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Latent Risk Subtypes Based on Injection and Sexual Behavior Among People Who Inject Drugs in Rural Puerto Rico

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Abstract

Background—People who inject drugs (PWID) in Puerto Rico engage in high levels of injection and sexual risk behavior, and they are at high risk for HIV and hepatitis C (HCV) infection, relative to their US counterparts. Less is known, however, about the clustering of risk behavior conducive to HIV and HCV infection among rural Puerto Rican communities.

Objectives—The purpose of this study was to examine concurrent injection and sexual risk subtypes among a rural sample of PWID in Puerto Rico.

Methods—Data were drawn from a respondent-driven sample collected in 2015 of 315 PWID in 4 rural communities approximately 30–40 miles from San Juan. Latent class analysis (LCA) was used to examine risk subtypes using 3 injection and 3 sexual risk indicators. In addition, demographic and other PWID characteristics were examined as possible predictors of latent class membership.

Results—Four LCA subtypes were identified: low risk (36%), high injection/low sexual risk (22%), low injection/high sexual risk (20%), and high risk (22%). Younger age and past year homelessness predicted high risk latent class membership, relative to the other classes. In addition, daily speedball use predicted membership in the high injection/low sexual risk class, relative to the low risk and low injection/high sexual risk classes.

Conclusion/Importance—The findings suggest ways in which PWID risk clusters can be identified for targeted interventions.

Keywords

hepatitis C; Hispanic; HIV; rural; substance use

Patterns of drug use and related health risks differ considerably, both across drug types and across geographic locales.[1,2] Recent changes in injection drug use have focused greater attention on the need for HIV and hepatitis C (HCV) prevention to move away from

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traditional urban venues toward rural communities.[3–5] Rural HIV and HCV outbreaks point to the growth in injection opioid use in non-urban areas, much of which is missed by traditional surveillance efforts.[6,7] Little is known, however, about patterns of injection drug use and associated risks in rural communities outside of the Appalachian region of the United States (US),[8] leaving intervention efforts to rely on either urban models, or rural models taken from potentially very different cultural areas.

Understanding risk patterns across diverse contexts is critical for predicting epidemiological outcomes and planning drug interventions aimed at both desistance and harm reduction. Decades of research on HIV and HCV transmission among people who inject drugs (PWID) shows the importance of drug-use-related risk behaviors such as sharing needles and cooking equipment, splitting drugs with used syringes, unprotected sex, multiple sexual partners, and exchanging sex for money/drugs to long-term community health outcomes.[9,10] Most often, however, these transmission factors are examined in isolation from one another.[11] New analytical means allow researchers to investigate the simultaneous contribution of many factors—drawn from both injection and sexual behaviors—to the presence of hidden risk subtypes that many not be apparent to users themselves, or to health officials and/or casual observers. Understanding and predicting risk profiles among active PWID allows for more realistic and efficient targeting of health promotion, particularly among underserved and vulnerable populations. The purpose of this study was to examine latent injection and sexual risk subtypes among one highly vulnerable PWID population—Puerto Ricans—in rural communities, which have been traditionally underserved and understudied.

In rural Puerto Rico, HIV prevalence remains low, but HCV rates among rural injectors have been measured at roughly 80%—indicating that HIV risk remains high.[12] In general, injection drug use in urban Puerto Rico (primarily San Juan and nearby Bayamon) has received considerable public health attention because of the high prevalence of HIV and HCV among Puerto Rican PWID relative to their US counterparts.[13,14] Furthermore, while the primary route of HIV transmission in the US is men who have sex with men, injection drug use comprises the most common route of transmission in Puerto Rico.[14–16] Heterosexual contact is the second most common route of transmission in Puerto Rico, and it is likely related to non-substance using individuals having sexual partners who inject drugs.[17] Risk profiles of Puerto Ricans on the US mainland have noted overall differences in risk behaviors. Comparative research in New York City and Bayamon indicated that PWID in Puerto Rico inject more frequently, use in riskier settings such as shooting galleries, frequently inject speedballs, and more often die of overdose than their counterparts on the mainland.[1,2,18–20] In addition, PWID in Puerto Rico are more likely to have multiple sex partners, have unprotected sex with main and casual sex partners, and exchange sex for money/drugs.[17] To the extent that risk patterns in Puerto Rico continue to inform the behavior of Puerto Ricans on the mainland, they may help explain differences in HIV and HCV seropositivity between Puerto Ricans and their non-Puerto Rican PWID counterparts.

Latent class analysis (LCA) is a statistical method which aims to identify subgroups within a population that share similar profiles on a set of observed indicators.[21,22] Prior research among PWID that employed LCA suggests gradations of risk based on injection and sexual risk practices, with most studies finding a low-risk group consisting of individuals who have

low probabilities of engaging in injection and sexual risk behavior, a high-risk group consisting of individuals who have high probabilities of engaging in both injection and sexual risk behaviors, and at least one additional group that does not fit this pattern.[11,23–26] Much of this research has applied LCA to understanding risk subtypes among large urban samples, and additional research is needed to examine whether or not profiles found in existing research can be replicated for other PWID populations.

Understanding subtypes of risk is particularly important for rural Puerto Rican communities, because services such as needle exchange programs are limited and underutilized in these settings.[27,28] This study drew participants from 4 mountainous rural districts in central Puerto Rico, with population densities generally less than 1,000 residents per square mile. Difficult travel between locations due to the mountain terrain added to the geographical isolation of the area. In these conditions, conventional needle exchanges operating out of a single storefront location are impractical. Instead, the total area is supported by a single outreach project operating from a mobile van. Under such conditions, LCA studies of concurrent injection and sexual risk factors may offer cost-effective approaches to identifying subtypes of risk that can be used to identify those most in need of intervention services in dispersed rural areas. Such studies may also suggest ways to tailor intervention programming for specific risk profiles. In addition, identifying demographic correlates of these risk subtypes may further help identify PWID most in need of targeted intervention programming. Because the composition and social context of rural communities differs from that of urban population centers,[7,29] demographic correlates of risk profiles among PWID in rural communities may also vary from prior research among urban samples. For this reason, a more precise understanding of the relationship between demographic factors/other PWID characteristics and risk profiles/types seems essential.

To address these issues, we employed a twofold analytical strategy based around LCA. First, we used LCA to examine subtypes of risk based on concurrent injection and sexual indicators among a respondent-driven sample of rural PWID in Puerto Rico. Second, we examined whether relevant demographic and other characteristics salient to PWID in Puerto Rico (eg, HCV seroprevalence, speedball injection) predict membership into these latent risk classes. This is the first time LCA has been used to understand a rural sample of PWID in order to uncover potential differences in rural subtypes of risk.

Methods

Sample

Interviews with 315 participants were completed at a single storefront location approximately 40 miles south of San Juan, Puerto Rico, between April and June of 2015. Recruitment via respondent-driven sampling (RDS) drew participants from the district in which the project was located (n = 143 from Cidra, pop. ~43,000, 1,200/mi^2) and from 3 neighboring districts (n = 60 from Cayey, pop. ~48,000, 960/mi^2; n = 28 from Aguas Buenas, pop. ~29,000, 960/mi^2; n = 60 from Comario, pop. ~21,000, 740/ mi^2; n = 24 from other districts). Eligible participants were alert, 18 years of age or older, and reported injecting drugs within the last 30 days. Visual inspections for injection signs, as well as questionnaires about drug injection knowledge, were used to confirm recent injection. Upon

completing the questionnaire, participants were compensated with $25. Recruitment into the sample was managed using RDS, whereby participants who completed the survey were given 3 referral coupons they could pass out to other qualified individuals who had not previously participated in the project (8 seeds total – 2 seeds per community). For every referral that then completed the survey, the referee could earn an additional $10. Though there are concerns about representativeness using this method of recruitment, they are minimal, and RDS is often preferred for stigmatized and hard to reach populations.[30–31] For more information on the RDS characteristics of this sample see Coronado-Garcia et al.[32] Post hoc analyses (available upon request) indicated low levels of homophily for the main demographic variables and latent classes, which suggests that recruitment preference and statistical bias is minimal.[30] Consequently, we did not weight the data.

In person, computer-assisted interviews were administered by trained field researchers. The questionnaire used in this study was based on the Centers for Disease Control and Prevention's National HIV Behavioral Surveillance on Injection Drug Use (Round 3) survey. In addition to recording the participants' self-reported HIV and HCV status prior to participating in the study, the project provided rapid testing for both HIV and HCV antibodies. Participants were compensated an additional $5 for each test completed. Participants who tested positive for HIV or HCV were offered referral and transportation to a primary care doctor for confirmatory testing and link-to-care. Written, informed consent was obtained from all individual participants included in the study. The study received Institutional Review Board approval through the University of Nebraska-Lincoln and the University of Puerto Rico, Medical Sciences Campus.

Measures

Injection Risk Behavior—Three past-year injection risk behaviors were assessed. Because each indicator was heavily skewed, dichotomous indicators were chosen over ordinal or continuous indicators. Respondents were asked how many people they shared a needle with after they had already injected with it, how many people they shared preparation equipment with (eg, cooker, cotton, and/or water), and how many times they injected drugs that had been divided with a syringe that someone else had already used (ie, backloading). For each item, those reporting zero partners/times were coded as zero and those reporting at least 1 partner/time were coded as 1.

Sexual Risk Behavior—Three past-year sexual risk behaviors were assessed. Similar to the injection risk indicators, each sexual risk indicator was heavily skewed. As such, dichotomous indicators were chosen over ordinal or continuous indicators. First, respondents were asked whether or not they had had sex without a condom (0 = zero unprotected sex partners; 1 = at least one unprotected sex partner). Second, respondents were asked how many sex partners they had. Those reporting 2 or more sex partners were coded as 1 and those with one or no sex partners were coded as zero (0 = no/single sex partner; 1 = multiple sex partners). Third, respondents were asked whether or not they exchanged sex for drugs or money or if they exchanged money or drugs for sex (0 = no sex exchange; 1 = any sex exchange).

PWID Characteristics—Five demographic variables were assessed including current age, gender (0 = male; 1 = female), marital status (0 = married or cohabitating; 1 = divorced, separated, or widowed; 2 = single), highest level of education (0 = less than high school; 1 = high school diploma; 2 = any college), and past year homelessness (0 = no; 1 = yes). In addition, 4 PWID characteristics were examined. First, a measure of injection drug use duration was created by subtracting the age at which respondents reported first injecting drugs from their current age. Second, respondents were asked whether or not they had gotten a new, sterile needle or preparation equipment for free, not including those given to them by a friend, relative, or sex partner (0 = no; 1 = yes). Third, HCV seroprevalence was assessed using the OraQuick HCV Rapid antibody test[33] (HCV seronegative = 0; HVC seropositive = 1). There were too few cases (n = 19) to include HIV seropositive status as a statistically meaningful predictor. Fourth, daily speedball injection was assessed from one question asking how often respondents injected speedballs (heroin and cocaine) in the past year. Because of heavy negative skew, response options were collapsed into (0) less than daily and (1) daily speedball injection.

Analytic Strategy

A total of 3 respondents (0.1%) were missing data on any variable included in the analyses. Consequently, these respondents were removed from the sample via listwise deletion, resulting in an analytic sample of 312 individuals. Latent class analysis[21,22] was used to examine risk profiles using the 3 injection risk and 3 sexual risk indicators. LCA aims to identify unobserved heterogeneity that represents response patterns in the data, and it estimates the proportion of individuals belonging to each class and the conditional probabilities linking responses to the risk indicators to membership in each class. Because the number of latent classes is unknown, class enumeration must be inferred from the data. To determine the optimal number of classes, 3 information criteria were used: Akaike information criteria (AIC),[34] Bayesian information criteria (BIC),[35] and sample size adjusted BIC (A-BIC). Lower values indicate better model fit. In addition, 2 likelihood ratio tests were used, which compare a k-class model to a k-1 class model: Lo-Mendel-Rubin likelihood ratio test (LMR-LRT)[36] and the bootstrap likelihood ratio test (BLRT).[37] Significant values indicate that a k-class model fits the data better than a k-1 class model. Because local maxima are common in mixture models, multiple random start values were used to ascertain that the best log-likelihood value was replicated.[21] Local independence was verified by examining the standardized bivariate residuals.[38]

All analyses were conducted in Mplus Version 7.4 (Muthén & Muthén, Los Angeles, California).[39] The traditional approach to predicting latent class membership is to classify individuals into their most likely class based on posterior probability values and using this observed variable as an outcome and/or predictor in regression models. Recent evidence suggests that this approach attenuates associations between predictor variables and class membership.[40,41] Means and probabilities were examined across latent class groups using the *DCON* and *DCAT* auxiliary commands for continuous and categorical predictors, respectively, in Mplus,[39,40] which accounts for class membership uncertainty.[42] Significant bivariate correlates from this step were simultaneously entered into a multivariate, multinomial logistic regression model predicting latent class membership. The 3-step

approach[41] was used, which is implemented in Mplus using the *R3STEP* command.[40] A simulation study[40] showed that the 3-step approach was as efficient as the 1-step (simultaneous estimation of latent classes and class membership) when class separation was large (entropy of 0.6 or higher).

Results

LCA Model Fit

AIC, BIC, A-BIC, LMR-LRT, and BLRT were examined for up to 5 classes (see Table 1). According to Nylund and associates'simulation study,[43] the A-BIC and BLRT tests had the highest rates of correctly identifying the number of classes when the indicators were categorical. Based on the A-BIC, a 4-class solution had the lowest value. The LMR-LRT and BLRT tests provided further support for the 4-class model compared to the 3-class model. Entropy is a measure of classification certainty with values approaching 1 indicating high class separation.[44] The 4-class model had an entropy value of 0.88, and average posterior probabilities within each group ranged from 0.91 to 0.96, which suggests high class separation and classification accuracy.[45]

Table 2 presents the past year prevalence of each of the 6 risk indicators examined, and their conditional probabilities across the 4 latent class groups, which were used to assign labels to groups: low risk (LR: 36%), high injection risk/low sexual risk (HILS: 22%), low injection risk/high sexual risk (LIHS: 20%), and high risk (HR: 22%). The LR class is characterized by low/moderate conditional probabilities for each of the risk indicators. The LIHS class is characterized by high probabilities of having sex without a condom and multiple sex partners and low/moderate conditional probabilities on the injection risk items. The HILS group is characterized by high conditional probabilities of injection risk and low/moderate conditional probabilities on the sexual risk indicators. The HR class is characterized by high conditional probabilities for each of the indicators, except for exchanging sex (respondents in the HR group, however, had the highest probability of exchanging sex).

Demographic and Injection Drug Use Characteristics

As shown in the left column of Table 3, respondents had an average age of 41.75 years and reported injecting drugs 19.82 years. A majority of the sample is male (male – 90.7%; female – 9.3%), single (single – 47.1%; married/cohabitating – 22.4%; divorced/separated/widowed – 30.4%), has less than a high school diploma (less than high school – 47.8%; high school diploma – 34.0%; any college – 18.3%), and reported no past year homelessness (61.5%). Approximately two-thirds (59.0%) of the sample obtained a sterile needle from a service agency, and approximately three-quarters of respondents tested positive for HCV (78.2%) and injected speedballs daily (73.4%).

Bivariate Latent Class Profiles

Table 3 displays the bivariate profile analysis. Of the 9 variables examined, only age, injection duration, past year homelessness, and daily speedball injection were significantly associated with latent class membership. Gender, marital status, highest level of education, obtaining sterile needles from a service agency, and HCV seropositivity were not significant

correlates. Respondents in the HR class were significantly younger in age than the other 3 classes. In addition, respondents in the LIHS class were significantly younger than the LR and HILS classes. There were no significant age differences between the LR and HILS classes. Similarly, respondents in the HR class reported injecting the fewest years, and they injected for significantly less years than respondents in the LR and HILS classes. There were no significant differences in injection duration between the HR and LIHS classes, or between the LR and HILS classes. The HR class had a higher proportion of respondents who reported past year homelessness than the LR and HILS classes. There were no significant differences in past year homelessness proportions between the HR and LIHS classes, nor between the LR and HILS classes. The HILS class had a higher proportion of individuals who inject speedballs daily compared to the LR and HR classes. There were no significant differences between the HILS and LIHS classes with regard to daily speedball use.

Multivariate Analyses Predicting Latent Class Membership

Table 4 presents the multinomial logistic regression models predicting class membership using variables that were significant in the bivariate profile analysis. Unlike the bivariate analyses, injection duration was not a significant predictor in any of the models. Age, past year homelessness, and daily speedball injection were all significant predictors of latent class membership. For every one-unit increase in age, the odds of HR membership relative to LR membership decreased by 8% (OR = 0.92, 95% CI: 0.88–0.96). In addition, for every year increase in age, the odds of LIHS and HILS membership increased by 5% and 7%, respectively, relative to HR membership (OR = 1.05, 95% CI: 1.00–1.11; OR = 1.07, 95% CI: 1.01–1.13, respectively). Age was a not a significant predictor of LIHS and HILS membership relative to LR membership, nor was it a significant predictor of LIHS membership relative to HILS membership. Stated generally, increases in age decreased the odds of HR class membership relative to the other 3 categories.

A similar pattern emerged for past year homelessness. Compared to respondents who reported no past year homelessness, those who reported any homelessness had increased odds of HR class membership relative to the LR class (OR = 4.74, 95% CI: 2.23–10.11). In addition, respondents who reported past year homelessness compared to no homelessness had decreased odds of LIHS and HILS membership relative to the HR class (OR = 0.42, 95% CI: 0.18–0.99; OR = 0.34, 95% CI: 0.16–0.73, respectively). None of the other comparisons for past year homelessness were significant, indicating that homelessness increases the odds of HR class membership relative to the other classes.

Compared to respondents who reported less than daily or no speedball injection, respondents who inject speedballs at least once per day had increased odds of HILS class membership relative to the LR and LIHS classes (OR = 2.51, 95% CI: 1.02–6.17; OR = 3.68, 95% CI: 1.39–9.71, respectively). Although daily speedball injection differentiated HR class membership from HILS class membership in the bivariate analyses, no significant differences were observed in the multivariate models. None of the other contrasts were significant.

Discussion

Despite growing public health concerns of HIV and HCV infection among PWID, few studies have examined risk profiles among rural injecting populations,[3] particularly in rural Puerto Rico where the injection drug use and risk of HIV and HCV infection are high[12] and resources are limited.[27,28] Understanding concurrent risk subtypes is critical for developing effective intervention efforts and adapting limited resources in rural communities for desistance and harm reduction efforts. To address this, the first purpose of the study was to examine latent classes of concurrent injection and sexual risk behavior among rural PWID in Puerto Rico.

Using LCA, 4 risk classes were identified, each comprising approximately a quarter of the sample: low risk (low on all risk indicators), high injection/low sexual risk (high conditional probabilities for injection risk and low conditional probabilities for sexual risk), low injection/high sexual risk (low conditional probabilities for injection risk and high probabilities for sexual risk), and high risk (high conditional probabilities on all injection and sexual risk indicators). The latent class groups were substantively similar to those found in prior studies among urban PWID,[11,23–26] wherein low-, moderate-, and high-risk groups were identified. The proportion of PWID considered “high risk,” however, was lower in this study than previous urban LCA studies,[11,25] which may be a function of slightly different risk indicators and possible geographic and cultural differences.

The second purpose of this study was to examine whether demographic and other PWID characteristics predict latent class membership to identify specific factors that can be used to tailor targeted interventions. In general, age, homelessness, and daily speedball injection were the characteristics most consistently and strongly associated with latent class membership. In the bivariate profile analysis, younger age and injection duration were associated with increased odds of HR class membership relative to LR and LIHS class membership. Only age, however, remained significant in the multivariate analyses. Post hoc analyses (available upon request) indicate that when age is removed from the multinomial logistic regression models, injection duration has a similar effect as age on latent class membership. Thus, both variables are likely redundant with one another.

Prior LCA research has found that older age decreases the odds of high-risk class membership, relative to lower- and moderate-risk classes.[24,26] These results also support non-LCA research in which younger age was associated with risky injection[46] and sexual behavior,[47] and other factors indirectly associated with injection and sexual risk behavior among PWID including poly-substance use[48] and homelessness.[47] Taken together, the associations between age and high-risk latent class membership may be a function of younger PWID being embedded in risk environments and social networks conducive to risk behavior.[49] Underscoring these results, the PWID population in Puerto Rico is younger than that in the mainland US.[2] Because HIV and HCV transmission generally occurs within the first few years of injection drug use,[50] intervention programming targeting younger users may be most efficacious in reducing new infections and limiting transmission to others within PWID social networks.

Similarly, past year homelessness increased the odds of HR class membership relative to the other risk classes. Although homelessness itself does not cause risky injection and sexual risk behavior, the social context of homelessness (eg, poverty, risky social networks, lack of resources) has been implicated as a possible mechanism linking it with high risk.[51] Homeless PWID in urban Puerto Rico are more likely to inject 3 or more times per day, share needles and cooking equipment, pool money for drugs, exchange sex for money or drugs,[52,53] and drop out of substance use treatment.[54] Homeless PWID in Puerto Rico also experience harassment from the police, which may cause them to rush injection and not use sterile needles or cooking equipment.[55] PWID are a hard-to-reach population, and homelessness likely magnifies this marginality and lack of visibility. Rural settings may compound these issues because outreach services and other preventive resources are scarce compared to urban communities.[26,27] Policies aimed at reducing the hardships of homelessness (eg, lack of stable housing, barriers to sterile needle access, safe injection settings) may reduce these compounded risks for HIV and HCV infection and transmission. Homeless peer outreach should be incorporated into rural intervention programming among PWID to target those least visible and at highest risk for multiple adverse health outcomes.

In addition to age and homelessness, daily speedball injection increased the odds of HILS membership, relative to LR and LIHS membership. Thus, it appears that daily speedball injection increases the odds of injection risk behavior without a consequent rise in sexual risk behavior. This finding is partially supported by prior research in which injection speedball use consistently predicted risky injection behavior, but not necessarily risky sexual behavior compared to other drugs such as powdered or crack cocaine.[56] This finding also has important implications for rural PWID in Puerto Rico because speedball is by far the primary injection drug of choice. Heavy injection speedball use partially explains why Puerto Ricans living in Bayamon inject more frequently than their counterparts residing in New York City.[1] In addition, injection speedball use is associated with joint drug purchasing, which may be considered an indirect injection risk behavior,[57] and increased odds of substance use treatment dropout and non-fatal overdose.[54] Because habitual injection speedball use predicts risky injection behavior over risky sexual behavior, interventions aimed at reducing risky injection behavior such as needle exchange programs could be an effective harm reduction strategy. In reality, limited access to needle exchange programs in rural communities likely renders this harm reduction strategy less effective. Peer outreach programs targeting habitual speedball users that emphasize injection risk reduction may be a more effective harm reduction strategy among rural PWID networks.[58]

Limitations

Several methodological limitations may affect the findings of this study. First, the data are cross-sectional, and consequently, temporal order cannot be established between the predictors and latent classes. Longitudinal data would be more suitable for establishing temporal ordering and estimating the predictive utility of latent class membership. Because this is an early attempt at understanding injection drug use in rural areas, more data and research are clearly needed to replicate and extend these results. Second, each indicator used to construct the latent classes was dichotomous (risk vs no risk). In reality, HIV and HCV risk behaviors exist along a continuum, with higher levels of risk corresponding with greater

opportunities for contracting and transmitting the viruses. Ordinal or continuous risk indicators would have provided a more nuanced and realistic understanding of risk profiles among this sample of PWID than dichotomous risk indicators. Because each risk indicator was heavily skewed and the sample size is relatively small, dichotomization was the most pragmatic approach to take, and it likely reduced potential recall bias because participants only had to recall ever engaging in each of the risk behaviors examined in the past 12 months, rather than the precise number/times.

Conclusions

Limitations notwithstanding, the data and results represent an important early step in understanding HIV and HCV risk among PWID in rural Puerto Rico. The results suggest that injection and sexual risk behaviors cluster together to comprise unique risk subtypes that may be conducive to contracting and transmitting HIV and HCV. Moreover, demographic factors, particularly age, homelessness, and daily speedball injection, predicted membership into these latent risk classes. Needle exchange programs and behavioral interventions among Hispanic populations have been found to be relatively effective at reducing HIV and HCV seroprevalence,[59] and decreasing risky injection and sexual behaviors.[28,60] At present, there is only one needle exchange program serving rural Puerto Rican communities.[27] In addition, many behavioral interventions are designed only for urban populations. The results of this study point to ways of identifying specific risk clusters within PWID networks, which can potentially be used to adapt limited programmatic resources for targeted interventions to improve health outcomes among rural PWID.

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Table 1

LCA Model Selection ($N = 312$)

Classes	AIC	BIC	A-BIC	LMR-LRT	BLRT	Entropy
1	2279.09	2301.54	2282.51			
2	2093.66	2142.32	2101.09	194.59*	199.43*	0.78
3	2067.20	2142.06	2078.62	39.48*	40.46*	0.85
4	2054.74	2155.80	2070.16	25.82*	26.46*	0.88
5	2053.91	2181.17	2073.33	14.47	14.83	0.79

*$P < .05$

NOTE: AIC – Akaike Information Criteria; BIC – Baysian Information Criteria, A-BIC – Sample-Adjusted BIC; LMR-LRT – Lo, Mendal, and Rubin Likelihood Ratio Test; BLRT – Bootstrapped Likelihood Ratio Test

Table 2

Unconditional and Conditional LCA Probabilities (N = 312)

	Total sample	LR (N = 118)	LIHS (N=64)	HILS (N = 65)	HR (N = 65)
Unconditional Probabilities:		.36	.20	.22	.22
Conditional Probabilities:					
Shared needle	.33	.06	.06	**.67**	**.69**
Shared cooking equipment	.60	.33	.27	**.92**	**1.00**
Backloading	.34	.00	.07	**.74**	**.74**
Sex without a condom	.42	.00	**1.00**	.00	**1.00**
More than 2 sex partners	.62	.47	**.73**	.49	**.87**
Any sexual exchange	.12	.03	.18	.05	.29

Note: Bold coefficients represent conditional probabilities above .50; LR – Low Risk, LIHS – Low Injection Risk/High Sexual Risk, HILS – High Injection Risk/Low Sexual Risk, HR – High Risk; Sample sizes within each class were derived from most likely latent class membership based on highest posterior probability values.

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Table 3

Means and Proportions Across Latent Class Groups ($N = 312$)

	Total Sample	LR ($N = 118$)	LIHS ($N = 64$)	HILS ($N = 65$)	HR ($N = 65$)	Chi-Square
Age†	41.75	44.72_a	40.20_b	43.56_a	36.51_c	35.82^{***}
Duration†	19.82	21.72_a	16.88_b	22.94_a	16.25_b	23.94^{***}
Female	.09	.13	.07	.08	.07	2.49
Marital Status						7.94
Single	.22	.29	.13	.24	.19	
Divorced/Separated	.30	.29	.32	.27	.36	
Married/Cohabiting	.47	.42	.55	.49	.45	
Highest Level of Education						3.43
Less Than High School	.48	.46	.47	.56	.42	
High School Diploma or GED	.34	.35	.36	.31	.34	
Some College	.18	.19	.17	.13	.23	
Past Year Homelessness	.39	$.25_a$	$.39_{a,b}$	$.40_a$	$.58_b$	16.84^{**}
Obtained Sterile Needles	.59	.66	.58	.60	.48	4.59
Daily Speedball Injection	.73	$.68_a$	$.62_{a,b}$	$.85_b$	$.79_a$	9.80^{*}
HCV Positive	.78	.81	.64	.86	.78	6.03

$^{*}P < .05$;

$^{**}P < .01$;

$^{***}P < .001$

†Values are expressed as means rather than proportions/probabilities.

NOTE: LR – Low Risk, LIHS – Low Injection Risk/High Sexual Risk, HILS – High Injection Risk/Low Sexual Risk, HR – High Risk; Coefficients that do not share a subscript are significantly different from one another (significant predictors only); Sample sizes within each class were derived most likely latent class membership based on highest posterior probability values.

Table 4

Multinomial Logistic Regression Models Predicting LCA Membership (N = 312)

	LR vs. LIHS	LR vs. HILS	LR vs. HR	HR vs. LIHS	HR vs. HILS	LIHS vs. HILS
	OR ***95% CI***	***OR*** ***95% CI***	***OR*** ***95% CI***	***OR*** ***95% CI***	***OR*** ***95% CI***	***OR*** ***95% CI***
Age	0.97	0.98	0.92*	1.05*	1.07*	1.01
	[0.92–1.01]	[0.93–1.03]	[0.88–0.96]	[1.00–1.11]	[1.01–1.13]	[0.95–1.08]
Injection Duration	0.98	1.03	0.99	0.99	1.04	1.05
	[0.93–1.02]	[0.98–1.07]	[0.95–1.03]	[0.93–1.04]	[0.99–1.10]	[0.99–1.11]
Past Year Homelessness	2.01	1.61	4.74*	0.42*	0.34*	0.80
	[0.91–4.42]	[0.76–3.42]	[2.23–10.11]	[0.18–0.99]	[0.16–0.73]	[0.35–1.82]
Daily Speedball Injection	0.68	2.51*	1.10	0.62	2.29	3.68*
	[0.33–1.42]	[1.02–6.17]	[0.46–2.63]	[0.24–1.62]	[0.77–6.79]	[1.39–9.71]

* $P < .05$

NOTE: OR – Odds Ratio; CI – Confidence Interval; LR – Low Risk; LIHS – Low Injection Risk/High Sexual Risk; HILS – High Injection Risk/Low Sexual Risk; HR – High Risk