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Social determinants of HIV/HCV co-infection: A case study from people who inject drugs in rural Puerto Rico

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1. Introduction

Worldwide there are an estimated 130 million people infected with hepatitis C (HCV), 40 million living with HIV, and between 4 and 5 million co-infected with HIV and HCV (Alter, 2006; Perz, Farrington, Pecoraro, Hutin, & Armstrong, 2004; WHO. AIDS epidemic update, 2004). In Western Europe and the United States, co-infection tends to concentrate among people who inject drugs (PWID) mainly driven by blood contained in shared syringes and contaminated injection equipment (Hahn, Page-Schafer, Lum, et al., 2002; Doerrbecker, Behrendt, Matheu-Gelabert et al., 2013). Epidemiological data shows wide discrepancies in HIV/HCV prevalence among PWID across the world (Bao & Li, 2009; Rahimi-Movaghar, Razaghi, Sahim-Izadian, & Amin-Esmaeili, 2010). In Western Europe some studies involving HIV positive individuals with a history of injection drug use documented a HIV/HCV co-infection rate of around 66%, while similar studies conducted on positive HIV patients who inject drugs enrolled in a large HIV clinical trial showed that between 72%–95% were co-infected with HCV (Denis et al., 1997; Roca et al., 2003; Sherman, Rouster, Chung, & Rajicic, 2002; Sulkowski & Thomas, 2003).

>30 years after its identification, HIV/AIDS remains one of the most serious public health problems in the United States and the world. The concern is especially high in Puerto Rico, one of the U.S. island territories. In 2010, the rate of HIV infection diagnosis in Puerto Rico was 33.8 per 100.000 population, the fourth highest in the U.S., while the infection rate for the U.S. as a whole was 19.7 (Centers for Disease Control and Prevention, 2015). Further, the island's HIV death rate is nearly 4 times higher than the national average, higher than any other U.S. state or territory (http://www.aidsunited.org/Programs-0024-Grantmaking/Puerto-Rico.aspx, n.d). The most common HIV transmission method in Puerto Rico is injection drug use—42% of male HIV cases are attributed to injection drug use, exactly double that of the U.S. as a whole which attributes 21% of male HIV cases to injection drug use. HCV has a prevalence among the general population on the island of close to 2% (Perez, Marrero, Melendez, et al., 2010) but most cases tend to concentrate in PWID where studies have shown a prevalence close to 90% in urban settings and 80% in rural areas (Reyes, Colon, Robles, et al., 2006; Abadie, Welch-Lazoritz, Acosta-Gelpi, Reyes, & Dombrowski, 2016).

Frequency of drug use, years of injection, using shooting galleries, number of injection partners, along with sharing syringes and injection equipment has been associated with a higher risk of HIV transmission (Miller et al., 2002; Dolan et al., 2010; Rolls, Sacks-Davis, Jenkinson, et al., 2013). While the social determinants of HIV transmission in PWID have been extensively studied (Gilbert et al., 2013; Des Jarlais et al., 2012; Travis et al., 2014), studies should be conducted specifically addressing the social determinants of HIV and HCV co-infection among PWID in order to develop more targeted and effective prevention strategies.

The current paper seeks to explore social and behavioral determinants of HIV and HCV co-infection among PWID in rural areas of Puerto Rico. A case study based on (n = 315) current intravenous drug users shows that 6% of the population (n = 19) is co-infected with both viruses. Co-infection correlates with age, longer period of drug use, medical insurance coverage and sexual identity. A positive HIV diagnosis was found to be a strong predictor of co-infection. No differences were found in risk behaviors, both groups report similar frequencies of drug use and sharing of needles and equipment but co-infected used reported using a new syringe at a higher frequency that those who were not co-infected.

2. Methods

2.1. Data

This paper utilizes data from 315 injection drug users residing in Cidra, Comerio, Aguas Buenas, and Cayey, four rural towns in the mountainous area of central Puerto Rico, about 30–40 miles from San Juan. Sites were selected because they were representative of rural PWID on the island (López, de Saxe Zerden, Bourgois, et al., 2015). In addition, these sites were chosen due to the presence of *El Punto en la Montaña*, the only syringe exchange program operating in rural Puerto Rico,

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with whom we established a close collaboration that facilitated data collection with this population. Interviews were completed between April 2015 and June 2015. Sample recruitment was managed using respondent driven sampling (RDS) and we started two seeds in each of the four towns (for a total of 8 seeds, 307 recruits). Participants who completed the survey were given three referral coupons to pass out to other PWID they knew and who had not previously participated in the study. Every eligible referral earned the recruiter an additional $10. Upon completion of the questionnaire, participants were given $25. RDS has proven effective in recruiting hard to reach populations (Abdul-Quander et al., 2006; Heckathorn, 2002; Heckathorn, 2007; Johnston, Chen, Silva-Santisteban, & Raymond, 2013; Cagle, Fisher, Senter, & Thurmond, 2002). Participants were 18 years of age or older, alert at the time of the interview, and active injection drug users (injected drugs within the last 30 days). Verification of current injection use was done through visual inspection of injection track marks as well as through a questionnaire that measuring knowledge of injection practices (Fisher et al., 1993; Pouget, Hagan, & Des, 2012).

The questionnaire was interviewer-administered and based off of the CDC NHBS IDU Round 3 Questionnaire version 13. In addition to demographic variables, we collected information about type and frequency of drug use, as well as HIV and HCV risk behaviors such as sharing of needles, cookers, cotton, and water in addition to sexual behaviors and alcohol use. HIV and Hepatitis C status was assessed through the use of INSTI Rapid HIV antibody tests (Biolytical Laboratories) and OraQuick HCV Rapid antibody tests (OraSure Technologies). Every participant was compensated an additional $5 for each rapid test performed. Participants who tested positive for HCV or HIV were offered referral and transportation to a primary care doctor for confirmatory testing. The study received IRB approval through the University of Nebraska-Lincoln (IRB# 20131113844FB) and the University of Puerto Rico School of Medicine (IRB# A8480115).

2.2. Measures

Age was calculated by subtracting the date of the interview from the participant's date of birth. *HIV status* and *HCV status* were determined by the results of the INSTI Rapid HIV and OraQuick Rapid HCV test. *Mean number of years injecting* was calculated by subtracting the age a participant reported first injecting drugs by their age at the time of interview. The *gay, lesbian, or bisexual* item includes participants who reported identifying as gay, lesbian, or bisexual (1) compared to those who reported identifying as straight or heterosexual. *Annual* per capita *income* was assessed by two questionnaire items, one which participants selected an income bracket and a second which participants reported how many people rely on that income during the year. The upper limit of the income bracket was then divided by the number of people relying on income to achieve an approximation of annual per capita income. *Graduated High School or higher* includes participants who reported graduating from high school (1), completing a GED equivalent, or higher (including some college, college graduates, and those with post-graduate education) and those who did not graduate/obtain a GED (0). *Born in Puerto Rico* measures whether participants were born on the island of Puerto Rico (1) or somewhere else (0). *Graduated High School or higher* includes participants who reported graduating from high school (1), completing a GED equivalent, or higher (including some college, college graduates, and those with post-graduate education) and those who did not graduate/obtain a GED (0). *Born in Puerto Rico* measures whether participants were born on the island of Puerto Rico (1) or somewhere else (0). *Percent Homeless in the past year* was assessed using a question that asked participants whether they had experienced homelessness within the past year and *currently homeless* used the question that asked whether participants were currently homeless. *Percent unemployed* was assessed using a question that asked participants which best described their employment status: employed full time, employed part time, full time student, retired, unable to work for health reasons, unemployed, or other. Participants were given a (1) on the *have health insurance* measure if they reported being covered by any type of health insurance, including state sponsored Medicare or Medicaid (Reforma in Puerto Rico), private health insurance, veterans health insurance, or some other type of health insurance. *Have a regular place for healthcare* is based on the question "is there a place that you usually go when you are sick or need advice about your health?" and the follow up "what kind of place is it?". Responses of yes (1) and a clinic, health center, or doctor's office were coded as (1) while "no" not having a place was coded as (0), or yes and reporting that that place is the emergency room was also coded as (0).

Frequency of injection was assessed using the question "in the last 12 months, on average, how often did you inject drugs?" with response choices of (1) one time per month, (2) 2–3 times per month, (3) one time per week, (4) 2–6 times per week, (5) one time per day, (6) 2–3 times per day, and (7) 4 or more times per day. *Frequency of* (1) *used needle utilization*, (2) *used cooker utilization*, (3) *used cotton utilization*, (4) *used water utilization*, *and* (5) *sterile needle utilization* are five categorical measures asking how often, in the past year, the participant used (1) needles that someone else had already injected with, (2) a cooker that someone else had already used, (3) a cotton that someone else had already used, (4) water that someone else had already used, and (5) a new, sterile needle to inject. The response options are: never (coded as 1), rarely (coded as 2), about half of the time (coded as 3), most of the time (coded as 4), and always (coded as 5).

2.3. Analytic approach

The results reported in this analysis stem from *t*-tests (for continuous variables) and ANOVA tests (for categorical or dichotomous variables) to compare HIV and HCV co-infected participants ($n = 19$) with the remainder of the sample ($n = 296$). We are aware that the very small sample size ($n = 19$) of the co-infected group likely limits our statistically significant findings. All analyses were conducted using IBM SPSS Statistics software.

3. Results

Exactly 19 participants (6.0% of the total sample) tested positive for HIV antibodies. All of these individuals also tested positive for HCV antibodies and are referred to as the co-infected group. Of the HIV+ participants, 63.2% ($n = 12$) already knew that they were HIV+ prior to participation in this study. The remaining 7 individuals were given an HIV positive rapid test result, HIV counseling, and offered transportation/referral to a medical doctor for confirmatory testing and medical care (though no individuals accepted this offer). Only 10 co-infected participants were already aware of their hepatitis C positive status prior to participation in this study, 8 of which found out they were HCV+ over ten years ago. Of the 10 co-infected participants who had known about their HCV status, only one had ever been treated for hepatitis C.

Table 1 includes demographic characteristics for the HIV/HCV co-infected group and the remainder of the sample (not co-infected; 68 of whom are both HIV− and HCV−, 228 are HCV+ but HIV−). Co-infected participants were significantly older (49 years compared to 41 years; $p < 0.001$) than PWID who were not co-infected. Additionally, co-infected participants showed significantly different injection drug use histories than PWID with no co-infection. Co-infected individuals had been injecting drugs for an average of 29.1 years, while their HIV− counterparts had been injecting for nearly a decade less (19.3 years; $p < 0.000$). However, the current habits of both co-infected and HIV− participants look similar. Both groups have about the same frequency of injection and inject with used needles and "works" (cooker, cotton, or water) that had been used first by someone else at about the same rate.

Table 1
HIV/HCV co-infection.

	HIV/HCV co-infected	Not co-infected	
Mean age	49.0***	41.3***	N = 315
Mean # years injecting	29.1***	19.3***	N = 315
% Gay, lesbian, or bisexual	21.5%***	2.7%***	N = 314
% Men	89.5%	90.5%	N = 315
Avg. per capita income	$4591	$4443	N = 242
% Graduated HS or higher	52.6%	52.3%	N = 315
% Born in Puerto Rico	93.9%	84.2%	N = 314
% Homeless past year	38.6%	36.8%	N = 315
% Currently homeless	26.3%**	21.6%	N = 315
% Unemployed	89.5%	85.7%	N = 312
% Have health insurance	100.0%***	81.4%***	N = 315
% Have regular place for healthcare	63.2%†	41.4%†	N = 315
How often use new sterile needle	4.2*	3.6*	N = 315

† $p < 0.10$
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

However, co-infected participants injected with a new, sterile needle significantly more often than their HIV − counterparts ($p = 0.026$).

Co-infected PWID were also significantly more likely to have health insurance (100% compared to 81%; $p < 0.000$). This difference could be driven by the co-infected participants who were aware of their status prior to study participation. In addition, most (63.2%) co-infected participants reported having a regular place to go for healthcare (not including the emergency department), compared to only 41.4% of HIV − individuals ($p = 0.063$). Both groups had similar gender proportions (the co-infected group is made up of 17 males and 2 females), average annual per capita incomes, and similar education levels. Co-infected PWID in this sample were significantly more likely to report being gay, lesbian, or bisexual (21.7% compared to 2.7%; $p < 0.000$) than those who are uninfected or mono-infected. Of the co-infected individuals who identified as gay, lesbian, or bisexual, one is female and three are male.

A few other differences were observed, although were not found to be statistically significant (also found in Table 1). A higher percentage of co-infected individuals had been born on the island of Puerto Rico (93.9% compared to 84.2%) than PWID who were not co-infected. Additionally, a higher percentage of HIV/HCV co-infected individuals experienced homelessness in the past year and were currently homeless than those who were not co-infected. Unemployment was slightly more prevalent among co-infected individuals as well.

4. Discussion

A positive HIV result strongly correlates with HCV co-infection. All PWID who tested HIV positive in our sample, also produced HCV positive results. This result might be related to virological characteristics of HCV which makes virus transmission risk higher than HIV. HCV has been shown to be ten times more infectious than HIV and the virus can live outside the body for many days (Paintsil, Binka, Patel, Lindenbach, & Heimer, 2014; Paintsil, He, Peters, Lindenbach, & Heimer, 2010; Thorpe et al., 2002). Those exposed to the HIV might have been more likely to be also exposed to HCV mainly through contaminated syringes and injection equipment (Hagan et al., 2001; Strathdee & Stockman, 2010).

Age and duration of injection use also correlates with co-infection. The more time a PWID has been using drugs, the higher the risks of HIV and HCV transmission. Unavailability of clean, unused syringes has been found to be associated with HIV/HCV transmission (Woods, Kerr, Motaner, et al., 2004; Pérez, Albizu-García, & Torres, 2015). In addition lack of awareness of the mechanisms of HCV transmission and in particular, its extreme transmissibility might have also played a role. These risk factors also correlate with imprisonment, which has been found to be a risk factor for HIV/HCV transmission as well (Deren, Gelpí-Acosta, Albizu-García, et al., 2014).

Our data suggests that access to medical care correlates with co-infection but this might not be a causal relationship. Since co-infected PWID are covered by the equivalent to Medicare/Medicaid in PR while those only affected by HCV are not, it is not surprising that co-infected patients report a higher medical coverage than those that are not. While 82.5% of our sample has state sponsored health insurance coverage, many are unable to access HCV treatment, as the state health insurance plan will not cover this expensive treatment unless the patient is also HIV positive. Barriers to HCV treatment in the island affects the vast majority of HCV patients who will carry the virus for many years (McCabe, Bostwick, West, & Boyd, 2010).

In turn, the fact that those co-infected tend to avoid sharing syringes and drug equipment in a higher frequency than those that are not, is explained by their need to avoid transmitting HIV/HCV virus to their injection partners.

Sexual identity has been found to strongly correlate with HIV/HCV co-infection. Those users self-identified as gay, lesbian, or transgender have a much higher chance of being co-infected than those that declared they were heterosexual and gender conforming. We have to consider the possibility that in a small sample of co-infected (n = 19) a few cases can produce a biased result. Yet, there is a strong case to be made that gay/lesbian and transgender PWID are more vulnerable to co-infection. LGBT populations have higher rates of injection drug use than heterosexuals (Conron, Mimiaga, & Landers, 2010; De Santis, 2009). Engaging in survival or commercial sex, or the exchange of sex for drugs along with riskier sexual practices places this population at higher risk for co-infection. Stigma, discrimination and violence compounds co-infection risk (Deacon, Mooney-Somers, Treolar, & Maher, 2013; Lombardi & Servellen van, 2000). Culturally sensitive prevention strategies focused on this particular population should be implemented to avoid co-infection [Perez, Marrero, Melendez, et al., 2010]. Yet, the most pressing heath care problem is presented not by those that are co-infected, which are a minority in our sample and whose access to care is ensured in Puerto Rico, but those that tested reactive to HCV and whose treatment is not provided unless they have access to private insurance which is unlikely given their socio-economic status. HCV among PWID in Puerto Rico has reached epidemic levels and if left untreated, it can have catastrophic effects not only in this group but its related health care costs associated might drain an already strained health care system.

4.1. Study limitations

One of the limitations of this study is that HIV and HCV testing was designed to identify the presence of virus but it did not measure viral load or in the case of HCV genotyping. As a result, we are able to document positive or reactive results but we are not able to measure where the participant had been successfully treated. Another limitation arises from the relatively small sample size of HIV/HCV co-infected PWID. While our overall sample size (N = 315) is robust, a sub-set of (n = 19) co-infected participants raises problems of statistical significance. Given the disparity between HIV and HCV prevalence among PWID, we believe that this problem will be present in similar studies and we stand behind the validity of our data.

5. Conclusion

While HCV and HIV co-infection is a serious public health issue, affecting millions of patients worldwide, with a strong prevalence of people who inject drugs (PWID) in Western Europe and the United States, little is known about social and behavioral determinants of HIV and HCV co-infection among PWID. Understanding the social determinants of co-

infection is critical in order to develop more effective prevention strategies. By outlining the factors that lead to co-infection, this paper contributes to identify the behaviors or risk profiles that need to be addressed to prevent the further spread of HCV among PWID in Puerto Rico and abroad.

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Contributions

RA conducted data collection and drafted the manuscript. MW coordinated the study and performed the data analysis. BK and KD conceived and designed the study and helped to draft the manuscript. All authors read and approved the final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

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