Understanding the Conflict Between Withdrawal and Disease Avoidance in the Risk Networks of People Who Inject Drugs in Rural Puerto Rico

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Vermont Center for Behavioral Health
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Why study rural drug use in Puerto Rico

Injection drug use in rural Puerto Rico has increased dramatically since the 1980s:

• Close link to New York and Boston heroin markets
• Evolution of the “trampoline” drug economy
• Gentrification and urban renewal that displace low-income high unemployment communities to rural areas
• Natural and fiscal disasters that hurt law enforcement efforts and exaggerated treatment deficits
2014-present “Vida Acción Salud (VAS)”

**Support**

- “Injection Risk Networks in Rural Puerto Rico” National Institute of Drug Abuse [R01 DA037117](#).
  - NIDA Minority Supplement [R01 DA037117-S1 -S2](#).
  - “Competing Supplement: Injection Risk Networks in Rural Puerto Rico”. National Institute on Drug Abuse [R01 DA037117-S3](#).
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- “Biomarkers for Dysbiosis-Related HIV-Associated Cognitive Disorders among Persons Who Inject Drugs in Puerto Rico” National Institutes of Health, National Institute on Drug Abuse [R01 DA047823](#).

**Local Partners:**

- **El punto en la Montaña SEP**
- **University of Puerto Rico Medical Sciences** (Juan Carlos Reyes, Professor and Chair of Epidemiology and Biostatistics)
- **Universidad Central del Caribe School of Medicine** (Department of Microbiology and Immunology)
- **CDC National HIV Surveillance Team San Juan** (Sandra Miranda, Puerto Rico Department of Health)
Conflicts of Interest Declaration

This presentation declares no conflicts of interest or sources of support other than the federal funding support and university/organization partnerships listed in the previous slide.
Association between alcohol consumption and injection and sexual risk behaviors among people who inject drugs in rural Puerto Rico
Melissa Welch-Lazoritz,1,2, Dana Hautala,3, Patrick Habecker,4, Kirk Dombrowski,5

Original Article
Latent Risk Subtypes Based on Injection and Sexual Behavior Among People Who Inject Drugs in Rural Puerto Rico
Dane Hautala, PhD1; Roberta Abadie, PhD1; Kirk Dombrowski, PhD2

Social determinants of HIV/HCV co-infection: A case study from people who inject drugs in rural Puerto Rico
Roberto Abadie1, Melissa Welch-Lazoritz, Bilal Khan, Kirk Dombrowski

Needle acquisition patterns, network risk and social capital among rural PWID in Puerto Rico
Ian Duncan1,2, Patrick Habecker1, Roberto Abadie1,3, Ric Curtis1, Bilal Khan1 and Kirk Dombrowski

Hepatitis C sero-sorting among people who inject drugs in rural Puerto Rico
Dane Hautala1, Roberto Abadie1, Bilal Khan, Kirk Dombrowski

Differential access to syringe exchange and other prevention activities among people who inject drugs in rural and urban areas of Puerto Rico
Melissa Welch-Lazoritz1,2,3, Patrick Habecker4, Kirk Dombrowski4, Angelica Rivera Villegas5, Carmen Ana Davila5, Yadira Rolón Colón1, Sandra Miranda De León6

1,2 University of Nebraska Medical Center, Omaha, Nebraska; 3,4 University of Minnesota Medical School, Minneapolis, Minnesota; 5,6 University of Puerto Rico, San Juan, Puerto Rico.
A team of researchers is working to understand, model, and create interventions to stop this epidemic.
The San Juan NHBS sample and the VAS sample are similar in many ways, except:
- Gender
- HIV Status
- Health Insurance/Care
- Drug and equipment sharing

Where national NHBS statistics were available, the rural PR cohort seemed more like the national population than the urban San Juan network.

Table 1. Descriptive Statistics.

<table>
<thead>
<tr>
<th>Demographics and health</th>
<th>Urban sample (512)</th>
<th>Rural sample (315)</th>
<th>Urban NHBS national aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>41.1</td>
<td>41.8</td>
<td></td>
</tr>
<tr>
<td>Gender (% female)</td>
<td>19%*</td>
<td>10%*</td>
<td></td>
</tr>
<tr>
<td>Mean per capita income</td>
<td>$4,918*</td>
<td>$4,451*</td>
<td></td>
</tr>
<tr>
<td>HIV + Status</td>
<td>13.4%*</td>
<td>6.0%*</td>
<td>11.00%</td>
</tr>
<tr>
<td>Been tested for HCV and HCV + Status</td>
<td>48.0%</td>
<td>49.0%</td>
<td></td>
</tr>
<tr>
<td>Have health insurance coverage</td>
<td>52.0%*</td>
<td>82.0%*</td>
<td>61.20%</td>
</tr>
<tr>
<td>Have a usual source of health care</td>
<td>71.0%*</td>
<td>90.0%*</td>
<td></td>
</tr>
<tr>
<td>Past year visited a health care provider</td>
<td>55.0%*</td>
<td>68.0%*</td>
<td>78.60%</td>
</tr>
<tr>
<td>Unable to access health care due to cost</td>
<td>26.0%*</td>
<td>12.0%*</td>
<td></td>
</tr>
<tr>
<td>No visit to health care in past 5 years</td>
<td>12.0%*</td>
<td>8.0%*</td>
<td></td>
</tr>
<tr>
<td>Ever tested for HIV</td>
<td>87.00%</td>
<td>90.00%</td>
<td>91.30%</td>
</tr>
<tr>
<td>Ever tested for HCV</td>
<td>65.0%*</td>
<td>77.0%*</td>
<td>78.00%</td>
</tr>
<tr>
<td>Injection drug use behaviors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at first injection</td>
<td>20.6*</td>
<td>21.9*</td>
<td></td>
</tr>
<tr>
<td># of years spent injecting</td>
<td>20.1</td>
<td>19.9</td>
<td></td>
</tr>
<tr>
<td># of people used needles after</td>
<td>2.7*</td>
<td>1.2*</td>
<td></td>
</tr>
<tr>
<td># of people used works after</td>
<td>6.3</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td># of people divided drugs with</td>
<td>4.3*</td>
<td>1.4*</td>
<td></td>
</tr>
<tr>
<td>Past year average frequency of injection</td>
<td>5.8*</td>
<td>5.5*</td>
<td></td>
</tr>
<tr>
<td>Frequency used a sterile needle</td>
<td>3.0*</td>
<td>2.7*</td>
<td></td>
</tr>
<tr>
<td>Frequency used a dirty needle after someone</td>
<td>0.7*</td>
<td>0.4*</td>
<td></td>
</tr>
<tr>
<td>Receptive sharing of syringes</td>
<td>36.90%</td>
<td>32.40%</td>
<td>33.00%</td>
</tr>
<tr>
<td>Receptive sharing of injection equipment</td>
<td>45.90%</td>
<td>59.00%</td>
<td>57.00%</td>
</tr>
<tr>
<td>Frequency shared a cooker with someone</td>
<td>1.0</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Frequency shared cotton with someone</td>
<td>0.9</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Frequency shared water with someone</td>
<td>0.8*</td>
<td>0.7*</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05
The baseline data

**Risk for HCV**
- Reported network size is positively associated with HCV+ status.
- Smaller injection networks among those who self-report HCV− status suggests that those who believe their status to be negative may take protective action by reducing their injection network compared to those have a self-reported HCV+ or an unknown status.
- Urban PWID in PR with a known HCV+ status were more likely to know their last co-injector partner’s HCV status than were their peers with a negative or unknown HCV status.
- Almost three-quarters (71.43%) used a cooker, cotton, or water that somebody had previously used, while one in three (32.14%) divided drugs with a syringe that had been previously used by somebody else.

**Risk for HIV**
- Self-reported HIV statuses are not associated with different numbers of injection partners.
- Latent class analysis indicated four distinct risk groups: 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.
- 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.
Vida Accion Salud
2015 Wave 1 – Respondent Driven Sampling, with a recruitment criteria of injection drug use in the last 30 days
2017 Wave 2 – Random resampling of the Wave 1 network for peer recruitment and micro ethnographic assays
2017 Post-Maria OAT study
2018 Wave 3 – Post-Maria resampling
2019 Photovoice Project
2019 Dysbiosis Related HIV Cognition Study

RDS sampling: we overlaid “micro-ethnographic assays” on RDS sampling to emphasize ethnographic consideration of network material

Micro-ethnographic assay: an extended version of “focalFollows” that involved consistent interaction, informal questions, focal follows, and “visual reconstruction”
Co-use network

Last 30 co-users of injection drugs

• Clustering shows “core” individuals in 4-5 different communities

• Co-use can include syringe sharing, but could also include shared equipment use (cookers, filters) in an arrangement called “caballo”
The big question:

Do members engage in partner restriction to lower their risk of contracting HIV or hepatitis C (HCV), or in informed altruism to prevent others from contracting these infections?

Nodes (individuals) are colored by the residence location of the individual represented. Edges are directed, with arrows pointing to the individual who used a needle after the other person. The size of nodes reflects the frequency with which individuals were using injection drugs, with larger nodes representing network members with a higher injection frequency.
Method: Using ERGM to model tie likelihood

<table>
<thead>
<tr>
<th></th>
<th>Model 1 (Base model)</th>
<th>Model 2 (+ Mutual)</th>
<th>Model 3 (+ Transitivity)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef.</td>
<td>S.E.</td>
<td>p-value</td>
</tr>
<tr>
<td>Edges</td>
<td>-5.47</td>
<td>0.62</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Node in-factor Female</td>
<td>0.20</td>
<td>0.36</td>
<td>0.58</td>
</tr>
<tr>
<td>Node match Female</td>
<td>1.89</td>
<td>0.53</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Node in-factor Age</td>
<td>-0.01</td>
<td>0.01</td>
<td>0.29</td>
</tr>
<tr>
<td>Absdiff Age</td>
<td>-0.03</td>
<td>0.01</td>
<td>0.03</td>
</tr>
<tr>
<td>Node in-factor Location 4</td>
<td>-1.69</td>
<td>0.60</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Nodematch Location 4</td>
<td>4.54</td>
<td>0.59</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Node in-factor Injection 1–3×</td>
<td>0.75</td>
<td>0.41</td>
<td>0.07</td>
</tr>
<tr>
<td>Node in-factor Injection 4–7×</td>
<td>1.34</td>
<td>0.40</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Node in-factor Injection 8+ x</td>
<td>1.67</td>
<td>0.44</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Mutual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GWESP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GWESP decay (α)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIC</td>
<td>1347.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIC</td>
<td>1422.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-663.54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HIV infection and needle-sharing. (a) Needle-sharing network colored by self-reported HIV status. “Pos (ART)” denotes individuals on antiretroviral treatment. The person represented by the grey node did not know their HIV status. (b) Estimates and odds-ratios of model coefficients (with 95% confidence intervals) for the partner restriction and informed altruism terms from the ERGMs considering HIV status.
HCV infection and needle-sharing. (a) Needle-sharing network colored by HCV status, shown as the combination of self-report (first term) and antibody test results (second term). (b) Estimates and odds-ratios of model coefficients (with 95% confidence intervals) for the partner restriction and informed altruism terms from the ERGMs considering self-reported HCV status.
Esto no es fácil, pero te alegra nada. Pero te quita yo de perdición Estremidades.
Validating the network interviews
Ethnographic versus Sociometric Samples

• Only three individuals appeared in the ethnographic network but not in the sociometric network.
• Key respondent network across the samples are highly correlated (product–moment correlation of .49, estimated p value of 0 based on a quadratic assignment procedure test with 10,000 permutations).
• There are 73 overlapping edges in the two networks (79% of the ties in the ethnographic network are present in the sociometric network; 19% of ties in the sociometric network are present in the ethnographic network).
• The ethnographers reported 15 edges between survey respondents that were not self-reported by the respondents.
Overall Alignment

In terms of both nodes and edges, the ethnographic network is largely a subset of the sociometric network. While the ethnographers drew a network with substantially fewer people and ties than the sociometric network, most of the edges they recorded were also reported as active, recent ties by study participants in formal interviews. Individuals who appear in the ethnographic network tend to have higher degree and belong to denser parts of the sociometric network than individuals who participated in the project but who were not included in the ethnographic network. This was not a result of a bias toward key respondents in the sociometric data because in the sociometric data, key respondents differed relatively little from other survey participants. Thus, the ethnographers seemed to be able to home in quite readily toward individuals who formed part of the core of the local PWID network. Further, the ethnographers’ qualitative argument that centrality in the network was partly driven by injection frequency is upheld by the sociometric data.
Caballo

In rural Puerto Rico, two or more PWID often pool funds necessary to acquire and later share drugs. Most participants in our study have as a drug of choice a combination of heroin “droga” and cocaine “perico”, referred to as “speedball”. Speedballs have more heroin than cocaine, and a usual way in which participants talk about their drug mix is by identifying the ratio of heroin to cocaine. For example, they would say “1–2” meaning one bag of cocaine and two of heroin. Other users might prefer three bags of heroin and one of cocaine “1–3”. In turn, this preference is also reflected in drug sharing arrangements. The drugs are mixed together in a cooker dissolved in water, and the resulting drug solution is shared usually through backloading, removing the plunger in a syringe and squirting the content using the tip of the needle of a loaded syringe, before placing it back. This practice is locally known as “caballo” (literally, horse). Participants do not recall the origin of the name, “caballo” but suggest that the same expression is used on the island in situations where people pool resources to acquire and later consume goods together, usually food but also transportation.
Social factors affecting risk

The need to acquire drugs while having limited money to pay for them draws PWID into social interactions with others in a way that considerably increases their risk of using shared equipment.

Most PWID in the study would prefer to avoid caballo if they could, particularly, for high frequency users, the economic demands make it extremely hard to go during the day without partnering with another user to acquire and use drugs.

Caballo can also be structured along defined social roles, with important epidemiological repercussions. A primary partner directs the preparation and distribution of the drug solution, usually keeping the cooker and cotton used to share drugs and using their own syringe to divide the solution. The soaked filter and the drug residue left in the cooker can be later re-used adding a little bit of water for another shot. Usually, this role is occupied by the user that contributed the most to the caballo.
Josephine:

“Look, let’s suppose that I want to use two and one [two bags of heroin and one bag of cocaine] and that you have $5 and I have $10. So, I ask you, Julio, ‘Do you have $5?’ ‘Yes,’ [you respond].[I say,] ‘Great! Let’s do two and one, you put in those $5 for the perico [cocaine] and I put [in for] the heroin.’ We put everything together in the cooker, and then we divide it in the syringe, half and half, and we get cured. That’s it.”

Sick:

The effects of heroin withdrawal, or what our participants call “being sick,” is characterized by bodily pain and discomfort, nausea, coldness, shivers, and diarrhea that leave them “unable to function.” Only “la cura”, the cure, another dose of heroin, will stop or prevent these symptoms from occurring.

Faced with limited resources to “get cured” the user must make a choice between partnering with somebody in a caballo or going it alone and hustling until they can afford the whole dose they need.

Entering into a caballo arrangement, enables them to feel normal again, while they can keep hustling to get their next dose. While the rewards of going alone might be higher because participants get a larger dose, so are the associated costs because users have to battle their withdrawal symptoms longer to come up with the money.
Fixers and Maximizers

• “Fixers” do caballo with a limited number of trusted injection partners in their network, usually kin, or others with whom they have close relationships, from school age friends, to neighbors or those with whom they have shared drugs extensively in the past.

• By minimizing the number of partners and routinizing sharing expectations, Fixers ensure access to resources while limiting the potential problems associated with doing caballo with strangers.

• “Maximizers,” enter into caballo with as many partners as possible, increasing their opportunities to access drugs by multiplying potential partners. Sometimes maximizers only know their caballo partners because they have seen them around, in Puntos, or shooting galleries, or because they have done a caballo in the past.

• The downside of the maximizer strategy is that this choice also increases the potential problems associated with the transaction—robbery, cheating, hoarding.

• Not always a fixed strategy: persons in our study might have been a maximizer but, over time, begun doing caballo with a limited number of partners, and the opposite also happens. Jail, drug treatment, quitting drug use, and migration can all affect a person’s social networks and their ability to engage in caballo by increasing their social networks and number of known / willing partners.
Syndemic Prevalence:

- PWID in rural Puerto Rico tend to avoid direct sharing of syringes; only 7.14% reported having used a needle after somebody else had employed it, and 84.62% used a sterile needle the last time they used drugs with somebody.

- In contrast, participants often engaged in indirect sharing: 71.43% divided drugs with a cooker or cotton that had been used by somebody else, and 32.14% divided drugs with a syringe that had been used by somebody else.

- These factors can help explain why HIV prevalence is low (8-10% in our study area—it is spread mainly through shared needles) and HCV is high (~80% in our study area—it can be spread more easily through backloading and shared cooker/cotton).

- Tim Rhodes, Merril Singer and others have use the term “syndemic” to describe this nexus of addiction, withdrawal and social factors related to drug use—which combine to create high prevalence levels and frustrate traditional intervention strategies like education.
Additional Sources:

• “Caballo”: risk environments, drug sharing and the emergence of a hepatitis C virus epidemic among people who inject drugs in Puerto Rico
  R Abadie, K Dombrowski Harm Reduction Journal 17 (1), 1-11 (2020)

• Comparing social network structures generated through sociometric and ethnographic methods

• Prevalence and risk factors associated with homelessness among drug users in Puerto Rico

• Competing forces of withdrawal and disease avoidance in the risk networks of people who inject drugs
  E Ready, P Habecker, R Abadie, B Khan, K Dombrowski PloS one 15 (6), e0235124 (2021)

• Migration to the US among rural Puerto Ricans who inject drugs: influential factors, sources of support, and challenges for harm reduction interventions
  R Abadie, P Habecker, CGelpi-Acosta, K Dombrowski BMC Public Health 19 (1), 1-9 (2021)

• Injection partners, HCV, and HIV status among rural persons who inject drugs in Puerto Rico
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