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The Impact of Fidelity on Behavioral Health Outcomes Among Individuals Experiencing Chronic Homelessness and Co-Occurring Disorders

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ABSTRACT

Background: People with co-occurring substance use and mental health disorders who experience chronic homelessness often have difficulty engaging in both treatment and support services. Maintaining Independence and Sobriety through Systems Integration, Outreach and Networking (MISSION) is a multicomponent wraparound integrated co-occurring substance use and mental health disorders treatment and linkage intervention comprised of three evidence-based components (Critical Time Intervention case management and peer support, Dual Recovery Therapy, and Peer Support). Although prior MISSION studies have demonstrated positive outcomes for this population, and fidelity (i.e., fidelity to the model) has predicted improvements in criminal legal outcomes, the present study builds on these findings by examining to what extent fidelity to the MISSION model improves behavioral health and housing outcomes.

Methods: Individuals with co-occurring substance use and mental health disorders experiencing chronic homelessness (N = 108) completed a comprehensive intake and were offered up to 12-months of MISSION treatment and services. Services received and fidelity to the MISSION model were tracked weekly. Generalized linear mixed models were used to examine whether fidelity to the overall MISSION model and to each component predicted improvements in behavioral health, substance use, and housing stability outcomes.

Results: Among the sample, 70.3% were male, 78.8% were non-Hispanic, 72.3% were White, and were homeless for 8.3 years on average. Fidelity to the overall MISSION model ranged from 0.0 to 296.0%. Generalized linear mixed models demonstrated mixed relationships between fidelity to the MISSION model (and each component) including improvements in behavioral health, reduced overall illicit substance use and alcohol use in the past 6-months, and improvements in housing stability.

Conclusions: This study demonstrated that fidelity to the MISSION model had a direct impact on improving outcomes for individuals with co-occurring substance use and mental health disorders who have experienced chronic homelessness. These findings have important implications for settings that implement MISSION or other multicomponent interventions as fidelity to the model will yield greater behavioral health, substance use, and housing stability improvements.

Keywords: *fidelity, homelessness, co-occurring disorders, mental health, substance use disorders, addiction, behavioral health multicomponent interventions*

Introduction

Rates of homelessness in the United States (US) increased by almost 12% from 2022 to 2023, with more than 650,000 individuals experiencing homelessness on a given night.[1] About one-third of this population experienced chronic homelessness (defined as patterns of homelessness continuous for one year or more, or at least four episodes of homelessness in the last three years where the combined length of time homeless was at least 12 months).[1] Unfortunately, the prevalence of co-occurring substance use and mental health disorders (COD) is disproportionately higher among individuals experiencing chronic homelessness,[2,3] which can lead to other adverse outcomes such as increased risk for criminal legal involvement, fragmented access to healthcare, as well as low treatment engagement and retention rates.[4-6] Lack of stable housing is a major social determinant of health (SDOH) need, which is associated with poor health status[7,8] such as mental health and substance use disorders.[4,9] Thus, solutions to address these disparities must approach homelessness as a combined medical and social issue.[7] Solutions that simultaneously address SDOH factors (e.g., homelessness), such as permanent housing, case management, harm reduction, and accessible medical care are needed.[10] While approaches such as Housing First support individuals in obtaining permanent housing, care is often fragmented with few evidence-based integrated treatment interventions to address both COD and SDOH needs simultaneously. Comprehensive interventions are needed to prevent returning to homelessness and address COD and other SDOH needs simultaneously and reduce care fragmintation.[11-13]

Maintaining Independence and Sobriety Through Systems Integration, Outreach and Networking (MISSION) is a multicomponent intervention providing comprehensive wraparound supports delivered by case manager and peer support specialist teams to individuals with COD experiencing chronic homelessness. MISSION augments Housing First[13-15] by sustaining permanent housing and targeting mental and substance use disorders through assertive community outreach, delivery of psychoeducational therapy sessions, and provision of service linkages to mainstream and community-based resources. MISSION is comprised of three evidence-based core components (Critical Time Intervention, Dual Recovery Therapy, and Peer Support) which work synergistically together. Critical Time Intervention (CTI) is a three-stage, time-limited form of case management and assertive outreach.[16-18] During these unstructured client sessions, MISSION teams facilitate linkages to, and improve engagement with community-based providers. Moreover, peer support specialists (i.e., individuals with lived experience with homelessness and COD) help clients achieve recovery and mental health stability by providing personal and intensive support.[19,20] Dual Recovery Therapy (DRT) consists of 13 psychoeducational structured sessions delivered by a case manager.[21,22] Sessions discuss the overlap of mental health and substance use challenges to simultaneously address them through skill-building and motivational interviewing techniques. Peer Support is delivered via 11 Peer-Led structured sessions facilitated by a peer support specialist on topics that have been determined essential to recovery.[23] Both DRT and Peer-Led sessions are considered *structured* sessions because they are manualized, whereas CTI is *unstructured* because they are based on the client's needs at the time of the session. MISSION has been shown to improve mental health and substance use outcomes, increase community tenure, reduce hospitalizations, and increase service utilization.[24-29] While MISSION shows positive outcomes among clients, the next step is to understand the processes by which implementation dimensions (i.e., fidelity to the model) impact intended client outcomes.

Multicomponent interventions offer a complex array of services, which makes implementing with fidelity challenging. Fidelity has been defined as the extent to which "prescribed program components were delivered as instructed in the program protocol."[30] Research often describes fidelity descriptively (e.g., mean number of sessions) or assessed as an outcome.[31,32] For example, Nelson and colleagues (2014) assessed

fidelity of the implementation of a Housing First approach for individuals experiencing homelessness and mental health disorders and found that more than 71% of the components demonstrated high fidelity (i.e., higher than 3.5 out of 4). Fidelity has also been found to impact client outcomes such as substance use, depressive symptoms, and physical health.[33-35]

Only one MISSION study has examined implementation fidelity as a predictor of six-month outcomes. Shaffer and colleagues (2021) examined fidelity to a criminal justice adaptation of MISSION (MISSION-CJ) delivered alongside Drug Treatment Court. This study conceptualized fidelity as adequate dosage and service fidelity to unstructured MISSION-CJ sessions and structured MISSION-CJ sessions, with 80% or more set as the threshold for high fidelity, and less than 80% for low fidelity. High fidelity among *structured* sessions was significantly associated with reduced nights incarcerated, while high fidelity among *unstructured* sessions was significantly associated with reduced illicit drug use. While fidelity was associated with improvements in criminal justice and substance use outcomes, there were no significant findings among mental health outcomes.[34]

Building upon Shaffer et al. (2021), this study examines fidelity as a predictor of 6- and 12-month behavioral health and housing outcomes among a complex population using the original MISSION model. This study fills a gap by assessing fidelity to a multicomponent intervention among a complex population of individuals with COD experiencing chronic homelessness. The present study examines the degree to which fidelity to the MISSION model as well as each component of care (i.e., DRT, CTI case management, Peer-Led sessions, and CTI peer support), predict clients' behavioral health and housing outcomes at 6- and 12-months post enrollment.

Methods

STUDY

Secondary data collected during a MISSION open pilot study implemented in an urban area in Western Massachusetts were used for the current study. MISSION services were provided by a multidisciplinary team comprised of a clinical case manager and a peer support specialist for up to 12-months beginning in 2017, with the last client enrolled in the fall of 2022. This study was approved by the Institutional Review Board of the University of Massachusetts Chan Medical School on September 19th, 2017, and was deemed program evaluation, exempt from human subjects research.

PARTICIPANTS

MISSION Clients

This study provided MISSION treatment and services to 108 clients identified through a Regional Network (i.e., established network of housing providers, outreach workers, homeless program staff and others working with individuals with a long-term history of homelessness). To be eligible to participate, individuals had to (1) meet the definition of chronic homelessness according to the US Department of Housing and Urban Development (i.e., patterns of homelessness continuous for one year or more, or at least four episodes of homelessness in the last three years where the combined length of time homeless was at least 12 months);[1] (2) be 18 years of age or older; (3) meet the *Diagnostic Statistical Manual for Mental Disorders 5th Edition* (*DSM-5*) criteria for a substance use disorder;[36] and (4) meet *DSM-5* criteria for at least one mental health disorder without the presence of acute psychotic symptoms, or instability (e.g., schizophrenia, bipolar I disorder with psychotic features).[36] Clients who enrolled and provided informed consent completed a baseline assessment. After completing the baseline assessment, MISSION staff provided each client with a MISSION client workbook[37] which contains worksheets that corresponded to the structured sessions in the MISSION manual[38] (e.g., DRT and Peer-Led sessions), as well as additional suggested readings on recovery. Clients were reassessed 6-months into MISSION care commencing, and again at 12-months post-baseline.

MISSION Team

The MISSION team consisted of two clinical case managers, two peer support specialists, and a clinical

supervisor. All providers received a MISSION manual, comprehensive virtual, synchronous training on delivering MISSION led by the intervention developers, as well as thorough training on how to track fidelity to the model. MISSION developers were responsible for ensuring that MISSION teams: (a) received training and consultation that monitored model fidelity and quality of service delivery; (b) promoted fidelity and competence of the providers; and (c) managed service delivery expectations so it promoted the model and allowed for delivery of MISSION in a way that the clients receive the benefit of high-quality services. MISSION teams also participated in a monthly fidelity call with one of the MISSION developers, who is also a trained clinical psychologist. These calls provided the MISSION team an opportunity to discuss challenging client cases, gain insight and advice on how to engage clients, and request any further training on how to deliver MISSION components (e.g., how to encourage use of the client workbook); fidelity data was also reviewed and discussed quarterly with MISSION teams during this time.

Measures and Data Collection

CLIENT DEMOGRAPHIC AND OTHER CHARACTERISTICS

Client demographic and other characteristics were self-reported at intake and at each follow-up assessment. Per our funding agency, SAMHSA's *Government Performance and Results Act* tool (*GPRA*)[39,40] was required, and includes the following *Addiction Severity Index* (*ASI*) items: gender; race; ethnicity; highest education level obtained; employment patterns in the prior 30-days and past 3-years; marital status; self-reported frequency and type of criminal legal involvement in the prior 30-days, previous 6-months, and over the lifetime (e.g., number of lifetime arrests and convictions, number of nights incarcerated in the previous 6-months) in the legal section; quantity, frequency, and severity of substance use in the drug and alcohol use section; as well as behavioral health and medical service utilization in the prior 30-days, past 6-months, and lifetime. Trauma symptomology was measured using the *Posttraumatic Stress Disorder (PTSD) Checklist-Civilian version* (*PCL-5*).[41] *PCL-5* is a self-report checklist of PTSD symptoms based closely on *DSM-5* criteria that has demonstrated good psychometric properties. Clients are asked to rate how bothered they have been by 20-items in the past month on a 5-point Likert scale ranging from 0 (Not at all) to 4 (Extremely bothered). Items are summed to create a total composite score, and research demonstrates that a total score of 31 or more indicates the probable presence of PTSD.[42]

FIDELITY (FIDELITY TO THE MISSION MODEL)

Fidelity tracking logs were entered weekly into REDCap[43] by the case manager and peer support specialist for each client while enrolled in the program. The *MISSION Fidelity Measure* tracks the core components of the MISSION model, including DRT sessions, CTI case management, Peer-Led sessions, CTI peer support, as well as linkages and referrals to supports and services, such as benefits and entitlements, vocational/educational supports, and trauma-informed care. The *MISSION Fidelity Measure* consists of 78-items assessing the presence or absence of certain activities offered within the MISSION model. For the purposes of this study, fidelity to the MISSION model overall as well as each component was calculated as a proportion, defined as the number of sessions supplied relative to the number of sessions expected. The number of sessions supplied was calculated by summing the number of sessions across all components of the MISSION model, as well as by session type (i.e., DRT, Peer-Led sessions, and CTI (both by case managers and by peer support specialists), per client). The number of sessions expected was calculated by summing all expected sessions across components of care according to the expectations for contact as outlined in the MISSION model manual based on the client's duration of treatment.[38]

PRIMARY OUTCOMES

MISSION case managers administered comprehensive behavioral health assessments at three time points,

baseline (i.e., MISSION intake), as well as 6- and 12-months post-baseline, to measure relevant client characteristics and outcomes over time. The three primary outcomes in this study included behavioral health functioning, substance use in the past 6-months, and housing stability.

Behavioral Health Functioning

Behavioral health outcomes were measured via the *Behavior and Symptom Identification Scale-32* (*BASIS-32*). The *BASIS-32* is a validated and reliable measure with demonstrated sensitivity to measure behavioral health symptoms.[44] The *BASIS-32* was used to assess a client's perspective on level of difficulty with a range of behavioral health symptoms and problems within the past week. This measure includes 32-items rated on a 5-point scale of 0 to 4, where 4 indicates extreme difficulty and 0 indicates no difficulty. An overall mean score as well as five sub-scale scores: depression and anxiety; psychosis; relation to self and others; impulsive and addictive behavior; and daily living and role functioning can be generated for the *BASIS-32*. *BASIS-32* scores were coded as continuous variables for our analyses.

Substance Use

Clients' self-reported information regarding frequency of substance use in the past 6-months was measured via the *ASI* within the *GPRA* tool (as described above). Days of substance use in the past 6-months were summed across all substances, and were also summed for each individual substance type (i.e., alcohol, cannabis, cocaine, and heroin).[45] For statistical analysis in the current paper, days of substance use was operationalized as a continuous variable.

Housing Stability

Housing placement and time spent being homeless in the last 30-days, 6-months, and lifetime were reported at baseline and follow-up via the *GPRA* tool. Clients were asked how many nights in the last 30-days and 6-months they have been homeless, as well as how many years in their lifetime they have spent homeless. Housing placement was operationalized as the main place where the individual resided in the past 30-days prior to assessment. We recoded these data into a dichotomous variable to categorize housing stability (i.e., unstable or stable housing). "Unstable housing" was defined as living in a shelter; transitional housing; detox facility; street/outdoors; a jail/prison; someone else's apartment, room, or house; halfway house; or residential treatment facility. "Stable housing" was defined as living in a house, room, or apartment rented or owned by the client; dormitory/college residence; or permanent supportive housing.

Statistical Analyses

Univariate descriptive analyses were conducted to examine client demographic characteristics at baseline, including mental health symptom patterns, substance use type and frequency, healthcare service utilization, and housing stability (see Tables 1 and 2). Second, we used repeated generalized linear mixed models (GLMM) to examine whether fidelity to the MISSION model (overall and to each component of care as independent variables) impacted behavioral health, substance use, and housing stability outcomes among clients in this study. GLMM is an extension of general linear models and is appropriate for the present study because it can accommodate both binary and continuous data with non-normal distributions and reduces bias with its ability to address potential within-cluster correlation in repeated measures data to ensure valid inference.[46]

Potential covariates for regression model building were selected based on two criteria. First, bivariate analyses determined which baseline characteristics and predictor variables were most significantly related to our study outcomes (i.e., behavioral health, substance use, and housing stability). This was determined using a threshold of $p \leq .2$. Second, preliminary predictors were also determined based on clinical relevance to our outcomes. Final regression models included the following covariates: age at baseline (continuous); gender (dichotomous; 0 = male, 1 = female); and years homeless in lifetime (continuous).

A total of six GLMMs were computed for each outcome (one unadjusted GLMM, and five adjusted

GLMMs to independently examine the contributions of fidelity to the MISSION model overall and to each component on outcomes). Unadjusted GLMMs examined whether improvements were observed over time. Adjusted GLMMs examined the impact of fidelity on each outcome, and were adjusted for age, gender, and years homeless reported at baseline.

Finally, the average marginal effects (AMEs) were computed for models where fidelity to MISSION was a significant predictor (i.e., behavioral health, substance use, and housing stability outcomes). AMEs of levels of fidelity to MISSION overall or to its individual components were used to interpret the direct impact that fidelity had on our primary outcomes while controlling for other important covariates, obtained from the regression models. For the purposes of computing the marginal predicted mean and ease of interpretation, fidelity to MISSION overall and by its components were collapsed from continuous variables and coded into a three-level nominal variable (1 ≤ 50% fidelity, 2 = 50-79% fidelity, 3 ≥ 80% fidelity). All data management and analyses were done using SAS software, Version 9,[47] and SPSS Version 29.0,[48] and Stata software, Version 18[49] was specifically used to compute the AMEs. All statistical tests are based on a two-sided alpha of $p < .05$.

Results

Table 1 includes client demographic and other baseline characteristics. Most clients were male (70.3%), White (72.3%), and non-Hispanic (78.8%), and on average were 43 years-old ($M = 43.8$, $SD = 12.8$). The majority of clients were unemployed (96.3%), and had completed high school (69.4%) at baseline.

Table 2 includes client behavioral health characteristics reported at baseline. Almost all clients were unstably housed at baseline (98.2%), and over half of all clients (56.0%) reported living in a place not meant for inhabitation (i.e., street, park bench, sidewalk, etc.). On average clients reported being homeless for over 8-years in their lifetime ($M = 8.3$, $SD = 6.2$); and on average, were 29 years-old ($M = 29.3$, $SD = 12.4$), when they first experienced being homeless, indicating a severe history of homelessness. On average, clients reported that they first used an illicit substance at age 14 ($M = 14.6$, $SD = 3.8$), and two-thirds of clients reported either alcohol (34.2%) or heroin (31.5%) as their most problematic substance of use. In addition, over two-thirds of clients experienced at least one trauma in their lifetime (67.6%), with 71.5% meeting criteria for PTSD based on the *PCL-5*. Most clients indicated mild-to-moderate functioning in terms of their mental health and daily living as per the *BASIS-32* ($M = 1.5$, $SD = 0.7$).

FIDELITY

Table 3 provides descriptive statistics on each measure of fidelity by MISSION component. MISSION facilitators' (i.e., case managers and peer support specialists) fidelity to the overall MISSION model ranged from 0.0 to 296.0% (i.e., exceeding model expectations). The average fidelity to the overall MISSION model was 56.8% ($SD = 44.4\%$). Fidelity by case managers to their respective MISSION components (i.e., DRT and CTI case management), was highest for DRT and ranged from 0.0 – 278.0% ($M = 87.1\%$, $SD = 56.6\%$), while for CTI case management fidelity ranged from 0.0 – 407.0% ($M = 53.9\%$, $SD = 63.5\%$). Fidelity by peer support specialists to their respective MISSION components (i.e., Peer-Led sessions and CTI peer support) ranged from 0.0 – 273.0% ($M = 60.4\%$, $SD = 78.3\%$) for Peer-Led sessions, and from 0.0 – 279.0% ($M = 52.0\%$, $SD = 53.7\%$) for CTI peer support.

Table 1. *Baseline MISSION Client Demographic and General Information (N = 108)*

Characteristic	*n*	*%*	*M (SD)*
Gender			
Female	32	29.7	
Male	76	70.3	
Age (Years)			43.8 (12.8)
Ethnicity			
Hispanic/Latino	24	22.2	
Non-Hispanic/Latino	84	78.8	
Race			
White	68	72.3	
Black or African American	23	24.5	
Two or More Races	3	3.2	
Marital Status			
Never married	85	78.7	
Divorced	16	14.8	
Separated	3	2.7	
Widowed	2	1.9	
Married	2	1.9	
Highest Level of Education (Lifetime)			
Less than high school diploma/GED	33	30.6	
High school diploma/GED	57	52.8	
Post-high school	18	16.6	
Unemployed	104	96.3	
Criminal Legal History			
Arrested at least one time (Lifetime)	90	84.9	
Average lifetime arrests			7.1 (11.2)
Average lifetime convictions			2.8 (5.8)
Average lifetime months incarcerated			22.1 (47.7)
Service Use (Lifetime)			
Treated for alcohol use	25	23.1	
Treated for drug use	47	43.5	
Inpatient for psychiatric complaint	55	50.9	
Outpatient for psychiatric complaint	51	47.2	
Emergency room for psychiatric complaint	49	45.4	
Service Use (Past 6-Months)			
Inpatient for psychiatric complaint	23	21.2	
Outpatient for psychiatric complaint	11	10.1	
Emergency room for psychiatric complaint	16	14.8	
Inpatient for substance use	24	22.2	
Outpatient for substance use	21	19.4	
Emergency room for substance use	17	15.7	

Table 2. *MISSION Client Behavioral Health Characteristics (N = 108)*

Characteristic	*n*	%	*M (SD)*
HOUSING			
Housing Placement			
Place not meant for inhabitation	61	56.0	
Emergency shelter (i.e., hotel/motel)	23	21.2	
Staying or living with family or friends	8	7.3	
Transition housing	7	6.4	
Institution[1]	6		
House/apartment/room rented by client	2	2.8	
Permanent supportive housing	1	0.9	
Unstably Housed	106	98.2	
Lifetime Years Homeless			8.3 (6.2)
Age When First Homeless			29.3 (12.4)
TRAUMA & MENTAL HEALTH			
Trauma			
Experienced ≥ 1 traumatic event (Lifetime)	73	67.6	
Met criteria for PTSD (≥ 31 *PCL-5*)	68	71.5	
PCL-5 score			41.2 (13.9)
BASIS-32			
Relation to self and others			2.0 (1.0)
Depression and anxiety			1.9 (0.9)
Daily living and role functioning			1.6 (0.9)
Impulsive/addictive behaviors			1.1 (0.7)
Psychosis			0.4 (0.5)
Total score			1.5 (0.7)
SUBSTANCE USE HISTORY			
Substance Use History (Lifetime)			
Average age of first use			14.6 (3.8)
Alcohol (years of use)			19.4 (15.7)
Cannabis (years of use)			10.9 (14.3)
Heroin (years of use)			5.4 (7.4)
Cocaine (years of use)			7.3 (8.6)
Any illicit drug (years of use)			16.2 (13.3)
Substance Use History (Past 6-Months)			
Alcohol (days)			58.2 (73.0)
Cannabis (days)			39.4 (64.9)
Heroin (days)			46.2 (71.7)
Cocaine (days)			40.1 (67.2)
Any illicit drug (days)			88.7 (79.8)
Most Problematic Substance (Lifetime)			
Heroin	34	31.5	
Alcohol	37	34.2	
Cocaine	21	19.5	
Cannabis	14	13.0	
Nicotine	1	0.9	
Benzodiazepines	1	0.9	

Note. [1]Includes jail/prison, residential treatment, hospital (psychiatric/non-psychiatric)

Table 3. Fidelity Characteristics to the Overall MISSION Model and by Component

Fidelity Type	% *M* (*SD*)	% Range (Min, Max)
Overall MISSION model	56.8 (44.4)	296.0 (0.0, 296.0)
DRT	87.1 (56.6)	278.0 (0.0, 278.0)
CTI case management	53.9 (63.5)	407.0 (0.0, 407.0)
Peer-Led	60.4 (78.3)	273.0 (0.0, 273.0)
CTI peer support	52.0 (53.7)	279.0 (0.0, 279.0)

CLIENT OUTCOMES OVER TIME

Unadjusted GLMMs examining *BASIS-32* scores demonstrated statistically significant improvements in total scores over time in behavioral health functioning (both from baseline to 6-months (*β* = -0.29, 95% CI [-0.49, -0.08]), and 6- to 12-months (*β* = -0.32, 95% CI [-0.55, -0.09]); and we also observed improvements over time for each *BASIS-32* sub-scale, see Table 4 for all unadjusted model statistics. We observed a significant improvement in housing stability over time from baseline (*β* = 2.93, 95% CI [1.43, 4.42]) to 6-month and 12-month follow-up (*β* = 3.41, 95% CI [1.92, 4.91]). We did not observe statistically significant changes for overall illicit substance use or any individual substance (e.g., heroin, alcohol).

Table 4. Unadjusted Generalized Linear Mixed Models

Outcome Domain	Outcome	*F*	*df*	*p*	BL *M* (*SD*)	6MN *M* (*SD*)	12MN *M* (*SD*)	BL vs 6MN (*t, df, p*)	6MN vs 12MN (*t, df, p*)	BL vs 12MN (*t, df, p*)	6MN Est	6MN 95% CI	12MN Est	12MN 95% CI
Behavioral Health Functioning	*BASIS-32* Total Score	5.64	(2, 269)	0.004	1.49 (0.70)	1.19 (0.77)	1.16 (0.83)	(2.74, 269, 0.007)	(0.31, 269, 0.76)	(2.82, 269, 0.005)	-0.29	(-0.49, -0.08)	-0.32	(-0.55, -0.09)
	BASIS-32 Daily Living Subscale Score	4.74	(2, 269)	0.009	1.55 (0.86)	1.25 (0.86)	1.17 (0.91)	(2.73, 269, 0.02)	(0.58, 269, 0.57)	(2.78, 269, 0.006)	-0.29	(-0.53, -0.05)	-0.37	(-0.63, -0.11)
	BASIS-32 Relation to Self & Others Subscale Score	5.64	(2, 268)	0.004	2.02 (0.98)	1.63 (1.05)	1.55 (1.10)	(2.66, 268, 0.008)	(0.42, 268, 0.68)	(2.92, 268, 0.004)	-0.39	(-0.68, -0.10)	-0.46	(-0.77, -0.15)
	BASIS-32 Depression & Anxiety Subscale Score	8.44	(2, 268)	<0.001	1.90 (0.93)	1.53 (0.90)	1.36 (0.88)	(2.74, 268, 0.007)	(1.28, 268, 0.20)	(3.97, 268, <0.001)	-0.36	(-0.62, -0.10)	-0.54	(-0.80, -0.27)
	BASIS-32 Impulsive & Addictive Behavior Subscale Score	2.21	(2, 269)	0.11	1.13 (0.74)	0.90 (0.83)	0.97 (0.91)	-	-	-	-0.22	(-0.45, -0.01)	-0.16	(-0.41, 0.09)
	BASIS-32 Psychosis Subscale Score	0.73	(2, 269)	0.48	0.37 (0.54)	0.32 (0.44)	0.42 (0.58)	-	-	-	-0.04	(-0.17, 0.09)	0.05	(-0.11, 0.22)
Substance Use	Illicit drug use Past 6-months (days)	1.57	(2, 269)	0.21	88.70 (79.80)	78.30 (78.90)	67.50 (77.10)	-	-	-	-0.12	(-0.39, 0.14)	-0.27	(-0.58, 0.03)
	Heroin use Past 6-months (days)	1.23	(2, 264)	0.29	46.20 (71.70)	39.50 (69.20)	29.90 (60.20)	-	-	-	-0.15	(-0.63, 0.31)	-0.43	(-0.98, 0.11)
	Alcohol use Past 6-months (days)	0.80	(2, 262)	0.45	58.20 (73.02)	46.00 (62.90)	49.80 (67.10)	-	-	-	-0.23	(-0.61, 0.14)	-0.15	(-0.54, 0.23)
	Cocaine use Past 6-months (days)	0.39	(2, 267)	0.68	40.10 (67.20)	32.10 (58.80)	35.80 (59.30)	-	-	-	-0.22	(-0.72, 0.27)	-0.11	(-0.61, 0.38)
	Cannabis use Past 6-months (days)	0.10	(2, 263)	0.93	39.40 (64.90)	37.90 (62.90)	42.10 (70.70)	-	-	-	-0.03	(-0.51, 0.43)	0.06	(-0.43, 0.56)
Housing Stability	Stable vs. Unstable Housing	10.25	(2, 263)	<0.001	2.00 (1.80)	22.00 (26.00)	27.00 (36.50)	(4.86, 263, <0.001)	(1.38, 263, 0.17)	(5.98, 263, <0.001)	2.93	(1.43, 4.42)	3.41	(1.92, 4.91)

Note: All models displayed are unadjusted models over time.

RELATIONSHIP BETWEEN FIDELITY AND OUTCOMES

Overall MISSION Model Fidelity

Overall fidelity to the MISSION model was a significant predictor in only one of our main outcomes, substance use: fidelity significantly predicted a reduction in days of heroin use in the past 6-months (*β* = -1.52, 95% CI [-2.30, -0.74]). The AME (see Table 5 & Appendix) of overall fidelity on days of heroin use in the past 6-months demonstrated that clients who received MISSION services with ≥80% fidelity had on average 16.6 less days of heroin use, and clients who received 50-79% fidelity had on average 6.1 less days of heroin when compared to those that received <50% fidelity, respectively.

Table 5. Adjusted Generalized Linear Mixed Models for Overall MISSION Model Fidelity

Outcome Domain	Outcome	*F*	*df*	*p*	BL vs 6MN (*t, df, p*)	6MN vs 12MN (*t, df, p*)	BL vs 12MN (*t, df, p*)	6MN Est	6MN 95% CI	12MN Est	12MN 95% CI	*AMEs*	Fidelity Beta (95% CI)	*p*
Behavioral Health Functioning	*BASIS-32* Total Score	5.64	(2, 265)	0.004	(2.81, 265, 0.005)	(0.26, 265, 0.79)	(2.79, 265, 0.006)	-0.29	(-0.49, -0.90)	-0.32	(-0.54, -0.10)	-	-	-
	BASIS-32 Daily Living Subscale Score	4.54	(2, 265)	0.01	(2.36, 265, 0.02)	(0.53, 265, 0.59)	(2.72, 265, 0.007)	-0.29	(-0.53, -0.05)	-0.36	(-0.63, -0.10)	-	-	-
	BASIS-32 Relation to Self & Others Subscale Score	5.88	(2, 264)	0.003	(2.79, 264, 0.006)	(0.35, 264, 0.73)	(2.95, 264, 0.003)	-0.40	(-0.68, -0.12)	-0.46	(-0.77, -0.15)	-	-	-
	BASIS-32 Depression & Anxiety Subscale Score	8.65	(2, 264)	<0.001	(2.85, 264, 0.005)	(1.26, 264, 0.21)	(4.01, 264, <0.001)	-0.37	(0.62, 0.11)	-0.54	(-0.81, -0.27)	-	-	-
	BASIS-32 Impulsive & Addictive Behavior Subscale Score	2.12	(2, 265)	0.12	-	-	-	-0.21	(-0.43, -0.01)	-0.13	(-0.37, 0.11)	-	-	-
	BASIS-32 Psychosis Subscale Score	0.84	(2, 265)	0.43	-	-	-	-0.04	(-0.17, 0.10)	0.07	(-0.10, 0.24)	-	-	-
Substance Use	Illicit drug use Past 6-months (days)	1.79	(2, 265)	0.17	-	-	-	-0.26	(-0.67, 0.13)	-0.38	(-0.81, 0.04)	-	-	-
	Heroin use Past 6-months (days)	3.58	(2, 260)	0.03	(1.57, 260, 0.12)	(0.74, 260, 0.45)	(1.89, 260, 0.05)	-0.89	(-1.77, -0.004)	-1.18	(-2.06, -0.30)	(-10.50, -16.61)	-1.52 (-2.30, -0.74)	0.01
	Alcohol use Past 6-months (days)	0.44	(2, 258)	0.64	-	-	-	-0.18	(-0.60, 0.22)	-0.12	(-0.53, 0.28)	-	-	-
	Cocaine use Past 6-months (days)	0.23	(2, 263)	0.80	-	-	-	-0.16	(-0.98, 0.65)	0.11	(-0.55, 0.78)	-	-	-
	Cannabis use Past 6-months (days)	1.05	(2, 259)	0.34	-	-	-	-0.33	(-1.01, 0.33)	-0.46	(-1.12, 0.19)	-	-	-
Housing Stability	Stable vs Unstable Housing	8.94	(2, 259)	<0.001	(4.64, 259, <0.001)	(1.40, 259, 0.16)	(5.64, 259, <0.001)	3.01	(1.35, 4.64)	3.51	(1.86, 5.15)	-	-	-

Note: All models displayed are adjusted for time, age, gender, and years homeless. AME figures in parenthesis are in reference to the highest fidelity group (≥80%).

DRT Fidelity

Fidelity to DRT was not associated with behavioral health or housing stability, but it did significantly predict several of our substance use outcomes (see Table 6). Fidelity to DRT significantly predicted clients' overall days using illicit substances in the past 6-months (*β* = -0.41, 95% CI [-0.73, -0.10]). Clients who received DRT with ≥80% fidelity had on average 7.4 less days of illicit substance use, and clients who received 50-79% fidelity had on average 12.0 more days of illicit substance use when compared to those that received <50% fidelity, respectively.

Fidelity to DRT significantly predicted clients' overall days of alcohol use in the past 6-months (*β* = -0.33, 95% CI [-0.65, -0.02]). Clients who received DRT with ≥80% fidelity had on average 9.2 less days of alcohol use, and clients who received 50-79% fidelity had on average 12.0 less days of alcohol use when compared to those that received <50% fidelity, respectively.

Notably, fidelity to DRT had a significant iatrogenic impact on days using heroin in the past 6-months (*β* = -0.89, 95% CI [-1.51, -0.27]). Clients who received DRT with ≥80% fidelity had on average 3.51 more days of heroin use, and clients who received 50-79% fidelity had on average 27.9 more days of heroin use when compared to those that received <50% fidelity, respectively.

Critical Time Intervention Case Management Fidelity

Fidelity to CTI case management was not associated with housing stability, but it did significantly predict several of our behavioral health and substance use outcomes (see Table 7). Higher fidelity to CTI case management significantly predicted higher *BASIS-32* relation to self and others sub-scale scores (*β* = 0.20, 95% CI [0.02, 0.40]). Clients who received CTI case management with ≥80% fidelity had an average relation to self and others score 0.3 points higher, and clients who received 50-79% fidelity had average scores 0.1 points higher when compared to those that received <50% fidelity, respectively.

Higher fidelity to CTI case management significantly predicted reductions in past 6-month heroin use (*β* = -2.01, 95% CI [-2.75, -1.45]). Clients who received CTI case management with ≥80% fidelity and those who received 50-79% fidelity both had on average 3.5 less days of heroin use, compared to those that received <50% fidelity.

Table 6. Adjusted Generalized Linear Mixed Models for Dual Recovery Therapy Fidelity

Outcome Domain	Outcome	*F*	*df*	*p*	BL vs 6MN (*t, df, p*)	6MN vs 12MN (*t, df, p*)	BL vs 12MN (*t, df, p*)	6MN Est	6MN 95% CI	12MN Est	12MN 95% CI	*AMEs*	Fidelity Beta (95% CI)	*p*
Behavioral Health Functioning	*BASIS-32* Total Score	5.33	(2, 265)	0.005	(2.74, 265, 0.007)	(0.25, 265, 0.80)	(2.71, 265, 0.007)	-0.28	(-0.48, -0.08)	-0.31	(-0.54, -0.09)	-	-	-
	BASIS-32 Daily Living Subscale Score	4.40	(2, 265)	0.01	(2.32, 265, 0.02)	(0.54, 265, 0.59)	(2.68, 265, 0.008)	-0.29	(-0.53, -0.04)	-0.36	(-0.62, -0.10)	-	-	-
	BASIS-32 Relation to Self & Others Subscale Score	5.46	(2, 264)	0.005	(2.69, 264, 0.007)	(0.33, 264, 0.74)	(2.84, 264, 0.005)	-0.39	(-0.68, -0.11)	-0.44	(-0.74, -0.13)	-	-	-
	BASIS-32 Depression & Anxiety Subscale Score	7.94	(2, 264)	<0.001	(2.71, 264, 0.007)	(1.24, 264, 0.21)	(3.86, 264, <0.001)	-0.35	(-0.61, -0.09)	-0.52	(-0.78, -0.25)	-	-	-
	BASIS-32 Impulsive & Addictive Behavior Subscale Score	2.05	(2, 265)	0.13	-	-	-	-0.21	(-0.43, -0.01)	-0.13	(-0.37, 0.11)	-	-	-
	BASIS-32 Psychosis Subscale Score	0.79	(2, 265)	0.45	-	-	-	-0.04	(-0.17, 0.10)	0.07	(-0.10, 0.24)	-	-	-
Substance Use	Illicit Drug use Past 6-months (days)	1.42	(2, 265)	0.24	-	-	-	-0.25	(-0.65, 0.14)	-0.33	(-0.76, 0.09)	(-19.50, -7.42)	-0.41 (-0.73, -0.10)	0.01
	Heroin use Past 6-months (days)	2.77	(2, 260)	0.06	-	-	-	-0.67	(-1.50, 0.15)	-0.97	(-1.79, -0.14)	(-24.40, 3.51)	-0.89 (-1.51, -0.27)	0.01
	Alcohol use Past 6-months (days)	0.18	(2, 258)	0.83	-	-	-	-0.12	(-0.54, 0.29)	-0.07	(-0.49, 0.34)	(2.87, -9.15)	-0.33 (-0.65, -0.02)	0.04
	Cocaine use Past 6-months (days)	0.76	(2, 263)	0.47	-	-	-	-0.08	(-0.83, 0.66)	0.41	(-0.33, 1.16)	-	-	-
	Cannabis use Past 6-months (days)	0.90	(2, 259)	0.41	-	-	-	-0.31	(-0.97, 0.34)	-0.42	(-1.08, 0.23)	-	-	-
Housing Stability	Stable vs Unstable Housing	9.54	(2, 259)	<0.001	(4.68, 259, <0.001)	(1.42, 259, 0.15)	(0.37, 259, <0.001)	3.01	(1.41, 4.62)	3.53	(1.93, 5.14)	-	-	-

Note: All models displayed are adjusted for time, age, gender, and years homeless. AME figures in parenthesis are in reference to the highest fidelity group (≥80%).

Table 7. Adjusted Generalized Linear Mixed Models for Critical Time Intervention Case Management Fidelity

Outcome Domain	Outcome	*F*	*df*	*p*	BL vs 6MN (*t, df, p*)	6MN vs 12MN (*t, df, p*)	BL vs 12MN (*t, df, p*)	6MN Est	6MN 95% CI	12MN Est	12MN 95% CI	*AMEs*	Fidelity Beta (95% CI)	*p*
Behavioral Health Functioning	*BASIS-32* Total Score	6.11	(2, 265)	0.003	(2.92, 265, 0.004)	(0.32, 265, 0.74)	(2.93, 265, 0.004)	-0.30	(-0.50, -0.10)	-0.33	(-0.56, -0.11)	-	-	-
	BASIS-32 Daily Living Subscale Score	4.91	(2, 265)	0.008	(2.45, 265, 0.01)	(0.58, 265, 0.56)	(2.84, 265, 0.005)	-0.30	(-0.54, -0.06)	-0.38	(-0.64, -0.12)	-	-	-
	BASIS-32 Relation to Self & Others Subscale Score	6.38	(2, 264)	0.002	(2.90, 264, 0.004)	(0.41, 264, 0.68)	(3.11, 264, 0.002)	-0.41	(-0.69, -0.13)	-0.48	(-0.78, -0.17)	(0.22, 0.32)	0.20 (0.02, 0.40)	0.03
	BASIS-32 Depression & Anxiety Subscale Score	9.14	(2, 264)	<0.001	(2.93, 264, 0.004)	(1.30, 264, 0.19)	(4.11, 264, <0.001)	-0.37	(-0.63, -0.13)	-0.56	(-0.82, -0.29)	-	-	-
	BASIS-32 Impulsive & Addictive Behavior Subscale Score	2.36	(2, 265)	0.09	-	-	-	-0.23	(-0.44, -0.02)	-0.15	(-0.39, 0.10)	-	-	-
	BASIS-32 Psychosis Subscale Score	0.77	(2, 265)	0.46	-	-	-	-0.04	(-0.18, 0.10)	0.06	(-0.11, 0.23)	-	-	-
Substance Use	Illicit Drug use Past 6-months (days)	1.63	(2, 265)	0.19	-	-	-	-0.26	(-0.67, 0.13)	-0.35	(-0.79, 0.07)	-	-	-
	Heroin use Past 6-months (days)	2.54	(2, 260)	0.08	-	-	-	-0.84	(-1.59, -0.10)	-0.65	(-1.62, 0.33)	(-0.01, -3.48)	-2.01 (-2.75, -1.45)	<0.001
	Alcohol use Past 6-months (days)	0.50	(2, 258)	0.61	-	-	-	-0.19	(-0.61, 0.21)	-0.14	(-0.55, 0.27)	-	-	-
	Cocaine use Past 6-months (days)	0.81	(2, 263)	0.44	-	-	-	-0.13	(-0.87, 0.60)	0.41	(-0.34, 1.17)	-	-	-
	Cannabis use Past 6-months (days)	0.90	(2, 259)	0.41	-	-	-	-0.32	(-0.97, 0.32)	-0.42	(-1.08, 0.24)	-	-	-
Housing Stability	Stable vs Unstable Housing	9.35	(2, 259)	<0.001	(4.64, 259, <0.001)	(1.41, 259, 0.16)	(5.68, 259, <0.001)	3.00	(1.39, 4.62)	3.52	(1.91, 5.13)	-	-	-

Note: All models displayed are adjusted for time, age, gender, and years homeless. AME figures in parenthesis are in reference to the highest fidelity group (≥80%).

Peer-Led Fidelity

Fidelity to Peer-Led sessions was not associated with housing stability, but it significantly predicted several of our behavioral health and substance use outcomes (see Table 8). Higher fidelity to Peer-Led sessions significantly predicted clients' lower *BASIS-32* total scores (β = -0.11, 95% CI [-0.21, -0.01]). Clients who received Peer-Led sessions with ≥80% fidelity had an average *BASIS-32* total score 0.20 points lower, and those who received 50-79% fidelity had scores 0.07 points lower, compared to those that received <50% fidelity, respectively.

In addition, higher Peer-Led fidelity also significantly predicted lower depression and anxiety sub-scale scores (β = -0.15, 95% CI [-0.28, -0.02]). Clients who received Peer-Led sessions with ≥80% fidelity had improved depression and anxiety scores of 0.22

points lower on average, and those who received 50-79% fidelity had scores 0.05 points lower, compared to those that received <50% fidelity, respectively.

Fidelity to Peer-Led sessions was also a significant predictor of *BASIS-32* psychosis sub-scale scores (*β* = -0.11, 95% CI [-0.18, -0.03]). Clients who received Peer-Led sessions with ≥80% fidelity had improved psychosis scores that were on average 0.13 points lower, and those who received 50-79% fidelity had scores 0.06 points lower, compared to those that received <50% fidelity, respectively.

Fidelity to Peer-Led sessions also significantly predicted reductions in past 6-month heroin use (*β* = -0.48, 95% CI [-0.91, -0.04]). Clients who received Peer-Led sessions with ≥80% fidelity had on average 29.4 less days using heroin in the past 6-months, and those who received 50-79% fidelity had 45.4 less days using heroin, compared to those that received <50% fidelity, respectively.

Critical Time Intervention Peer Support Fidelity

Fidelity to CTI peer support was not associated with behavioral health or substance use, but it did significantly predict housing stability (see Table 9). Higher fidelity to CTI peer support significantly predicted stable housing placement over time (*β* = 0.65, 95% CI [0.04, 1.26]). Clients who received CTI peer support with ≥80% fidelity were 14.5% more likely to obtain stable housing at follow-up, and those who received 50-79% fidelity were 11.4% were more likely to obtain stable housing, compared to those that received <50% fidelity, respectively.

Table 8. Adjusted Generalized Linear Mixed Models for Peer-Led Fidelity

Outcome Domain	Outcome	*F*	*df*	*p*	BL vs 6MN (*t, df, p*)	6MN vs 12MN (t, df, p)	BL vs 12MN (t, df, p)	6MN Est	6MN 95% CI	12MN Est	12MN 95% CI	*AMEs*	Fidelity Beta (95% CI)	*p*
Behavioral Health Functioning	*BASIS-32* Total Score	5.41	(2, 265)	0.005	(2.76, 265, 0.006)	(0.22, 265, 0.83)	(2.72, 265, 0.007)	-0.28	(-0.48, -0.08)	-0.31	(-0.53, -0.09)	(-0.13, -0.19)	-0.11 (-0.21, -0.01)	0.04
	BASIS-32 Daily Living Subscale Score	4.46	(2, 265)	0.01	(2.35, 265, 0.02)	(0.51, 265, 0.61)	(2.69, 265, 0.007)	-0.29	(-0.53, -0.05)	-0.36	(-0.61, -0.10)	-	-	-
	BASIS-32 Relation to Self & Others Subscale Score	5.48	(2, 264)	0.005	(2.71, 264, 0.007)	(0.30, 264, 0.76)	(2.85, 264, 0.005)	-0.39	(-0.68, -0.11)	-0.44	(-0.74, -0.14)	-	-	-
	BASIS-32 Depression & Anxiety Subscale Score	8.10	(2, 264)	<0.001	(2.74, 264, 0.006)	(1.20, 264, 0.23)	(3.89, 264, <0.001)	-0.35	(-0.61, -0.10)	-0.51	(-0.78, -0.25)	(-0.17, -0.21)	-0.15 (-0.28, -0.02)	0.02
	BASIS-32 Impulsive & Addictive Behavior Subscale Score	2.17	(2, 265)	0.11	-	-	-	-0.22	(-0.43, -0.01)	-0.13	(-0.37, 0.11)	-	-	-
	BASIS-32 Psychosis Subscale Score	0.91	(2, 265)	0.41	-	-	-	-0.03	(-0.16, 0.10)	0.08	(-0.09, 0.24)	(-0.07, -0.13)	-0.11 (-0.18, -0.03)	0.01
Substance Use	Illicit Drug use Past 6-months (days)	1.63	(2, 265)	0.19	-	-	-	-0.27	(-0.67, 0.12)	-0.35	(-0.78, 0.07)	-	-	-
	Heroin use Past 6-months (days)	3.01	(2, 260)	0.05	-	-	-	-0.70	(-1.55, 0.15)	-1.01	(-1.85, -0.18)	(15.97, -29.41)	-0.48 (-0.91, -0.04)	0.03
	Alcohol use Past 6-months (days)	0.45	(2, 258)	0.63	-	-	-	-0.19	(-0.60, 0.22)	-0.13	(-0.54, 0.28)	-	-	-
	Cocaine use Past 6-months (days)	0.82	(2, 263)	0.44	-	-	-	-0.10	(-0.87, 0.65)	0.43	(-0.32, 1.19)	-	-	-
	Cannabis use Past 6-months (days)	0.91	(2, 259)	0.40	-	-	-	-0.33	(-0.99, 0.31)	-0.41	(-1.07, 0.25)	-	-	-
Housing Stability	Stable vs Unstable Housing	9.43	(2, 259)	<0.001	(4.68, 259, <0.001)	(1.49, 259, 0.14)	(5.79, 259, <0.001)	3.04	(1.41, 4.68)	3.59	(1.95, 5.23)	-	-	-

Note: All models displayed are adjusted for time, age, gender, and years homeless. AME figures in parenthesis are in reference to the highest fidelity group (≥80%).

Table 9. Adjusted Generalized Linear Mixed Models for Critical Time Intervention Peer Support Fidelity

Outcome Domain	Outcome	*F*	*df*	*p*	BL vs 6MN (*t, df, p*)	6MN vs 12MN (*t, df, p*)	BL vs 12MN (*t, df, p*)	6MN Est	6MN 95% CI	12MN Est	12MN 95% CI	*AMEs*	Fidelity Beta (95% CI)	*p*
Behavioral Health Functioning	*BASIS-32* Total Score	5.71	(2, 265)	0.004	(2.83, 265, 0.005)	(0.27, 265, 0.79)	(2.81, 265, 0.005)	-0.29	(-0.49, -0.09)	-0.32	(-0.55, -0.10)	-	-	-
	BASIS-32 Daily Living Subscale Score	4.57	(2, 265)	0.01	(2.37, 265, 0.02)	(0.53, 265, 0.59)	(2.72, 265, 0.007)	-0.29	(-0.53, -0.05)	-0.36	(-0.63, -0.10)	-	-	-
	BASIS-32 Relation to Self & Others Subscale Score	5.82	(2, 264)	0.003	(2.78, 264, 0.006)	(0.34, 264, 0.73)	(2.93, 264, 0.004)	-0.40	(-0.68, -0.12)	-0.46	(-0.76, -0.15)	-	-	-
	BASIS-32 Depression & Anxiety Subscale Score	9.16	(2, 264)	<0.001	(2.92, 264, 0.004)	(1.30, 264, 0.19)	(4.12, 264, <0.001)	-0.37	(-0.63, -0.12)	-0.55	(-0.82, -0.29)	-	-	-
	BASIS-32 Impulsive & Addictive Behavior Subscale Score	2.14	(2, 265)	0.12	-	-	-	-0.22	(-0.43, -0.01)	-0.13	(-0.37, 0.11)	-	-	-
	BASIS-32 Psychosis Subscale Score	0.87	(2, 265)	0.42	-	-	-	-0.04	(-0.17, 0.10)	0.07	(-0.10, 0.24)	-	-	-
Substance Use	Illicit drug use Past 6-months (days)	1.83	(2, 265)	0.16	-	-	-	-0.28	(-0.68, 0.11)	-0.37	(-0.81, 0.05)	-	-	-
	Heroin use Past 6-months (days)	3.98	(2, 260)	0.02	(1.50, 260, 0.13)	(1.05, 260, 0.29)	(1.98, 260, 0.04)	-0.81	(-1.69, 0.07)	-1.25	(-2.12, -0.37)	-	-	-
	Alcohol use Past 6-months (days)	0.46	(2, 258)	0.63	-	-	-	-0.19	(-0.60, 0.22)	-0.13	(-0.54, 0.28)	-	-	-
	Cocaine use Past 6-months (days)	0.26	(2, 263)	0.76	-	-	-	-0.13	(-0.94, 0.67)	0.16	(-0.94, 0.67)	-	-	-
	Cannabis use Past 6-months (days)	1.05	(2, 259)	0.35	-	-	-	-0.31	(-0.98, 0.36)	-0.46	(-1.12, 0.18)	-	-	-
Housing Stability	Stable vs Unstable Housing	7.01	(2, 259)	0.001	(4.55, 259, <0.001)	(1.38, 259, 0.17)	(5.42, 259, <0.001)	3.01	(1.13, 4.89)	3.52	(1.64, 5.41)	(0.03, 0.14)	0.65 (0.31, 2.09)	0.04

Note: All models displayed are adjusted for time, age, gender, and years homeless. AME figures in parenthesis are in reference to the highest fidelity group (≥80%).

Discussion

Individuals with COD experiencing chronic homelessness have unique service and treatment needs that few treatment options fully address in an integrated approach. This study examined the impact of fidelity to the MISSION model, an evidence-based, multicomponent integrated COD wraparound treatment and linkage intervention, on outcomes after 6- and 12-months of MISSION services among clients with COD experiencing chronic homelessness. MISSION studies among similar populations have found improvements in behavioral health outcomes, substance use outcomes, increased community tenure, reduced hospitalizations, and increased service utilization among clients.[24-29] While these improvements among MISSION clients are an important goal, it is also critical to understand the degree to which fidelity (an implementation dimension determined by the MISSION facilitators' behavior)[30] to MISSION and to its components impact client outcomes. Knowledge of these relationships can aid in further adaptations or potential enhancements to the implementation of MISSION to reduce disparities in outcomes. When fidelity to MISSION overall and to each component were individually added to models, we observed several instances where fidelity was a significant predictor of outcomes. For example, higher fidelity to MISSION overall, CTI case management, and Peer-Led sessions independently reduced days of heroin use, higher fidelity to DRT reduced substance use and alcohol use, higher fidelity to Peer-Led sessions improved behavioral health, and CTI peer support improved rates of housing stability. These findings demonstrate that higher fidelity by MISSION teams can have some beneficial impact on clients' outcomes across domains, underscoring the importance of adhering to intended implementation of this evidence-based intervention. While numerous studies show significant relationships between fidelity and client outcomes,[30,33,34,50] this study expands the current literature by examining fidelity to a multicomponent intervention delivered among a sample of clients with complex clinical and social needs.

Providing peer support specialists with training to deliver evidenced-based interventions including structured services (here, facilitating group sessions and guiding clients through a treatment workbook) can have a positive impact on client outcomes.[51] Thus it is positive that we observed that fidelity to Peer-Led sessions had significant benefits on both client behavioral health and substance use outcomes. These findings are noteworthy since more peer-based positions are being professionalized however

the nature of their role often varies and is mostly unstructured. For instance, Chinman et al., (2016) reported mental health peer specialists' roles include actions such as sharing recovery stories, engaging people in services, advocating for recovery, and teaching coping and problem solving skills. Future peer-roles may provide strategies and tools to offer clients and enhance working with clients. The qualities of a peer support specialist (i.e., person with previous COD and homelessness experience) are also important in MISSION as the Peer-Led sessions focus on recovery-based discussions. For example, we observed clients receiving Peer-Led sessions with mid-tier fidelity (50-79%) had the greatest reduction in heroin use followed by (≥80%) compared to those with lower fidelity (<50%); this finding highlights that the higher tier of fidelity received has a harm reduction approach to reducing heroin use. Harm reduction, often integrated within Housing First, recognizes substance use recovery as a staged process (compared to abstinence being the goal),[52] which has been found to be beneficial among populations with COD and homelessness in obtaining and maintaining housing whilst not negatively impacting substance use or mental health symptoms.[15] MISSION peer support specialists may be better suited for engaging clients in such recovery-oriented conversations being able to reflect on past personal experiences. Nonetheless, few models examine fidelity to peer support interventions, which based on our findings could improve outcomes and would be pivotal to enhancing peer-based services and supports. Other research surrounding the development of peer support fidelity measures highlight the importance of determining whether peer support services delivered are distinct from other clinical roles,[53] as well as being able to dissect whether a lack of impact on client outcomes could be due to ineffective peer services or a mismatch between the peer-role and services delivered.[51]

Notably, when we evaluated fidelity to each of the components of MISSION, fidelity to CTI peer support was the only significant predictor of housing stability. We observed that clients who received CTI peer support with higher fidelity were more likely to obtain stable housing compared to lower fidelity. This finding is of critical importance; following a Housing First approach, it is important to stabilize housing prior to addressing other SDOH needs in order for individuals to address their behavioral health needs and in turn increase their likelihood of maintaining stable housing. Moreover, this is positive since MISSION peer support specialists not only focus on recovery services (e.g., 12-step programs), but they also have a strong role in linking clients to housing services. The benefit of implementing peer support with individuals experiencing homeless is in line with previous research, however, this area is limited and again often does not evaluate the impact of peer support when integrated with other treatments.[54-56]

This study also acknowledges the relationships between DRT and CTI case management were mixed. For example, clients who received DRT with 50-79% fidelity, had more days of illicit substance use compared to <50% fidelity. This finding may indicate that it is critical for case managers to deliver DRT with high fidelity (a threshold here set to ≥80%) in order for clients to receive the maximum benefit from this component of MISSION to influence reductions in illicit substance use outcomes. This is particularly important as DRT is a psychoeducational curriculum that simultaneously addresses individuals' substance use and mental health needs. While DRT provides psychoeducation around substance use, individuals who use heroin may have more severe substance use challenges, worsened by additional behavioral health and SDOH needs, and require higher levels of care.[57] We also observed an iatrogenic relationship between higher fidelity to CTI case management and worsening behavioral health outcomes. These findings may suggest that the gravity of the behavioral health and substance use problems among this population are not only more severe, but also require case managers to provide more linkages to medical and other behavioral services which take longer to establish care.

Several limitations of the present study should be acknowledged. First, this study included a relatively

small sample size with limited geographic representation, and therefore the findings may not be generalizable to other regions with populations with COD experiencing chronic homelessness. This is particularly relevant as geographic location can influence SDOH needs which are risk factors for behavioral health needs. Second, while examining the relationship between fidelity and client outcomes was a strength of the study; all measures were self-reported by the facilitators. Despite receiving the same training, there may be inconsistencies in how MISSION facilitators recorded fidelity in the tracking logs. Facilitators may confuse what services they provided to whom when having many clients on a single caseload or misremember the extent of an unstructured session they had with a client. Third, self-report measures, in particular for reporting substance use, from clients may contain bias as well as relies on memory to complete fidelity tracking logs.[58] Lastly, this study did not account for severity of substance use disorders using *ICD-10* or *DSM-5* severity designations which may confound the relationship between fidelity and client outcomes.

Continued study of the relationship between fidelity and client outcomes is needed to better understand how services can be improved to reduce disparities in outcomes and meet the unique needs of marginalized populations. Since there are many contextual factors that are related to the clients' circumstances at the time of MISSION services, future studies may include a measure of client responsiveness (i.e., clients' engagement, satisfaction, or practice of skills learned), as literature is mixed, finding responsiveness both mediates and moderates the relationship between fidelity and client outcomes.[30,59,60] Moreover, further research is needed on the long-term outcomes post-MISSION services. For example, not all clients were housed at 12-months so the services provided by MISSION case managers may not offset the impact of unstable housing described in previous literature.[61,62] Additionally, future studies using DRT may collect qualitative data or record sessions to probe the therapeutic themes that emerge during sessions to clarify whether both substance use and mental health challenges are being discussed during sessions as intended by the MISSION model.

Conclusion

Understanding if and how implementation outcomes such as fidelity are associated with delivering evidence-based interventions in communities allows intervention developers and providers to adapt, refine, and enhance services to meet the unique needs of marginalized clients and reduce health disparities. Consistent with previous research, this study found mixed associations between fidelity to MISSION and client behavioral health, substance use, and housing outcomes. This study does highlight the distinctive role MISSION peer support specialists serve in supporting clients with COD and chronic homelessness which has important practice implications for enhancing future integrated treatment approaches.

Conflicts of Interest Statement:

The authors have no conflicts of interest to declare.

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References:

1. Development USDoHaU. *The 2023 Annual Homelessness Assessment Report (AHAR) to Congress.* 2023.

2. Caton CL, Wilkins C, Anderson J. People who experience long-term homelessness: Characteristics and interventions. Paper presented at: National symposium on homelessness research2007.

3. Foster S, LeFauve C, Kresky-Wolff M, Rickards LD. Services and supports for individuals with co-occurring disorders and long-term homelessness. *The Journal of Behavioral Health Services & Research.* 2010;37:239-251.

4. Greenberg GA, Rosenheck RA. Mental health and other risk factors for jail incarceration among male veterans. *Psychiatric Quarterly.* 2009;80(1):41-53.

5. Padgett DK, Henwood B, Abrams C, Davis A. Engagement and retention in services among formerly homeless adults with co-occurring mental illness and substance abuse: voices from the margins. *Psychiatric rehabilitation journal.* 2008;31 (3):226.

6. Schütz C, Choi F, Jae Song M, Wesarg C, Li K, Krausz M. Living with dual diagnosis and homelessness: Marginalized within a marginalized group. *Journal of Dual Diagnosis.* 2019;15(2):88-94.

7. Stafford A, Wood L. Tackling health disparities for people who are homeless? Start with social determinants. *International journal of environmental research and public health.* 2017;14(12):1535.

8. Braveman P, Egerter S, Williams DR. The social determinants of health: coming of age. *Annual review of public health.* 2011;32(1):381-398.

9. Hossain MM, Sultana A, Tasnim S, et al. Prevalence of mental disorders among people who are homeless: An umbrella review. *International Journal of Social Psychiatry.* 2020;66(6):528-541.

10. Liu M, Hwang SW. Health care for homeless people. *Nature Reviews Disease Primers.* 2021;7(1):5.

11. Drake RE, Yovetich NA, Bebout RR, Harris M, McHugo GJ. Integrated treatment for dually diagnosed homeless adults. *The Journal of nervous and mental disease.* 1997;185(5):298-305.

12. Hwang SW, Burns T. Health interventions for people who are homeless. *The Lancet.* 2014;384(9953):1541-1547.

13. Padgett DK, Gulcur L, Tsemberis S. Housing first services for people who are homeless with co-occurring serious mental illness and substance abuse. *Research on social work practice.* 2006;16(1):74-83.

14. Stefancic A, Tsemberis S. Housing First for long-term shelter dwellers with psychiatric disabilities in a suburban county: A four-year study of housing access and retention. *The journal of primary prevention.* 2007;28:265-279.

15. Tsemberis S, Gulcur L, Nakae M. Housing first, consumer choice, and harm reduction for homeless individuals with a dual diagnosis. *American journal of public health.* 2004;94(4):651-656.

16. Herman D, Opler L, Felix A, Valencia E, Wyatt RJ, Susser E. A critical time intervention with mentally ill homeless men: impact on psychiatric symptoms. *The Journal of nervous and mental disease.* 2000;188(3):135-140.

17. Herman DB, Mandiberg JM. Critical time intervention: Model description and implications for the significance of timing in social work interventions. *Research on Social Work Practice.* 2010;20(5):502-508.

18. Susser E, Valencia E, Conover S, Felix A, Tsai WY, Wyatt RJ. Preventing recurrent homelessness among mentally ill men: a "critical time" intervention after discharge from a shelter. *Am J Public Health.* 1997;87(2):256-262.

19. Klein AR, Cnaan RA, Whitecraft J. Significance of peer social support with dually diagnosed clients: Findings from a pilot study. *Research on Social Work Practice.* 1998;8(5):529-551.

20. Vayshenker B, Mulay AL, Gonzales L, West ML, Brown I, Yanos PT. Participation in peer support services and outcomes related to recovery. *Psychiatric rehabilitation journal.* 2016;39(3):274.

21. Ziedonis DM, & Stern, R. . Dual recovery therapy for schizophrenia and substance abuse. *Psychiatric Annals.* 2001;31(4):255.

22. Ziedonis DM. Integrated treatment of co-occurring mental illness and addiction: clinical intervention, program, and system perspectives. *CNS Spectr.* 2004;9(12):892-904, 925.

23. Chinman M, George, P., Dougherty, R. H., Daniels, A. S., Ghose, S. S., Swift, A., & Delphin-Rittmon, M. E.. Peer support services for individuals with serious mental illnesses: assessing the evidence. *Psychiatric Services.* 2014.

24. Smelson D, Kalman, D., Losonczy, M.F., Kline, A., Sambamoorthi, U., Hill L.S., ...& Ziedonis, D. A brief treatment engagement interventions for individuals with co-occurring mental illness and substance use disorders: results of a randomized clinical trial. *Community mental health journal.* 2012;48(2):127-132.

25. Smelson D, Kline A, Kuhn J, et al. A wraparound treatment engagement intervention for homeless veterans with co-occurring disorders. *Psychological Services.* 2013;10(2):161-167.

26. Smelson DA, Chinman M, Hannah G, Byrne T, McCarthy S. An evidence-based co-occurring disorder intervention in VA homeless programs: outcomes from a hybrid III trial. *BMC health services research.* 2018;18(1):332.

27. Smelson DA, Perez CK, Farquhar I, Byrne T, Colegrove A. Permanent Supportive Housing and Specialized Co-Occurring Disorders Wraparound Services for Homeless Individuals. *Journal of Dual Diagnosis.* 2019:1-10.

28. Shaffer PM, Helm A, Andre M, et al. Rapidly Adapting a Multicomponent Treatment for Persons Experiencing Chronic Homelessness with Comorbid Substance Use and Mental Health Disorders During the Coronavirus Disease 2019 Pandemic. *Medical Research Archives.* 2023;11(11).

29. Helm AF, Andre MA, Shaffer PM, et al. Multicomponent Co-Occurring Disorders Treatment and Wraparound Services for Individuals Experiencing Chronic Homelessness. *Community Mental Health Journal.* 2024:1-11.

30. Berkel C, Mauricio AM, Schoenfelder E, Sandler IN. Putting the pieces together: An integrated model of program implementation. *Prevention Science.* 2011;12:23-33.

31. Nelson G, Stefancic A, Rae J, et al. Early implementation evaluation of a multi-site housing first intervention for homeless people with mental illness: a mixed methods approach. *Evaluation and program planning.* 2014;43:16-26.

32. Dates B, Young MS, Bennett-Clark F, et al. Assertive Community Treatment fidelity in programs serving persons who are homeless with co-occurring mental and addictive disorders. *Journal of Dual Diagnosis.* 2009;5(3-4):264-286.

33. Durlak JA, DuPre EP. Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. *American journal of community psychology.* 2008;41:327-350.

34. Shaffer PM, Rodriguez CP, Gaba A, et al. Engaging vulnerable populations in drug treatment court: Six month outcomes from a co-occurring disorder wraparound intervention. *International Journal of Law and Psychiatry.* 2021;76:101700.

35. Marques L, Valentine SE, Kaysen D, et al. Provider fidelity and modifications to cognitive processing therapy in a diverse community health clinic: Associations with clinical change. *Journal of consulting and clinical psychology.* 2019;87(4):357.

36. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders (DSM-5®).* American Psychiatric Pub; 2013.

37. Smelson DA, Sawh L, Harter J, Ziedonis D. *The MISSION Participant Workbook: Second Edition.* Worcester, MA: University of Massachusetts Medical School,; 2014.

38. Smelson D, Kline A, Hills S, Ziedonis D. *The MISSION treatment manual: Second Edition.* Worcester, MA: University of Massachusetts Medical School; 2014.

39. Moynihan DP. The new federal performance system: Implementing the GPRA Modernization Act. *Improving performance.* 2013.

40. Administration SAaMHS. CSAT GPRA Modernization Act Data Collection Tools. In:2015.

41. Weathers FW, Litz, B.T., Keane, T.M., Palmieri, P.A., Marx, B.P., & Schnurr, P.P. The PTSD Checklist for DSM-5 (PCL-5). Scale available from the National Center for PTSD at www.ptsd.va.gov. Published 2013. Accessed.

42. Blevins CA, Weathers FW, Davis MT, Witte TK, Domino JL. The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5): Development and Initial Psychometric Evaluation. *Journal of traumatic stress.* 2015;28(6):489-498.

43. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of biomedical informatics.* 2009;42(2):377-381.

44. Eisen SV, Wilcox M, Leff HS, Schaefer E, Culhane MA. Assessing behavioral health outcomes in outpatient programs: Reliability and validity of the BASIS-32. *The Journal of Behavioral Health Services & Research.* 1999;26:5-17.

45. McLellan AT, Grissom GR, Zanis D, Randall M, Brill P, O'brien CP. Problem-service'matching'in addiction treatment: A prospective study in 4 programs. *Archives of General Psychiatry.* 1997; 54(8):730-735.

46. Breslow NE, Clayton DG. Approximate inference in generalized linear mixed models. *Journal of the American statistical Association.* 1993;88(4 21):9-25.

47. SAS Institute I. SAS/STAT® 15.3 user's guide. In: SAS Institute, Inc.; 2023.

48. Corp. I. IBM SPSS Statistics for Windows, Version 29.0.2.0. In. Armonk, NY: IBM; 2023.

49. StataCorp. Stata Statistical Software: Release 18. In. College Station, TX: StataCorp LLC.; 2023.

50. McHugo GJ, Drake RE, Teague GB, Xie H. Fidelity to assertive community treatment and client outcomes in the New Hampshire dual disorders study. *Psychiatric Services.* 1999;50(6):818-824.

51. Chinman M, McCarthy S, Mitchell-Miland C, Daniels K, Youk A, Edelen M. Early stages of development of a peer specialist fidelity measure. *Psychiatric rehabilitation journal.* 2016;39(3):256.

52. Pauly B, Reist D, Belle-Isle L, Schactman C. Housing and harm reduction: What is the role of harm reduction in addressing homelessness? *International Journal of Drug Policy.* 2013;24(4): 284-290.

53. Gillard S, Banach N, Barlow E, et al. Developing and testing a principle-based fidelity index for peer support in mental health services. *Social Psychiatry and Psychiatric Epidemiology.* 2021;56(10):1903-1911.

54. Barker SL, Maguire N. Experts by Experience: Peer Support and its Use with the Homeless. *Community Mental Health Journal.* 2017;53(5):59 8-612.

55. Barker SL, Maguire N, Bishop FL, Stopa L. Peer support critical elements and experiences in supporting the homeless: a qualitative study. *Journal of Community & Applied Social Psychology.* 2018; 28(4):213-229.

56. Erangey J, Marvin C, Littman DM, et al. How peer support specialists uniquely initiate and build connection with young people experiencing homelessness. *Children and Youth Services Review.* 2020;119:105668.

57. Ross J, Teesson M, Darke S, et al. The characteristics of heroin users entering treatment: findings from the Australian treatment outcome study (ATOS). *Drug and alcohol review.* 2005;24(5): 411-418.

58. Breitenstein SM, Gross D, Garvey CA, Hill C, Fogg L, Resnick B. Implementation fidelity in community-based interventions. *Research in nursing & health.* 2010;33(2):164-173.

59. Berkel C, Mauricio AM, Sandler IN, Wolchik SA, Gallo CG, Brown CH. The cascading effects of multiple dimensions of implementation on program outcomes: A test of a theoretical model. *Prevention Science.* 2018;19:782-794.

60. Leadbeater BJ, Thompson K, Sukhawathanakul P. Enhancing social responsibility and prosocial leadership to prevent aggression, peer victimization, and emotional problems in elementary school children. *American journal of community psychology.* 2016;58(3-4):365-376.

61. Padgett DK. Homelessness, housing instability and mental health: making the connections. *BJPsych Bulletin*. 2020;44(5):197-201.

62. Zerger S, Strehlow AJ, Gundlapalli AV. Homeless young adults and behavioral health: An overview. *American behavioral scientist.* 2008;51 (6):824-841.