TREATMENT

A Randomized Clinical Trial of a Therapeutic Workplace for Chronically Unemployed, Homeless, Alcohol-Dependent Adults

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Abstract — Aims: To assess the efficacy of the Therapeutic Workplace, a substance abuse intervention that promotes abstinence while simultaneously addressing the issues of poverty and lack of job skills, in promoting abstinence from alcohol among homeless alcoholics. Methods: Participants (n = 124) were randomly assigned to conditions either requiring abstinence from alcohol to engage in paid jobs skills training (Contingent Paid Training group), offering paid jobs skills training with no abstinence contingencies (Paid Training group) or offering unpaid job skill training with no abstinence contingencies (Unpaid Training group). Results: Participants in the Contingent Paid Training group had significantly fewer positive (blood alcohol level ≥ 0.004 g/dl) breath samples than the Paid Training group in both randomly scheduled breath samples collected in the community and breath samples collected during monthly assessments. The breath sample results from the Unpaid Training group were similar in absolute terms to the Contingent Paid Training group, which may have been influenced by a lower breath sample collection rate in this group and fewer reported drinks per day consumed at intake. Conclusion: Overall, the results support the utility of the Therapeutic Workplace intervention to promote abstinence from alcohol among homeless alcoholics, and support paid training as a way of increasing engagement in training programs.

INTRODUCTION

Alcoholism and chronic unemployment are some of the most prevalent problems facing the homeless. Studies estimated that between 30 and 50% of homeless adults have current alcohol-use disorders (Breakey et al., 1989; Johnson and Barrett, 1995; Roberston et al., 1997). Furthermore, alcohol-use disorders are between 2 and 15 times more common in the homeless than in housed individuals (Fischer and Breakey, 1991).

While many substance abuse treatments in this population are ineffective at reducing alcohol use or abuse (Braucht et al., 1995; Burnam et al., 1995; Lapham et al., 1995; Smith et al., 1995; Stahler et al., 1995; Wright and Devine, 1995), a few treatments have been shown to be effective (Miller, 1975; Lam et al., 1995; Sosin et al., 1995; Milby et al., 1996). One effective and promising intervention for homeless substance abusers used the principles of contingency management, a system where a desirable incentive is provided to the patient contingent on some therapeutically relevant behavior. In a series of studies, Milby et al. (1996, 2000, 2005) provided housing and work therapy to homeless substance-abusing individuals who could remain in the housing and attend work therapy contingent upon periodic urinalysis tests confirming the absence of drug use. This intervention decreased substance use significantly. Alcohol use in homeless adults with frequent arrests for public drunkenness was targeted by a contingency management intervention that provided access to goods and services including temporary work or housing contingent upon objective measures of reductions in alcohol use (Miller, 1975). This intervention was shown to decrease arrests for public drunkenness and decrease alcohol use.

Other contingency management interventions have shown some promise in treating alcohol-use disorders (for review, see Wong et al., 2008) and substance use in general (Higgins et al., 2008). However, these abstinence reinforcement contingencies alone do not often address the range of problems associated with extreme poverty that homeless people face. To address some of these problems, our research group has developed the Therapeutic Workplace—a novel, employment-based substance abuse treatment intervention that may have considerable potential in promoting sustained abstinence from alcohol and drugs in homeless alcohol-dependent individuals, while simultaneously addressing some of their interrelated and critical problems of poverty, unemployment and homelessness. This intervention, the Therapeutic Workplace, integrates the voucher-based abstinence reinforcement contingencies of proven efficacy into an employment program. In this program, substance-abuse patients are hired and paid to work each day, performing data entry jobs. Persons who lack prerequisite academic or job skills are given intensive and individualized computerized training. To reinforce abstinence, participants in an experimental group are allowed to work and earn wages only when they remain abstinent, and abstinence is biologically verified. This intervention has been shown to be effective at promoting abstinence from heroin and cocaine in treatment-resistant young mothers (Silverman et al., 2001, 2002) and abstinence from cocaine in unemployed injection drug and crack cocaine users enrolled in methadone treatment (Silverman et al., 2007; Donlin et al., 2008; DeFulio et al., 2009).

The present randomized, controlled trial was conducted to evaluate the efficacy of the Therapeutic Workplace intervention in homeless, alcohol-dependent adults and to assess the contribution of the abstinence reinforcement component of the intervention. A control condition offering job skills training was compared with two experimental conditions—one assessing the impact of payment for participation in the training and one assessing the impact of requiring alcohol abstinence as a daily pre-condition of access to paid training.
METHODS

Setting and participant selection
This study was conducted at the Center for Learning and Health, a treatment-research unit at the Johns Hopkins Bayview Medical Center (Baltimore, MD) and was approved by the Johns Hopkins Institutional Review Board. Participants were enrolled in this study from December 2001 to October 2005.

Participants were recruited by one of the two methods. First, individuals were recruited from an inpatient detoxification unit located on the Johns Hopkins Bayview Medical Center, the Chemical Dependency Unit, while undergoing detoxification from alcohol. While on the inpatient detoxification unit, interested participants completed a full screening interview to determine study eligibility. Individuals were also recruited from local community agencies that provide services to the homeless, including food kitchens and homeless shelters. Eligible participants recruited from community agencies were then assessed by a physician for risk of experiencing severe adverse effects from alcohol withdrawal. Participants determined to be at risk for experiencing severe adverse effects from alcohol withdrawal were required to receive inpatient alcohol detoxification at the Johns Hopkins Bayview Chemical Dependency Unit prior to study enrollment.

Full screening interview
The full screening included urine and breath samples collected under observation and tested for cocaine, opiates, benzodiazepines, amphetamines and alcohol; the Addiction Severity Index (McLellan et al., 1980), a subsection of the psychoactive substance-abuse sections of the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) Checklist (the questions relating to alcohol, cocaine, opiate, and benzodiazepines) (Hudziak et al., 1993); the Risk Assessment Battery (Metzger et al., 1993) and the Timeline Follow-Back interview (Sobell and Sobell, 1996). Questionnaires developed in our research program on demographics and homelessness also were administered during the intake interview. The Wide Range Achievement Test (WRAT-3; Wilkinson, 1993) was administered to assess reading and spelling ability. Participants were paid $50 in vouchers for completing the full intake interview.

To be eligible, a participant had to be at least 18 years of age, report being homeless (stayed in a shelter, on the street or in an abandoned house at least one night over the past 30 days; lost public housing assistance recently or are at risk of losing residence; or slept in more than two places over the past 30 days), report being unemployed and meet DSM-IV criteria for alcohol dependence. Participants were excluded if they reported current suicidal ideation or reported hallucinations. Eligible participants were invited to sign a main study consent form.

Experimental design and study groups
Stratification and random assignment
Of the 321 participants screened, 125 met eligibility criteria. One participant was removed from the study 2 days after signing consent when it was found out that he lied at intake, and was actually employed in a position that could compromise other participants’ confidentiality. The remaining participants (n = 124) were enrolled and randomly assigned to the Unpaid Training (n = 39), Paid Training (n = 42) or Contingent Paid Training (n = 43) group. Participants were randomized to study conditions by a study coordinator, using a stratification procedure (similar to Silverman, 2004) based on whether the participant received inpatient detoxification for alcohol dependence prior to randomization, whether full screen urine sample tested positive for cocaine, and whether full screen urine sample tested positive for opiates. Note that the 125 randomized participants are fewer than the intended 156 participants called for by a power analysis conducted prior to the study. Additional participants could not be randomized without extending the study duration beyond that allowed by available funding.

All participants were invited to receive training in the Therapeutic Workplace for 4 h every weekday throughout a 26-week intervention period, and were required to provide ‘daily’ and ‘random’ breath samples that were tested for alcohol.

Daily breath samples
After signing into the workplace each morning and after the daily lunch break, all participants were required to provide a breath sample under observation. Breath samples were collected with the Alco-Sensor III (AlcoPro, Inc., Knoxville, TN, USA).

Randomly scheduled breath assessments
To attempt to capture instances of alcohol use outside the workplace and to add an unpredictable element to breath sample measurements, randomly scheduled breath samples were also collected. On average, all participants were scheduled to provide two breath samples on a random schedule during a 7-day week between the hours of 9 a.m. and 5 p.m. Each day was split into four 2-h periods, and each participant was randomly assigned to be contacted during an average of two periods per week (minimum one each week). Participants were provided with a pager or cell phone, and were informed that they would be randomly paged or phoned so that staff could collect a breath sample from them. Participants were informed that if they answered their pager or cell phone and allowed research staff to collect a breath sample within 60 min, they would receive a $35 voucher. Random breath samples scheduled to occur while a participant was in the workplace were still collected as scheduled, and were in addition to the daily breath samples described previously.

Monthly assessments
Independent of Therapeutic Workplace attendance, participants were contacted once each month and offered $30 in vouchers for the completion of an assessment, except the 6-month assessment for which they were offered $50 in vouchers. These assessments included the collection of a breath, blood and urine samples, as well as the administration of some or all of the questionnaires collected at intake by a staff person blinded to the group assignment of the participants.
Unpaid training group

Participants assigned to the Unpaid Training group were invited to receive training independent of their daily or randomly collected breath sample results, and they did not earn monetary vouchers for their participation in the workplace. Vouchers were still earned for providing randomly scheduled breath samples and completing assessments.

Paid training group

Participants in the Paid Training group were invited to attend the workplace every weekday to receive stipend-supported keyboarding training. Participants in this group could earn a base pay hourly wage in vouchers for attending the workplace and productivity pay for performance on the training programs. These participants were allowed to work and earn vouchers independent of whether their daily or randomly scheduled breath samples were positive for alcohol (blood alcohol level (BAL) ≥ 0.004 g/dl).

Contingent paid training group

Participants in the Contingent Paid Training group were invited to attend the workplace to receive stipend-supported keyboarding training similar to participants in the Paid group. However, for Contingent Paid participants, access to the workplace and to earn voucher pay was contingent upon the alcohol content of the daily and randomly scheduled breath samples. A Contingent Paid participant who provided an alcohol-positive breath sample (BAL ≥ 0.004 g/dl) was not permitted access to the workplace on that day and received a temporary decrease in pay on subsequent days (see below).

Therapeutic workplace training programs

The Therapeutic Workplace is delivered via a web-based application, which allows staff to administer and electronically monitor treatment and training for each trainee. Aspects of the treatment most relevant to the keyboarding training are described below in detail. Other details of the web-based Therapeutic Workplace treatment are described in detail elsewhere (Silverman et al., 2005).

In the workplace, participants were taught keyboarding skills using two computer-based training programs (see Dillon et al., 2004 for a detailed description of the training programs). Trainees worked on the training programs for 2 h in the morning (10:00 a.m.–12:00 p.m.) and for 2 h in the afternoon (1:00 p.m.–3:00 p.m.).

Voucher pay

All participants earned $50 in vouchers for completing the intake and 6-month assessments, $30 in vouchers for completing other monthly assessments and $35 in vouchers for each random assessment. Participants in the Contingent Paid and Paid groups could earn an hourly wage as well as pay for performance on the training programs. All voucher earnings were automatically added to each participant’s voucher account and displayed on the participant’s computer screen. Voucher earnings were exchangeable for goods and services in the community that were purchased for participants by staff.

Base pay

Hourly base pay began at an initial low rate of $1.00/h and increased by $.10 to a maximum of $5.00/h for each day a participant arrived on time (i.e. 10 a.m.) and completed a work shift (≥3.5 out of 4 h in attendance). The base pay rate could be reset to $1.00/h if the participant failed to complete a work shift, or arrived late to the workplace (Paid and Contingent Paid groups). Base pay was also reset for Contingent Paid participants if a breath sample was positive or missed. Once the base pay hourly rate was reset, it increased again by $.10 per hour for each day the participant met the attendance and abstinence requirements. After nine consecutive days of meeting each of the requirements, base pay was restored to the value in place before the reset. Productivity pay was not affected by a reset.

To provide some flexibility, participants started training with 5 ‘late-not-reset days’ and 5 ‘personal days’. In addition, participants earned 1 ‘late-not-reset day’ for every 10 completed work shifts and 1 ‘personal day’ for every 5 completed work shifts. Participants could use ‘late-not-reset’ or ‘personal’ days to prevent a reset for being late or failing to work a complete work shift, respectively.

Productivity pay

Paid and Contingent Paid participants were able to earn additional voucher pay for performance on the training programs. First, participants could earn and lose voucher money for correct and incorrect characters, respectively. Second, participants could earn bonuses for each step they passed. On most steps, participants earned 0.03 cents for every 10 correct characters and lost 0.01 cent for every incorrect character. The bonuses began at $1.00 and increased in value as trainees progressed through the program.

Standard treatment services

Standard treatment services were available to all participants.

Motivational enhancement therapy

Motivational Enhancement Therapy was offered to all participants in this study according to the procedures specified in the Project MATCH MET Manual (Miller et al., 1992) by a Masters-level clinical social worker. In this therapy, a therapist provides feedback to participants of the risks associated with alcohol and drug use, utilizes empathy, emphasizes personal responsibility, gives participants a menu of options for change and attempts to facilitate self-efficacy (Miller et al., 1992). Motivational Enhancement Therapy was provided in four individual sessions.

HIV transmission risk reduction counseling

A masters-level clinical social worker provided HIV risk reduction counseling following the National Institute on Drug Abuse HIV Counseling and Education Intervention Model (Coyle, 1993).

Employment case management

A clinical social worker used the Job Club approach developed by Azrin and Besalel (1980), a manualized behavioral approach to vocational counseling.
Clinical case management
A clinical social worker provided clinical case management services, including referrals to address patient needs in the areas of employment, and mental/medical health. The social worker also assisted participants in finding shelter/housing and encouraged them to use voucher earnings to pay for shelter. The clinical social worker guided participants to seek available social service benefits, and to utilize Baltimore City’s network of emergency shelters, transitional shelters and motel placements, as needed.

Outcome measures
The breath samples collected from the participants during the random and monthly assessments represented the primary outcome of interest. These samples were analyzed with two cutoff values: BAL $\geq 0.004$ g/dl (which was the cutoff used to deny access to the workplace or reset base pay for the Contingent Paid group) and BAL $\geq 0.05$ g/dl (which represents a level with more alcohol-related impairment). Self-reports of heavy drinking was also collected at monthly and random assessments. A participant was considered to have engaged in heavy drinking if he/she reported consuming more than four drinks (females) or five drinks (males) in the 24 h prior to a random assessment or during at least one day in the month prior to a monthly assessment. Separate analyses were conducted with missing breath samples and reports of drinking behavior considering missing (missing-missing, MM) or positive (missing-positive, MP).

Data analysis
Between-group comparisons on single measurement baseline variables were conducted to detect whether group adjustments were needed. Fisher’s exact tests were performed for dichotomous variables, and one-way analysis of variances were performed for continuous variables.

Dichotomous outcomes assessed repeatedly over time within the baseline and intervention periods were analyzed with an exchangeable correlation structure using general estimating equations (GEE) (Liang and Zeger, 1986). GEE is particularly suited for analyses of longitudinal data, and allows for correlations among observations within an individual subject. GEE was chosen over generalized linear mixed models as the better of two imperfect options. GEE assumes that data are missing completely at random (Hu et al., 1998), an assumption that may have been violated in the MM analyses (this was not a concern for the MP analyses as there were no missing data). However, GEE is preferable to alternative subject-specific approaches such as generalized linear mixed models that make less stringent assumptions about missing data for two reasons: (i) GEE makes group-level inferences about results instead of individual-level inferences (Hu et al., 1998), which is preferable when interested in group effects, and (ii) the interpretation of group-level regression estimates differs between the two approaches when the outcome is binary, and GEE generates estimates that are more applicable to the treatment-effect-oriented experimental questions of the current study (Neuhaus et al., 1991). Group comparisons were conducted both with no covariates, and with reported drinks consumed per day at intake and breath sample collection rate included as covariates. Drinks consumed per day at intake was chosen as a covariate because the groups reported marginally different levels of this variable ($P=0.08$), and previous reports show a consistent association of this variable with treatment outcomes (for review, see Adamson et al., 2009). Collection rate was included as a covariate when it significantly differed among groups. Two-tailed tests were used and $\alpha=0.05$ was used for statistical significance. GEE analyses were conducted in SPSS Statistics v. 17.02 (IBM Corporation, Somers, NY, USA).

RESULTS

Participant characteristics
Overall, participants in all three groups reported high rates of alcohol use, unemployment and homelessness at intake. In the 30 days prior to intake, participants reported drinking alcohol to intoxication on 23.85 (SD = 8.01) days, working on average 3.35 (SD = 6.53) days and earning $112 (SD = $369) in net income. No statistically significant differences among the Contingent Paid, Paid and Unpaid groups were detected on any of the characteristics collected at intake (Table 1). Some characteristics did approach statistical significance, including the racial composition of the groups ($P=0.06$), the number of drinks consumed per day at intake ($P=0.08$), lifetime treatment episodes for alcohol ($P=0.08$) and other drugs ($P=0.08$), and likelihood of living in a residence at least one day out of the past 30 ($P=0.09$).

Workplace attendance
Workplace attendance and the result of the daily breath samples for each participant are shown in Fig. 1. It is apparent by visual examination that the Contingent Paid participants attended with no alcohol use more regularly than the Paid participants, although this difference was not statistically significant (Table 2). Workplace attendance was significantly lower in the Unpaid group than each of the other two groups (19 vs. 39% and 45%; $P<0.001$; Table 2). The two groups receiving payment for attendance and performance on the training programs arrived at the workplace more frequently were granted access to the workplace more frequently, and attended with no detected alcohol use more frequently than the Unpaid group (Table 2). There were no significant differences between the Paid and Contingent Paid group on these three outcomes.

Breathalyzer outcomes from random assessments
The Contingent Paid group provided significantly fewer breath samples with BAL $\geq 0.004$ g/dl than the Paid group (Fig. 2 top; Table 2). Random breath samples with BAL $\geq 0.004$ g/dl in the Unpaid group did not significantly differ from either of the other groups. The percentage of breath samples meeting or exceeding 0.05 g/dl and self-reports of heavy drinking followed a similar pattern as the data for breath with BAL $\geq 0.004$ g/dl, but neither of these measures differed significantly among groups (Table 2). If missing breathalyzer samples or self-reports of drinking were considered positive, no significant differences were observed on percent of samples $\geq 0.004$ g/dl, percent of samples $\geq 0.05$ g/dl or self-reported heavy drinking.
The collection rate of random breath samples differed significantly among groups, with the highest rate in the Paid group, lowest in the Unpaid group and an intermediate rate in the Contingent Paid group (Table 2). Exploratory analyses of abstinence results when collection rate and the number of drinks consumed per day at baseline were entered as covariates are presented in Supplementary Table S1. Collection rate significantly influenced abstinence outcomes in the MP analyses, and number of drinks consumed per day at baseline influenced abstinence rates with all outcome measures. The different levels of these covariates among the groups had an impact on the obtained abstinence rates, since when they were included in the analyses, the estimated marginal means of alcohol use among the Unpaid group was somewhat higher than the Contingent Paid group. This is in contrast to the unadjusted means (Table 2), which show no consistent difference between these two groups. The inclusion of these covariates did not change the overall pattern of group effects, however (Supplementary Table S1). The largest difference was between the Contingent Paid and Paid groups, which met or approached statistical significance, depending on the outcome measure. The other groups did not differ statistically from one another.

Breathalyzer outcomes from monthly assessments

The results from the monthly assessment breath samples largely mirror those from the randomly collected breath
samples. Percent samples with BAL $\geq 0.004$ g/dl (Fig. 2 bottom; Table 2) and percent samples with BAL $\geq 0.05$ g/dl (Table 2) were lowest in the Contingent Paid group, significantly higher in the Paid group and at an intermediate level in the Unpaid group that did not differ statistically from either of the other groups. While a similar pattern of results was seen with MP analyses of these variables, the differences were not statistically significant. In addition, self-reported heavy drinking did not differ among groups.

Unlike with the randomly collected samples, the collection rate of samples collected during monthly assessments did not differ among groups (Table 2), and therefore no covariate analysis is reported with this variable. The number of drinks consumed per day at intake was considered as a covariate in an exploratory analysis, however (Supplementary Table S1). This covariate was significantly associated with verified and reported alcohol use in both the MM and MP analyses, and like with the randomly collected breath samples, increased the spread between the Contingent Paid and Unpaid group somewhat when included in the analysis. With this covariate, the Contingent Paid group had significantly lower rates of verified alcohol use than the Paid group and the Unpaid group in the MM analyses (BAL $\geq 0.05$ g/dl only), with the Paid and Unpaid groups not significantly different. No significant difference among groups was noted in the MP analyses of verified or reported alcohol use (Supplementary Table S1).

**DISCUSSION**

The current study demonstrates two things: (i) that pay improves workplace attendance of homeless alcohol-dependent adults, and (ii) that making access to the workplace contingent on negative breathalyzer results improves alcohol abstinence without reducing workplace attendance. It is perhaps not surprising that pay improves workplace attendance, but the observation that requiring abstinence as a daily precondition to workplace access significantly improves abstinence without decreasing attendance is a new finding that has important implications for how contingency management procedures can be clinically implemented to improve...
alcohol treatment outcomes. The homeless adults in this study faced many barriers to overcoming their alcohol dependence. Participants were undereducated, and the vast majority was usually unemployed for 3 years prior to intake. Housing instability was a serious issue, with a large majority spending at least one day in the past 30 outdoors, in a vehicle or in an abandoned house, and 30–40% spending at least one day in a hospital. Many also lacked social support, and only one participant out of 124 was married. In addition, concurrent cocaine or opioid dependence was a common problem. These data suggest a treatment approach that addresses multiple barriers simultaneously could be useful for this population. The current study demonstrated that providing vouchers contingent upon job skills training attendance can increase attendance, and vouchers contingent on alcohol abstinence can promote abstinence from alcohol.

While the Contingent Paid group had less verified and reported alcohol use than the Paid group on a number of measures, the Unpaid group had an intermediate level of use that was not statistically more than the Contingent Paid group in any of the analyses of the raw data without covariates included in the analysis. The relatively low level of verified and reported alcohol use in the Unpaid group was in no instance statistically less than the Paid group, but warrants discussion due to the similar level of abstinence in absolute terms as the Contingent Paid group. The similar levels of abstinence in the Contingent Paid and Unpaid groups may have been an artifact of the collection rate of random breath samples, as the Unpaid group had the lowest collection rate. It seems plausible that missing samples would be more likely to be positive than successfully collected samples (an assumption that is the basis of MP analyses), raising the possibility that measured alcohol use in the Unpaid group was artificially low due to the higher rate of uncollected samples. Second, one of the variables on which the groups

<table>
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<th>Group means</th>
<th>Group GEE results</th>
<th>Bonferroni-corrected post hoc P-value</th>
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<tr>
<td>Attendance</td>
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<td>Days arrived at workplace</td>
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<tr>
<td>Days worked at least 1 min</td>
<td>39 45 19</td>
<td>16.7</td>
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<td>Days attended with no alcohol use</td>
<td>37 29 13</td>
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Group means for each dependent variable are shown, as well as the results from the GEE analyses comparing these groups with no covariates entered in the analyses. The P values of post hoc tests are also displayed. Bold values indicate statistical significance.

MM, missing samples were treated as missing (missing-missing); MP, missing samples were treated as positive for alcohol use (missing-positive); Cont., contingent.

Fig. 2. Positive breath sample results. Positive breath samples (BAL ≥ 0.004 g/dl) during random breath assessments (top panel) and during monthly assessments (bottom panel), expressed as a percent of collected breathalyzer samples. Points represent individual participants in each group and horizontal lines indicate group means.
were stratified was the number of self-reported days out of 30 preceding intake with any level of drinking. The average number of drinks per day was not a stratification variable, however, and the Unpaid group had a lower number of reported drinks per day at intake, a difference that approached statistical significance ($P = 0.08$; Table 1). Amount of alcohol consumption has consistently predicted poorer treatment outcomes across a range of alcohol treatment methodologies, with no known report showing the opposite association (e.g. Solomon and Annis, 1990; Duckert, 1993; Sobell et al., 1995; Kavanagh et al., 1996; Breslin et al., 1997; Kranzler et al., 1999; Greenfield et al., 2002; Haver, 2003; Staines et al., 2003). It is possible that the relatively low level of measured alcohol use in the Unpaid group was partially due to these factors, a supposition that is supported by the estimated marginal means displayed in Supplementary Table S1. Accounting for collection rate (random samples only) and drinks per day at intake increased the level of positive breath samples in the Unpaid group relative to the Contingent Paid group for both random and monthly breath samples, as evidenced by the estimated marginal means displayed in Table 2 and Supplementary Table S1.

A factor that complicated the execution of the current experiment was the collection procedure for the random breath samples. Due to the relatively rapid elimination rate of alcohol, standard breath analyses require frequent testing to obtain an accurate representation of alcohol use. Across the three groups, the collection rate of the random samples in this study was ~60%. In addition, no random breath samples were collected before 9 a.m. or after 5 p.m., leaving open the possibility that much alcohol use was not captured by these assessments. These factors might contribute to artificially low measured rates of alcohol use, and explain why rates of self-reported heavy drinking were typically higher than rates of positive breath samples. These limitations do not necessarily eliminate the possibility of using contingency management interventions for alcohol use, however. Other biological assays that have a longer detection window could be used, as could measurement techniques that reduce the costs associated with the random assessment procedure in the current experiment. For example, internet-based verification techniques have been developed for measuring carbon monoxide levels for smoking behavior (Dallery et al., 2007). Similar techniques could allow for obtaining and verifying breath samples remotely, although these techniques would not be practical for homeless populations that lack internet access.

Moving homeless, alcohol-dependent adults out of poverty is a difficult task with many obstacles, but this study suggests two features of treatment programs that could be important when addressing this population. First, payment for attendance in training or assistance programs can significantly increase attendance and utilization of these services. Second, abstinence-contingent access to paid training can significantly increase abstinence from alcohol.

**SUPPLEMENTARY DATA**

Supplementary data are available at Alcohol and Alcoholism online.

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**REFERENCES**


