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Translating transdermal alcohol monitoring procedures for contingency management among adults recently arrested for DWI

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Abstract

Recent developments in alcohol monitoring devices have made it more feasible to use contingency management (CM) procedures to reduce alcohol use. A growing body of literature is demonstrating the effectiveness of CM to reduce alcohol use among community recruited adults wearing transdermal alcohol concentration (TAC) monitoring devices. This article describes the quality improvement process aimed at adapting TAC-informed CM aimed at minimizing alcohol use and maximizing treatment completion. This extends literature to a high-risk population; adults arrested and awaiting trial (pretrial) for criminal charge of driving while intoxicated (DWI). Participants were enrolled during their orientation to pretrial supervision conditions of DWI bond

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Conflict of Interest
None of the authors have conflict of interest to declare. Specifically, we have no financial interest or disclosures for the transdermal alcohol monitor (SCRAM) used in this project.

Contributors

- The design of this project was developed by authors: Mathias, Hill-Kapturczak, Karns-Wright, Mullen, Roache, and Dougherty.
- Data collection, administration, and analyses was the responsibility of authors: Mathias, Karns-Wright, and Mullen
- Interpretation of the data contributed to by authors: Mathias, Hill-Kapturczak, Karns-Wright, Mullen, Roache, Fell, and Dougherty
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release. At enrollment, participants completed a screening, brief intervention, and referral to treatment; those with high risk alcohol histories were enrolled in an 8-week CM procedure to avoid TAC readings. Four Plan-Do-Study-Act (PDSA) quality improvement cycles were conducted where the TAC cutoff for determining alcohol use, the quantity of reinforcer, and handling of tampers on the transdermal alcohol monitor were manipulated. Across four PDSA cycles, the retention for the full 8-weeks of treatment was increased. The proportion of weeks with alcohol use was not decreased across cycles, the peak TAC values observed during drinking weeks were significantly lower in Cycles 1 and 4 than 3. CM may be developed as a tool for pretrial supervision to be used to increase bond compliance of those arrested for DWI and for others as a method to identify the need for additional judicial services.

Keywords

alcohol; transdermal alcohol monitor; contingency management; driving while intoxicated; pretrial

1. Introduction

Driving while intoxicated (DWI) offenses are prevalent and associated with severe consequences. DWI is among the most frequently committed offenses in the U.S. (FBI, 2015), yet it's estimated that only 0.1% of alcohol-impaired drivers are arrested (Zaloshnja et al., 2013). Further, nearly 30% of those arrested for DWI will be re-arrested for alcohol impaired driving (NHTSA, 2014b). DWI recidivists are over-represented in fatal crashes by a factor of 1.62, as drinking drivers in fatal crashes by a factor of 2.38, and as a high blood alcohol concentration (BAC) driver in fatal crashes by a factor of 3.81 (Fell, 2014). National rates show 31% of motor vehicle fatalities involve a driver with a BAC ≥ 0.08 (legal intoxication) and cost $49.8 billion annually (NHTSA, 2014a).

The period after DWI arrest is a unique context for targeting reduction in alcohol use. The time between arrest and adjudication (pretrial) is typically lengthy and involves bond stipulation for alcohol abstinence and monitoring (Buner, 2015; Fell, 2006; Widgery, 2015). Despite inherent contingencies (fines, incarceration) within the pretrial supervision period, rates of alcohol use are alarmingly high. One large study (n = 7,743) using ignition interlock data (car-installed breathalyzer) found that alcohol is detected in as many as 70% of cases (Vanlaar et al., 2010). In light of ongoing alcohol use in pretrial, we were interested in adapting a contingency management procedure to ultimately determine if it reduces alcohol use among DWI defendants under pretrial supervision.

Contingency management (CM) may be an effective intervention to reduce alcohol use during the pretrial supervision period. CM is a behavioral intervention involving the delivery of rewards or removal of punishment to achieve a specific behavior, like reductions in alcohol use. CM is effective in reducing the quantity and frequency of using drugs of abuse (Benishek et al., 2014; Lussier et al., 2006) and is well-tolerated by patients (Petry et al., 2016). Until recently, limitations in blood, breath, or urine alcohol use biomarkers (e.g., Javors & Johnson, 2003; Maenhout et al., 2013) hindered progress in applying CM for reducing alcohol use. However, continuous remote detection of alcohol use is now available through transdermal alcohol monitors that passively measure alcohol excreted in sweat (Swift, 2000; 2003; Marques & McKnight, 2009; McKnight et al., 2012). One study has shown that DWI offenders mandated to transdermal alcohol monitoring during pretrial supervision have delayed recidivism to DWI compared to non-monitored offenders (360 days to rearrests versus 271; Tison et al., 2015).

Transdermal alcohol concentration (TAC)-informed CM procedures have been shown to reduce alcohol use among community samples and this article describes the quality improvement process of adapting these procedures for a new population and treatment context: adults recently arrested for a DWI and under bond-stipulation of alcohol abstinence. Previous studies examined manipulations of CM parameters (i.e., size of reinforcers and the TAC cut-offs) in studies of community volunteers (Barnett et al., 2011; 2017; Dougherty et al., 2014; 2015a; 2015b). The issue of limits of detection is important because the forensic criteria for TAC cut-offs to confirm a drinking event is deliberately conservative to avoid false positive readings. In contrast, clinical research has focused on the reliability of detection of lower TAC values (i.e., is higher sensitivity; Roache et al., 2015). Across various adaptations in TAC-informed CM procedures, studies have consistently found reductions in alcohol use among community-recruited heavy drinkers (Barnett et al., 2011; 2017; Dougherty et al., 2014; 2015a; 2015b). Because the DWI population tends to have more complex needs and more limited resources than general community samples (Mullen et al., 2015b), we anticipated that the CM procedure would require adaptation for the high-risk pretrial DWI offender population. This project used quality improvement methodology as a mechanism to adapt TAC-informed CM procedures for this new target population with the goal of minimizing alcohol use and maximizing treatment completion among those recently arrested for DWI offenses.

2. Material and Methods

2.1 Participants

Between May 2015 and June 2017, adults who had been recently arrested for a DWI were offered enrollment into an evaluation and intervention program. Enrollment occurred at pretrial orientation, where offenders are instructed on the conditions of their bond release supervision. In our local jurisdiction, this orientation typically occurs two weeks after arrest. As an adjunct to the typical orientation process, our staff advertised the availability of alcohol evaluation and intervention services. Participants were informed that these services are separate from the pretrial supervision, voluntary, and confidential. They specifically were informed that participation in the program was not intended to impact the outcome of their pending DWI case and that information gathered as part of participation in the intervention would not be shared with the pretrial supervision officers. Those who attended all 8-weekly CM visits received a program completion certificate. Of the 213 potential participants approached during this 2-year project, 86 were enrolled in CM, 88 were excluded for low AUDIT score, and 39 declined participation.

2.1.1 Screening, Brief Intervention, Referral to Treatment (SBIRT)—Interested participants first experienced an approximately 45 min computer-assisted alcohol screening, brief intervention, and referral to treatment (SBIRT) as previously described in Mullen et al., 2015a. During the SBIRT session, data were collected about participant demographic and alcohol use characteristics (including the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993). Those who score risky, harmful, or in the dependent range (i.e. scores > 4) in the AUDIT were offered participation in the CM intervention. Participants were included if they were: adults (≥ 21 years); arrested for DWI; under pretrial supervision; and willing to undergo voluntary transdermal alcohol monitoring for the purpose of treatment. Participants were excluded if they: were court mandated to transdermal alcohol monitoring; had significant alcohol withdrawal symptoms (Clinical Institute Withdrawal Assessment for Alcohol (CIWA score ≥ 10; Sullivan et al., 1989); or had medical conditions that might contraindicate wearing the ankle monitor (e.g., pregnancy, diabetes). While not an entry criteria, the clinic from which this data was gathered serves a high proportion of low-income, uninsured clients.

2.2 Transdermal Alcohol Monitoring

Participants who qualified and agreed to volunteer were fitted with the Secure Continuous Remote Alcohol Monitors [SCRAM, Alcohol Monitoring Systems (AMS); Highlands Ranch, CO] for detecting transdermal alcohol concentrations (TAC). The monitors were worn on the ankle and detected ethanol emitted through the skin every 30 minutes, 24 hours/day. Attempts to obfuscate alcohol use were measured by infrared reflectivity and body temperature sensors.

SCRAM data was uploaded to the AMS web interface ($SCRAM_{NET}$; Highlands Ranch, CO) during weekly visits. Then, data was downloaded and run through a program we developed for processing TAC data and producing a CM payment decision. The data processing removes TAC data points that are uninterpretable because they do not conform to characteristics of actual alcohol use events based on known absorption and elimination rates, or producing implausibly high or low, but long, TAC readings. After processing, the application then produces a CM payment decision (yes/no) and provides a summary of TAC, infrared, and temperature data.

2.3 Quality Improvement Cycles

This project describes four QI cycles following the Plan, Do, Study, Act (PDSA) model (described in Moran et al., 2012). Each cycle involved: Planning a CM intervention using a well-defined set of contingency criteria; Doing the intervention in a cohort of participants; Studying the outcomes of that cycle of intervention; and Acting to implement change in the subsequent round of intervention. The goal of the PDSA process was to improve the quality of the CM intervention to minimize alcohol use and maximize treatment completion. Cycles were conducted in approximately 6-month intervals and sample size within each cycle was the outcome of recruitment rate within that interval. Outcomes of the analysis conducted in the Study cycle are presented in the Results, while the Discussion reflects the interpretations made at each Plan cycle.

In each cycle, the CM intervention was divided into 8 consecutive 7-day weeks for each participant. Whether or not participants attended their scheduled weekly appointment or came in on a later date to collect their transdermal and self-report alcohol data, all data were analyzed by their original 7-day weekly blocks and up to 8 monetary reinforcements were paid for these each of these one-week intervals.

Cycle 1—During the first Do cycle, 22 participants were enrolled and treated between May and November 2015. In this cycle participants were instructed that any evidence of alcohol use would result in forfeiture of that week's contingency earning. Monetary reinforcement was delivered at each weekly monitoring showing transdermal alcohol concentration (TAC) = 0.00. The escalating-resetting payment scale started at $20 in week 1 and this increased by $10/week for consecutive weeks of TAC = 0.00. If TAC > 0.00 there was no payment for that week, and the following week's payment was reset to $20, resuming $10/week escalation thereafter. Completing all 8 visits earned a $50 bonus and $50 was paid for returning the SCRAM monitor.

Cycle 2—During the second cycle, 20 participants were enrolled and treated between April and October 2016. In this cycle participants were instructed to avoid alcohol use and that evidence of heavy drinking would result in forfeiture of that week's contingency earning. Maintaining TAC below 0.02 (Barnett et al., 2011) for the week resulted in contingency payments of $50/week, along with completion bonus ($50) and monitor return ($50) bonus.

Cycle 3—During the third cycle, 18 participants were enrolled and treated between September 2016 and January 2017. In this cycle, instructions and TAC contingencies were similar to Cycle 2, with the addition of $70/week paid for wearing the SCRAM monitor (consistent with Dougherty et al., 2014; Dougherty et al., 2015a, 2015b).

Cycle 4—During the fourth cycle, 26 participants were enrolled and treated between January and June 2017. Participants were instructed to avoid an "alert" on the monitor to receive their contingency payment. They were instructed that alerts could be caused by drinking alcohol and/or by tampering with the device; either of these would result in forfeiture of the $50/week contingency payment. Potential tampers are identified in the alert log of the AMS Client Report generated at the time of upload of data to $SCRAM_{NET}$. Authors TEKW and CWM visually inspected the AMS Client report output for large variability in infrared voltage and reductions temperature collected by the transdermal alcohol monitor. The participant was also queried about their experience wearing the device, specifically during the tamper alert period. Based on this review, the contingency payment was withheld in 3 instances on account of tamper as indicated by high infrared voltage variability. Subsequently, AMS reviewed and confirmed all 3 of these as tamper events. AMS tamper criteria include fluctuations in infrared voltage deviation and temperature drop that is visually inspected by AMS technicians trained in interpretation of transdermal alcohol, temperature, and infrared data patterns collected by the SCRAM device. Payments for wearing the monitor, treatment completion, and returning the device remained the same as Cycle 3.

2.4 Timeline Followback Interview (TLFB)

TLFB was used to gather self-reported alcohol use during each 7-day contingency period. The TLFB procedure is a calendar-based interview (Sobell & Sobell, 1992) to document date, time, type, quantity, frequency, and duration of alcohol use.

2.5 Ethics Approval

Data from this project involved analyses of de-identified electronic health record information of patients who consented to receive alcohol assessment and intervention. Analyses were conducted for the purpose of QI, and our local institutional review board determined this publication is not regulated as research as defined by DHHS regulations at 45 CFR 46 and FDA regulations at 21 CFR 56.

2.6 Data Analyses

The primary outcomes of interest are the proportion of weeks with: Non-Drinking, Alcohol Use, Dropout, or Tamper. Because each participant may separately demonstrate each of these outcomes depending on week, outcome comparisons were conducted focusing on the proportion of weeks rather than by individual. The proportion of weeks was calculated as the count of weeks with each type of outcome (i.e., Non-Drinking, Alcohol Use, Dropout, and Tamper) divided by the number of weeks within that cycle ($N = 688$ observations: Cycle 1 = 176, Cycle 2 = 160, Cycle 3 = 144, and Cycle 4 = 208 weeks).

Univariate analyses of variance (ANOVA) were used to compare outcomes, as well as peak TAC, time in observation (days between arrest and SBIRT, days between SBIRT and start of CM, and days so complete CM), alcohol history, and demographic characteristics that were on an interval scale. Significant outcomes were retested in analyses to explore the effect of covariates, separately including: days between SBIRT and CM, AUDIT score, past alcohol treatment, number of DWI arrests, and heavy drinking days in the month prior to arrest. Chi-square analyses were used for comparison of dichotomous, nominal, and ordinal scale characteristics (e.g., sex, past alcohol treatment). In instances, where there was a significant main effect of Cycle, follow-up comparisons were conducted using the Benjamini and Hochberg (1995) procedure correcting for multiple comparisons. All analyses were conducted using IBM SPSS Statistics version 24 (IBM Corp. Armonk, NY).

3. Results

3.1 Quality Improvement Cycles

QI dashboards showing the sequence of participant enrollment and outcomes by cycles appear in Figures 1a–1d, which show; earning CM incentive payments did not differ by Cycle ($p = .47$), dropout typically occurred during the first half of treatment, drinking events were not concentrated within any particular week or week range, and peak TAC was similar across individual weeks when drinking did occur (there were no Week or Week X Cycle effects of peak TAC; p's > .30). Descriptive measures are reported by QI cycle in Table 1, where the proportion of Non-Drinking, Alcohol Use, Dropout, and Tamper are reported and analyzed as the proportion of scheduled weeks (e.g., in Cycle 1, 22 participants were enrolled in the 8-weeks treatment, resulting in 176 observations toward outcome). The rate of treatment completion and level of TAC varied across the four different QI cycle CM conditions. There was a significant QI Cycle difference in proportion of weeks with dropout ($F_{3,683}$ = 4.19, p = .006; Cohen's d = .27; observed power = .85); compared to Cycles 1 and 2, there was significantly lower dropout under Cycle 3 (p's = .023 and .028) and Cycle 4 (p's = .006 and .008) CM conditions. There were no significant differences in proportion of weeks drinking between the four cycles (p = .833), but the average TAC during weeks with alcohol use did differ by CM conditions ($F_{3,159}$ = 5.76, p = .001, Cohen's d = .66; observed power = .95). There was significantly higher average TAC for Cycle 3 conditions than both Cycle's 1 and 4 (p's = .0015 and .0015), which were not different from one another. Average TAC in Cycle 2 was not statistically different from any other cycle. Differences in rate of Dropout and average TAC remained significant after accounting for the following covariates: days between SBIRT and CM, AUDIT score, past alcohol treatment, number of DWI arrests, and heavy drinking days in the month prior to arrest.

The four QI cycle cohorts were compared for time to treatment completion (see Table 1, bottom panel). The time between SBIRT and the start of CM differed significantly by cohort ($F_{3,82}$=6.80, p <.001); Cycle 4 was significantly longer than in Cycles 1 and 2 (p's = .001), but not Cycle 3. The longer time for Cycle 4 resulted from delays in starting CM due to end of year holidays. However, 72% completed in exactly 8-weeks and the remaining participants completed within ±1 week of the 56 day of treatment. There were no significant differences between the four cohorts in terms of time between arrest and SBIRT or length of time to complete the CM treatment.

3.2 Demographic and Alcohol Use Characteristics

Demographic characteristics are reported separately by the four QI cycles in Table 2. Across each of the four cohorts, the majority of participants were Hispanic men, with low income and uninsured for healthcare. There were no significant differences between the cohorts in terms of age, sex, ethnicity, education, health insurance coverage, poverty status, or court appointed attorney (all p > 0.05). There were no significant differences between the cohorts in terms of pre-intervention patterns of alcohol consumption (Table 3). The cohorts generally scored in the risky range on the AUDIT, reported driving more than twice after consuming three or more drinks in the month prior to arrest, spending > $2,000/year on alcohol, anticipated the cost of their DWI to be > $7,000, had not previously been treated for alcohol misuse, and had heavy alcohol use in the month prior to DWI arrest. Although not all participants were recidivists, the median number of DWI arrests was 2 in each cohort.

4. Discussion

This project describes four QI cycles aimed at adapting TAC-informed CM for minimizing alcohol use and maximizing treatment completion among adults arrested for DWI who are awaiting trial. Under the different CM conditions, the proportion of participants retained for the full 8-weeks of treatment was highest by the final QI cycles. Participants who dropped out, tended to do so during the first half of treatment. The overall proportion of weeks with- and without-alcohol use increased under that later QI cycle conditions (due to fewer dropouts), but these effects did not reach statistical significance. Lower TAC values were observed under Cycles 1 and 4 conditions than Cycle 3 CM conditions. There were no systematic differences between the four cohorts in term of their demographic and alcohol use characteristics prior to treatment.

4.1 The Quality Improvement Process

4.1.1 Cycle 1—The first cycle was administered using a zero-tolerance strategy, where any TAC value > 0.00 was interpreted as a drinking event and the contingency payment for that week was forfeited. While this approach was planned with a strong emphasis on the amount of drinking, the salient outcome of this cycle was an undesirably high proportion of weeks with treatment dropout. Inspection of the TAC values revealed that a substantial proportion (about 40%) of these drinking events were less than the .02 g/dl TAC used by AMS for evidentiary purposes and anecdotally many of the participants protested that drinking did not occur. While concluding with this PDSA cycle, literature emerged cautioning against unreliability of interpreting TAC < 0.02 (Roache et al., 2015). In an effort to increase treatment retention across the 8-weeks of CM, the next cycle was planned to increase the TAC cut-off of above 0.02 g/dl for withholding contingency payment. While this criterion represents a lower bar for alcohol event detection than the AMS criteria (which requires 3 or more values above the .02 threshold), it is consistent with what has been used to detect drinking events in previous CM studies (e.g., Barnett et al., 2011) and alcohol administration studies demonstrate this criterion reliably detects consuming 3 or more alcohol drinks (Marques & McKnight, 2007; Roache et al., 2015).

4.1.2 Cycle 2—Following evaluation of Cycle 1 outcomes, changes were made in Cycle 2 to increase the criterion for withholding the contingent payment to TAC ≥ .02 g/dl and this level was used for the remaining QI cycles. Despite increasing to a higher TAC cut-off, outcomes observed were relatively unchanged from Cycle 1. Discussion continued to focus on the high proportion of treatment dropout and as a result a second payment manipulation was planned, to deliver an incentive payment for wearing the monitor in Cycle 3. Our previous research successfully included this approach to compensate participants for the burden of wearing the device (Dougherty et al., 2014; 2015a; 2015b).

4.1.3 Cycle 3—Under conditions including incentive payments for both maintaining TAC below .02 g/dl and for wearing the monitor there was a significant reduction in treatment dropout observed in Cycle 3 (relative to Cycles 1 & 2), a significant increase in the average maximal TAC values (relative to Cycle 1), and a non-significant increase in the proportion of weeks Non-Drinking. While encouraged by the reduction in Dropout, in evaluating Cycle 3 outcomes concerns were raised over two instances of tampering with the transdermal alcohol monitor. In both cases the tamper was detected concurrent with a drinking event (i.e., observed both TAC > .02 and AMS confirmed tamper event based on infrared and temperature readings). This lead to a retrospective review of previous cycles where we noted four additional AMS confirmed tamper events across the cycles. The analysis discussion raised the question if participants could receive their incentive payment by obscuring alcohol use through tampering. Out of this concern, Cycle 4 was planned to include altering instructions and including tampering as criterion for withholding incentive payment.

4.1.4 Cycle 4—During the final cycle, Dropout remained significantly below Cycles 1 & 2, average TAC values were significantly less than Cycle 3, there was a non-significant decline in the proportion of non-drinking weeks, and incentive payment was withheld on 3 occasions for tampering. Having explored several parameters of TAC cut-off, participant instruction, and incentive payment parameters, weeks with detected alcohol use was resistant to change, while Dropout and TAC values significantly varied under the different CM conditions. The purpose of this project was the use of a quality improvement methodology as a mechanism to adapt CM procedures for minimizing alcohol use and maximizing treatment retention among those recently arrested for DWI offenses. After 4 QI cycles, ideal outcomes were not achieved and there remains room for reducing alcohol use and increasing in treatment retention across the 8-weeks intervention. While we continue to develop a procedure for maximizing outcomes, desire for achieving ideal outcomes are balanced against need to use incentive values of a magnitude feasibly implementable within this context.

4.2 Pretrial Context

The pretrial context offers opportunities to overcome barriers typically faced in implementing CM procedures. Fundamental challenges to implementing CM for substance abuse are: the negative perception of paying someone for avoiding unhealthy behavior; dispersion of responsibility if the patient is not in a closed system of care; and lack of resources available to incentivize behavioral change (Gupta, 2015). Pretrial supervision offers the advantage of being a context where transdermal alcohol monitors are widely used, it is a closed system solely responsible for managing offender behavior (within the bond stipulations), and it is inherently a contingent-rich environment. Typically, TAC violations are used to return someone to jail as a punitive last resort. However, pretrial supervision has a host of other contingencies at their disposal, including: monetary incentives (levy or forgiveness of fines) and time incentives (e.g., frequency of required visits to the pretrial office; participation alcohol education classes, community service), which could be used for recurring non-compliance including TAC violations. We seek to evaluate the utility of CM using manipulation of incentives that can be contingent when a positive change in behavior is witnessed or at the first sign of a TAC violation. Ongoing efforts are underway to develop algorithms for CM of transdermal detection of drinking in the pretrial context, which have the potential to improve drinking outcomes for those with recent DWI arrests.

Even in the absence of ideal outcomes, the CM procedure can be developed as an effective tool to improve pretrial supervision of DWI offenders. Beyond the response rate to CM directly, another benefit of this approach is it is a relatively quick method to identify those who are unable to limit alcohol use in the context of contingencies. In this way CM can be used to inform a stepped-care approach to alcohol treatment. Stepped-care has been described as a useful heuristic approach for making decisions about treatment, where the intensity and dose of treatment delivered is based on the individual need (Sobell & Sobell, 2000). Delivery of alcohol interventions soon after DWI arrest is suggested to increase the likelihood of favorable response (Lapham, 2004); staging CM at the beginning of the pretrial process to detect early alcohol violations is a rapid method for identifying those requiring a greater level of intervention to reduce their alcohol use. The relatively limited resources for treatment services (e.g., psychological treatment) or enhanced judicial services (specialty DWI court) can then be reserved for those cases who are unsuccessful in CM.

4.3 Limitations

As with any attempt to use data to inform practice, this project is not without its limitations. First, the transdermal alcohol monitor used in this project has a lower limit of detection; the SCRAM reliably detects the consumption of 5 beers, but 45.9% of all occasions of drinking 1–3 beers were undetected using TAC > 0.02 (Roache et al., 2015). Second, outcomes were only based on objective criteria based on TAC readings, while qualitative interview would have add breadth to the quality improvement process (Moran et al., 2012). Finally, lacks rigor, control and precision that would be gained in a randomized controlled trial. As a result generalizable inferences about the effectiveness of CM for alcohol in DWI cannot be drawn. However, the PDSA cycle approach is consistent with current methodology for improving health intervention best practice and was selected for adapting the CM procedure for those with DWI rather than systematic research which would be too slow, expensive, and elaborate for rapid cycle change (Solberg et al., 1997). Using the PDSA process is a method to achieve improvement in outcomes, within its constraints it is what is feasibly delivered in this treatment context, and establishes baseline rates of response that can be used to inform design of randomized controlled trials for testing effectiveness of transdermal-informed contingency management for reducing alcohol use for DWI offenders.

4.4 Conclusions

In this quality improvement project, we collected and analyzed data for a CM intervention across four distinct quality improvement cycles. Outcomes from this project extend previous literature focusing on TAC-informed CM for heavy drinkers recruited from the community by documenting rates of alcohol use and dropout for a pretrial DWI offender population and under four different CM conditions. This data may help inform future efficacy studies of CM for alcohol use among DWI offenders. CM is a promising intervention for reducing alcohol use. This procedure can be informed through the use of transdermal alcohol monitors, which are widely used in the criminal justice system, especially in the pretrial supervision period. The current program is aimed at adapting CM procedures for adults arrested for DWI who are awaiting trial. Ongoing refinement of procedures are underway toward implementation of a CM program in pretrial services with those mandated to wear transdermal alcohol monitors. Our ultimate goal is development of algorithms for TAC-informed CM that can be scaled across pretrial jurisdictions and downstream result in reduction in the high recidivism of DWI.

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Highlights

- Describes four Plan-Do-Study-Act (PDSA) cycles of quality improvement.
- Adapting transdermal alcohol concentration monitoring for contingency management.
- Treatment retention was greatest under final round of contingency management conditions.
- The proportion of weeks with alcohol use remained stable across the four PDSA cycles.

Cycle 1 Quality Improvement								
	Contingency Management Week							
Sequence	1	2	3	4	5	6	7	8
1		.008		.014				
2	.034							
3								.017
4	.010	.027						
5	.027	.017	.025t					
6								
7			.012		.013			
8			.013		.015			.020
9			.030		.030	.142	.132	
10		.025	.014		.016	.041	.197	.060
11						.020		
12							.012	
13	.021	.012	.041	t				
14		.019						
15				.033				
16		.022	.022		.029	.012	.079	.025
17					.020			
18			.016					

19				.108			.013	.053
20								
21			.040					
22								

Escalating contingency $20+$10/consecutive weeks with low TAC

TAC cut-off > 0.00 g/dl

t – tamper confirmed by Alcohol Monitoring Systems, Inc.

Drop out

Contingency payment earned. No TAC > 0.00 g/dl

Contingency payment withheld. Numbers within cells reflect the maximum TAC value recorded during that week.

Cycle 2 Quality Improvement								
	Contingency Management Week							
Sequence	1	2	3	4	5	6	7	8
23					.026			
24	.062							
25				.028			.030	.065
26								
27						.027		
28	.021							
29	.035	.045	.206	.046	.122	.048	.068	.312
30	.157	.128						
31								
32							.028	.021
33	.041	.269t	.154t	.238	.312	.066	.148	.261
34								
35								
36	.048		.078		.038			
37	.104					.032		
38								
39	.091							
40		.034	.028					

41								
42			.040	.047			.038	

Fixed contingency $50/ week low TAC

TAC cut-off ≥ .02

t – tamper confirmed by Alcohol Monitoring Systems, Inc.

Drop out

Contingency payment earned. No TAC ≥ 0.020 g/dl

Contingency payment withheld. Numbers within cells reflect the maximum TAC value recorded during that week.

Cycle 3 Quality Improvement								
	Contingency Management Week							
Sequence	1	2	3	4	5	6	7	8
43			.035					
44		.032		.045				
45								
46							.025	
47	.021					t		
48			.064				.028	
49	.437	.348	.290	.259	.102	.350	.267	.279
50	.026							
51	.044	.032	.151	.264		.064	.184	.277t
52					.029			
53								
54					.042	.040	.031	
55								
56	.041							
57			.028					
58								
59		.038				.050	.043	

60	.022			.182	.044	.135	.228t	

Fixed contingency $50/week low TAC

+ $70/week wearing monitor.

TAC cut-off ≥ .02

t – tamper confirmed by Alcohol Monitoring Systems, Inc.

Drop out

Contingency payment earned. No TAC ≥ 0.020 g/dl

Contingency payment withheld. Numbers within cells reflect

the maximum TAC value recorded during that week.

Cycle 4 Quality Improvement								
	Contingency Management Week							
Sequence	1	2	3	4	5	6	7	8
61								
62		t				.072		
63	.047	.032	.044	.052	.107	.038		
64	.114	.065		.058	.268	.159	.031	.071
65		.021					.021	
66								
67							.029	.037
68								
69	.028	.054	.029	.238		.032	.097	.047
70								
71		t		.027				
72	.022		.036			.050	.028	.024
73	.078	.046	.046	.025			.084	
74	.047	.056	.030	.082	.032	.026		.032
75			.022					
76	t			.043				
77		.039						
78								

79	.023	.025					.044	
80	.047						.038	
81								
82				.055			.034	.048
83	.085							
84		.050						
85		.033						
86		.153		.025	.034			.066

Fixed contingency $50/week low TAC and no tamper.

+ $70/week wearing monitor.

TAC cut-off ≥ .02

t – tamper confirmed by Alcohol Monitoring Systems, Inc.

Drop out

Contingency payment earned. No TAC ≥ 0.020 g/dl

Contingency payment withheld. Numbers within cells reflect the maximum TAC value recorded during that week.

Figure 1.

a. Quality Improvement Cycle 1 for Developing Transdermal-Informed Contingency Management

b. Quality Improvement Cycle 2 for Developing Transdermal-Informed Contingency Management

c. Quality Improvement Cycle 3 for Developing Transdermal-Informed Contingency Management

d. Quality Improvement Cycle 4 for Developing Transdermal-Informed Contingency Management

Table 1

Outcomes of Four Quality Improvement Cycles by Week of Treatment.

Outcome	Cycle 1 *n* = 22 176 weeks	Cycle 2 *n* = 20 160 weeks	Cycle 3 *n* = 18 144 weeks	Cycle 4 *n* = 26 208 weeks	*p*	*Cycle Comparison*
Non-Drinking	52%	53%	60%	56%	.879	--
Alcohol Use	25%	24%	25%	29%	.833	--
Dropout	23%	23%	15%	13%	.006	1,2>3,4
Tamper	--	--	--	1%	--	--
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)		
Average Max TAC *	.050 (.045)	.093 (086)	.124 (.125)	.063 (.055)	.001	3>1,4
	Median	Median	Median	Median		
Days between arrest and SBIRT	19	14	14.5	17	.204	--
Days between SBIRT and CM	1	7	8	23	<.001	1,2<4

* Max TAC scores for Cycle 1 were post-hoc constrained to same cut-off as Cycles 2–4 (include only TAC≥.02) for this analysis.

The primary unit of measure for outcomes was the proportion of weeks for each outcome divided by the number of weeks within that cycle. Alcohol Use – proportion of weeks TAC greater than the cycle cut-off target; CM – contingency management; Dropout – proportion of weeks discontinued participation; Non-Drinking – proportion of weeks TAC zero or less than the cycle cut-off target; SBIRT – alcohol screening, brief intervention, and referral to treatment; Tamper – proportion of weeks AMS confirmed tamper event.

Table 2

Demographic Characteristics of Participants in Four Quality Improvement Cycles.

Demographic Characteristics	Cycle 1 *n* = 22 *M* (*SD*)	Cycle 2 *n* = 20 *M* (*SD*)	Cycle 3 *n* = 18 *M* (*SD*)	Cycle 4 *n* = 26 *M* (*SD*)
Age, years	38.5 (12.0)	37.3 (12.1)	39.3 (12.3)	42.6 (23.7)
	% (*n*)	% (*n*)	% (*n*)	% (*n*)
Male	91 (20)	80 (16)	94 (17)	88 (20)
Race/Ethnicity				
Hispanic	86 (19)	85 (17)	94 (17)	76 (20)
White	14 (3)	5 (1)	0 (0)	8 (2)
Black	0 (0)	0 (0)	0 (0)	8 (2)
More than 1 race	0 (0)	10 (2)	6 (1)	8 (2)
Education				
Less than HS	36 (8)	10 (2)	28 (5)	27 (7)
HS diploma/GED	9 (2)	40 (8)	34 (6)	35 (9)
Some College	46 (10)	35 (7)	28 (5)	35 (9)
College degree	9 (2)	10 (2)	5 (1)	3 (1)
>Undergraduate	0 (0)	5 (1)	5 (1)	0 (0)
Uninsured, health	45 (10)	60 (12)	61 (11)	62 (16)
<200% poverty	86 (19)	100 (20)	78 (14)	81 (21)
Court appointed lawyer	54 (12)	55 (11)	67 (12)	50 (13)

<200% poverty – earning less than 200% of the Federal Poverty Level, adjusted for number of people in the household; Court appointed lawyer – self-reported representation in pending DWI will be public defender;

HS – high school; Uninsured, health – self-reported absence of health insurance.

Table 3

Alcohol Characteristics of Participants in Four Quality Improvement Cycles.

Alcohol Characteristics	**Cycle 1** ***n* = 22** ***M* (*SD*)**	**Cycle 2** ***n* = 20** ***M* (*SD*)**	**Cycle 3** ***n* = 18** ***M* (*SD*)**	**Cycle 4** ***n* = 26** ***M* (*SD*)**
AUDIT Score	12.7 (9.5)	14.8 (8.8)	15.2 (9.4)	13.8 (7.4)
Driving after 3+ drinks	1.5 (1.6)	2.6 (3.6)	3.7 (5.2)	3.2 (3.8)
Alcohol spending	$1,423 (950)	$3,120 (2,700)	$2,620 (2,487)	$2,070 (2,348)
DWI Cost	$6,322 (5,131)	$6,647 (4,520)	$7,361 (4,422)	$8,677 (5,579)
Drinks per month[a]	66.7 (100.2)	56.1 (49.4)	90.4 (101.1)	68.0 (73.2)
Drinking days[a]	9.3 (9.9)	8.5 (7.1)	11.5 (10.9)	8.0 (8.5)
Heavy drinking days[a]	5.6 (9.9)	5.6 (6.9)	8.8 (9.3)	6.3 (9.0)
	% (*n*)	% (*n*)	% (*n*)	% (*n*)
Past alcohol treatment	50 (11)	30 (6)	44 (8)	46 (12)

[a]= Timeline follow back self-report of alcohol use for the month prior to DWI arrest.

Alcohol spending – estimated annual alcohol expenditures based on self-reported weekly expenditures on alcohol; Driving after 3+ drinks – self-reported number of times driving after ≥3 drinks in the month prior to arrest; DWI cost – self-report estimate of total cost of the pending DWI charge by after final adjudication; Heavy drinking days – number of days with self-reported alcohol consumption of 5 or more drinks during the month prior to arrest.