JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2008, **41,** 617–622 NUMBER 4 (WINTER 2008)

CONTINGENCY MANAGEMENT PROMOTES SMOKING REDUCTIONS IN RESIDENTIAL SUBSTANCE ABUSE PATIENTS

SHEILA M. ALESSI, NANCY M. PETRY, AND JULIE URSO

UNIVERSITY OF CONNECTICUT HEALTH CENTER

Rates and consequences of cigarette smoking are more severe in substance abusers. In this 12-week pilot study, residential substance abuse treatment patients received standard care for smoking cessation ($n = 12$) or prize contingency management ($n = 12$) for expired carbon monoxide (CO) tests $\leq$ 8 ppm and salivary cotinine $<$ 10 ng/ml, which are indicative of smoking abstinence. Percentage of negative CO tests and the highest number of consecutive negative CO tests were greater in contingency management compared to standard care.

DESCRIPTORS: cigarette smoking, contingency management, reduced smoking, substance abuse treatment

Cigarette smoking is the most common source of preventable morbidity and mortality, with adult prevalence rates of 13% to 31% (median 23%) in the U.S. (''Annual Smoking-Attributable Mortality,'' 2002). Smoking rates are two to three times higher (Substance Abuse and Mental Health Services Administration, 2003) and untoward health consequences more severe (Hurt et al., 1996) in smokers with substance use disorders. The Centers for Disease Control, National Institute on Alcohol Abuse and Alcoholism, and the Association for Addiction Professionals recommend that smoking be addressed in treatment for substance abuse, although few programs do so beyond brief advice (Richter, Choi, & Alford, 2005). Furthermore, both passive (e.g., omission of smoking treatment components; treatment providers who smoke) and active (e.g., regular smoking breaks) endorsement of smoking is common (Knapp, Rosheim, Meister, & Kottke, 1993; Willenbring, Kivlahan, & Grillo, 2001).

Substance abuse patients treated for smoking tend to have relatively poor smoking outcomes (Prochaska, Delucchi, & Hall, 2004). Therefore, more effective intervention strategies are needed. Contingency management (CM) procedures that involve reinforcing objective evidence of drug abstinence are efficacious in improving outcomes (Higgins & Silverman, 1999). The malleability of smoking behavior with CM has mostly been examined in pseudolaboratory studies (e.g., Alessi, Badger, & Higgins, 2004; Roll & Higgins, 2000), and results indicate that smoking is sensitive to reinforcement contingencies using vouchers exchangeable for retail goods and services (Glenn & Dallery, 2007). Voucher CM may improve smoking outcomes in substance abuse treatment patients as well (Robles et al., 2005; Shoptaw et al., 2002).

Another type of CM procedure is prize CM, in which participants draw cards and have the opportunity to earn items or prizes for target behaviors. Draws are made from a bowl with 500 cards, of which 50% result in items worth $1.00, $20.00, or $100.00 in value. Prize CM increases abstinence and treatment retention in many substance abuse populations (Peirce et al., 2006; Petry, Martin, Cooney, & Kranzler, 2000; Petry et al., 2005). Prize CM may similarly facilitate smoking abstinence. The present study compared effects of prize CM

This study was supported by pilot funds from the Alcohol Research Center at the University of Connecticut Health Center and Grant P50-DA09241 from the National Institute on Drug Abuse. We thank the clinical staff, support staff, and clients at Morris Foundation, Inc., for their involvement in this project.

Address correspondence to Sheila M. Alessi, 263 Farmington Ave., MC 3944, Farmington, Connecticut 06030 (e-mail: alessi@psychiatry.uchc.edu).

doi: 10.1901/jaba.2008.41-617

and standard smoking treatment care without CM on smoking behavior in a residential drug treatment program that did not offer formal smoking treatment.

METHOD

Participants ($N = 24$) were entering long-term (at least 3 months) residential substance abuse treatment for men; were at least 18 years old; had current alcohol, cocaine, or heroin abuse or dependence; were daily smokers; and stated interest in quitting smoking. Exclusion criteria included medication for smoking, in recovery for pathological gambling, and serious psychiatric illness. Documented sobriety (excluding smoking) of at least 10 days was required for treatment entry. Treatment included individual and group therapy, job search or employment after 30 days, random drug tests, and merit-based privileges. Quitting smoking was not encouraged or discouraged, smoking breaks occurred every 2 hr, smoking was outdoors only, and cigarettes could be bought at nearby stores.

Procedures were approved by the local institutional review board and were conducted by research staff. Staff screened 77 patients, consented 40, and assigned 36 to conditions. Recruitment failures were due to not meeting criteria (substance abuse, $n = 31$; smoking, $n = 6$; gambling, $n = 2$; interest, $n = 1$) or discharge ($n = 1$). Intake involved completion of a demographic form, structured clinical interview checklists (First, Gibbon, Spitzer, & Williams, 2002), and timeline follow-back (Sobell & Sobell, 1992). Carbon monoxide (CO) tests, an indicator of recent (e.g., past 8 hr) smoking, were done via a PicoSmokerlyzer, a handheld device that requires a 15-s breath-hold followed by expiration into the device through a disposable cardboard tube, after which expired CO levels (in parts per million; ppm) are displayed. Salivary cotinine (nicotine metabolite; $t_{1/2} \leq 40$ hr) tests were done with Accutest NicAlert. Smoking medication was not provided in treatment, and no one reported usage. Follow-ups at 4, 12, and 24 weeks after quit date included CO and cotinine tests (follow-up rates: 75% to 92%). Compensation was $15.00 to $35.00 in certificates or checks for interviews.

After intake, the quit preparation session included a consumer guide for smoking cessation (Agency for Health Care Policy and Research, 1996), craving control tips (American Cancer Society, 2003), and CO and cotinine tests. A quit date was set. Study samples were usually collected on weekdays between 6:00 a.m. and 9:00 p.m. when patients were not in group or individual therapy and were otherwise not predictable. Same-day CO and cotinine tests were possible.

The first 12 participants received CM for smoking abstinence (nonrandom assignment). A randomized trial began 3 months later. Results from the first 12 control participants are presented for comparison. In the interim, no major facility changes occurred. Instructions were the same, except for a slight change in testing frequency.

Standard care condition. Starting on the quit date, CO samples were collected for 12 weeks (four per week in Weeks 1 through 4, two per week in Weeks 5 through 8, and one per week in Weeks 9 through 12). Cotinine tests occurred on one random day each week. Each day, staff conducted a brief check-in based on smoking cessation guidelines. Compensation was one standard bowl draw (see below) each day.

CM condition. Cotinine monitoring and check-in were as stated above. The schedule for CO samples was four per week in Weeks 1 through 3, three per week in Weeks 4 through 6, and two per week in Weeks 7 through 12.

In Weeks 1 and 2, negative CO ($\leq$ 8 ppm) tests resulted in at least one draw from a guaranteed bowl and at least one prize to promote initial abstinence. This bowl had 25

cards: 17 $1.00 prizes (e.g., toiletries), seven $20.00 prizes (e.g., MP3 player), and one $100.00 prize (e.g., stereo). Draws began at one and increased by one for each negative CO test in a row (36 draws maximum). A positive CO test or unexcused absence reset draws to one, after which two negative tests in a row reinstated the number of draws before reset (e.g., 5 draws; reset; one, two, then five draws). In Weeks 3 through 12, draws occurred using a standard bowl with 500 cards (219 $1.00, 30 $20.00, 1 $100.00, 250 "good job for not smoking"). Draws increased by one for consecutive negative COs, up to 12 per test (294 draws maximum). Draws were reset and reinstated as described above. As in the standard condition, cotinine was tested on one random day per week, and CM participants earned five bonus draws for each negative cotinine (< 10 ng/ml, 60 draws maximum). Draws occurred from the guaranteed (Weeks 1 and 2) or standard (Weeks 3 to 12) bowl. Overall, on average, $910.00 in prizes could be expected for 100% negative tests.

Analyses include all assigned participants. Groups were compared on demographics and percentage of samples submitted. Primary outcomes are percentage of negative CO tests, greatest number of consecutive negative CO tests, and percentage of negative cotinine tests (missing samples were coded positive). Secondary outcomes are days retained, percentage retained in treatment throughout, and days of drug use and sample results at follow-up. Tests were chi-square, ANOVA, and Mann-Whitney U ($\alpha = .05$).

RESULTS AND DISCUSSION

Smokers who received prize CM or standard smoking cessation without CM did not differ ($p > .05$) on age ($M = 36.6$ years, $SD = 7.8$), race (54% Caucasian), marital status (67% never married), employment (67% usually employed full time), or education (median = 12 years, interquartile range [IQ] = 1.0 year); cigarettes per day ($M = 18.8$, $SD = 7.0$), median years smoking that amount (20.5, $IQ = 10.75$), age first smoked ($M = 15.0$, $SD = 3.8$), or number of quit attempts ($M = 0.5$, $SD = 3.0$); or substance abuse (96%, 58%, and 33% were alcohol, cocaine, and opiate dependent, respectively). Groups did not differ on percentage of samples submitted ($ps \geq .52$; $M = 75.4\%$, $SD = 27.2\%$ of CO samples; $M = 65.6\%$, $SD = 28.5\%$ of cotinine samples). Off-site employment led to most missed visits.

The results are presented in Figure 1. Percentage of negative CO tests differed by condition, $U = 36.0$ ($p = .04$; median = 70.7%, $IQ = 67.3\%$ in CM; median = 12.8%, $IQ = 24.8\%$ in standard care), as did duration of consecutive negative CO tests, $U = 33.0$ ($p = .02$; median = 5.0, $IQ = 17.5$ in CM; median = 1.0, $IQ = 1.0$ in standard care). One participant in standard care and 5 in CM tested negative on most days (96% of 23 tests and a median of 88% of tests in each group, respectively); 4 standard care participants and 1 CM participant never met CO criterion. CO readings and number of cigarettes smoked were correlated overall and in each condition ($rs \geq 0.47$, $p < .001$). Cigarettes per day declined ($M = 29.6\%$, $SD = 22.6\%$) from baseline without group differences ($p = .58$). Median percentage of negative cotinine tests was 0 ($IQ = 0$) overall without group differences ($p = 1.0$).

Groups did not differ on days retained in the study and percentage retained throughout ($ps \geq .52$). Median number of days retained was 57.0 ($IQ = 58.8$) with 45.8% retained throughout the study. Retention failures were due to voluntary treatment discharge ($n = 6$), noncompliance or incarceration ($n = 6$), and treatment completion ($n = 1$).

Sample and self-report data indicate notable reductions in smoking but not cessation. Consequently, the median draws earned was 33.0 ($IQ = 185.3$) for CO and 0 ($IQ = 0$) for cotinine tests, and the value of prizes per person

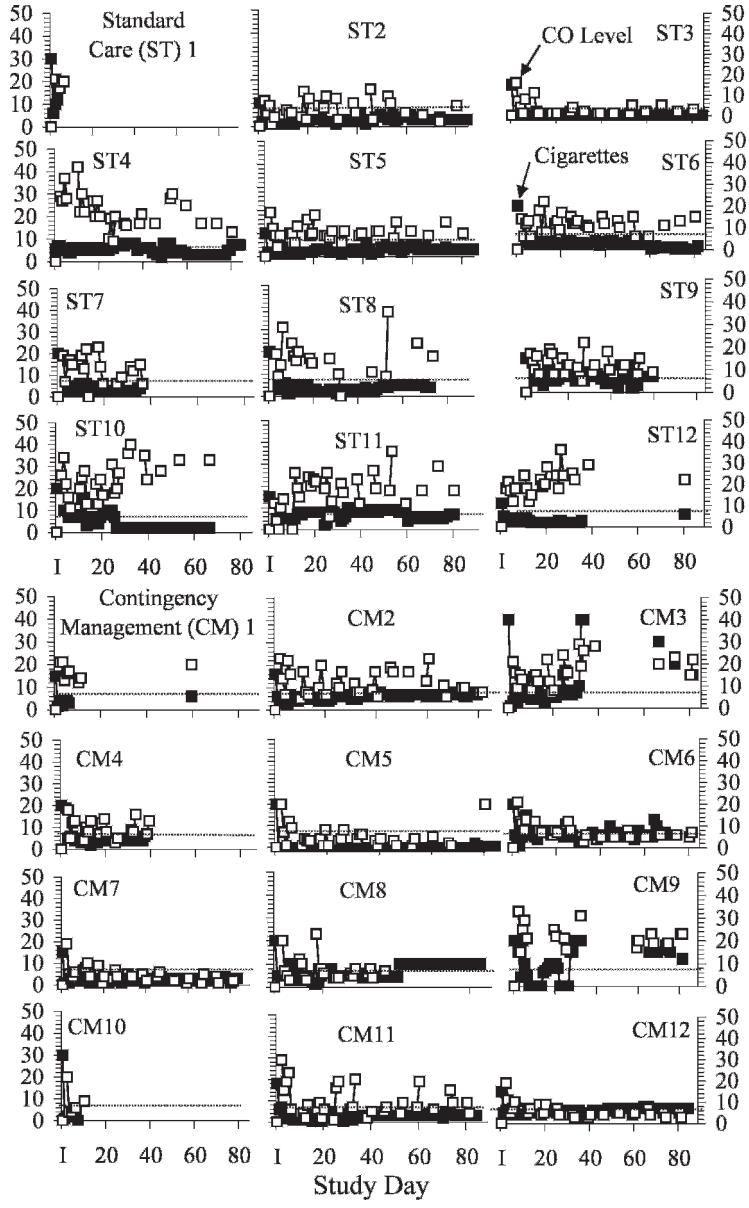

Figure 1. Individual data are presented for the 24 residential substance abuse treatment patients who were assigned to receive standard care ($n = 12$) or standard care plus contingency management ($n = 12$) for smoking abstinence for 12 weeks. Expired COlevels are depicted by open squares, and the number of self-reported cigarettes smoked per day is depicted by filled squares. On the *x* axis is study day (intake [I] and Day 1 through Day 84); on the *y* axis is a count from 0 through 50. A horizontal dashed line crosses the *y* axis at 8 to indicate the abstinence criterion (CO $\leq$ 8 ppm) as a reference point.

was \$157.00 (\$400.00). Procedural adjustments such as increasing reinforcement available during the initial days of the quit attempt (Higgins et al., 2007) and more frequent sample collection (Alessi et al., 2004) may improve outcomes. Another consideration is the liberal CO criterion, applied in part to lower rates of false negatives from secondhand smoke

exposure, an important concern due to the large number of smokers who resided with participants. However, liberal criteria can increase rates of false positives.

Even brief abstinence is noteworthy given the contextual challenges to smoking abstinence. Most participants' housemates were daily smokers who were presumably not trying to quit. Frequent smoking breaks occurred each day, and breaks were the primary outdoor opportunity. House grounds covered 0.25 acre without a no-smoking section. Efforts to develop smoking interventions for this population should resolve such obstacles to maximize success.

CO and cotinine results and days of substance use did not differ by group at follow-ups ($ps \geq .45$). Three participants tested CO negative at Month 3 and 1 at Month 6; there were no negative cotinine tests.

Overall, prize CM promoted significant reductions in smoking in this sample of residential substance abuse treatment patients. Limitations include nonrandomized assignment to conditions, differences in sample testing frequency, that all participants were men, and that the study was run in a single program. The relatively small sample size was adequate for this pilot study but limits conclusions.

It is important to note that this study explored promoting smoking abstinence in a historically difficult-to-treat population. It was also a first attempt to examine prize CM for smoking abstinence. Areas for future work include continued efforts to identify effective parameters of CM for smoking and to address setting characteristics that may hinder successful smoking cessation in this population.

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Received July 30, 2007
Final acceptance November 2, 2007
Action Editor, John Roll