

Publicly Funded Systems Utilization in the Context of Combined Pharmacobehavioral Harm Reduction Treatment for People with Lived Experience of Homelessness and Hazardous Drinking

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Research Article

Keywords: alcohol use disorder, alcohol treatment, harm reduction, extended-release naltrexone, homelessness, jail, emergency department, hospitalization

Posted Date: September 24th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11037611/v1>

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Abstract

Harm reduction treatment for alcohol (HaRT-A) reduces alcohol-related harm and improves health-related quality of life (HRQoL) without requiring abstinence. HaRT-A is efficacious alone and with extended-release naltrexone (XR-NTX) for people experiencing homelessness and alcohol use disorder (AUD). This study extended analyses from a prior randomized controlled trial (RCT) to test HaRT-A effects on jail and healthcare costs. Exploratory analyses tested baseline sociodemographic, HRQoL and substance-use variables as predictors of system utilization.

RCT participants experienced homelessness and AUD (N=308). They were randomized to 12 weeks of HaRT-A plus XR-NTX, HaRT-A plus placebo, HaRT-A alone, or services-as-usual control. Baseline sociodemographics, HRQoL, and substance-use data were assessed with single-items on self-report measures. Use and cost of emergency medical services (EMS), emergency department, hospitalizations, and jail were extracted from administrative records. Exploratory analyses included a larger screened sample of people with lived experience of homelessness and hazardous drinking (N=401).

There were no significant HaRT-A or XR-NTX effects on costs ($ps > .05$). Exploratory analyses showed age was inversely correlated with EMS use (IRR=0.97, $p=0.002$). Smoking (IRR=2.02, $p=0.03$) and alcohol-related harm (IRR=1.04, $p=0.005$) were associated with more jail bookings. Less alcohol use (IRR=0.94, $p=0.02$), greater alcohol-related harm (IRR=1.06, $p=0.01$), and higher mental-health QoL (IRR=1.13, $p=0.04$) were associated with more jail days.

Lack of HaRT-A and XR-NTX effects on costs may reflect low power, brief follow-up period, and the treatment's brevity. Studies testing longer-term HaRT-A + XR-NTX may provide a stronger test of its potential to reduce costs. Exploratory analyses provide points for potential intervention.

Introduction

People experiencing homelessness (PEH) have significantly higher all-cause mortality rates and die at much younger ages than the general population.¹⁻³ Alcohol and other substances account for a significant proportion of morbidity⁴ and of mortality.^{1,5} In one study, 22% of deaths among PEH were attributable to alcohol use disorder (AUD).³ This high prevalence of hazardous drinking and severe alcohol-related harm precipitates correspondingly high-intensity, high-cost health care involvement. Specifically, PEH utilize emergency medical services (EMS) up to 19 times more than the general population,⁶ emergency department (ED) 2 to 18 times more frequently than the general population,⁸⁻¹⁰ and have more frequent and longer inpatient hospital admissions.^{8,9,11}

This population is also disproportionately involved with the justice system. One international metanalysis demonstrated that people in prisons are 20 times more likely to be homeless than the general population.¹² Another study indicated that 42% of PEH who were booked into jail underwent medically supervised alcohol withdrawal.¹³ Together, these findings underscore the high prevalence of

AUD among PEH in jails as well as the potential medical complications involved in incarceration of this population.

One strategy for reducing high-cost publicly funded system utilization is to address AUD among PEH upstream by providing effective, accessible treatment. Harm reduction, which entails low-barrier, person-centered, nonabstinence-based interventions to reduce substance-related harm and improve health-related quality of life (HRQoL) is well-positioned to address these needs.¹⁴ Efficacious harm-reduction approaches for AUD in this population include community-level models, such as low-barrier, nonabstinence-based housing¹⁵ and managed alcohol programs.¹⁶ On the individual level, behavioral harm-reduction treatment for AUD (HaRT-A) has been shown to be acceptable and effective for this population.^{17,18} HaRT-A entails low-intensity, low-barrier and community-based counseling that does not require abstinence but focuses on reducing alcohol-related harm and improving HRQoL.¹⁹ HaRT-A comprises three primary components: (a) collaborative tracking of alcohol-related harm among other alcohol and health indices, (b) elicitation of harm-reduction and HRQoL goals, and (c) discussion of safer-drinking strategies. In a previous study, behavioral HaRT-A led to decreased alcohol use and decreased alcohol-related harm for PEH with AUD.¹⁷

To understand whether the efficacy of HaRT-A could be enhanced with pharmacotherapy, an additional randomized controlled trial (RCT) combined HaRT-A with extended-release naltrexone (XR-NTX).¹⁸ XR-NTX is a long-acting injectable opioid receptor antagonist that is safe and effective, even among people who are actively drinking and have liver disease,^{20,21} particularly at facilitating reductions in alcohol frequency,²² quantity, and alcohol-related harm.^{20,23} The RCT findings showed that, compared to the services-as-usual control arm, the HaRT-A plus XR-NTX arm showed significant reductions in peak alcohol quantity, alcohol frequency, and alcohol-related harm as well as improvements in physical HRQoL.¹⁸ Findings for the HaRT-A plus placebo and HaRT-A alone arms also showed significant improvements in alcohol outcomes compared to the services-as-usual control. An additional exploratory study indicated the three active treatment groups showed significantly reduced polysubstance use and cannabis use frequency compared to the services-as-usual control.²⁴

In this follow-up study, we tested the efficacy (N=308) of the active treatment arms (HaRT-A plus XR-NTX, HaRT-A plus placebo, and HaRT-A alone) compared to the services-as-usual control arm in reducing costs of EMS, ED, hospitalization, and jail utilization. It was expected that, compared to the services-as-usual control arm, the active treatment arms would show reduced costs over the course of the treatment and follow-up period. In additional exploratory analyses, we tested associations between the larger, initially screened sample's (N=401) baseline publicly funded system utilization (i.e. number of EMS dispatches, ED visits, inpatient hospitalizations, and jail bookings and days) and baseline sample features, including sociodemographics (i.e. age, sex assigned at birth, race, and ethnicity), past-month substance use (i.e. cigarette smoking, alcohol quantity and frequency, and other drug use), physical and mental HRQoL, and alcohol-related harm.

Methods

Parent Trial Design

The design of the parent study was a four-arm RCT (N=308) testing the efficacy of the HaRT-A plus XR-NTX, HaRT-A plus placebo, and HaRT-A alone arms compared to a services-as-usual control arm in a sample of PEH with AUD. In prior studies, we tested whether the active treatment arms would improve alcohol, other substance use, and HRQoL outcomes compared to the control arm. In this secondary study, we leveraged the same design to test whether the active treatment arms experienced decreases in costs associated with publicly funded system utilization compared to the services-as-usual control arm. In exploratory analyses, we used a cross-sectional, correlational design to test whether self-reported baseline characteristics (N=401) were associated with baseline utilization of jail, EMS, ED, and inpatient hospitalization.

Participants

RCT participants were 308 adults (age 21-65) who experienced homelessness in the past year, met the DSM-IV-TR criteria for alcohol dependence, and were medically cleared for participation. (Please refer to parent study for more information on inclusion and exclusion criteria and study design.¹⁸)

For the exploratory component of this analysis, we included the entire baseline sample who had initially screened positive for lived experience of homelessness and hazardous drinking according to the AUDIT-C²⁵ prior to the application of the parent RCT's more limiting inclusion and exclusion criteria (N=401). As such, this sample included participants who had lived experience of homelessness but had moved into publicly funded housing or permanent supportive housing facilities in recent months (N=9). It also included those who had screened positive for hazardous drinking but did not meet full DSM-IV-TR criteria for alcohol dependence (n=16). It included participants who had lab results indicating a need for more immediate medical attention (i.e., aspartate/alanine aminotransferase levels >5 times the upper limit [n=19], serum creatinine >2mg/dL [n=1]); were too medically frail for a medication trial (n=8); had a history of suicidality (n=22); experienced co-occurring opioid use disorder (n=18); or were older than 65 (n=1). Finally, this expanded sample included one person who was deemed a safety risk to staff and four who had been recruited to other studies involving the same treatment.

Measures

Sociodemographic questions. Single items were used to assess age, sex assigned at birth, race, and ethnicity. These items were used to describe the sample and as predictors in exploratory analyses.

Administrative data for primary outcomes. Data on publicly funded system utilization were obtained for up to 24 months prior to and 9 months following the baseline data collection. Specific data extracted included: (a) number of King County Medic One/EMS dispatches and associated costs; (b) number of the primary safety-net hospital's ED visits and associated costs; (c) number of inpatient hospital

admissions and total costs per admission, and (d) number of bookings, length of stay, and daily cost for the King County Correctional Facility. Costs were considered incurred upon use of the service, regardless of the payer. Average monthly costs were calculated for 24 months prior to baseline, 12 weeks during treatment, and 24 weeks post-treatment and used in primary outcome analysis. Specific system utilization counts for the 36 weeks prior to baseline were used in exploratory analyses.

Self-reported alcohol and HRQoL correlates for exploratory analyses. The following measures were used to form predictors of system utilization in exploratory analyses.

The “Alcohol and Drugs” section of the *Addiction Severity Index (ASI)* ²⁶ was used to assess frequency of alcohol and other substance use over the past month.

The *Alcohol Quantity Use Assessment (AQUA)* was created in initial studies with this population²⁷ and was refined in a subsequent study²⁸ to better capture alcohol use that does not conform to standard drink measures (e.g., sharing bottles, consuming beverages from large-volume containers [16, 24 and 40 oz. bottles and cans] or beverage type [e.g., high-gravity malt liquor, non-beverage alcohol]). This measure yielded number of drinks consumed on a peak drinking day in the past 30 days.

The *Short Inventory of Problems (SIP-2R)*,^{29,30} a 15-item, Likert-type questionnaire, was used to measure social, occupational, medical, and psychological alcohol-related harm over the past month. Items were summed to create a single score reflecting overall alcohol-related harm.

The *Short Form-12 (SF-12)*³¹ was used to document participants’ current perceptions of their physical (i.e., general health, physical functioning, ability to fulfill daily tasks/roles in light of physical limitations, bodily pain) and mental (i.e., sense of vitality, social functioning, ability to fulfill daily tasks/roles given emotional problems, mental health) HRQoL. These measures yielded a numeric score, with higher scores indicating higher HRQoL.³²

Procedures

The Institutional Review Board at the University of Washington approved all participant procedures. The settings for this study included community-based service, shelter, and housing programs in an urban city in the Pacific Northwest. On-site recruitment occurred between October 14, 2013, and November 30, 2017, and data collection was completed October 11, 2018.

As previously described,^{18,28} potential participants were approached by research staff at 3, community-based service agencies serving PEH with AUD (N=417). A larger group of participants that had consented and screened positive for hazardous drinking and lived experience of homelessness went on to complete the baseline questionnaire session but were excluded from the parent RCT due to lack of fulfillment of other inclusion criteria that were important to the RCT’s safety protocol and study aims. This larger sample was, however, included in the exploratory analyses (N= 401).

Those who qualified to participate in the RCT (N=308) were randomized into one of four treatment arms: HaRT-A plus XR-NTX, HaRT-A plus placebo, HaRT-A alone, and services-as-usual control. All four arms continued to receive services from the community-based agencies and attended additional follow-up assessments at weeks 4, 8, 12, 24, and 36. Participants were paid \$20 per assessment session.

Participants randomized to the 3 active treatment arms (HaRT-A plus XR-NTX, HaRT-A plus placebo, and HaRT-A alone) attended five manualized HaRT-A sessions delivered by study physicians and nurses in weeks 0, 1, 4, 8, and 12. In HaRT-A sessions, study physicians/nurses used a compassionate, pragmatic and patient-centered style in administering the following treatment components: a) feedback on results of self-report measures, physical exams and lab testing that had implications for alcohol-related harm, which was then tracked collaboratively with the participant; b) elicitation of harm-reduction and HRQoL goals; and c) discussion of safer-drinking strategies. Participants in the HaRT-A plus XR-NTX arm and HaRT-A plus placebo arm also received information about the medication and were administered 380 mg extended-release naltrexone injections intramuscularly by research physicians and nurses in weeks 0, 4, and 8. Please see the parent study for more treatment-group specific content.^{18,33}

Statistical Analysis Plan

Primary outcome analyses. Growth models were conducted in MPlus 8.4 testing the impact of the active treatments versus services-as-usual control arms on overall costs.³⁴ Mean monthly costs were indicators of the intercept (i.e., baseline) and linear slopes (i.e., change in outcomes over time). Treatment arm was the primary predictor of slope. Mean monthly costs were computed for the 2 years prior to baseline (week 0), during the 12 weeks of treatment (weeks 0-12), and during the 24-week follow-up (weeks 12-36). Due to skewness in the outcome, cost at each timepoint was log transformed.

There were two parts to this analysis. First, we tested the efficacy of the 3 active treatment arms (i.e., HaRT-A plus XR-NTX, HaRT-A plus Placebo, HaRT-A alone) compared to the services-as-usual control arm. Second, we compared the cost outcome across the double-blinded HaRT-A plus XR-NTX (active medication) and HaRT-A plus Placebo arms.

Exploratory analysis. StataNow/MP 18.5 was used for exploratory analyses, testing the prediction of association between baseline sociodemographics, substance use outcomes, and publicly funded system utilization. Regarding predictors, we dichotomized sex assigned at birth (female = 1, male = 0), ethnicity (1=Latinx/e, 0 = non-Latinx), and dummy coded race into three variables, including Black/African American, American Indian/Alaska Native, and Other People of Color, with white/European American as the contrast category (1= White). Of note, one participant who had intersex assigned at birth was excluded from the sex assigned at birth variables for exploratory analysis because a single observation can produce no within-group variance. Number of alcohol use days was a count variable (0-30), and cigarette smoking and other substance use were dichotomized (i.e., 0 = no past-month use, 1 = any past-month use).

Negative binomial regressions, a type of generalized linear model that accommodates overdispersed and skewed count outcomes, were used to document the cross-sectional associations between publicly funded system utilization for the 36 weeks prior to the baseline assessment (i.e. EMS dispatches, ED visits, inpatient hospitalizations, and number of jail bookings and jail days) and baseline assessment of sociodemographics (i.e. age, sex assigned at birth, race, and ethnicity), past-month substance use (i.e. frequency of alcohol use, peak alcohol quantity, cigarette and other substance use), physical and mental HRQoL, and alcohol-related harm.

Results

Sample Descriptive Statistics

Descriptive statistics outlining the utilizations costs by RCT treatment arm for the baseline (24 months prior), treatment (12 weeks), and posttreatment (6 months following) are outlined in Table 1. Please refer to the parent RCT for descriptive statistics of the smaller sample (N=308).¹⁸

The average age of the participants who completed baseline interviews (N=401) was 48.1 years old (SD=9.10). Rounding the percentages, 83% (n=331) were assigned male sex at birth, 17% (n=69) female, and less than 1% (n=1) intersex. Regarding race, 33% (n=132) identified as white/European American, 30% (n=121) as Black/African American, 15% (n=61) as American Indian/Alaska Native/First Nations, 14% (n=55) as Multiracial, 6% (n=25) as self-described “other,” 1.5% (n=6) as Native Hawaiian/Pacific Islander, and less than 1% (n=1) as Asian/Asian American. Regarding ethnicity, 12% (n=47) identified as Hispanic or Latinx/e. Descriptive statistics for baseline substance use variables, HRQoL, and systems utilization data are provided in Table 2.

Primary Outcome Analyses

The growth model testing the impact of the 3 active treatment arms compared to the services-as-usual control arm on overall costs showed good fit to the data, $X^2(4, N = 308) = .75, p = .95, CFI = 1.00, RMSEA < .001, SRMR = .008$. There were, however, no statistically significant treatment arm effects when comparing the services-as-usual control arm with the HaRT-A plus XR-NTX ($B = -.04, CI = -.28, .20, p = .75$), HaRT-A plus placebo ($B = -.15, CI = -.38, .08, p = .20$), or HaRT-A alone arms ($B = .10, CI = -.13, .32, p = .39$).

We next isolated the potential medication effect by comparing the double-blinded active medication and placebo arms on cost of publicly funded service utilization. The model evinced good fit, $X^2(2, N = 152) = .43, p = .81, CFI = 1.00, RMSEA < .001, SRMR = .012$. There were, however, no statistically significant treatment arm effects when comparing HaRT-A plus placebo and HaRT-A plus XR-NTX ($B = .12, CI = -.10, .34, p = .27$).

Exploratory Analyses

The negative binomial models for inpatient hospitalizations, $X^2(13, N = 372) = 16.94, p = 0.20$, and emergency department use, $X^2(13, N = 372) = 10.80, p = 0.63$, were not statistically significant.

The negative binomial model for EMS encounters was statistically significant, $X^2(13, N = 372) = 23.66, p = 0.03$. For each year older, participants had 3% fewer EMS contacts in the nine months prior to baseline. No other variables were significant predictors (all $ps > 0.05$; see Table 3 for model parameters).

The negative binomial model for jail bookings was significant, $X^2(13, N=372) = 26.87, p=0.01$ (see Table 3 for model parameters). In the nine months prior to baseline, female participants had 59% fewer jail bookings than male participants. Each one-point increase in the alcohol-related harm score at baseline was associated with 4% more jail bookings, and past-month cigarette smoking was associated with twice the jail bookings.

The negative binomial model predicting jail days was significant, $X^2(13, N=372) = 25.90, p=0.02$ (see Table 3 for model parameters). In the nine months prior to baseline, female participants spent 87% fewer days in jail than male participants. Each additional day of drinking one month prior to baseline was associated with 6% fewer days in jail in the 36 weeks prior to baseline; however, each one-point increase on the alcohol-related harm scale was associated with 7% more days spent in jail. Each one-point increase in the mental health QOL score was associated with 13% more days spent in jail in the nine months prior to baseline.

Discussion

The primary aim was to test the efficacy of HaRT-A and XR-NTX in reducing costs from publicly funded systems utilization among PEH with AUD. The additional exploratory aim was to document the relative associations of sociodemographics, substance use, and HRQoL with baseline systems utilization.

Primary Analyses

HaRT-A and XR-NTX did not significantly reduce costs associated with inpatient hospitalizations, ED visits, EMS encounters, or jail bookings and days. This outcome was unsurprising, as these secondary analyses were not powered for a cost analysis, and the relatively short 12-week treatment and 24-week posttreatment timeframes may not have been wide enough windows to capture meaningful changes in accrued costs.

Another explanation for the null finding could be the brief, low-intensity nature of the intervention, which consisted of five sessions and three months of medication. In contrast, community-level harm-reduction interventions that have engendered reductions in publicly funded costs, such as Housing First programs, integrate long-term, more comprehensive services (e.g., housing, clinical care, and social services).^{15,35} It is understandable that such a comprehensive intervention would be more impactful on publicly funded systems costs than a brief behavioral intervention and short-term medication provision. Future studies might explore ways to enhance the impact of pharmacobehavioral harm-reduction treatments on longer-

term health outcomes and resulting system utilization and costs. For instance, administration of these treatments as maintenance therapy or their integration within larger community-based interventions may yield more meaningful reductions in healthcare and justice system costs.

Exploratory Analyses

We conducted additional exploratory analyses to test the cross-sectional associations between baseline self-report variables (e.g., sociodemographics, substance-use variables, and HRQoL) and healthcare and jail utilization from the broader baseline sample (N=401). These exploratory analyses were intended to describe the sample and indicate potential risk and protective factors associated with systems utilization.

Findings indicated that participants had high levels of alcohol use, reporting a mean of 24 drinking days in the past month and 33 standard drinks on their peak drinking day. This pattern of alcohol use aligns with the primary recruitment settings, which included an emergency shelter expressly for PEH who were intoxicated above the legal limit in Washington state. Compounding the impact of heavy alcohol use, the sample also reported a relatively high prevalence of polysubstance use (80%). Participants showed extensive systems utilization: administrative records indicated that over half had at least one EMS or ED encounter, and 30% spent at least one day in jail in the 9 months prior to the baseline interview. These findings underscore the high alcohol morbidity as well as the significant social systems involvement in this sample population.

Age was inversely associated with EMS encounters, such that each additional year was associated with 3% fewer EMS encounters. One study showed that PEH who are over 50 had a strong connection to health insurance³⁶ and lower use of EMS (28%) relative to outpatient clinic visits (86%). Thus, PEH who are older may have built, over time, connections with various service providers in their community and may be less reliant than younger PEH on emergency healthcare services.

Demographic outcomes associated with jail bookings and days mirror those in the larger literature that have likewise found that people assigned male sex at birth are more likely to be incarcerated than those assigned female.^{37,38} Beyond the demographic data, substance-use variables accounted for four out of the six significant predictors of jail outcomes. First, cigarette use in the past month was associated with double the jail bookings. This finding aligns with current prevalence findings in both the justice system and in people with histories of incarceration: In one survey of older urban jail inmates (>55), with high rates of homelessness and hazardous drinking, 71% reported current tobacco use, compared to 15% in the general population of US adults in a similar age group.^{39,40}

Second, past-month alcohol frequency at baseline was inversely associated with jail days. Although this finding initially appears to suggest that people who engage in more frequent alcohol use spend less time in jail, it more likely reflects confounding due to the inaccessibility of alcohol within the jail system, especially for participants recently released from incarceration. This point also underscores a significant potential risk to this population, as abrupt changes in alcohol access can trigger potentially lethal

alcohol withdrawal syndrome: The third leading cause of death in the jail population is alcohol- or drug-related.⁴¹ This project provides additional data supporting the need for treatment for alcohol and drug withdrawal within carceral settings.⁴²

Greater alcohol-related harm at baseline was associated with a greater number of jail bookings and jail days in the prior nine months. Because jail exposure was assessed retrospectively, this association likely reflects participants' recognition of recent alcohol-related harm, including that which resulted in justice system involvement. One qualitative study demonstrated that among people experiencing AUD and homelessness, legal involvement was seen as a disadvantage of alcohol use, with one participant stating "every legal problem [he'd] ever had has been due to alcohol."⁴³ Taken together, greater jail exposure and the conditions that led to it appear to spark greater recognition or underscore participants' perceptions of both personal and structural alcohol-related harm.

Finally, greater mental HRQoL was associated with more days spent in jail in the nine months prior to baseline. This finding is unlikely to indicate that longer incarceration improves mental health, social or daily functioning, given the established literature demonstrating the carceral system's negative impact on mental health.⁴⁴ It is, however, possible that jail could have produced temporary relief from a stressful daily experience of chronic homelessness in its short-term provision of shelter, meals, and daily routine. Another explanation is temporal: mental HRQoL was assessed at the baseline interview, which may reflect its improvement *after* release from jail. This finding points to a need for more research on how emergency shelter and carceral settings impact mental HRQoL in this population and how these settings may be improved. It also signals the need for more adaptive spaces than carceral and emergency shelter settings for people to recover from the extreme systemic stressors of the jail-to-shelter cycle and this population's co-occurring medical, psychiatric and substance use disorders.

Taken together, these findings are relevant for clinicians and others working with PEH and AUD. As participants who reported greater alcohol-related harm had greater experience of jail bookings and days, in addition to high rates of cigarette use, justice settings may present important, necessary and opportunistic intervention points. Given the disproportionate prevalence of alcohol use and alcohol-related harm among both PEH and incarcerated people, it is critical to assess for and proactively treat for alcohol withdrawal syndrome as well as offer other harm-reduction and treatment services upon entry to and exit from jail health systems.

Limitations

Several limitations of this secondary study deserve mention. Although HaRT-A plus XR-NTX had statistically significant and clinically meaningful impact on proximal outcomes (e.g., alcohol use, alcohol-related harm, physical HRQoL), its brief nature paired with the RCT's underpowering for cost analyses likely limited its ability to impact the more distal variables measured in this study. Additionally, the recruitment period occurred when alcohol was the most dominant substance used by PEH in our area and prior to the COVID-19 pandemic and the widespread accessibility and decreased cost of more

potent, synthetic drugs. Future studies should test combined pharmacobehavioral harm-reduction treatments across substances, including concurrent use patterns. Finally, in exploratory analyses, we tested the association of self-report data with publicly funded system utilization data from the 9 months prior to the baseline. Because we cannot speak to temporal prediction or causation, these analyses are intended to be hypothesis-generating and are not definitive.

Conclusions and Future Directions

The combined pharmacobehavioral harm-reduction treatment that was the focus of the parent RCT did not reduce overall costs resulting from emergency healthcare and jail system utilization in a sample of PEH with AUD. Given the low-intensity and short-term nature of the interventions and inadequate power for this analysis, this finding was not surprising. Future studies are needed to provide more robust tests of the potential for such harm-reduction treatments to impact larger systems-level outcomes.

Declarations

Author Note

This work was supported by a grant from the National Institute on Alcohol Abuse and Alcoholism (R01AA022309; PI: Collins) and a grant from the National Institute on Drug Abuse (R25DA050985; PI: Tsui). Neither NIAAA nor NIDA played a role in study design; collection, analysis and interpretation of the data; report writing; or decision to submit the article for publication.

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Disclosures: Dr. Collins is a cofounder and holds equity in a small business that provides training and consultation in substance use treatment.

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Tables

Table 1. Descriptive Statistics for Utilization Costs by Treatment Arm Over Time (N=308)

	<i>M(SD)/%</i>		
Variables	Baseline	Treatment period	Posttreatment
HaRT-A+XR-NTX	583.55(707.79)	913.43(1384.25)	1286.62(2329.87)
HaRT-A+Placebo	511.62(665.10)	1516.09(4274.35)	1277.21(1876.49)
HaRT-A	829.22(1447.25)	871.57(1549.52)	1326.28(2967.28)
TAU	722.32(1054.45)	1371.51(2649.40)	1576.97(2871.47)

Notes. Primary outcome is average monthly costs across use of inpatient hospitalizations, emergency department, emergency medical services, and jail. Time points include baseline (i.e., average monthly costs in the 24 months prior to baseline), treatment period (i.e., average monthly costs during the 3-month treatment period), and posttreatment (i.e., average monthly costs for the 6 months following the treatment period). HaRT-A = Harm reduction treatment for alcohol use disorder, which is the counseling portion of the combined pharmacobehavioral treatment in this trial. XR-NTX = Extended-release naltrexone. TAU = community-based services-as-usual control condition. HR-QoL = health-related quality of life.

Table 2 Descriptive Statistics for Baseline Sample Predictor and Outcome Variables (N=401)

Variables	M(SD)/ N (%)
Substance use outcomes, last 30 days	
Alcohol frequency	23.60 (8.23)
Peak alcohol quantity	32.80 (21.94)
Alcohol-related harm	23.5 (12.2)
Cigarette use (y/n)	81.80%
Other substance use (y/n)	79.55%
Physical HRQoL	16.4 (4.72)
Mental HRQoL	18.3 (5.06)
System Utilization Data, last 36 weeks	
EMS Encounters	
<u>Participants with >1 encounter</u>	203 (50.6%)
Mean encounters	1.99 (4.37)
ED Visits	
Participants with at ≥ 1 ED visit	265 (66.1%)
Mean visits	3.88 (6.18)
Inpatient Hospitalizations	
Participants with at least one inpatient hospitalization	56 (14.0%)
Mean hospitalizations	0.23 (0.69)
Incarceration	
Participants with at least one jail booking	121 (30.2%)
Jail bookings, cohort mean	0.56 (1.06)
Jail days, cohort mean	8.85 (24.87)

Notes. HRQoL = health-related quality of life. EMS= emergency medical systems. Utilization outcomes are 36-week accumulations prior to baseline.

Table 3 Model Parameter Statistics for Exploratory Analyses

	IRR	Robust SE	CI (95%)	Z	P
Predictors					
Emergency Medical Services					
Age	0.97	0.01	(0.94, 0.99)	-3.10	0.002
Sex Assigned at Birth	1.43	0.37	(0.86, 2.37)	1.37	0.17
Race					
African American/Black	0.62	0.15	(0.38, 1.00)	-1.95	0.05
AI/AN	0.68	0.22	(0.36, 1.27)	-1.22	0.22
Other race	0.71	0.20	(0.41, 1.23)	-1.24	0.22
Ethnicity	0.67	0.22	(0.35, 1.26)	-1.25	0.21
Cigarette Smoking	1.36	0.37	(0.80, 2.31)	1.14	0.26
Other Substance Use	0.83	0.21	(0.50, 1.36)	-0.74	0.46
Peak alcohol quantity	1.00	0.01	(0.99, 1.01)	-0.66	0.51
Alcohol frequency	1.01	0.01	(0.99, 1.04)	0.98	0.33
Alcohol-related harm	1.00	0.01	(0.98, 1.02)	0.23	0.82
Physical HRQoL	0.99	0.02	(0.95, 1.04)	-0.35	0.72
Mental HRQoL	0.98	0.03	(0.93, 1.03)	-0.81	0.42
Jail Bookings					
Age	0.98	0.01	(0.96, 1.00)	-1.65	0.10
Sex Assigned at Birth	0.41	0.14	(0.21, 0.80)	-2.61	0.009
Race					
African American/Black	1.06	0.28	(0.62, 1.80)	0.22	0.83
AI/AN	0.75	0.29	(0.36, 1.59)	-0.74	0.46
Other race	1.13	0.37	(0.60, 2.15)	0.39	0.70
Ethnicity	0.74	0.30	(0.33, 1.63)	-0.75	0.45
Cigarette Smoking	2.02	0.66	(1.07, 3.82)	2.17	0.03
Other Substance Use	0.86	0.25	(0.49, 1.50)	-0.52	0.60
Peak alcohol quantity	1.00	0.01	(0.99, 1.01)	0.18	0.86

Alcohol frequency	1.00	0.01	(0.97, 1.02)	-0.35	0.73
Alcohol-related harm	1.04	0.01	(1.01, 1.06)	2.84	0.005
Physical HRQoL	1.00	0.03	(0.95, 1.06)	0.13	0.90
Mental HRQoL	1.05	0.03	(0.99, 1.11)	1.67	0.10
Jail Days					
Age	0.98	0.02	(0.94, 1.03)	-0.70	0.48
Sex Assigned at Birth	0.13	0.07	(0.05, 0.36)	-3.86	0.000
Race					
African American/Black	0.99	0.51	(0.36, 2.70)	-0.01	0.99
AI/AN	1.27	0.88	(0.33, 4.96)	0.34	0.73
Other race	1.78	1.06	(0.56, 5.69)	0.98	0.33
Ethnicity	0.67	0.45	(0.18, 2.48)	-0.60	0.55
Cigarette Smoking	1.68	0.86	(0.62, 4.57)	1.02	0.31
Other Substance Use	1.06	0.58	(0.37, 3.10)	0.12	0.91
Peak alcohol quantity	1.00	0.01	(0.98, 1.02)	0.21	0.84
Alcohol frequency	0.94	0.02	(0.90, 0.99)	-2.26	0.02
Alcohol-related harm	1.07	0.03	(1.02, 1.12)	2.62	0.01
Physical HRQoL	1.02	0.05	(0.93, 1.13)	0.49	0.63
Mental HRQoL	1.13	0.07	(1.01, 1.27)	2.06	0.04

Notes. IRR = incident rate ratio. AI/AN = American Indian/Alaska Native. HRQoL = health-related quality of life. We dichotomized sex assigned at birth (female = 1, male = 0), ethnicity (1=Latinx/e, 0 = non-Latinx), and dummy coded race into three variables, including Black/African American, American Indian/Alaska Native, and Other People of Color, with white/European American as the contrast category (1= White). Of note, one participant who had intersex assigned at birth was excluded from the sex assigned at birth variables for exploratory analysis because a single observation can produce no within-group variance. Number of alcohol use days was a count variable (0-30), and cigarette smoking and other substance use were dichotomized (i.e., 0 = no past-month use, 1 = any past-month use). Of note, one participant who had intersex assigned at birth was excluded from the dummy coded sex assigned at birth variables because a single observation can produce no within-group variance.