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IDENTIFYING PREDICTORS OF SUBSTANCE USE AND RECIDIVISM OUTCOME TRAJECTORIES AMONG DRUG TREATMENT COURT CLIENTS

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Drug treatment court (DTC) is a diversion program for individuals with drug-related crimes. However, the DTC literature is conflicting with regard to substance use and recidivism outcomes. This study examines factors associated with improved client outcome trajectories among a multisite, national DTC sample. We conducted a secondary analysis of 2,295 participants using the Global Appraisal of Individual Needs assessment tool. Participants in community-based treatment comprised a nonequivalent comparison group. Zero-inflated Poisson (ZIP) regression examined client sociodemographics in relation to substance use and rearrest at 6-month follow-up. Employed DTC clients were more likely to abstain from substances, but among all study participants, higher baseline use, male gender, and employment predicted substance use. Similarly, among DTC clients, older age and employment predicted no rearrests, but among all study participants, older and employed individuals had worse arrest outcome trajectories. Future work is needed to better understand how client characteristics may inform individualized treatment approaches.

Keywords: drug treatment court; drug court; recidivism; substance use; client characteristics; adaptive programming; Global Appraisal of Individual Needs

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INTRODUCTION

SUBSTANCE USE IN THE UNITED STATES AND DRUG TREATMENT COURT (DTC)

A significant proportion of individuals living in the United States use psychoactive drugs, especially those involved with the justice system (Chandler, Fletcher, & Volkow, 2009). Specifically, the National Survey on Drug Use and Health (NSDUH) found that approximately 24 million Americans used psychoactive drugs in 2013 (Substance Abuse and Mental Health Services Administration [SAMHSA], 2014). Furthermore, of the 22 million individuals who meet substance use disorder (SUD) diagnostic criteria, only 3 million (14%) received adequate treatment (SAMHSA, 2014). These figures are worse when examining individuals with justice-system involvement. Sixty-five percent of individuals incarcerated in state and federal prisons, 34% of people on parole, and 37% of people on probation meet diagnostic criteria for SUD, compared with 8% of the general population (SAMHSA, 2014). These data support the use of court-based interventions that incorporate SUD treatment into legal proceedings to increase public safety, while decreasing incarceration rates (Fulkerson, Keena, & O'Brien, 2013).

Miami-Dade County established a DTC in 1989, the first therapeutic diversion program for individuals with nonviolent drug-related crimes (Goldkamp & Weiland, 1993). While DTCs vary by geographic region and population, most programs collaborate with community SUD treatment centers, legal professionals, and corrections staff to provide services, including drug testing, case management, hearings with the DTC judge to assess progress, and recovery support (Messer, Patten, & Candela, 2016; Mitchell, Wilson, Eggers, & MacKenzie, 2012). DTC judges use "legal leverage" and therapeutic jurisprudence to replace incarceration with individualized treatment plans and legal contingencies in consultation with community treatment providers (Dentzer, 2007; Fisher, 2014; Lamberti et al., 2014; Winick, 1997). The intensity of DTC-mandated treatment, rewards, and sanctions are tailored to each participant's individual needs and progress (Messer et al., 2016). One concern that has arisen, however, is the variability in the application of these guidelines, which is, in turn, associated with variability in DTC outcomes (Shaffer, 2011).

SUBSTANCE USE AND RECIDIVISM OUTCOMES AMONG DTC CLIENTS

The primary focus of research relating to DTCs has been to address client outcomes following program completion. Generally, individuals who successfully complete DTC are less likely to use illegal substances, engage in criminal behavior, and require assistance obtaining education or employment (Marchand, Waller, & Carey, 2006; Rossman, Roman, Zweig, Rempel, & Lindquist, 2011); however, success rates can vary widely from 10% to 90%, with an average DTC completion rate of 48% (Shaffer, 2011). Systematic reviews of over 130 drug court programs have demonstrated greater reductions in recidivism rates among justice-involved individuals with drug offenses who successfully completed DTC compared with those who failed to complete the program (Shaffer, 2011; Wilson, Mitchell, & MacKenzie, 2006).

Despite reported reductions in recidivism, there has been little examination of decreases in drug use following program completion and even fewer studies that identify individual-level factors affecting long-term drug use. One study found that overall drug use, marijuana use, alcohol use, and prescription drug misuse were 20%, 13%, 20%, and 9% lower, respectively, among DTC clients compared with non-DTC clients at the completion of the study

(Rossman et al., 2011). Moreover, clients who were younger, Black, and male had worse drug use outcomes (Rossman et al., 2011). The dearth of research surrounding this important outcome impedes the ability of DTCs to evaluate the effectiveness of treatment programs partnering with courts and inhibits potential improvements to DTC programs, such as gender and culturally informed SUD treatment strategies (Morse et al., 2014; Taxman, Pattavina, & Caudy, 2014).

While DTC studies demonstrating decreased drug use and rearrest are promising, they have limitations: (a) Many are relatively outdated, (b) some fail to adequately control for varying participant sociodemographic characteristics, and (c) most neglect to ascertain mediating factors for decreases in drug use and rearrest following DTC completion. For these reasons, we aim to better characterize covariates associated with reductions in drug use and recidivism using a large, multisite sample of DTC and community-based clients.

FACTORS AFFECTING DTC CLIENT OUTCOMES

Five DTC client sociodemographic variables of particular interest for the current study include age, race and ethnicity, gender, education, and employment:

Age

Most studies show a positive correlation between older age and successful DTC completion among adults, with younger DTC clients more likely to drop out (Gallagher, Ivory, Carlton, & Miller, 2014; Jewell, Rose, Bush, & Bartz, 2016; Shannon, Jackson, Newell, Perkins, & Neal, 2015). However, some studies (DeMatteo, Marlowe, Festinger, & Arabia, 2009; Gray & Saum, 2005) did not observe a significant relationship between age and DTC success, and others (Senjo & Leip, 2001) actually found increased age hindered DTC progress (Hickert, Boyle, & Tollefson, 2009). Perhaps for these individuals, familial (e.g., women with children) or other age-related commitments may preclude them from fully engaging in the DTC process or receiving appropriate program-based social supports (Fischer, Geiger, & Hughes, 2007; Hickert et al., 2009). When examining substance use and recidivism outcomes among DTC clients, older age correlates with greater reductions in drug use and likelihood of rearrest (Rossman et al., 2011). These mixed findings warrant additional research to both clarify the role of age in predicting DTC success and inform strategies to maximize age-specific DTC programming.

Race and Ethnicity

Numerous DTC studies document that White participants are more likely to complete DTC compared with both Black and Hispanic participants (Hepburn & Harvey, 2007; Rossman et al., 2011; Shannon et al., 2015). In addition, Brown (2010) found DTC clients of color adhered less frequently to SUD treatment, while Rossman and colleagues (2011) observed greater reductions in drug use for White DTC clients at 18-month follow-up. However, some of these differences may be attributable to nonrepresentative study samples and confounding individual-level variables (Hickert et al., 2009; Howard, 2016). For instance, in one study, when controlling for factors such as employment and education, race did not predict DTC completion (Evans, Li, & Hser, 2009). The current study aims to lend clarity to the relationship between race/ethnicity and DTC outcomes by analyzing more recent data and assessing how race moderates substance use and rearrest outcome trajectories.

Gender

The role of gender in moderating DTC outcomes is unclear, as studies have examined other sociodemographic characteristics in relation to DTC outcomes without stratifying results by gender (Gallagher, 2014; Schnittker, Massoglia, & Uggen, 2012). Of the few studies that have systematically explored gender, some indicate that women in DTC have a lower likelihood of rearrest and program dropout compared with men (Gray & Saum, 2005; Rossman et al., 2011), while others have not found a significant association between gender and DTC completion (Evans et al., 2009; Hickert et al., 2009).

Because women DTC clients have different treatment needs (Binswanger et al., 2010; Greenfield, Back, Lawson, & Brady, 2010) and women with trauma histories are less likely to graduate from DTC (Hickert et al., 2009; Richman, Moore, Barrett, & Young, 2014), a few studies have considered whether gender-specific strategies could enhance DTC client outcomes. Fischer et al. (2007) noted that gender-specific “wrap-around” services such as child care, women’s health care, domestic violence advocacy, and employment assistance can improve DTC and substance use outcomes. Moreover, Messina and colleagues (Messina, Calhoun, & Warda, 2012; Messina, Grella, Cartier, & Torres, 2010) found women benefited from gender-responsive treatment components that are oriented toward their specific needs. While women tend to benefit from gender-specific DTC programming, there is significant variability among different gender-specific programs (Tang, Claus, Orwin, Kissin, & Arieira, 2012). In light of these findings, we seek to examine whether there is a significant moderation effect for gender in relation to substance use and recidivism.

Education

The relationship between education and DTC outcomes has not been fully elucidated in the literature. A small number of studies reveal that individuals in DTC with more education have increased likelihoods of successful DTC or SUD treatment completion (Brown, 2010; Gallagher et al., 2015; Shannon et al., 2015). Specifically, one study demonstrated that for every year of education, DTC clients had a 15% improved odds of graduating from the program (Hickert et al., 2009). Conversely, other studies have not discovered a link between education and DTC outcomes (Rossman et al., 2011). Many argue that, similar to race and ethnicity, socioeconomic indicators mediate the relationship between education and DTC outcomes as opposed to a direct correlation between the two variables (Howard, 2016). By including education in our study, we aim to assess the nature and extent of its impact upon substance use and rearrest outcome trajectories.

Employment

In most studies, employment is associated with enhanced graduation and SUD treatment retention rates for both DTC and community participants (Brown, 2010; Gallagher et al., 2015; Shannon et al., 2015). Employment interventions tailored specifically for DTC clients have demonstrated considerable success in increasing participants’ legal income and decreasing illegal income streams (e.g., via drug-related crimes; Leukefeld, Webster, Staton-Tindall, & Duvall, 2007). However, other studies have not found employment status to be a significant predictor of graduation, substance use, or recidivism outcomes (Hickert et al., 2009; Rossman et al., 2011). This trend may be due to other confounding factors, selection bias, or inadequate variance among study cohorts (Brown, 2010). The lack of

clarity associated with these studies underscores the need to reexamine the relationship between employment and client outcomes.

STUDY AIMS

The variations in DTC services, components, and client success mandate a better understanding of client characteristics that may longitudinally influence substance use and rearrest outcome trajectories (Marlowe, Festinger, Lee, Dugosh, & Benasutti, 2006; Merrall & Bird, 2009). Through a secondary analysis of a large sample spanning 23 sites in 12 states, the present study seeks to assess the ability of intrinsic factors including age, race and ethnicity, and gender along with extrinsic factors—namely, education and employment—to predict substance use and recidivism outcome trajectories of DTC clients relative to a non-equivalent comparison group comprised of individuals in community-based treatment (CBT) programs at 6-month follow-up.

METHOD

DATA SOURCE

We conducted a secondary analysis of a dataset from a multisite study that utilized the Global Appraisal of Individual Needs (GAIN) biopsychosocial outcome assessment tool (Ives, Funk, et al., 2010). This research team previously conducted an analysis of the present study's dataset (manuscript under review), with relevant details summarized below. GAIN is a standardized set of measures that examine DTC and community SUD treatment outcomes; it has been studied in over 400 published journal articles, book chapters, and research reports (Dennis, Chan, & Funk, 2006; Ives, Chan, et al., 2010). The current study's data are derived from the 2012 GAIN Summary Analytic Dataset, which was compiled by applied behavioral researchers at Chestnut Health Systems, Inc. (<http://chestnut.org>), and longitudinally measured a broad array of self-reported DTC and CBT outcomes; however, the current analysis solely examines substance use and recidivism outcome trajectories. Between 2008 and 2010, the SAMHSA's Center for Substance Abuse Treatment (CSAT) funded 81 adult DTC/CBT sites under its TI-08-007/TI-09-003/TI-10-011 grant programs, 12 of which chose the GAIN for standardized assessment at DTC programs (Clearwater, FL; Jacksonville, FL; Gallipolis, OH; Memphis, TN; Miami, FL; Reno, NV; Tampa, FL; Cleveland, OH; East Lansing, MI; Galena, MO; San Diego, CA; and New Port Richey, FL). The 11 CBT sites included Laredo, TX (two separate sites); Nashville, TN; San Antonio, TX; Lynchburg, VA (two separate sites); Bridgeport, CT; The Dalles, OR; Houston, TX; St. Petersburg, FL; and Tucson, AZ.

Figure 1 depicts the study's design and selection of participants comprising the final analytic sample. Data from these sites were collected from adults at intake and at 3, 6, and 12 months postintake (9-month follow-up was optional) during clinical visits or research studies. Each site's respective institutional review board provided approval for the studies, and informed consent was administered prior to data collection via self-reported surveys. Data were subsequently de-identified and provided by the Chestnut Health Systems' Institutional Review Board for research purposes. The University of Rochester's Institutional Review Board approved the current study.

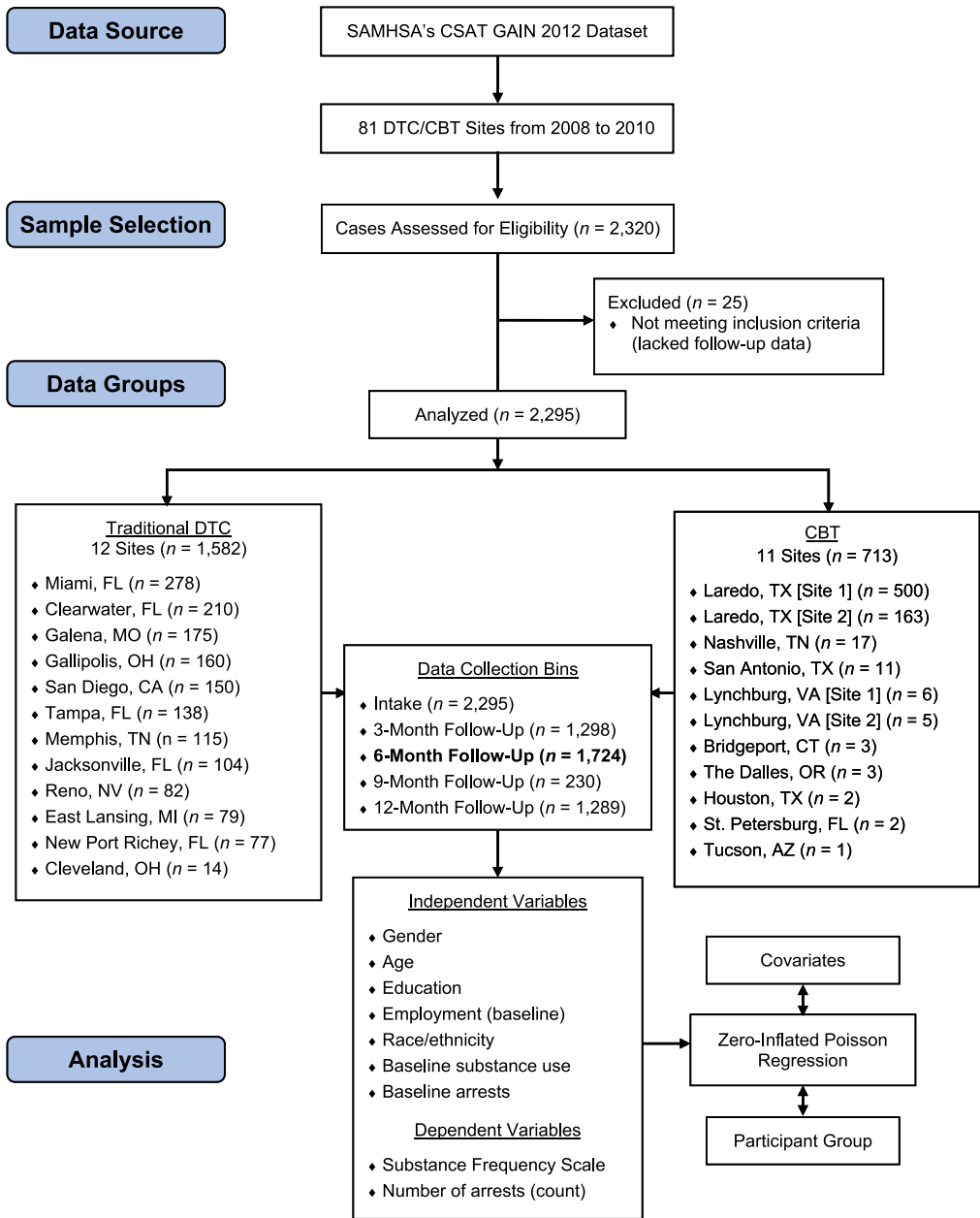


Figure 1: Study Design and Selection of Participants (n = 2,295) Comprising the Final Analytic Sample
Note. See text for additional details. SAMHSA = Substance Abuse and Mental Health Services Administration; CSAT = Center for Substance Abuse Treatment; GAIN = Global Appraisal of Individual Needs; DTC = drug treatment court; CBT = community-based treatment.

SAMPLE

Of the 2,320 DTC/CBT participants aged 18 or older in the dataset, 2,295 (98.9%) had the requisite data (i.e., sociodemographic information with substance use and rearrest outcomes) and were selected for analyses in the present study (see Figure 1). Of the 2,295

TABLE 1: Study Sample Sociodemographics (N = 2,295)

	Participant group		<i>p</i>
	DTC (<i>n</i> = 1,582)	CBT (<i>n</i> = 713)	
Chi-square results	<i>n</i> (%)	<i>n</i> (%)	
Gender			<.001
Female	916 (57.9)	159 (22.3)	
Male	666 (42.1)	554 (77.7)	
Race			<.001
White, non-Hispanic	971 (61.4)	47 (6.6)	
Black, non-Hispanic	208 (13.2)	9 (1.3)	
Other, non-Hispanic	94 (5.9)	4 (0.6)	
Mixed, non-Hispanic	157 (9.9)	29 (4.1)	
Hispanic	152 (9.6)	624 (87.5)	
Employment	703 (44.6)	424 (59.6)	<.001
<i>t</i> -test results	<i>M</i> ± <i>SD</i>	<i>M</i> ± <i>SD</i>	<i>p</i>
Age	31.5 ± 10.6	29.7 ± 10.0	.043
Education (years)	12.0 ± 1.7	10.9 ± 2.2	<.001
Baseline drug use (days)	15.1 ± 16.2	18.3 ± 18.0	.001
Baseline arrests (total)	0.54 ± 1.0	0.2 ± 0.5	<.001

Note. Bold formatting indicates values statistically significant at $p < .05$. DTC = drug treatment court; CBT = community-based treatment.

participants included in the study, 1,582 were DTC clients and 713 were enrolled in CBT programs for SUD treatment. Response rates at 3-, 6-, 9-, and 12-month follow-up for DTC participants were 79.7%, 70.0%, 14.3%, and 47.0%, respectively; for CBT participants, response rates were 5.2%, 86.4%, 0.6%, and 76.6%, respectively. Because the composite response rate for 6-month follow-up was the highest between both groups (i.e., currently enrolled DTC participants and CBT participants; $n = 1,724$, 75.1%), we chose to analyze data from this timepoint. While women and Hispanic clients were oversampled in the original dataset, we proceeded with analysis because both groups are considered understudied populations. Sociodemographic data are presented in Table 1.

MEASURES

Self-report and interview-based measures were administered under each treatment site's specific voluntary consent procedures and have been implemented in both research and clinical settings (Dennis, Titus, White, Unsicker, & Hodgkins, 2003; Ives, Funk, et al., 2010). The GAIN measures are a component of the National Institutes of Health data harmonization strategy, in this study measuring DTC and community SUD treatment outcomes (Garner, Belur, & Dennis, 2013). The GAIN utilizes validated self-report measures, including measures for the American Society of Addiction Medicine's (ASAM; Gastfriend, 2004) criteria for SUD and epidemiological questions from the National Household Survey on Drug Abuse (NHSDA; SAMHSA, 2014, now NSDUH). Its main scales have exhibited good internal consistency (with α s typically greater than .90 on main scales and .70 on subscales) and good test-retest reliability (ρ hs greater than .70 on days/problem counts and kappas greater than 0.60 on categorical measures; Dennis et al., 2006; Garner, Godley,

Passetti, Funk, & White, 2014). Versions of the GAIN instruments and further information regarding validity and variables are publicly available at www.chestnut.org/li/gain. All sites received standardized training and exhibited proficiency in GAIN data collection to permit data harmonization with other grantees collecting GAIN data (Ives, Funk, et al., 2010).

INDEPENDENT AND OUTCOME VARIABLES

We explored a variety of sociodemographic variables at intake from the 2012 GAIN Summary Analytic Dataset for the bivariate and Poisson regression analyses. We selected gender (binary), race/ethnicity (categorical), baseline employment (binary), age (continuous), years of education (continuous), and baseline substance use and total arrests (both continuous) as variables of interest based on the literature and in accordance with parsimonious analytic techniques. The initial variable for race included five groups: non-Hispanic White, non-Hispanic Black, non-Hispanic Mixed, non-Hispanic Other, and Hispanic; however, some of these groups had very small membership and were consequently consolidated for the bivariate analyses and zero-inflated Poisson (ZIP) regression as detailed below. For years of education, high school diploma/general equivalency diploma was equilibrated to 12 years. Substance use and total arrests within the past 90 days at 6-month follow-up served as our two primary outcome measures.

Substance Use

The Substance Frequency Scale ($\alpha = .82$) assesses frequency of use and associated problems related to the average percentage of days (of the past 90 days) of any alcohol or other drug use; the scale includes 14 categories of substances, such as alcohol, marijuana, crack/cocaine, heroin/opioids, nonprescription medications, methamphetamines, and other drugs. Three additional scale questions inquire about abstinence, intoxication, and impact of drug use on personal responsibilities. Scores are calculated by averaging the percentage of days (within the past 90 days) with self-reported drug use for each of the 14 categories. Higher scores (i.e., greater than 0.14, or 14% of days with substance use) represent increased frequencies of substance use (by days of use, days staying high most of the day, and days causing related problems), as well as associated problems and difficulty stopping without significant assistance and/or a controlled environment (Dennis et al., 2006).

Arrests

We chose the total number of arrests in the past 90 days to measure recidivism outcome trajectories. This included arrests reported by participating DTCs in each locale. Outcomes were measured at intake and at 3-, 6-, 9-, and 12-month follow-up appointments. However, while we have longitudinal data on substance use and total arrests for the past 90 days after 3- through 12-month follow-ups for both DTC and CBT participants, we have the most complete data ($n = 1,724$) for both programs at baseline and at 6-month follow-up as previously stated.

STATISTICAL METHODS

The research team conducted bivariate analyses to explore associations among variables of interest. We performed chi-square tests and *t* tests for the categorical and continuous

sociodemographic characteristics, respectively, to assess their association with substance use and recidivism outcome trajectories. While the five initial race groups (non-Hispanic White, non-Hispanic Black, non-Hispanic Mixed, non-Hispanic Other, and Hispanic) are listed in Table 1, they were consolidated to non-Hispanic White and non-Hispanic Black/Other due to the distribution of race within the CBT group. Moreover, interactions between participant groups (DTC vs. CBT) and the independent variables mentioned above are explored in relation to outcomes of interest.

ZIP REGRESSION MODEL

We sought to investigate whether DTC clients have better substance use and rearrest outcome trajectories compared with individuals enrolled in CBT programs, and whether baseline drug use, gender, age, education, employment, or race/ethnicity have effects on the outcomes based on the participant group (i.e., DTC or CBT). To do so, DTC status (vs. CBT status) was used as a moderator in a ZIP regression model to determine the extent of interaction effects of DTC status on all independent covariates. In the presence of an excess of zero-valued observations in the outcomes, the ZIP regression allows one to investigate the source of contribution to the zero values separately from the nonzero outcomes. Because there was evidence of structural zeros in the 2012 GAIN Summary Analytic Dataset for both substance use and rearrests, we constructed a ZIP model to fit the data, instead of the traditional Poisson model. The ZIP model has two independent components: a Poisson count model with expected count μ that generates the counts ($\log [\mu] = X^T\beta$), and a logit model governed by a binomial distribution for predicting excess of zeros with probability π ($\text{logit} [\pi] = X^T\beta$).

As discussed earlier, because of the distribution of the race variable among CBT participants, we built ZIP models for each outcome with the race variable dichotomized to two groups, non-Hispanic White (total $n = 1,018$; DTC $n = 971$ and CBT $n = 47$) and Hispanic/non-White (total $n = 1,277$; DTC $n = 611$ and CBT $n = 666$) to facilitate statistical inferences.

The models were constructed with all independent variables in both of the model parts (i.e., Poisson model and logit model), as well as the moderation term of DTC versus CBT. For the categorical covariates—namely, gender, race, and employment—the reference levels were established as male, Hispanic/non-White, and unemployed status, respectively; CBT status served as the reference level for all DTC–covariate interaction effects. Odds ratios (ORs) for the likelihood of structural zeros and expected means for the nonzero outcome were calculated from the model estimates. While we did consider using propensity scoring to compare the two groups, matched on cases with scores comprised of descriptive variables, we opted not to use this approach for a few reasons. We considered the importance of having the sociodemographic variables in the model due to the nascent stage of DTC literature, as well as the ability to assess gender and race/ethnicity as independent variables. If we had comprised propensity scores, we likely would have matched on these variables, which were of salient interest to this research team. We analyzed the data analysis using SAS/STAT software, Version 9.4, of the SAS System for Windows (SAS Institute, Inc., 2002).

RESULTS

BIVARIATE ANALYSIS

The results for the chi-square and *t*-test bivariate analyses are presented in Table 1. The findings provided justification for the use of a ZIP model with DTC client status as a

moderator, along with predetermined substance use and recidivism outcomes of interest. Individuals in DTC and CBT differed significantly on all selected sociodemographic variables. Fewer individuals in DTC were employed (44.6% vs. 59.6%, $p < .001$). Results from t tests indicated that, compared with CBT participants, DTC clients were older (M age = 31.5 vs. 29.7, $p = .043$), had more years of education ($M = 12.0$ vs. 10.9, $p < .001$), and had lower average baseline percentage of days with drug use ($M = 15.1$ vs. 18.3, $p = .001$), but had a higher baseline rates of arrests ($M = 0.5$ vs. 0.1, $p < .001$).

ZIP REGRESSION

Substance Use Outcome Trajectories

Zero-inflated results. The ZIP component of the regression model (Table 2) revealed the likelihood of no drug use at 6-month follow-up was lower among all participants (those in DTC and CBT) with higher baseline substance use (OR = 0.974; 95% confidence interval [CI] = [0.965, 0.984]; $p < .001$) and employment (OR = 0.625; 95% CI = [0.439, 0.890]; $p = .001$). Conversely, female study participants were approximately 51% more likely (OR = 1.511; 95% CI = [0.999, 2.283]; $p = .050$) to not use substances at 6 months compared with men. When participant group (i.e., DTC vs. CBT) was introduced as a moderator, employed DTC clients were over 2 times more likely (OR = 2.254; 95% CI = [1.430, 3.552]; $p < .001$) to not use drugs at follow-up compared with unemployed CBT participants.

Expected counts. Subsequently, we examined outcomes among DTC and CBT individuals with reported substance use (i.e., nonzero substance use outcomes) at 6-month follow-up. Substance use at 6 months was significantly associated with participant group, baseline substance use, education, employment, and race. Among those who reported substance use at 6-month follow-up, the expected rate of substance use by DTC clients was over 6 times greater (expected $M = 6.487$; 95% CI = [4.310, 9.762]; $p < .001$) than that of CBT participants. Moreover, using one additional substance at baseline increased the expected rate of substance use by 2.7% (expected $M = 1.027$; 95% CI = [1.026, 1.029]; $p < .001$). With regard to education, having 1 additional year of schooling increased the expected rate of drug use by 3.1% (expected $M = 1.031$; 95% CI = [1.015, 1.047]; $p < .001$), but employed clients (both DTC and CBT clients) had a 21% less (expected $M = 0.789$; 95% CI = [0.742, 0.839]; $p < .001$) expected rate of substance use. In terms of race, the expected rate of substance use by Whites was 56% lower (expected $M = 0.437$; 95% CI = [0.345, 0.552]; $p < .001$) than expected among Hispanic/non-White study participants.

Because an interaction effect between employed DTC clients and unemployed CBT participants was found while calculating probabilities of zeros, we performed additional calculations to explain the moderating effects of participant group on selected client covariates separately among substance-using clients. For these comparisons, the reference levels were modified as described below. Among those who used substances at 6 months, both employed and unemployed DTC clients had higher expected rates of substance use than employed/unemployed CBT clients (reference levels), with the rates being almost 5 times higher (expected $M = 4.758$; 95% CI = [3.121, 7.256]; $p < .001$) in employed DTC clients and 6.5 times (expected $M = 6.487$; 95% CI = [4.310, 9.762]; $p < .001$) in unemployed DTC clients. While the expected rates of substance use were higher among both of these DTC client

TABLE 2: Zero-Inflated Poisson Regression Results (Probabilities of Zeros)

Covariate	Substance use					Arrests				
	Estimate	SE	OR	95% CI		Estimate	SE	OR	95% CI	
				Lower bound	Upper bound				Lower bound	Upper bound
Intercept	-0.355	0.555	0.701	0.236	2.080	1.676	4.355	5.346	0.001	27,391.828
Participant group	0.238	0.800	1.269	0.264	6.091	-1.592	4.638	0.203	<0.001	1,816.742
Respective outcome at baseline	-0.026	0.005	0.974	0.965	0.984	-0.542	0.637	0.582	0.167	2.030
Gender	0.413	0.211	1.511	0.999	2.283	-4.539	3.284	0.011	<0.001	6.695
Age	0.012	0.009	1.012	0.995	1.030	-0.171	0.074	0.843	0.729	0.975
Education	0.036	0.041	1.036	0.957	1.122	0.388	0.395	1.474	0.679	3.200
Employment	-0.470	0.180	0.625	0.439	0.890	-2.899	1.093	0.055	0.006	0.470
Race	0.060	0.400	1.062	0.485	2.328	4.111	248.970	61.014	<0.001	7.166 × 10 ²¹³
DTC × Respective Outcome at Baseline	0.010	0.007	1.010	0.997	1.023	0.716	0.682	2.046	0.538	7.790
DTC × Gender	-0.335	0.256	0.715	0.433	1.180	4.740	3.305	114.423	0.175	74,839.418
DTC × Age	0.019	0.011	1.019	0.997	1.042	0.254	0.077	1.289	1.108	1.498
DTC × Education	-0.020	0.060	0.980	0.871	1.103	-0.520	0.414	0.594	0.264	1.339
DTC × Employment	0.813	0.232	2.254	1.430	3.552	3.164	1.151	23.656	2.475	226.083
DTC × Race	-0.031	0.426	0.970	0.421	2.234	-3.370	248.970	0.034	<0.001	4.044 × 10 ²¹⁰

Note. Bold formatting indicates values statistically significant at $p < .05$. OR = odds ratio; CI = confidence interval; DTC = drug treatment court.

cohorts, the differing rates between employed and unemployed clients demonstrated that employment was a slight protective factor (approximate rate reduction of 1.729) against substance use at follow-up (data not shown). Female DTC clients had a 5.5 times (expected $M = 5.552$; 95% CI = [3.659, 8.334]; $p < .001$) higher expected substance use rate compared with CBT females (reference level), while male DTC clients had 6.5 times (expected $M = 6.487$; 95% CI = [4.310, 9.762]; $p < .001$) higher rates than males in CBT (reference level; data not shown), similarly demonstrating that female gender slightly improved outcomes among substance users at follow-up. Last, Hispanics/non-Whites in DTC had a nearly 10 times (expected $M = 9.771$; 95% CI = [6.073, 15.719]; $p < .001$) higher expected substance use rate than Hispanics/non-Whites in CBT (reference level), and White DTC clients had a 6.5 times (expected $M = 6.487$; 95% CI = [4.310, 9.762]; $p < .001$) higher rate than those in CBT (reference level; data not shown).

Recidivism Outcome Trajectories

Zero-inflated results. The probability of no arrests at 6 months among all clients was significantly associated with client age and employment. With every 1-year increase in age, the odds of no rearrests among all study participants decreased by 16% (OR = 0.843; 95% CI = [0.729, 0.975]; $p = .021$). However, DTC clients specifically had a 29% greater odds (OR = 1.289; 95% CI = [1.108, 1.498]; $p = .001$) of no rearrests than the CBT clients with every 1-year increase in age. While employed clients overall were 18-fold (OR = 0.055; 95% CI = [0.006, 0.470]; $p = .008$) less likely to have no arrests at 6-month follow-up, interaction analyses demonstrated that employed DTC clients were over 23 times more likely (OR = 23.656; 95% CI = [2.475, 226.000]; $p = .006$) to have not been arrested at 6-month follow-up. Again, we explain the group effects separately for the group–employment interaction below for those who have arrests at 6-month follow-up.

Expected counts. Table 3 shows that the total number of arrests as reported at 6 months was significantly associated with gender, age, and employment. Among the clients who were arrested in the 90 days prior to 6-month follow-up, the expected count of arrests in female clients was 17-fold (expected $M = 0.061$; 95% CI = [0.014, 0.259]; $p < .001$) less compared with male clients. Being 1 year older decreased the expected count of arrests by 13% (expected $M = 0.871$; 95% CI = [0.821, 0.924]; $p < .001$), and the expected count of arrests was fourfold (expected $M = 0.257$; 95% CI = [0.096, 0.687]; $p = .007$) lower in all employed participants (i.e., DTC and CBT; reference level = unemployed participants).

The effect of age was significantly different between DTC and CBT clients who had arrests at 6 months: While older individuals had an overall lower expected count of arrests at 6-month follow-up, clients in DTC at 6 months had an 18% higher (expected $M = 1.177$; 95% CI = [1.100, 1.258]; $p < .001$) expected count of arrests for each additional year of age than the CBT clients (reference level). Additional analysis revealed that among the clients who had arrests, there were no significant differences of expected rearrest rates among employed DTC clients versus employed CBT clients or unemployed DTC clients versus unemployed CBT clients (data not shown).

DISCUSSION

The present study explored whether sociodemographic variables could predict longitudinal substance use and recidivism outcome trajectories among a national sample of

TABLE 3: Zero-Inflated Poisson Regression Results (Poisson Counts)

Covariate	Substance use						Arrests					
	Estimate	SE	Expected M	95% CI		p	Estimate	SE	Expected M	95% CI		p
				Lower bound	Upper bound					Lower bound	Upper bound	
Intercept	1.698	0.111	5.463	4.390	6.797	<.001	1.923	1.887	6.843	0.169	277.0	.308
Participant group	1.870	0.208	6.487	4.310	9.762	<.001	-3.235	1.327	0.039	<0.001	3.776	.165
Respective outcome at baseline	0.027	0.001	1.027	1.026	1.029	<.001	0.225	0.198	1.252	0.849	1.847	.257
Gender	-0.075	0.043	0.928	0.852	1.010	.084	-2.794	0.736	0.061	0.014	0.259	<.001
Age	-0.001	0.002	0.999	0.996	1.003	.701	-0.138	0.030	0.871	0.821	0.924	<.001
Education	0.031	0.008	1.031	1.015	1.047	<.001	0.091	0.143	1.095	0.828	1.449	.523
Employment	-0.237	0.031	0.789	0.742	0.839	<.001	-1.360	0.502	0.257	0.096	0.687	.007
Race	-0.829	0.119	0.437	0.345	0.552	<.001	-3.688	182.940	0.025	<0.001	1.7 × 10 ¹⁵⁴	.984
DTC × Respective Outcome at Baseline	-0.014	0.002	0.986	0.983	0.989	<.001	-0.061	0.329	0.941	0.494	1.794	.853
DTC × Gender	-0.161	0.064	0.851	0.751	0.965	.012	2.559	0.810	12.919	2.639	63.240	.002
DTC × Age	0.002	0.003	1.002	0.996	1.008	.518	0.163	0.034	1.177	1.100	1.258	<.001
DTC × Education	-0.156	0.016	0.855	0.830	0.882	<.001	-0.120	0.176	0.887	0.628	1.253	.496
DTC × Employment	-0.310	0.063	0.734	0.649	0.830	<.001	1.234	0.594	3.434	1.071	11.010	.038
DTC × Race	0.410	0.129	1.506	1.170	1.938	.002	4.909	182.940	135.436	<0.001	9.2 × 10 ¹⁵⁷	.979

Note. Bold formatting indicates values statistically significant at $p < .05$. CI = confidence interval; DTC = drug treatment court.

participants enrolled in DTC and CBT programs. Participants in DTC and CBT differed significantly on each of the sociodemographic variables described in the study. Specifically, DTC clients were older, more educated, less frequently employed, had lower baseline drug use, and had higher baseline arrest. Moreover, females and White/non-Hispanic clients were more prevalent within the DTC group compared with the CBT group. However, our analysis accounted for this variation.

SUBSTANCE USE

In multivariate analysis, five sociodemographic covariates were significantly associated with substance use outcome trajectories among both DTC and CBT participants, and there were significant differences in substance use among clients of both programs. Overall, individuals with higher baseline substance use, more years of education, those of Hispanic or non-White race/ethnicity, and those lacking employment generally saw fewer reductions in substance use at 6-month follow-up. These findings align with those from other studies showing greater reductions in substance use among Whites and the employed, yet contradict some studies that demonstrate the benefits of education on SUD treatment outcomes (Brown, 2010; Rossman et al., 2011; Shannon et al., 2015). Our findings, consistent with recent literature, suggest that participants who use substances more frequently may not be well served by current SUD treatment programs that are geared toward average-level users (Festinger, Dugosh, & Marlowe, 2015). Our research underscores the need for SUD treatment resources to better adjust to the needs of individuals with higher baseline substance use, whose reductions in drug use at follow-up trailed those of lower level substance users in our study.

Total abstinence from drug use at follow-up was associated with gender, employment, and baseline substance use. Refraining from substance use at follow-up was more likely for women among the entire study sample. Conversely, abstinence was less likely in the employed (DTC or CBT) and those with higher baseline substance use. Total abstinence from substance use could not be linked to education or race.

We believe our findings regarding employment offer important insight for DTC client requirements. Employment improved outcomes for all DTC clients, but certain DTC subpopulations tended to benefit more than others. For instance, employed DTC clients were twice as likely to abstain from drug use at follow-up compared with unemployed CBT clients. Given recent literature, we hypothesize these individuals are low- to average-level drug users, whom current DTC strategies are often best suited to serve. Conversely, among those who reported substance use at 6 months, expected rates of substance use were significantly higher among both employed and unemployed DTC clients relative to the corresponding CBT clients. While there was a reduction in expected substance use rate observed among employed DTC clients, the mitigating effect of employment seems to offer less benefit to these higher level drug users. It may be that while employment may offer benefit to some individuals with lower baseline substance use or motivation for behavior change, interactions with multiple legal, social services, and medical systems may overburden other clients in early recovery (Morse, Silverstein, Thomas, Bedell, & Cerulli, 2015). This suggests that DTC policies mandating participants to obtain employment as a program requirement may fail to provide the support needed to simultaneously handle the demands of DTC, sobriety, and employment for certain high-risk clients. Therefore, in some cases, employment may

actually be counterproductive to DTC clients' complete recovery. This is especially relevant for women, who constituted the majority of the study's DTC sample and are frequently required to navigate parenting and their sobriety simultaneously (Harp, Oser, & Leukefeld, 2012). However, when we attempted to include interaction effects with employment and gender for study outcomes, they were not statistically significant for substance use trends at 6-month follow-up, and there was no convergence for arrest outcomes, possible due to collinearity and redundancy among covariates.

Rather than a one-size-fits-all approach, DTCs should individualize program requirements and intensity to match clients' treatment needs and optimize substance use outcomes. For example, not all programs consistently increase treatment intensity when clients fail in their sobriety, as is recommended (Marlowe et al., 2012). Our findings are worthy of more detailed, perhaps qualitative or longitudinal study beyond 6-month follow-up, as those with less severe SUD were able to abstain at 6-month follow-up, but those with more severe symptoms likely require longer to detect improvement. Future research should focus on the development of statistical and assessment tools that can characterize each DTC client's unique biopsychosocial needs.

RECIDIVISM

With regard to legal outcome trajectories, the regression analysis demonstrated that employment made all individuals 18 times more likely to have rearrests at follow-up. Conversely, employed DTC individuals were over 23 times less likely to have arrests compared with reference-level participants (i.e., unemployed and CBT participants). The conflicting nature of these findings is in agreement with the existing research (Hickert et al., 2009; Rossman et al., 2011). Perhaps for some participants, the income earned helped them pay legal fees and costs associated with SUD treatment, whereas other participants may have used the money they earned while employed to purchase drugs in high-crime neighborhoods, leading to continued substance use and client rearrest. This is plausible, given research (Kirk, 2009; Wehrman, 2010) has shown that neighborhood characteristics can mediate the postrelease behavior of substance-using individuals. For instance, two studies (Kubrin & Stewart, 2006; Stahler et al., 2013) found that justice-involved individuals were more likely to be reincarcerated if they resided in neighborhoods with higher rates of recidivism and criminal activity due to a "spatial contagion" effect involving close proximity to other reoffending individuals (Mennis et al., 2011). More research is warranted with regard to the effect of client geography on rearrest outcomes, specifically aimed at discerning whether employment mediates this relationship in high-recidivism neighborhoods, as well as whether systemic DTC changes have the potential to improve neighborhood dynamics.

In addition, the burden of employment concurrent with time-intensive DTC programming and obligations could have taken time away from recovery activities (such as 12-step programs), making them more susceptible to stress with consequent relapse to drug use and crime (Brewer & Heitzeg, 2008). In accordance with these findings, DTC policymakers should examine employment mandates and develop practices to determine which clients would most benefit from employment to curb rearrest rates among DTC clients.

Other than employment, gender and age had significant effects on recidivism. Older individuals were overall more likely to have rearrests, but for DTC clients, age was a protective factor against rearrests. Moreover, among those who had recidivated by the 6-month

follow-up visit, older clients were more likely to have fewer arrests. This was a finding that supported many of the studies previously cited showing a positive correlation between age and reduced rearrests for DTC clients (Gallagher et al., 2014; Shannon et al., 2015). It is known that substance use patterns differ among adolescent, adult, and elderly populations, which warrants age-appropriate and recovery-oriented strategies for SUD treatment and DTC programming (Bartels, Blow, Brockmann, & Van Citters, 2005). While juvenile drug treatment courts (JDTCs) have been established to offer tailored services in a developmentally appropriate manner, supports for young adults lack standardization across sites and may not be available in all jurisdictions (Henggeler et al., 2006; Marlowe, 2011). This represents an important area for future research.

Because recovery is a developmental and gradual process, DTC strategies ought to be tailored to each DTC client's individualized characteristics and risks (Marlowe et al., 2006; Mitchell et al., 2012). Prior work has explored a "Risk-Needs-Responsivity" (R-N-R) model and adaptive algorithms designed to assess DTC clients' criminogenic needs, match clients to needed interventions, and accurately direct community/systemic resources, maximizing chances of success (Andrews, Bonta, & Wormith, 2006; Dowden & Andrews, 1999; Taxman et al., 2014). Rather than a one-size-fits-all approach, adaptive programming based on client characteristics, SUD severity, and available resources likely offers the highest probability for participant success (Belenko, 2006; DeMatteo et al., 2009; Marlowe et al., 2014).

For DTC populations, the need for age-sensitive programming is critical, especially as younger and older DTC clients differ with regard to their cognitive, physical, and social development (Merline, O'Malley, Schulenberg, Bachman, & Johnston, 2004). Furthermore, types of substances used by individuals typically vary as a function of age, with younger populations more frequently using illicit substances and older populations misusing alcohol and prescription drugs more often (Bartels et al., 2005). Understanding DTC clients' individual needs across the life span remains a crucial goal of future DTC programming and policy evaluations (Marlowe et al., 2012).

In addition to adaptive DTC programming based on client age and developmental stage, gender and trauma-specific DTC programs featuring peer support may also enhance participant outcomes and streamline service delivery across the health-corrections continuum (Bedell, Wilson, White, & Morse, 2015; Taxman, 2014). While we did not find interaction effects with regard to gender and rearrest outcome trajectories, we did find differences with regard to substance use, and it is well documented that women face additional challenges that impede DTC success, such as intimate partner violence (IPV), parenting, trauma histories, and substance use-related stigma (Amaro et al., 2007; Palm, 2007; Wright, Van Voorhis, Salisbury, & Bauman, 2012). Moreover, women differ with regard to factors that precipitate and perpetuate drug use, the contexts in which they use drugs, and how they engage in treatment (Belenko & Houser, 2012; Millay, Satyanarayana, O'Leary, Crecelius, & Cottler, 2009; Palm, 2007). It may be that our employment findings account for some of the differences that would otherwise be seen among women. Additional research is needed to examine whether these trends are consistent among larger DTC samples and how they may mediate drug use and rearrest outcomes (Kissin, Tang, Campbell, Claus, & Orwin, 2014; Saxena, Messina, & Grella, 2014; Van Voorhis, Wright, Salisbury, & Bauman, 2010).

IMPLICATIONS AND FUTURE WORK

We believe our study has several implications for research, policy, and practice. Although the GAIN provided a significant amount of data in a standardized manner, the present study emphasizes the need to refine certain questions and scales to collect data more accurately and systematically across study sites. Specifically, better measures could be developed to properly distinguish between important variables such as race versus ethnicity and baseline employment versus stable employment (Caudy, Tang, Wooditch, & Taxman, 2014). Relatedly, our study operationalized recidivism as rearrest, but other studies define recidivism in different ways; developing a consistent definition of recidivism remains a crucial goal for future DTC research (Brown, 2010). While our study followed DTC and CBT participants for 6 months after initiating SUD treatment, additional research is needed to determine whether employment and age reliably predict client retention and outcomes longitudinally (e.g., 1-2 years following DTC participation; Jewell et al., 2016). This is especially pertinent because the relationships between certain client characteristics (e.g., employment) and program outcomes are contradictory among cross-sectional and longitudinal studies, including the nonstatistically significant DTC client characteristics in our study (i.e., gender, education, and race). Developing evidence-based practices for DTCs nationally necessitates a clear understanding of what client characteristics are most influential in predicting and improving substance use and recidivism outcomes, and whether these improvements are sustained over time (Hiller et al., 2010; Jones & Kemp, 2011; Morse et al., 2015; Taxman, 2014). Last, more research (e.g., to address nonconvergence with zero-inflated models) is needed to accommodate analytic techniques that were not permitted in this study as previously described.

STRENGTHS AND LIMITATIONS

Our study has several strengths. First, our analysis included a relatively large national sample size from 23 sites spanning 12 states and featured a CBT comparison group. Second, data were collected using validated biopsychosocial measures and harmonized to enable multisite analysis. Last, the use of the ZIP statistical model allowed us to access the DTC clients with no substance use or rearrests at 6-month follow-up visits separately from participants with substance use and/or rearrests at 6-month follow-up.

However, there are some important limitations to note. First, our findings are limited to client outcome trajectories at 6-month follow-up as opposed to more traditional longitudinal (i.e., 12-month, 24-month, etc.) client outcomes. While the authors recognize DTCs are typically at least 1 year in duration, we still believe our study sheds light upon an understudied area of DTC research relating to real-world challenges associated with attrition. By studying outcomes at 6-month follow-up (at which time all individuals were still enrolled clients), we were able to characterize outcome trajectories at the midpoint of a routinely 1-year program. This information is critical for improving DTC programming geared toward noncompleters.

Other limitations associated with the present study relate to specific methodological issues. For instance, while our study sampled individuals from varied geographic regions, due to small numbers in some sites and limited information about specific program components, our model was not able to control for study site in our analysis. Different DTC/CBT programming or consequences of noncompliance between various sites might have

influenced substance use and rearrest outcome trajectories differently for certain study participants. Better contextualization of DTC/CBT programs remains an important goal for future DTC research so that program administrators and policymakers can better ascertain which specific program components are most effective in improving client outcomes. Also, the dichotomization of the race variable due to lower-than-expected percentages of certain racial groups was not ideal; however, we believe the preponderance of Hispanic/Latino and women in our study sheds light on an important yet understudied population. Proper data collection regarding the race/ethnicity distinction is an important implication for future studies, which could examine whether the present study's findings are robust within other cohorts. Relatedly, we operationalized recidivism outcomes as total rearrests, but data on the nature or precipitating factors for rearrest were not available; characterization of the specific causes of rearrests among DTC clients is an essential area for future research.

Last, using parsimonious analytic strategies, we chose specific self-reported variables from the GAIN data for our model (not including physical and mental health symptomatology and types of substances used, for example). This may have influenced the effects of employment and age upon substance use and recidivism outcome trajectories. An analysis of DTC clients' health risks and types of substances used in relation to program outcomes is worthy of further exploration.

CONCLUSION

Age and employment predict positive substance use and recidivism outcome trajectories for individuals enrolled in DTC. These findings are critical for the development, expansion, implementation, and improvement of DTC programs. Future work is needed to assess the effectiveness of adaptive interventions targeted toward the younger, unemployed, and those DTC clients with more severe SUD, as well as the role of other client characteristics that may inform individualized treatment approaches and enhance client outcomes.

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