Misuse" **or** "Drug" **or** "Narcotic*" **or** "Tobacco" **or** "Smok*" **or** "Stimulan*" **or** "Cocaine" **or** "Alcohol" **and** "Opiate" **or** "Opioid" **or** "Heroin" **or** "Methadone". The search was limited to studies published between each database's inception and March 2015; published in the English language and including only humans. See appendix[1] for full search strategy.

2.2. Inclusion and exclusion criteria

Studies were eligible for inclusion if they: *i)* Tested one or more CM intervention(s) aimed at substance use reduction or abstinence in patients receiving treatment for opiate addiction. CM included any intervention that consistently administered rewards to positively reinforce substance use reduction or abstinence in patients receiving treatment for opiate addiction; *ii)* used a controlled trial design–either a no/delayed treatment control group or an alternative therapy control group, or controlled by repeated participation in two or more treatment arms; *iii)* randomised participants to conditions; *iv)* provided reinforcement or punishment contingent on biological verification of substance use/abstinence; *v)* used consistent measures of substance use at baseline and follow-up; *vi)* Published in a peer reviewed journal. Studies were excluded if: *i)* Participation was non-voluntary – e.g., court orders, prison inmates etc.; *ii*) means and standard deviations for treatment effects were not available from the published data or the authors.

2.3. Study selection

Studies were reviewed for inclusion by three independent reviewers, with all studies being reviewed for inclusion twice. TA processed all titles and abstracts as first reviewer, RC and LB jointly processed half each as second reviewers. An agreement rate of 96% was reached between reviewers; disagreements were discussed and resolved by a separate reviewer, AM.

2.4. Quality assessment

The 'Quality Assessment Tool for Quantitative Studies' (Effective Public Health Practice Project, 2003) was used to assess the internal and external validity of all studies, as well as any biases and confounds. This assesses the quality of studies as strong, moderate or weak on six domains (selection bias, study design, confounds, blinding, data collection and withdrawals/dropouts), providing an overall score for the quality of the evidence in the study. A study is rated as providing strong evidence only when all domains are rated as moderate or strong, and a moderate rating when strong or moderate ratings are achieved for all bar one of the domains. Inter-rater reliability has been shown to be 'fair' across the six domains and 'excellent' overall, often performing better than the Cochrane Collaboration Risk of Bias Tool (Armijo-Olivo et al., 2012).

2.5. Data extraction and synthesis

All data extraction was completed by a single reviewer (TA) using an extraction table designed specifically for the current review and agreed by all reviewers (see supplementary materials). Where studies did not contain means and standard deviations for treatment effects, authors were contacted up to two times to obtain the data. Requests for data were sent to authors of 35 studies, with data for six studies being received (Carpenedo et al., 2010; Downey et al., 2000; Epstein et al., 2009; Kirby et al., 2013; Petry et al., 2007; Vandrey et al., 2007). Where means and standard deviations were not obtained, alternative data including F tests, *t*-tests and chi square were used to calculate an effect size where feasible (Dunn et al., 2010; Shoptaw et al., 2002; Silverman et al., 1998, 1996).

2.6. Outcome measures

Standardised mean differences (Cohen's *d* (Cohen, 1988)) were calculated for each individual study using either: 1) longest duration of abstinence (LDA) data or 2) percentage of biochemically verified negative samples (PNS). As follow-up data were available for only three of the 10 studies that included a follow-up period, all data used in analyses are those recorded during treatment.

2.7. Moderators

A number of possible moderators were assessed, based on those