Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____ _____

Dylan Falk Date

A Cross-Sectional Analysis of the Association Between Houselessness Among People Who Inject Drugs and Using Syringe Service Programs in the Rural United States

By

Dylan Falk

Master of Public Health

Epidemiology

Hannah Cooper, ScD, SM

Faculty Thesis Advisor

A Cross-Sectional Analysis of the Association Between Houselessness Among People Who Inject Drugs and Using Syringe Service Programs in the Rural United States

By

Dylan Falk

B.S.

University of Pittsburgh

2020

Thesis Committee Chair: Hannah Cooper, ScD, SM

An abstract of

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of
Master of Public Health
in Epidemiology

2022

Abstract

A Cross-Sectional Analysis of the Association Between Houselessness Among People Who Inject Drugs and Using Syringe Service Programs in the Rural United States

By Dylan Falk

Background: Multiple studies conducted in urban areas have found that houselessness among people who inject drugs (PWID) reduces access to and utilization of health and harm reduction care services, including syringe service programs (SSPs). Given that both drug-related epidemics and houselessness are rising in rural areas, the present study seeks to extend this vital line of urban research about their inter-relationships to rural areas.

Methods: PWID (N=2587) in 8 rural sites across the United States took part in cross-sectional surveys that queried self-reported drug use, houselessness status over the past 6 months, SSP utilization over the past 30 days, and sociodemographic characteristics. We used multivariable logistic models to regress houselessness on SSP program use. We next limited the sample to the 933 PWID who had used an SSP in the previous month, and used a polytomous multivariable model to regress houselessness on the *frequency* of SSP use in the past month.

Results: The odds of SSP use were greater for those who experience houselessness than for those who do not (aOR = 1.27 [95% C.I. = 1.04, 1.55]). We found, however, that the odds of visiting an SSP weekly or more than weekly were lower (aOR = .55 [95% C.I. = .32, .94] ,aOR = .74 [95% C.I. = .46, 1.18], respectively) among PWID experiencing houselessness.

Conclusion: In this large sample of rural PWID, we found that experiencing houselessness is associated higher odds of using an SSP but with lower odds of frequent SSP use. PWID who experience houselessness are not receiving the same level of care from SSPs, since it is important to access naloxone, syringes, and the other services offered as often as possible.

A Cross-Sectional Analysis of the Association Between Houselessness Among People Who Inject Drugs and Using Syringe Service Programs in the Rural United States

By

Dylan Falk

B.S.

University of Pittsburgh

2020

Thesis Committee Chair: Hannah Cooper, ScD, SM

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of
Master of Public Health
in Department of Epidemiology

2022

Table of Contents

Introduction

Syringe service programs (SSPs) provide services such as sterile syringe distribution, used syringe disposal, STI testing, naloxone training, and other important harm reduction services for people who inject drugs (PWID). SSPs have been shown to be an effective intervention for a number of adverse health outcomes for PWID, including reducing the spread of HIV and HCV in PWID, reducing overdoses, and reducing injection-related wounds among PWID (Bornstein et al., 2020; Heinzigler et al., 2007). SSPs are expanding into rural areas, following the expansion of drug-related epidemics outside of metropolitan areas globally. SSPs have been shown to be just as effective in rural areas as they are in cities, but evidence indicates that rural residents have poorer access to SSPs(Canary et al., 2017; Lancaster et al., 2020; Troppy et al., 2018; Des Jarlais et al., 2015).

PWID experience high rates of houselessness. A 2018 study of 23 urban areas in the United States found that 68.2 percent of PWID reported experiencing houselessness over the previous 12 months (Center for Disease Control and Prevention, 2018). PWID who experience houselessness have been shown to have a perceived and measured reduction in access to healthcare services (Wise and Phillips, 2013; Gunner et al., 2019). In urban areas, houselessness status is also associated with higher risk behaviors: experiencing houselessness was shown to have a strong effect on receptive syringe sharing (aOR 95 % C.I. = 1.67-2.23), equipment sharing (C.I. =1.43-2.05), and exchange sex (C.I = 2.17-2.76) in a logistic regression model run on a sample of PWID in Chicago (Hotton, Mackesy-Amiti, and Boodram, 2021). At the same time, PWID experiencing houselessness in urban areas in the United States have shown that they are just as interested in the services provided by SSPs as those who have housing (Kenney et al., 2021). In qualitative interviews, some urban PWID have reported that gaining temporary

housing, such as hostel living, has allowed them to access harm reduction care services (Briggs et al., 2009). Experiencing houselessness has also been shown to lead to lower access to naloxone, which is often distributed through SSPs (Lipira et al., 2021). Despite this, a previous rural study in Maine found that houselessness was correlated with greater usage of SSPs. This cross-sectional study recruited 102 hospitalized patients with OUD-associated infections and found the adjusted odds ratio of the association between houselessness and SSP use to be 3.0 (95% C.I. = 1.1 – 8.1)(Thakarar et al., 2021).

Recently, there has been increases in the level of houselessness among rural residents, especially in young people. Families with school-aged children in rural areas experienced a 13.8 percent increase in houselessness between 2013 and 2017 in rural areas, and in states such as Kentucky, Iowa, and Tennessee this bucked a trend of a decrease of student houselessness in urban areas (Institute for Children, Poverty, and Homelessness, 2019). As rural areas became less of an economic driver within the United States, houselessness and other economic hardships have continued to affect these areas more (Yousey and Samadra, 2018).

Here, we expand Thakarar's research on houselessness and SSP use to include rural areas across multiple sites in the United States, as well as including an analysis of frequency of use along with a general SSP utilization analysis. The sample examined here encompasses eight rural areas in the United States, across ten states. Utilization of SSPs will be compared across PWIDs who experience houselessness and those with stable housing, and the association between the two will be measured. Then the frequency of number of times the SSP was accessed will be compared across these groups. We believe that the results will model regular healthcare access, and there will be a negative association between experiencing houselessness and ability to access SSPs.

Methods

Study Design

This is a cross-sectional analysis of data generated by the Rural Opioid Initiative (ROI), a multi-state study designed to investigate drug use, HIV, Hepatitis C, and co-morbidities among rural PWID and people who use opioids, regardless of whether they inject. The ROI has eight rural sites spanning ten states: Kentucky, Wisconsin, New England (including Massachusetts, Vermont, and New Hampshire), Illinois, West Virginia, Oregon, Ohio, and North Carolina. Participants were recruited from January 2018 to March 2020 using modified chain referrals based on respondent driven sampling (RDS) methods. RDS relies on waves of peer-to-peer recruitment and then uses a statistical adjustment to approximate a random sample. To be eligible, participants had to (1) be at least 18 years old, except in IL and WI where the age minimum was 15 years; (2) self-report any injection drug use or non-injection opioid use in the prior 30 days "to get high;" and (3) live in the site's catchment area.

The purpose of this analysis is to identify the correlation, if any, that houselessness has with PWID's ability to use SSPs. We first investigate the relationship between houselessness and receiving syringes or needles from an SSP in the 30 days prior to data collection. As such, for the purposes of this analysis, we developed an analytic sample of people who reported injecting drugs in the prior 30 days (N=2587). The final analytic sample also excluded individuals who lacked data on variables of interest (houselessness, SSP use, SSP use amount, and covariates), creating a final sample size of 2280 (88 percent of eligible participants included). Next, among those who received syringes or needles at least once in the prior 30 days, we sought to understand the relationship between houselessness and the ***number*** of times participants received needles from an SSP in the prior 30 days. For these analyses, we further refined the analytic

sample to only include PWID who reported using an SSP as their primary way of getting needles in the previous 30 days (N = 933).

Data collection

Five of the sites used audio-assisted self interviews, two used computer-assisted self-interview methods, and one used computer-assisted personal interviews. Surveys contained a core set of items that were standardized across sites and captured demographic characteristics, drug use patterns, drug use consequences such as overdose and other related harms, opiate use disorder (OUD) treatment with methadone and other treatment options, and healthcare access and utilization, among others. Interviews were conducted in a private space; participants received $10-20 as an incentive, depending on the site.

Measures

The exposure of interest is experiencing houselessness in the prior six months, which was self-reported by participants. Houselessness was defined as "living from place-to-place, 'couch-surfing', on the street, in a car, park, abandoned building, squat, or shelter."

Our analyses focused on two outcomes of interest related to SSP use. The first outcome of interest was whether an individual reported that they had received any syringes or needles from an SSP in the prior 30 days. Specifically, participants were asked "During the last 30 days, where have you gotten syringes or needles?" The survey offered multiple answers (e.g., a pharmacy, SSP, farm supply store, dealer) and allowed participants to select all that apply. We analyzed responses to this item to create a variable capturing whether the individual had received a needle or syringe from an SSP. Sixty-two participants reported that they had used the SSP zero times despite listing that they had received syringes from an SSP in the previous 30 days. Therefore, these participants were assigned a primary outcome value of 0.

The second outcome of interest was the ***number*** of times individuals had used an SSP in the prior 30 days. Participants who reported using an SSP as a source of syringes and needles in the prior 30 days were subsequently asked how many times they had visited the SSP in the last 30 days. Given the skewed distribution of this outcome, we created an ordinal categorical variable, categorizing number of visits into monthly, biweekly, three times in a month, weekly, and more than weekly.

Covariates include demographic characteristics (e.g., gender, age, race, educational attainment), entitlements (e.g., SNAP use, food pantry use), site of enrollment, and use of specific drugs (e.g., heroin, methamphetamine, other opiates). Entitlements were included as a proxy for poverty level, since poverty has been shown to be associated with houselessness and SSP use in the past. Use of drugs has also been shown to affect both variables within the literature, and we believe them to be an important consideration in our models. Gender/sex is either marked as male, female, or transgender. Transgender individuals were excluded (N=7) so that models were able to run without small number issues; we were unable to run the multivariable model without removing these individuals.

Analyses

For descriptive purposes all variables were analyzed using basic frequency and mean calculations (PROC FREQ, PROC MEANS, PROC UNIVARIATE).

To learn if SSP use is associated with houselessness, logistic binomial regression was used to regress SSP use on houselessness status. Collinearity assessment was conducted using a SAS macro that calculated the collinearity matrix, and determined if the overall collinearity index (CI)was less than 30 and if the variance inflation factors (VIFs) for individual variables were more than .5 in the full model. To decide whether to include potential confounders in the

final model the adjusted prevalence ratios (aPR) between houselessness and SSP use were calculated for a full model and for models excluding each potential covariate. For example, to check if educational attainment was a confounder, a logistic binomial model was run with all potential confounders (full model) twice, once including the educational attainment variable and the other excluding it. If the reduced model had an aPR that did not have a 10 percent difference from the aPR calculated from the full model, the covariate was excluded from the final model. All potential confounders did not meet the 10 percent difference when running full and reduced models for each. Despite not reaching the 10 percent rule, we still included all covariates identified in the literature in our final model in deference to past research that has found an association. Finally, potential clustering from the RDS sampling was controlled for to stabilize our standard error estimates.

To analyze the association between houselessness and ***frequency*** of SSP use we used polytomous regression to test the hypothesis that frequency of SSP use is inversely associated with houselessness. First, we ran an ordinal regression model of frequency of SSP visits on houselessness, but since the model did not meet its priors (specifically, it violated the proportional odds assumption) we used a polytomous model instead. A polytomous logistic model allows us to calculate an adjusted odds ratio (aOR) that is same when changing from one level to another of the SSP frequency variable. Collinearity assessment and confounding assessment were conducted using the same methods as the primary model. Again, no confounders met the 10 percent rule. As with the previous model, we decided to include all potential covariates identified in the literature in deference to past research that has found an association. Finally, potential clustering from the RDS sampling was controlled for to stabilize our standard error estimates. All analyses were conducted using SAS 9.4.

Ethics

Each site received approval from their corresponding Institutional Review Board and all data are protected by a Certificate of Confidentiality.

Results

SSP Use Analysis

The final analytic sample for the SSP use analysis contained 2280 participants. The sample is predominantly white (85.9 %) and men (57.7 %), and the average age of the participants was 35.7 (standard deviation [s.d.] = 10.0). One-thousand-two-hundred-eighty (56.1 %) participants reported that they had experienced houselessness in the previous 6 months. Overall demographic characteristics stratified by SSP use can be found in Table 1a.

A bivariate analysis revealed that people who reported experiencing houselessness in the previous six months were slightly more likely than those who did not experience houselessness report experiencing houselessness to have used an SSP in the previous 30 days (aOR = 1.27[95% C.I. = 1.07, 1.51]). Multivariable models controlling for possible confounders revealed that the bivariate analysis produced a robust estimate that was unaltered by the inclusion of confounders (aOR = 1.27 [95% C.I. = 1.04, 1.55]).

Frequency of SSP Visits Analysis

The final analytic sample for the SSP visits analysis contained 933 participants. The sample is predominantly white (83.3 %) and men (57.0%), and the average age of the participants was 34.9 (s.d. = 9.2). Of participants included in this model approximately one quarter reported visiting the SSP once a month (23.5%); one fifth reported biweekly (21.5 %) use; 14% reported visiting the SSP three times a month or (14.1 %) or weekly (14.8%), and one quarter reported going more than weekly (26.0 %). Five-hundred-fifty-eight (59.8%) of the participants reported that they had experienced houselessness in the previous six months. The complete demographic characteristics for the sub-analytic sample can be seen in Table 1b.

We assessed the number of SSP visits per month using houselessness as the primary predictor variable. For this analysis, once a month was used as the index level for comparison with the other levels of SSP utilization. Those experiencing houselessness were less likely than those who were not experiencing houselessness to use an SSP weekly (aOR = .55 [95% C.I. = .32, .94]) and more than weekly (aOR = .74 [95% C.I. = .46, 1.18]). We also found that those who experienced houselessness in the previous 6 months were just as likely as those who did not experience houselessness to use an SSP biweekly (aOR = .98 [95 % C.I. = .64 , 1.51]) and three times a month (aOR = 1.24 [95% C.I. = .74, 2.08]). These results can be found in Table 2.

Discussion

Findings and Conclusions

The goal of this study was to identify whether or not houselessness was correlated with past-month SSP use in our sample. Our first model analyzing SSP access among PWID experiencing houselessness suggests that SSP use is higher in this population compared to those not experiencing houselessness. This finding builds on a previous rural study conducted in Maine, which likewise found that houselessness is correlated with *higher* use of SSPs (Thakarar et al., 2021). These findings are counter to studies showing that harm reduction care access, specifically naloxone distribution, is *lower* among PWID experiencing houselessness in both urban and suburban areas (Lipira et al., 2021). Our second model analyzing the frequency of SSP visits per month found that experiencing houselessness was associated with lower use at higher frequencies of visits per month (weekly or more than weekly). This finding is aligned withthe finding in urban areas that PWID experiencing houselessness are less likely to use harm reduction care services (Lipira et al., 2021).

One suggestion for why experiencing houselessness is associated with *higher* past-month odds of SSP utilization in this sample is that many SSPs provide resources outside the normal bounds of SSP services, such as food banks and other services that are necessary to people experiencing houselessness. Including services such as this in an SSP is common practice, and it will attract a higher number of PWID experiencing houselessness to the services provided. This expanded level of services should be confirmed by researching the SSPs that are utilized within the ROI sample.

This finding further suggests that SSPs are also an integral part of combatting stigma felt by PWID, especially those experiencing houselessness, that they may experience elsewhere. In

many traditional healthcare settings, PWID experience stigma for their drug use, and as another marginalized population people experiencing houselessness may feel a compounding of judgement. PWID have reported in the past that they feel judgement from healthcare professionals for attending SSPs (Miller-Lloyd et al., 2020). At the same time, rural studies of people experiencing houselessness show that there is lower access in general of healthcare resources (Craft-Rosenberg et al., 2000,Wise and Phillips, 2013; Gunner et al., 2019). Another study found that the development of trusting relationships and non-judgmental staff leads to harm reduction care being acceptable, feasible, and accessible to people experiencing houselessness (Parkes et al., 2022).. This acceptability is shown in an upcoming qualitative study on SSPs in the Kentucky areas of the ROI has found that they have been able to meet the core features of a SSP, specifically, that they were able to minimize perceived impacts of stigma by lowering thresholds to service (Batty et al., 2021). This dichotomy where PWID experiencing houselessness do not feel accepted in traditional healthcare, but they do feel accepted in SSPs may lead to this association between houselessness, since this dichotomy is less present in PWID not experiencing houselessness.

The implications of this increased access could have multiple beneficial health outcomes for PWID experiencing houselessness in rural areas suffering high burdens of overdoses, HCV, and other drug-related harms. SSPs offer many harm reduction services outside of syringes, which includes but is not limited to: naloxone distribution, cooker and cotton distribution, HIV and HCV testing, and linkage to medication for OUD (MOUD) and aftercare. An urban study examining access to MOUD found that SSPs were a significant point of entry for those experiencing houselessness (Hood et al. 2019.) Another study looking at an SSP in the Seattle area showed that this SSP combatted issues surrounding stigma and provided outreach to people

experiencing houselessness (Miller-Lloyd et al., 2020). Higher access to SSPs will hopefully lead to higher access of MOUD, reduced overdoses, and reduced risk of HIV and HCV, and lower feelings of marginalization from PWID experiencing houselessness. Rural SSPs should thus be studied for their outreach services, and the practices that are leading to their success should be expanded upon.

Our second finding showing a negative correlation between SSP use at higher frequencies and experiencing houselessness gives us a more complicated view on how SSPs are able to reach PWID experiencing houselessness. PWID experiencing houselessness, while still being able to access SSPs, will not have the ability to use them *often* – perhaps because they will regularly have trouble accessing transportation, will need choose between different priorities, and are more likely to have comorbidities that hurt their ability to access SSPs regularly.

First, people experiencing houselessness are more likely to have reduced access to transportation which is a foundation of access, and in rural areas the barriers that PWID experiencing houselessness face in accessing transportation to paces of care is compounded (Barile, Pruitt, and Parker, 2018). The built environment of rural areas is less walkable, and distance from place to place is often massive in comparison to urban areas (Marr, 2015). Thus, a PWID experiencing houselessness may be able to make use of an SSP's services, but due to reduced transportation access, it may be difficult use them frequently despite their consistent use at a lower frequency. This would give us reason to believe consistent but infrequent use of SSPs in rural areas among PWID who experience houselessness is possible. Second, people experiencing houselessness have many competing priorities, since they may need to prioritize other needs such as food, shelter, or income over accessing healthcare. Studies show these competing priorities lead to lower access in healthcare settings (Gelberg et al., 1997). Finally,

mental health issues compound the issues of lower access to healthcare and harm reduction care that PWID experiencing houselessness have. People experiencing houselessness are at higher risk of mental health issues (Susser, Moore, and Link, 1993). Experiencing both at the same time leads to a higher need of access of healthcare, but oftentimes the individual's need is not met outside of emergency department visits (Stergiopoulos et al., 2017). We expect that a similar phenomenon is happening in the access of SSPs by PWID who experience houselessness, as they may need an SSP more but are unable to utilize it at a higher frequency. These three reasons may give us an idea why there is lower utilization of SSPs at higher frequencies among PWID experiencing houselessness, but research should be expanded on the barriers to access created by transportation, competing priorities, and mental health declines affect the population of rural PWID experiencing houselessness.

This potential decrease in use at higher frequencies is concerning for the health of PWID experiencing houselessness. The many practices of harm reduction care at SSPs are most effective when used frequently (Fernàndes-Calderòn et al., 2019). The primary care tool, needle exchanges, only works if the person is using an SSP regularly enough to always have clean needles for each use. Any receptive syringe sharing can lead to negative health outcomes such as HIV or HCV contraction. Accessing needles regularly at an SSP is associated with a lower amount of receptive syringe sharing in rural settings (White et al., 2021). If a PWID experiencing houselessness is not accessing an SSP frequently, they are at higher likelihood of receptive syringe sharing since they will have less access to needles, and therefore, of the negative outcomes that come with receptive syringe sharing. This is compounded by some SSPs including caps on the number of needles someone can take in one visit. This will further limit PWID

experiencing houselessness if they are unable to use the SSP frequently since they will be unable to “stock up” on syringes.

Secondly, the population of PWID experiencing houselessness is more likely to need to use harm reduction care more frequently. PWID experiencing houselessness take part in a higher level of receptive syringe sharing, equipment sharing, and exchange sex (Hotton, Mackesy-Amiti, and Boodram, 2021). Regular utilization of an SSP gives them access to the tools that would protect against these behaviors, such as clean needles, cottons, ties, and condoms. Populations experiencing houselessness have also been shown to have a higher likelihood of encounters with police (Kouyoumdjian et al., 2019). Higher police encounters lead to worse health outcomes of PWID; through violent interactions, drug paraphernalia confiscation, and negative stigma (Cooper, 2015). Therefore, if PWID experiencing houselessness are finding themselves at a higher rate of encounters with police, they will have a higher rate of these negative outcomes; specifically, paraphernalia confiscation. Thus, they will have a lower number of clean needles more frequently and will need to access and use SSPs at a higher frequency. As we have shown here, they are unable to use the SSP as frequently as those not experiencing houselessness. Again, this would compound the issues with receptive syringe sharing, and lead to more negative health outcomes in PWID who experience houselessness.

Increasing the frequency of SSP visits for PWID experiencing houselessness should be a priority. SSPs should provide space to meet the needs of PWID experiencing houselessness more comprehensively. To do this, more food banks, other healthcare resources, sanitation stations, etc need to be included in SSPs. This allows PWID experiencing houselessness to meet many of their competing interests in one space. Increasing the access of SSPS for PWID experiencing houselessness will allow for more frequent utilization. This increase in the frequency of SSP use

will lead to PWID experiencing houselessness gaining the ability to replenish needles, naloxone, literature, and access other services provided by SSPs more often. As shown previously, all these services can lead to better health outcomes in the population through multiple pathways (Bornstein et al., 2020; Heinzigler et al., 2007, Hood et al. 2019). More frequent access to clean needles will lead to lower incidence of HIV and HCV in the population. More frequent access to naloxone will lead to a lower rate of overdose in the population. More frequent access to literature provided at SSPs will give PWIDs experiencing houselessness the knowledge on different potential OUD treatments available to them. Thus, increasing the frequency of SSP use for PWID experiencing houselessness could lead to a multitude of desired health outcomes. Investment in mobile SSPs and public transportation in rural areas will increase access. Changing state laws and organizational policies requiring prescriptions at pharmacies for syringes can also offset lower usage of SSPs in the population of PWID experiencing houselessness in rural areas.

Strengths and Limitations

This study's strength comes from the geographic scope of the ROI dataset. The population extends across eight rural sites that recruit from ten states. The dataset contains 2280 participants who have completed extensive profiles on their covariates. We have been able to include known covariates in our models, and this gives us confidence that the correlation we are seeing between experiencing houselessness and SSP use is present in this sample. Along with having a large sample, we successfully were able to adjust our models for potential RDS clustering. This gives us more accurate standard error estimates.

The cross-sectional nature of this study limits the ability to conclude there is a lack of internal validity and leads to a lack of temporality and causality in our findings. The issue of

recall bias may also be present within our sample, which may be limited to our explanatory variable since the recall period for SSP use is only 30 days, which is relatively short. Another issue arises in the two variables we are looking at in houselessness experience and SSP use. The survey asks participants if they report having experienced houselessness in the previous 6 months while it asks participants if they have used an SSP in the previous 30 days. Thus, it is possible that those marked off as having experienced houselessness, may not have been experiencing houselessness at the time they used (or did not use) an SSP. This could lead to us incorrectly measuring the correlation between the two in this population. Future studies into the topic should prioritize reporting these variables over similar timelines. Finally, despite the large size of our sample, it is lacking in diversity in a few ways. The sample is overwhelmingly white and lacks representative samples of African Americans and Native Americans in rural areas. The study samples mostly from sights in the Northern United States and is lacking generalizability to the Southwest and the Southeast. We also removed the seven transgender individuals from our sample due to model fitting, but literature has demonstrated that transgender individuals are more likely to be at risk of experiencing houselessness and lower access to harm reduction care, so we may be missing that relationship in our model. Along with this our answers of "male" or "female" when asking for the gender of participants may miss out on the differences between sex and gender. Other studies into this topic would have more strength by including a more diverse population across these variables.

Despite these limitations, we are confident this study tests our hypotheses and analyzes the associations between both houselessness and SSP use, and houselessness and the frequency of SSP use. These associations can teach us lessons about rural PWID experiencing houselessness and their access to SSPs. Even though the PWID experiencing houselessness in

this study had success in using SSPs, they were unable to use an SSP as frequently as those not experiencing houselessness. The latter finding is concerning, since the success of harm reduction care hinges on frequent usage by PWID. From here, we must learn how to reach out to the population experiencing houselessness more successfully, and then, bring them into the many paths that regular harm reduction care has for reducing negative health outcomes experienced by rural PWID.

Table 1a : Rural Opioid Initiative participant characteristics of people who have injected drugs in the previous 30 days

Full Sample			
Variable	Use SSP[a] = 1 (n=996 [43.7%])	Use SSP = 0 (n=1284 [56.3%])	Total (n=2280)
Experienced Houselessness In Previous 6 Months	594(46.4%)	686(61.7%)	1280
Race			
White	826(42.2%)	1132(57.8%)	1958
Black	18(30.0%)	42(70.0%)	60
Native American	112(65.5%)	59(34.5%)	171
Other	40(44.0%)	51(56.0%)	91
Ethnicity			
Hispanic	32(41.6%)	32(41.6%)	77
Non-Hispanic	964(43.8%)	1239(56.2%)	2203
Gender/Sex			
Male	577(43.9%)	738(56.1%)	1315
Female	419(43.4%)	546(56.6%)	996
Age(years)	34.8(sd = 9.3)	36.5(10.4)	35.7(10.0)
<30	326(47.7%)	357(52.3%)	683
30-39	401(45,3%)	472(54.7%)	873
40-49	192(40.2%)	286(59.8%)	478
50+	77(31.3%)	169(68.7%)	246
High School Graduate	801(44.7%)	993(55.4%)	1794
Use SNAP	533(40.8%)	774(59.2%)	1307
Use a Food Pantry	497(40.8%)	720(59.2%)	1217
Site of Enrollment			
Illinois	15(12.7%)	103(87.3%)	117
Kentucky	85(45.0%)	104(55.0%)	189
North Carolina	99(35.9%)	177(64.1%)	276
New England	106(26.5%)	294(73.5%)	400
Ohio	96(49.7%)	97(50.3%)	193
Oregon	54(37.2%)	91(62.8%)	145
Wisconsin	303(36.6%)	526(63.5%)	829
West Virginia	14(10.8%)	116(89.2%)	130
Drug Use			
Heroin	763(45.5%)	915(54.5%)	1678
Street Fentanyl	395(43.3%)	576(56.7%)	913
Other Opiates	539(41.6%)	756(58.4%)	1295
Meth and Other Amphetamines	848(46.2%)	986(53.8%)	1834

Note: Categorical variables are counts stratified across SSP use variable with percentage of total in parentheses

a. SSP Use is a variable saying whether or not a PWID uses a needle exchange as their main source to receive new needles

Table 1b: Rural Opioid Initiative participant characteristics of people who have injected drugs in the previous 30 days and have used an SSP in the previous 30 days.

Frequency that SSP is used (Per month)	Once a Month (n =219)	Biweekly (n = 201)	Three times a Month (n = 132)	Weekly (n = 138)	More than Weekly (n = 243)	Total (n=933)
Experienced Houselessness In Previous 6 Months	139*(24.9%)*	126(22.6%)	91(16.3%)	62(11.1%)	140(25.1%)	558
Race						
White	188(24.2%)	175(22.5%)	110(14.2%)	119(15.3%)	185(23.8%	777
Black	2(12.5%)	3(18.8%)	0	2(12.5%)	9(56.3%)	16
Native American	19(18.6%)	15(14.7%)	14(13.7%)	12(11.8%)	42(41.2%)	102
Other	10(26.3%)	8(21.1%)	8(21.1%)	5(13.2%)	7(18.4%)	38
Ethnicity						
Hispanic	7(23.3%)	4(13.3%)	3(10.0%)	8(26.7%)	8(26.7%)	30
Non-Hispanic	212(23.5%)	197(21.8%)	129(14.3%)	130(14.4%)	235(26.0%)	903
Gender/Sex						
Male	127(23.9%)	116(21.8%)	70(13.2%)	79(14.9%)	140(26.3%)	532
Female	92(22.9%)	85(21.2%)	62(15.5%)	59(14.7%)	103(25.7%)	401
Age(years)	35.9(9.2)	35.3(8.9)	32.7(8.7)	35.7(9.4)	34.5(9.3)	34.9(9.2)
<30	60(20.4%)	54(18.4%)	58(19.7%)	37(12.6%)	85(28.9%)	294
30-39	90(23.5%)	92(24.0%)	45(11.8%)	62(16.2%)	94(24.5%)	383
40-49	53(28.5%)	39(20.9%)	24(12.9%)	27(14.5%)	43(23.1%)	186
50+	16(22.7%)	16(22.9%)	5(7.1%)	12(17.1%)	21(30.0%)	70
High School Graduate	181(23.9%)	175(23.2%)	108(14.3%)	99(13.1%)	193(25.5%)	756
Use SNAP	121(24.1%)	108(21.5%)	68(13.5%)	76(15.1%)	130(25.8%)	503
Use a Food Pantry	109(23.0%)	106(22.3%)	69(14.5%)	76(16.0%)	115(24.2%)	475
Site of Enrollment						
Illinois	4(26.7%)	5(33.3%)	1(6.7%)	1(6.7%)	4(26.7%)	15
Kentucky	23(27.1%)	15(17.7%)	11(12.9%)	30(35.3%)	6(7.1%)	85
North Carolina	16(16.2%)	7(7.1%)	15(15.2%)	9(9.1%)	52(52.5%)	99
New England	18(17.0%)	23(21.7%)	12(11.3%)	21(19.8%)	32(30.2%)	106
Ohio	9(9.3%)	17(17.5%)	15(16.5%)	39(40.2%)	16(16.5%)	97
Oregon	21(39.6%)	16(26.4%)	5(9.4%)	4(7.6%)	9(17.0%)	53
Wisconsin	122(26.3%)	119(25.7%))	71(15.3%)	31(6.7%)	121(26.1%)	464
West Virginia	6(42.9%)	1(7.1%)	1(7.1%)	3(21.4%)	3(21.4%)	14
Drug Use						
Heroin	132(18.2%)	154(21.2%)	110(15.1%)	118(16.2%)	213(29.3%)	727
Street Fentanyl	63(16.5%)	68(17.8%)	55(14.4%)	73(19.1%)	123(32.2%)	382
Other Opiates	92(18.6%)	86(17.3%)	77(15.5%)	77(15.5%)	164(33.1%)	496
Meth and Other Amphetamines	193(24.4%)	165(20.9%)	116(14.7%)	111(14.1%)	205(26.0%)	634

Note: Categorical variables are counts stratified across SSP use variable with percentage of total in parentheses

Table 2: Adjusted[a] model results using houselessness status as predictor among PWID.

Independent Variable	Odds Ratio (95% C.I.)
Model 1	
SSP use in the past 30 days	1.26(1.04, 1.55)
Model 2	
Number of SSP visits per month *(1 Time a month used as reference level)*	
Biweekly	.98(.64, 1.51)
3 Times a Month	1.24(.74, 2.08)
Weekly	.55(.32, .94)
More than Weekly	.74(.46, 1.18)

a. Race, ethnicity, gender/sex, age, education, entitlement use, site of enrollment, and drug usage were included as covariates in both models

References

Barile, J. P., Pruitt, A. S., & Parker, J. L. (2020). Identifying and understanding gaps in services for adults experiencing homelessness. *Journal of Community and Applied Social Psychology*, *30*(3), 262–277. https://doi.org/10.1002/casp.2440

Batty, E., Ibragimov, Fadanelli, M., Gross, S., Cooper, K., Klein, E., Ballard, A.M., Young, A.M., Lockard, A.S., Oser, C.B, & Cooper, H.L.F. (2021). A Qualitative Analysis of Rural Syringe Service Program Fidelity in Appalachian Kentucky: Staff and Participant Perspectives. [Manuscript submitted for publication]. Department of Sociology, University of Kentucky.

Bornstein, K. J., Coye, A. E., Onge, J. E., Li, H., Muller, A., Bartholomew, T. S., & Tookes, H. E. (2020). Hospital admissions among people who inject opioids following syringe services program implementation. *Harm Reduction Journal*, *17*(1), 1–6. https://doi.org/10.1186/s12954-020-00376-1

Briggs, D., Rhodes, T., Marks, D., Kimber, J., Holloway, G., & Jones, S. (2009). Injecting drug use and unstable housing: Scope for structural interventions in harm reduction. *Drugs: Education, Prevention and Policy*, *16*(5), 436–450. https://doi.org/10.1080/09687630802697685

Canary, L., Hariri, S., Campbell, C., Young, R., Whitcomb, J., Kaufman, H., & Vellozzi, C. (2017). Geographic Disparities in Access to Syringe Services Programs Among Young Persons With Hepatitis C Virus Infection in the United States. *Clinical Infectious Diseases*, *65*(3), 514–517. https://doi.org/10.1093/cid/cix333

Center for Disease Control and Prevention. (2012). *HIV Infection, Risk, Prevention, and Testing*

Behaviors among Persons Who Inject Drugs -NHBS PWID 2012. 24. http://www.cdc.gov/hiv/%5Cnhttp://www.cdc.gov/hiv/library/reports/surveillance/%5Cnhttp://www.cdc.gov/cdc-info/requestform.html

Cooper, H. L. F. (2015). War on Drugs Policing and Police Brutality. *Substance Use and Misuse*, *50*(8–9), 1188–1194. https://doi.org/10.3109/10826084.2015.1007669

Craft-Rosenberg, M., Powell, S. R., Culp, K., Craft-Rosenberg, M., Rae Powell, S., Culp, K., Cowen, H., Friedrich, R. M., Levy, S., Lively, S., Reilly, P., Rosenthal, D., & Jo Gagan, M. (2000). Health status and resources of rural homeless women and children. *Western Journal of Nursing Research*, *22*(8), 863–878. https://doi.org/10.1177/01939450022044845

Des Jarlais, D. C., Nugent, A., Solberg, A., Feelemyer, J., Mermin, J., & Holtzman, D. (2015). Syringe Service Programs for Persons Who Inject Drugs in Urban, Suburban, and Rural Areas — United States, 2013. *MMWR. Morbidity and Mortality Weekly Report*, *64*(48), 1337–1341. https://doi.org/10.15585/mmwr.mm6448a3

Fernández-Calderón, F., Díaz-Batanero, C., Barratt, M. J., & Palamar, J. J. (2019). Harm reduction strategies related to dosing and their relation to harms among festival attendees who use multiple drugs. *Drug and Alcohol Review*, *38*(1), 57–67. https://doi.org/10.1111/dar.12868

First, R. J., Rife, J. C., & Toomey, B. G. (1994). Homelessness in rural areas: Causes, patterns, and trends. In *Social Work (United States)* (Vol. 39, Issue 1, pp. 97–108). https://doi.org/10.1093/sw/39.1.97

Fortier, E., Alavi, M., Micallef, M., Dunlop, A. J., Balcomb, A. C., Day, C. A., Treloar, C., Bath,

N., Haber, P. S., Dore, G. J., Bruneau, J., & Grebely, J. (2015). The effect of social functioning and living arrangement on treatment intent, specialist assessment and treatment uptake for hepatitis C virus infection among people with a history of injecting drug use: The ETHOS study. *International Journal of Drug Policy*, *26*(11), 1094–1102. https://doi.org/10.1016/j.drugpo.2015.06.001

Gelberg, L., Gallagher, T. C., Andersen, R. M., & Koegel, P. (1997). Competing priorities as a barrier to medical care among homeless adults in Los Angeles. *American Journal of Public Health*, *87*(2), 217–220. https://doi.org/10.2105/AJPH.87.2.217

Gunner, E., Chandan, S. K., Yahyouche, A., Paudyal, V., Marwick, S., Saunders, K., & Burwood, S. (2019). Provision and accessibility of primary healthcare services for people who are homeless: A qualitative study of patient perspectives in the UK. *British Journal of General Practice*, *69*(685), E526–E536. https://doi.org/10.3399/bjgp19X704633

Heinzerling, K. G., Kral, A. H., Flynn, N. M., Anderson, R. L., Scott, A., Gilbert, M. L., Asch, S. M., & Bluthenthal, R. N. (2007). Human immunodeficiency virus and hepatitis C virus testing services at syringe exchange programs: Availability and outcomes. *Journal of Substance Abuse Treatment*, *32*(4), 423–429. https://doi.org/10.1016/j.jsat.2006.11.002

Hood, J. E., Banta-Green, C. J., Duchin, J. S., Breuner, J., Dell, W., Finegood, B., Glick, S. N., Hamblin, M., Holcomb, S., Mosse, D., Oliphant-Wells, T., & Shim, M. H. M. (2020). Engaging an unstably housed population with low-barrier buprenorphine treatment at a syringe services program: Lessons learned from Seattle, Washington. *Substance Abuse*, *41*(3), 356–364. https://doi.org/10.1080/08897077.2019.1635557

Hotton, A., Mackesy-Amiti, M. E., & Boodram, B. (2021). Trends in homelessness and injection

practices among young urban and suburban people who inject drugs: 1997-2017. *Drug and Alcohol Dependence*, *225*(October 2020), 108797. https://doi.org/10.1016/j.drugalcdep.2021.108797

Institute For Children Poverty & Homeless. (2019). *Student Homelessness in Rural America Student Homelessness Growing Fastest* (Issue February).

Kenney, S. R., Anderson, B. J., Bailey, G. L., Herman, D. S., Conti, M. T., & Stein, M. D. (2021). Examining Overdose and Homelessness as Predictors of Willingness to Use Supervised Injection Facilities by Services Provided Among Persons Who Inject Drugs. *American Journal on Addictions*, *30*(1), 21–25. https://doi.org/10.1111/ajad.13065

Kouyoumdjian, F. G., Wang, R., Mejia-Lancheros, C., Owusu-Bempah, A., Nisenbaum, R., O'Campo, P., Stergiopoulos, V., & Hwang, S. W. (2019). Interactions between Police and Persons Who Experience Homelessness and Mental Illness in Toronto, Canada: Findings from a Prospective Study. *Canadian Journal of Psychiatry*, *64*(10), 718–725. https://doi.org/10.1177/0706743719861386

Lancaster, K. E., Cooper, H. L. F., Browning, C. R., Malvestutto, C. D., Bridges, J. F. P., & Young, A. M. (2020). Syringe Service Program Utilization, Barriers, and Preferences for Design in Rural Appalachia: Differences between Men and Women Who Inject Drugs. *Substance Use and Misuse*, *55*(14), 2268–2277. https://doi.org/10.1080/10826084.2020.1800741

Lipira, L., Leichtling, G., Cook, R. R., Leahy, J. M., Orellana, E. R., Korthuis, P. T., & Menza, T. W. (2021). Predictors of having naloxone in urban and rural Oregon findings from NHBS and the OR-HOPE study. *Drug and Alcohol Dependence*, *227*(January), 108912.

https://doi.org/10.1016/j.drugalcdep.2021.108912

Marr, E. (2015). Assessing Transportation Disadvantage in Rural Ontario, Canada: A Case Study of Huron County. *Journal of Rural & Community Development*, *10*(2), 100–120.

Miller-Lloyd, L., Landry, J., Macmadu, A., Allard, I., & Waxman, M. (2020). Barriers to Healthcare for People Who Inject Drugs: A Survey at a Syringe Exchange Program. *Substance Use and Misuse*, *55*(6), 896–899. https://doi.org/10.1080/10826084.2019.1710207

Parkes, T., Matheson, C., Carver, H., Foster, R., Budd, J., Liddell, D., Wallace, J., Pauly, B., Fotopoulou, M., Burley, A., Anderson, I., Price, T., Schofield, J., & MacLennan, G. (2022). Assessing the feasibility, acceptability and accessibility of a peer-delivered intervention to reduce harm and improve the well-being of people who experience homelessness with problem substance use: the SHARPS study. *Harm Reduction Journal*, *19*(1), 1–22. https://doi.org/10.1186/s12954-021-00582-5

Stergiopoulos, V., Gozdzik, A., Nisenbaum, R., Lamanna, D., Hwang, S., Tepper, J., & Wasylenki, D. (2017). Integrating Hospital and Community Care for Homeless People with Unmet Mental Health Needs: Program Rationale, Study Protocol and Sample Description of a Brief Multidisciplinary Case Management Intervention hypoplasia. In *International Journal of Mental Health & Addiction* (pp. 362–378). https://doi.org/10.1007/s11469-017-9731-5

Susser, E., Moore, R., & Bruce, L. (1993). Risk Factors for Homelessness. In *American Journal of Epidemiology* (Vol. 15, Issue 2, pp. 1–12). https://www.scopus.com/inward/record.uri?partnerID=HzOxMe3b&scp=85053399111&ori

gin=inward

Thakarar, K., Sankar, N., Murray, K., Lucas, F. L., Burris, D., & Smith, R. P. (2021). Injections and infections: understanding syringe service program utilization in a rural state. *Harm Reduction Journal*, *18*(1), 1–9. https://doi.org/10.1186/s12954-021-00524-1

Troppy, S., Soliva, S., Onofrey, S., Demaria, A., Haney, G., Cranston, K., & Klevens, R. M. (2018). Geographic disparities in access to syringe services programs among young persons with hepatitis C virus infection in Massachusetts. *Clinical Infectious Diseases*, *67*(2), 314. https://doi.org/10.1093/cid/ciy068

United States Goverment Accountability Office. (2010). *RURAL Better Collaboration by HHS and HUD Could Improve Delivery of Services in Rural Areas H ighlights Delivery of S ervice s in Rural Area s. July*, 8678.

US Department of Housing and Urban Development. (2020). The 2020 Annual Homeless Assessment Report to Congress. *Development, January*, 48.

White, R. H., O'Rourke, A., Kilkenny, M. E., Schneider, K. E., Weir, B. W., Grieb, S. M., Sherman, S. G., & Allen, S. T. (2021). Prevalence and correlates of receptive syringe-sharing among people who inject drugs in rural Appalachia. *Addiction, 116*(2), 328–336. https://doi.org/10.1111/add.15151

Wise, C., & Phillips, K. (2013). Hearing the silent voices: Narratives of health care and homelessness. *Issues in Mental Health Nursing*, *34*(5), 359–367. https://doi.org/10.3109/01612840.2012.757402

Yousey, A., & Samudra, R. (2018). Defining Homelessness in the Rural United States. *Online*

Journal of Rural Research & Policy, *13*(4). https://doi.org/10.4148/1936-0487.1094