How Substance Use Disorder Treatment Access Shapes Racial and Ethnic Disparities in Treatment Duration and Completion: Tests of Several Non-Normal Structural Equation Models

Section on Drugs and Society- ASA

Roundtable 2: Race-Ethnicity, Structural Inequalities,

and Stigma in Relation to Substance Use.

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Abstract

The aim of this study is to examine racial and ethnic differences in substance use disorder (SUD) treatment outcomes. To do so we model SUD treatment completion rates as a function of race- and ethnicity- related treatment access (source of payment covering SUD treatment) as well as treatment duration. Source of payment (i.e., private, public, none) is expected to determine treatment duration (i.e., length of stay) and whether or not patients successfully complete SUD treatment. We use the National Survey of Drug Use and Health, a well-known source of national behavioral health estimates, to test this process framework. We examine two models underlying this framework. The first model (see Figure 1) is a process-mediation model linking race-ethnicity, access, duration and completion. We argue that treatment access, based on source of payment, will be limited among racial and ethnic minority populations resulting in an attenuated length of stay which in turn reduces the likelihood of successful SUD treatment. The second model relaxes the implicit causal linkages that underlie the first model, allowing greater uncertainty with regard to the racial and ethnic dimensions of the SUD treatment completion, particularly when source of payment is taken into account. Hence, the second model features the interaction of source of payment and the other variables in the process-mediation model, race/ethnicity->duration->completion; a conditional or moderated effect (see Figure 2). We refer to this model as the process-moderation model and argue that differential source of payments will shape the way in which race and ethnicity impact treatment duration and SUD treatment completion. Since conditional models are sometimes symmetrical, we also examine a moderated-mediated model, to determine how race and ethnicity shape the effects of payment source on treatment duration and completion (Figure 3). Using NSDUH population estimates of access (i.e., payment source), duration (i.e., length of stay as days in treatment) and completion (i.e., successful or not), for selected sample years 2002-2014 (replicated in 2015-2019, not shown), we constructed and analyzed several general simultaneous equation models (GSEM). Results of analyses support arguments for the utility of both kinds of analytic strategies. We conclude that both mediated and moderated models are important largely because of the complex interplay of race/ethnicity, source of payment and duration. For example, in mediation models (Table 2), not surprisingly, duration of treatment has a positive effect on the likelihood of completion. However, although longer duration is a function of private treatment payment and Whites are more likely than Latinx or Black populations to benefit, minority populations' treatment payment sources are not clearly differentiated in these models. That is, Latinx are most likely to have no treatment insurance and Whites to have private insurance. All three populations, however, have access to some public sources of treatment payment (e.g., Medicaid and Medicare). To examine the relationship more closely, we analyzed models conditioned by source of payment (Tables 3 and 4). In these moderated models we found that,

consistent with the first set of models, duration of treatment fosters completion, and, Whites and Latinx demonstrate a greater likelihood of treatment completion than Blacks. The remaining question is, how does source of treatment payment shape the relationship between race/ethnicity and duration? In the moderated models, we found that private insurance promotes longer treatment stays for White and Black people, although not for Latinx populations, while public insurance underwrites longer treatment duration for Blacks, but not for Whites or Latinx. Ongoing analyses of data for the paper involves specifying and analyzing factors generating these results (e.g., how do other socioeconomic factors impact these putatively simple interrelationships?). The study's key contributions are to: 1) extend the process framework with mediated and moderated simultaneous equation models of SUD treatment duration and completion; 2) test outcome-disparities' hypotheses in minority populations; 3) develop and test the causal linkages in the hypothesized processes, based on innovations in general structural equation models for non-normal variables, which bolster findings on the nature of direct and indirect effects, and the dual role payment source plays in SUD treatment (see Figures 1, 2 and 3, below), and 4) generate national population estimates of these linkages which are underutilized in this kind of research framework.

1. Introduction

1.1 Background

Substance use disorders place a considerable burden on individuals, their families, neighborhoods and society. While an estimated 20.4 million individuals in the U.S. have a substance use disorder, just over 4 million or 1.5% receive treatment in any given year (SAMHSA, 2020). Racial and ethnic minorities experience greater hardship as a result of the disorder (Burlew, McCuistian & Szapocznik, 2021). According to federal government statistics, of that attenuated treatment cohort, about 41% of patients complete treatment, including roughly equal proportions of Black and White populations (40%), and a slightly higher proportion (45%) of Latinx (SAMHSA-CBHSQ, 2017). Since treatment completion precipitates long-term benefits for individuals, such as higher rates of abstinence, reduction in criminal activity, and enhanced occupational, social, and psychological functioning (NIDA, 2012; Stahler, Mennis & Ducette, 2016; see also e.g., Brorson,Arnevik, Rand-Hendriksen & Duckert, 2013), these SAMHSA-CBHSQ findings of racial/ethnic parity in completion bode well for reduction in disparities among groups.

Other research, however, suggests a less optimistic conclusion. Most studies of the relationship between race/ethnicity and treatment outcomes typically report lower odds of minority-group completion relative to Whites (Grooms & Ortega, 2021; Guerrerro et al., 2013; Mennis & Stahler, 2016; Saloner & Le Cook, 2013; Stahler, Mennis & DuCette, 2016). Studies of treatment duration, such as Delphin-

Rittmon et al. (2012), show non-White groups taking longer to complete treatment, although as Mennis et al (2019) conclude, the relationship between race/ethnicity and duration has not been settled.

Because duration and completion are presumed to have a strong interconnection, such ambiguous findings make it difficult to evaluate whether treatment duration increases or decreases successful treatment completion and how that occurs. The resulting ambiguity is especially problematic when applied to understanding racial/ethnic disparities in completion, which arise earlier in the treatment process when barriers to access emerge. For instance, research has argued that disparities among racial/ ethnic groups in treatment completion (i.e., Black and Latinx populations have lower completion rates and take longer to complete treatment than Whites), are a function of economic disadvantage, accessibility and ancillary social service needs (Acevedo et al 2015; Mennis et al. 2019). This inference is supported by studies finding race- and ethnicity-related inequities in access and utilization among individuals in need of treatment (Acevedo et al., 2018; Acevedo et al., 2012; Archibald & Putnam Rankin 2013; Cummings et al 2014; Lewis et al 2018; Melnick et al 2011).

While treatment studies have examined racial/ethnic disparities at various stages in the treatment process, no one set of analyses has explicitly modelled the effects of racial/ethnic disparities across the central stages in the treatment process, from access to completion. For example, prior studies of mediation models, highlighting socioeconomic (e.g., income, employment) and clinical mechanisms implicit in racial and ethnic disparities in treatment access (Le Cook & Alegria 2011; Pinedo 2019) provide a partial answer, as have studies exploring racial/ethnic moderating effects on treatment duration (Mennis & Stahler 2016; Mennis et al 2019). Taken together these studies suggest a cumulative effect of race/ethnicity across the treatment cycle, beginning with the relationship between race/ethnicity and socioeconomic resources (Le Cook & Alegria 2011) that, in turn, shapes access to as well as duration and completion of treatment.

Treatment research relies on two general methods for modeling the dynamics of the treatment process and the differential burden of race and ethnicity in that dynamic. The first focuses on discrete stages in the process, such as accessibility, utilization, retention, and outcomes, to investigate how race/ethnicity impact these benchmarks in the treatment process, and what factors explain that impact, including socioeconomic variables as well as clinical ones (see e.g., Le Cook & Alegria 2011; Pinedo 2019). The second examines the contextualizing or moderating effects of race/ethnicity on covariates at discrete linkages in the process, for instance, between race/ethnic and outpatient/ residential treatment setting as they combine to impact completion rates (Stahler, Mennis & Ducette, 2016).

The challenge of the mediation and moderation models is that, while analyses of the linkages in the treatment process detail specific variables and their explanatory and interactive features, neither fully model the direct and indirect effects which are potentially shaped by race/ethnicity. Since racial and

ethnic disparities have been shown to impact these discrete stages in the treatment cycle, inequities in access and utilization are often presumed to translate into differential retention rates, which are predicted to yield less salutary outcomes for some groups relative to others (Burlew, McCuistian & Szapocznik, 2021). Taken together the underlying dynamic of this research suggests a cumulative effect of race/ethnicity across the treatment cycle.

Yet, no one set of analyses has fully tested the mechanisms linking racial/ethnic disparities across the various stages in the treatment process, relying instead on single models of individual sets of causal factors presumed to impact outcomes such as duration and completion (see e.g., Mennis & Stahler 2016). Moreover, while some studies have incorporated sources of treatment payment none model the process as a simultaneous system of mechanisms connecting the discrete stages. This is important because studies of treatment access cover a broad range of potential mechanisms facilitating or constraining treatment. These address payment sources and policies, firm programming and practices (see e.g., Boucher et al 2012; Chuang, Wells & Alexander, 2011; Edwards, Knight & Flynn 2011; Freidman, Lemon, Stein & D'Aunno, 2003; Wenn et al 2013), and include the spatial dimensions of service availability and provision as well (see e.g., Acevedo, et al 2018; Archibald & Putnam Rankin, 2013; Cummings et al. 2014;; Lo & Cheng, 2011; McAuliffe & Dunn, 2004). For individuals with both a substance use disorder and a mental health diagnosis, service availability and provision, diagnostic identification, provider training, and insurance and referral serve as factors which impact treatment (Priester et al 2016). Despite the range of potential constraints on treatment, lack of insurance coverage and inability to pay are most often cited as barriers to access (Center for Behavioral Health Statistics and Quality 2016). Although treatment payment sources are likely to have a racial/ethnic component, since race/ethnicity are related to healthcare resource access (Williams, Lawrence & Davis, 2019), the relationship between access, especially when operationalized as payment sources, treatment retention, and race/ethnicity, remains unclear.

To that end, this study investigates race- and ethnicity-related disparities in substance use disorder treatment duration and completion as a function of access, vis-à-vis sources of payment, through the use of simultaneous equation models. These models permit examining sets of causal factors as an ongoing process. In addition, because mediation models may be too rigid in their expectation of an uncomplicated linear path from race/ethnicity to payment source to treatment duration to completion, we introduce a moderated model in an SEM framework that permits flexibility in the kind of questions we ask with regard to SUD treatment completion. That is, whereas the mediation model allows us to ask how race and ethnicity translate into differential completion rates, vis-à-vis duration of treatment, the conditional model focuses on how group membership and payment source interact to foster or hinder treatment duration, and subsequently, completion rates.

II. Methods

Data and study population

To understand how SUD treatment duration functions as a consequence of sources of treatment payment and as a precursor to treatment completion among non-majority racial and ethnic populations, we examine socioeconomic and mental health data from the NSDUH (2002-2014)[2], a nationally representative sample comprising the US population's behavioral health information (SAMHSA 2019). NSDUH data serve as a preeminent source of yearly US incidence and prevalence estimates of behavioral health, including measures of major depression, anxiety, schizophrenia, substance use disorders and treatment for those disorders. The NSDUH surveys assess substance use disorders based on the diagnostic guidelines for substance dependence and substance abuse found in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994). The DSM-IV provides a classification system for clinicians, insurance providers, researchers, and policymakers to use in matters related to diagnosing, researching, and treating behavior health conditions including substance use disorders. In the NSDUH, survey respondents answer detailed questions about substance use behavior. For those respondents meeting DSM criteria, their answers are categorized as indicating substance dependence or abuse for each of the following substances: alcohol; marijuana; cocaine (including crack); heroin; hallucinogens; inhalants; and prescription pain relievers, stimulants, sedatives, and tranquilizers. In 2013 measurement of substance use disorders was changed based on changes to the DSM-5. The DSM-5 revision contained changes in organization and changes to the diagnostic criteria for nearly every DSM-IV disorder, including those for substance use disorders. These changes prompted a revision process to redesign and update NSDUH to provide high-quality data on substance use disorders that reflect the DSM-5 criteria. As a consequence, substance dependence and abuse are no longer continuous pre-2014 and post-2014 when the new criteria were instituted. We therefore selected our pooled sample and primary outcome measures based on this consideration.

The sample consisted of respondents with a past year diagnosis of a substance use disorder, who also reported having received treatment in the past 12 months, and whose file contained information on treatment duration and completion (n=3,803). Data were pooled to maximize subgroup analyses. Following previous studies, we operationalized racial and ethnic group membership based on self-identified race-ethnicity: Latino/a/Hispanic, White (non-Latino/ non-Hispanic), and Black (non-Latino/

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[2] We also examined 2015-2019 data. We discuss the reasons for focusing on these particular early years 2002-2014 in an extended discussion in Archibald, Behrman and Yakoby (2022).

Non-Hispanic). Since we cannot adequately theorize about SUD treatment for other racial/ethnic groups such as Asian Americans, Native Americans, and mixed racial/ethnic groups, and because their sample sizes diminish rapidly, these populations have been excluded from analyses.

[Table 1 here]

Measures

Completion and duration. NSDUH asks respondents to indicate whether they were ever in treatment as well as whether they were in treatment during the past 12 months. Because we restrict our sample to those with a current SUD diagnosis, the latter measure of treatment in the past year is more appropriate than whether or not they ever received SUD treatment. They were then asked the length of the most recent treatment episode and the outcome. Some of these included: " You are still in treatment," "You successfully completed treatment," "You left because you had a problem with program," "You left because you couldn't afford to continue ," "You left because your family needed you" and so forth. Respondents were also asked the number of days they remained in treatment (regardless of the outcome).

Source of payment. Respondents who were in treatment were also asked for the payees of their treatment. These included: private health insurance, Medicare, Medicaid, public assistance program other than Medicaid, own savings or earnings, family members, courts, Champus, Tricare, Champva, VA, other military health , employer, free, some other source, friend/neighbor/sponsor/stipend, church/faith-based organization, school, treatment program/facility/provider, Indian Health Service/Bia/Tribe, public assistance, welfare; and so forth. We collapsed these categories into private, which included self-pay, and public, which included all other responses. Some respondents indicated they knew of no treatment payee, either private or public, so we coded these as "no insurance."

Covariates. In our initial models, for simplicity, we did not include covariates that may influence the relationships between race/ethnicity, sources of payment, duration and completion. These are age, gender, SES, and marital status. Although the tables below do not show estimates for these covariates, we did run models which adjusted for them.

Analytic Strategy

A review of the statistical methods commonly used to analyze the relationships identified in a process framework shows a mix of linear models as well as structural/ simultaneous equation models (SEMs). Researchers use SEMs because the former can be problematic with regard to establishing cause-effect relationships due to endogeneity, multi-collinearity among explanatory variables, and erroneous handling of non-normal and non-continuous distributions of response variables. Except for multi-collinearity, our

data share all of these challenges. Therefore, our approach relies on the principles underlying SEM. Moreover, NSDUH data are culled from the population through a complex stratified sampling scheme, further taxing the underlying assumption of normality on which most least squares models depend (see discussion NSDUH Methodological Resource Book 2018). To meet these various conditions, we propose an approach based on modification of SEMs for non-normal variables (see Muthen 1984 for discussion of non-normality in SEMs). These are generalized structural equation models (GSEM). GSEMs combine the power and flexibility of both SEM and linear models. The variables in the following analyses are observed, not latent, and therefore the standard simultaneous equation reduces to an econometric-type path model. That is, there are several variables that serve as predictors of some variables, yet are predicted by others. This holds for both the mediation and moderation models. The simultaneous mediation model constructed for GSEM analysis can be described by:

$$x' = a'_0 + a'x'' + \Sigma_k e_k m_k \qquad\qquad \text{[path a']}$$

$$z = a''_0 + a''x' + \Sigma_k e_k m_k \qquad\qquad \text{[path a'']}$$

$$y = b'_0 + bz + \Sigma_k e_k m_k \qquad\qquad \text{[path b]}$$

$$y = b''_0 + c'x'' + b_1x' + b_2z + b_3y + \Sigma_k e_k m_k \qquad\qquad \text{[path c']}$$

where each path, a', a'', b and c' are linked to coefficient estimates (b'', c', b_1, b_2, b_3) based on the specific type of distribution for each x'', x', z, y, (i.e., Gaussian, Bernoulli and Bernoulli, respectively). The $\Sigma_k e_k m_k$ are the covariates and error terms. We ran two versions of the model: a constrained version and an unconstrained one. A potential causal (indirect) mediation effect was then estimated using the product of coefficients method (MacKinnon, Fairchild, and Fritz, 2007). A bootstrap analysis with 1,000 replications was applied to estimate the average causal mediation effects without requiring the assumption of normality (Preacher & Hayes, 2008). With a bias-corrected bootstrap technique, the total, direct and indirect (mediation) effects and their 95% CIs were estimated.

We ran the same model for the two separate moderation analysis. In the first moderation analyses, we x'' is still the exogenous variable but payment sources is the moderating term. In the second moderation analysis, instead of x'' (race-ethnicity), the first term in the model is x', payment source, (followed by duration and completion) This second model varies by subpopulation and allows us to examine direct and indirect effects for each of the subpopulations and test whether or not the paths, a, b and c' differed significantly between our sub-groups. The program we use to estimate the equations is Stata 17.

[Figure 1 here]

III. Results

Figures 1 presents the mediation model. We tested a single version of the model. It is a constrained model in which race and ethnicity are expected to influence SUD treatment by way of payment source, which impacts duration. The broken line between race/ethnicity and SUD treatment indicates that the direct effect of minority group membership is constrained to operate through payment source. In another version (not shown) we create an unconstrained model, in which race and ethnicity are freed to impact all three factors in the model. Estimates of the constrained model, the direct and indirect effects, are shown in Table 2 and discussed in the Introduction.

[Table 2 here]

The advantage of structural models is that they estimate parameters simultaneously rather than piecemeal. Moreover, in this system of equations, the size of direct and indirect effects of the parameters can be estimated. Overall, the system of relationships between payment source->treatment duration->SUD treatment was supported with these data. Black populations have fewer treatment resources and, therefore, a more limited length of stay, resulting in a diminish likelihood of completion (Table 2). However, this linkage needs to be examined varying the conditions of treatment payment. It may be that Black and Latinx populations who do have private insurance fare as well as Whites. Moreover, private insurance pays for more days (or at least is associated with longer stays in treatment) than public insurance. Hence, the question arises as to the whether payment is the deciding factor.

[Figures 2 and 3 here]

Figures 2 and 3 present the moderation model. The basic idea is that to the extent that race and ethnicity structure the relationships in the system, they should reveal greater variation in the effects of payment source. Tables 3 and 4 provide two sets of statistics to assess this model. In Table 3, we examine the moderating effect of payment source on the mediation model: race/ethnicity->duration->completion. Then we examine whether the parameter estimates of factor effects are significant for each of the three groups.

[Table 4 here]

In Table 4, we constrain the parameters and evaluate whether they are significantly different (greater or less) than one another. We can also decompose those effects into direct and indirect effects (not shown) in order to determine whether the model operates the same for each group. As in Table 2, there is support for expectations of the conditioning effects of payment source of the model, although the pattern of findings is complicated.

In brief: in the moderated models we found that, consistent with the first set of models, duration of treatment fosters completion, and, Whites and Latinx demonstrate a greater likelihood of treatment completion than Blacks. The remaining question is, how does source of treatment payment shape the relationship between race/ethnicity and duration? In the moderated models, we found that private insurance promotes longer treatment stays for not only Whites but for Blacks as well, although not for Latinx populations, while public insurance underwrites longer treatment duration for Blacks, although not for Whites or Latinx. Further development of the analyses will involve specifying and analyzing factors (e.g., socioeconomic variables) generating these results.

IV. Conclusion and discussion

This study explored two simplified analytic models related to racial and ethnic minority SUD treatment outcomes: the process-mediation model and a conditional or moderation model, both of which link race-ethnicity with access, duration and completion. The mediation model allowed us to ask how race and ethnicity translate into differential completion rates, vis-à-vis duration of treatment. The conditional model focused on how group membership and payment source interact to foster or hinder treatment duration, and subsequently, completion rates. Results of analyses supported arguments for the utility of both kinds of analytic strategies. We conclude that both mediated and moderated models are important largely because of the complex interplay of race/ethnicity, source of payment and duration.

There are however, several limitations that motivate future analyses of these data. We are in the process of addressing some of these issues as we update the analyses. Studies, for instance, have identified treatment effects of racial/ethnic dimensions of individuals' clinical profile, such as primary substance, severity of disorder, and co-occurring mental health issues (Le Cook and Alegria 2011; Mennis et al 2019; Merical et al. 2012; Priester et al 2016). Individuals' clinical profile notwithstanding, structural inequalities (such as treatment source and type) become disparities when they act as barriers to access and utilization of services in such a way as to disadvantaged some groups relative to others (Lamb, Greenlick and McCarty, IOM, 1998). Treatment infrastructure and access to treatment resources are therefore

central processes linking group membership to elements of the completion models. Our results indicate that Blacks and Latinx have divergent treatment resources compared to Whites.

In addition, to what extent does the stigma – especially in minority communities – associated with mental health issues interfere with SUD treatment? There are multiple conditions which might lead to greater minority vulnerability to substance use disorder (Lustig and Strauser, 2007), and our study highlights the need for further study examining how greater vulnerability to substance use disorder among Black and Latinx groups is linked to socioeconomic and political conditions. We posit that perhaps higher minority drug dependence disorder creates greater vulnerability (e.g., via racial-based criminalization of substance use disorders) but we are not sure which factors structure this vulnerability. It is likely there are differences in risk/protective factors among Blacks and Latinx compared to Whites. Our next step is to focus on the unique factors among Blacks and Latinx that impact these relationships.

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Figure 1: SUD Treatment Process Model

$\boldsymbol{\varepsilon}_{x'i}$

$\boldsymbol{\varepsilon}_{zi}$

Payment Source

X'_i

a''

Treatment Duration

Z_i

b

$\boldsymbol{\varepsilon}_{yi}$

a'

Race- ethnicity

X''_i

c'

Treatment Completion

Y_i
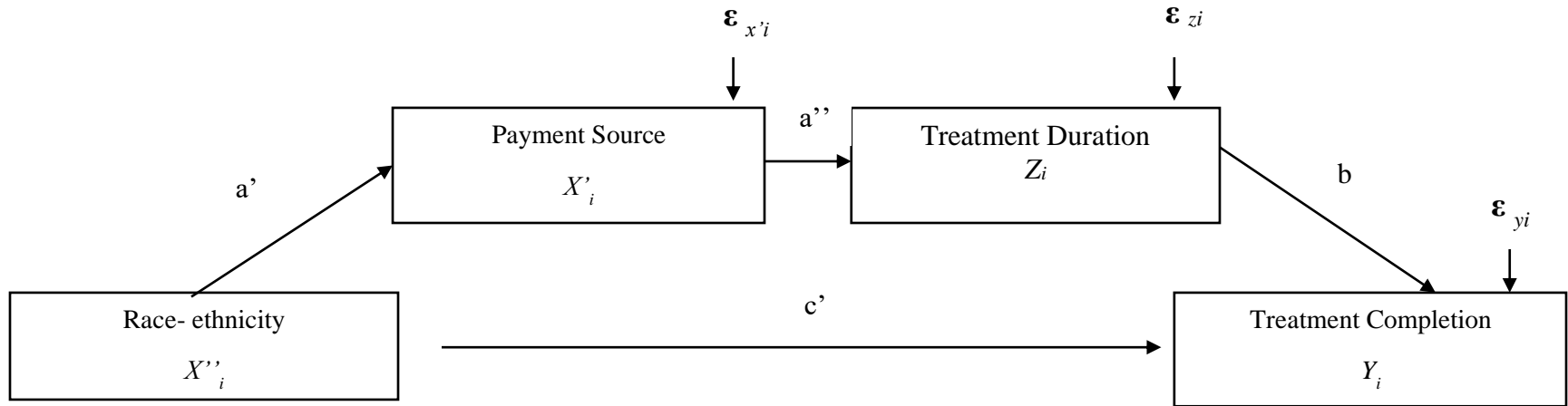
Figure 2: SUD Treatment Conditional Process Model

Payment Source
X''_i

ε_{zi}

Treatment Duration
Z_i

ε_{vi}

Race/ethnicity
X'_i

Treatment Completion
Y_i

Figure 3: SUD Treatment Conditional Process Model

Race/ Ethnicity

X''_i

ε_{zi}

Treatment Duration

Z_i

ε_{vi}

Payment Source

X'_i

Treatment Completion

Y_i
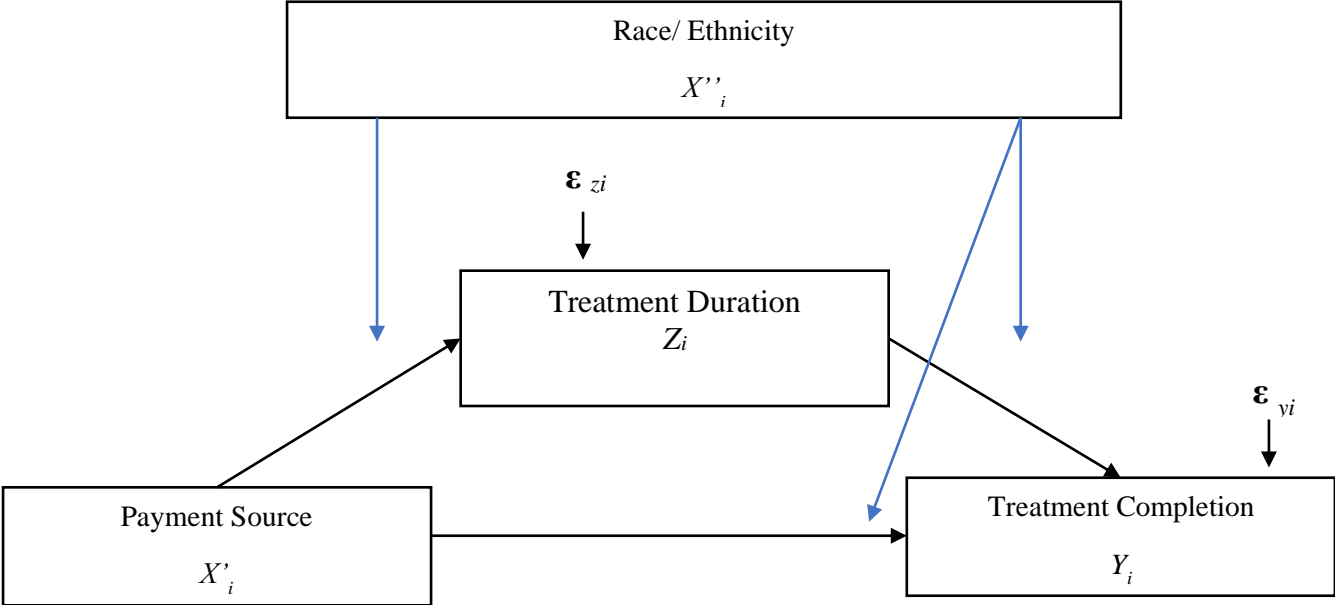
Table 1: Descriptive statistics for generalized structural equation models; NSDUH 2002-2014 (n=3803) [a]

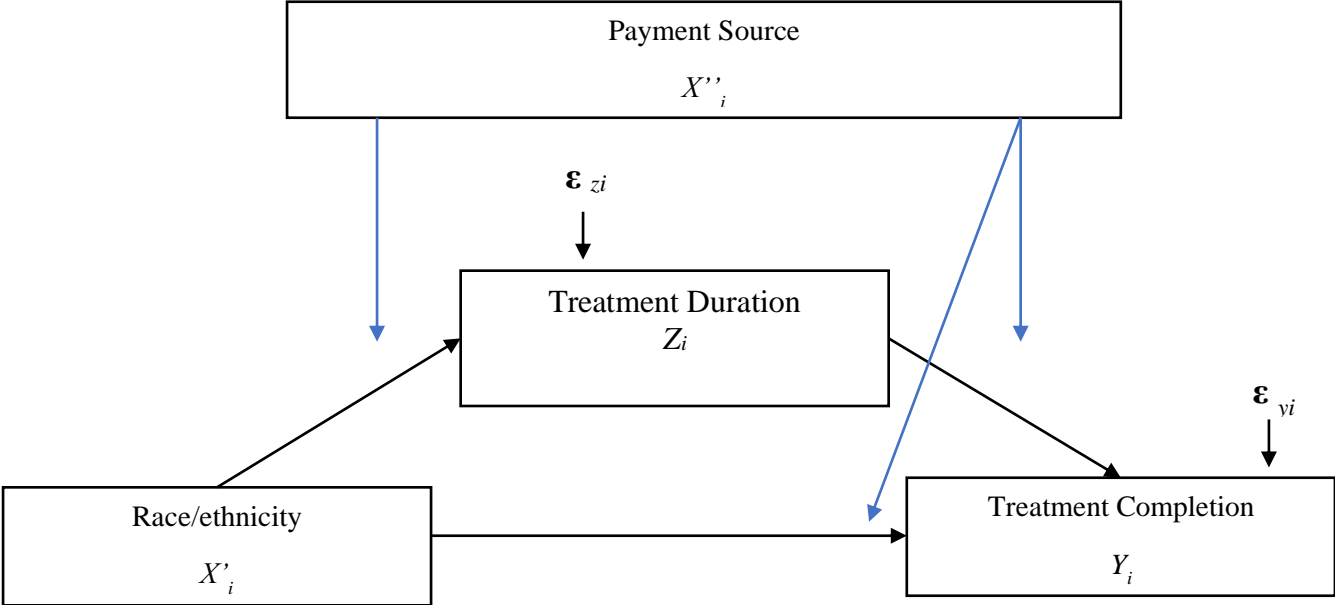| Variables	Description	Range	Proportion	SD
SUD Tx completion	Successful completion of SUD treatment	0,1	0.598	0.490
Duration (in days)	Days in treatment	1-3	2.008	1.054
Race/ ethnicity				
Wh	White	0,1	0.710	0.454
L	Latinx	0,1	0.133	0.340
Bl	Black	0,1	0.157	0.364
Payment source				
Private	Collapsed all private	0,1	0.461	0.499
Public	Collapsed all public (e.g., Medicaid)	0,1	0.191	0.393
None	No identified source of insurance	0,1	0.318	0.466

[a] Samples weight- and design- adjusted: see series NSDUH releases 2002-2014

Table 2: Generalized structural equation models; A mediated model. Odds ratios and standard errors [a] for payment source, treatment duration and treatment completion; NSDUH 2002-2014 [b]

Constrained Mediation Model		Private payment source		Public payment source [c]	
Endogenous	Exogenous	Odds ratio (SE)	Prob	Odds ratio (SE)	Prob
SUD Tx completion (0,1)	← Duration (in days) [d]	2.22(.115)	.000	2.22(.115)	.000
	← Race/ ethnicity (Bl (ref), Wh, L)				
	Wh	1.30(.203)	.091	1.30(.203)	.091
	L	1.45(.309)	.076	1.45(.309)	.076
	Intercept (Bl)	.204(.033)	.000	.204(.033)	.000
Duration	← Payment source (None(ref) private, public)				
	Private	1.09(.092)	.329		
	Intercept (None)	2.64(.137)	.000		
	Public			.768(.074)	.006
	Intercept (None)			2.92(.138)	.000
Payment source	← Race/ ethnicity (Bl (ref), Wh, L)				
	Wh	1.63(.165)	.000		
	L	1.06(.141)	.688		
	Intercept (Bl)	.597(.055)	.000		
	Wh			.613(.061)	.000
	L			.730(.098)	.019
	Intercept (Bl)			.684(.058)	.000
Model Fit – Adjusted Wald (3, 108 df)		285.10	.000	274.80	.000
Number of Cases (unweighted)		3803		3803	

[a] Odds ratios (unadjusted for socioeconomic factors). [b] Samples weight- and design- adjusted: see series NSDUH releases 2002-2014, 2015-2019 [c] For ease of interpretation, we run each model with only a single payment source dummy variable. Non duplicate estimates are provided in separate columns. [d] To normalize treatment days, we coded: 0=none; 1=one day; 2=up to 30 days and; 3=more than 30 days .

Table 3: Generalized structural equation models; A moderated model. Odds ratios and standard errors [a] for payment source, treatment duration and treatment completion; NSDUH 2002-2014 [b]

Constrained Moderation Model		Odds ratio (SE)	Prob
Endogenous	**Exogenous**	Odds ratio (SE)	Prob
Private source of	payment		
SUD Tx completion (0,1)	← Duration (in days) [c]	1.93(.160) [d]	.000
	← Race/ ethnicity (Bl (ref), Wh, L)		
	Wh	1.80(.488)	.031
	L	1.44(.541)	.335
	Intercept (Bl)	.242(.069)	.000
Duration	← Race/ ethnicity (Bl (ref), Wh, L)		
	Wh	1.69(.371)	.017
	L	1.46(.374)	.143
	Intercept (Bl)	1.87(.385)	.002
Model Fit – pseudo LL		-1107*10³	
Number of Cases (unweighted)		1753	
Public source of	payment		
SUD Tx completion (0,1)	← Duration (in days) [c]	2.52(.264) [d]	.000
	← Race/ ethnicity (Bl (ref), Wh, L)		
	Wh	1.33(.419)	.362
	L	2.23(.887)	.044
	Intercept (Bl)	.110(.034)	.000
Duration	← Race/ ethnicity (Bl (ref), Wh, L)		
	Wh	1.35(.253)	.103
	L	1.10(.265)	.678
	Intercept (Bl)	1.87(.258)	.000
Model Fit – pseudo LL [e]		-1107*10³	
Number of Cases (unweighted)		728	

[a] Odds ratio. [b] Samples weight- and design- adjusted: see series NSDUH releases 2002-2014, 2015-2019 [c] To normalize treatment days, we coded: 0=none; 1=one day; 2=up to 30 days and; 3=more than 30 days .[d] In his model, payment source is an interaction variable for each path. Hence, unlike Table 2, the estimates vary by level of payment source. [e] Note the same pseudo likelihoods for both models are given for convention's sake. Non normal models cannot estimate likelihoods. Instead, we focus on individual coefficients.

Not complete do not use……Table 4: Generalized structural equation models; A moderated-mediated model. Odds ratios and standard errors [a] for source treatment payment, treatment duration, and SUD treatment completion. NSDUH 2002-2014 [b]

Conditional model for private payment					Race/Ethnicity		
Endogenous	Exogenous	Non Hispanic (Wh)	African American (Bl)	Latinx (L)	Contrast	Chi test (1, 110)	Prob
Treatment completion (0,1)	← Treatment duration (0 thru 3) [c]	1.96(.123)	3.22(.416)	2.48(.335)	Wh v Bl	11.95	.000
					Wh v L	2.44	.117
					Bl v L	1.90	.160
Treatment duration	← Private source of payment (0,1) [d]	1.06(.109)	.787(.183)	.128(.247)	Wh v Bl	0.20	.654
					Wh v L	0.72	.399
					Bl v L	1.22	.272

Conditional model for public payment							
Endogenous	Exogenous	Non Hispanic (Wh)	African American (Bl)	Latinx (L)	Contrast	Chi test (1, 110)	Prob
Treatment completion (0,1)	← Treatment duration (0 thru 3) [c]	1.96(.123)	3.22(.416)	2.48(.335)	Wh v Bl	11.95	.000
					Wh v L	2.44	.117
					Bl v L	1.90	.160
Treatment duration	← Private source of payment (0,1) [d]	.785(.107)	.774(.153)	.874(.195)	Wh v Bl	0.00	.951
					Wh v L	0.16	.687
					Bl v L	0.16	.687

[a] Odds ratio (not adjusted for age, socioeconomic status, marital status, gender). [b] Samples weight- and design- adjusted: see series NSDUH releases 2002-2014, 2015-2019 [c] To normalize treatment duration we collapsed the variable into 0=no days; 1=one day; 2=two to thirty days; 3=more than thirty days in treatment. Source pf payment consists of private payment (0,1) and pubic payment (0,1), no insurance is the reference category.