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HCV Communication Within Ego-centric Networks of Men and Women who Inject drugs

Marisa Felsher, Ph.D.[1], **Karin E. Tobin, Ph.D.**[2], **Mark Sulkowski, M.D.**[1], **Carl Latkin, Ph.D.**[2], **Oluwaseun Falade-Nwulia, M.B.B.S. MPH**[1]

[1]Johns Hopkins University School of Medicine, Division of Infectious Diseases, 5200 Eastern Avenue, MFL Center Tower, Suite 381 Baltimore, MD 21224, USA

[2]Johns Hopkins Bloomberg School of Public Health, 615 N. Wolfe Street, Baltimore, MD 21205, USA

Abstract

Introduction: Leveraging interpersonal communication among social networks of people who inject drugs (PWID) may be an innovative strategy to increase awareness and access to hepatitis C (HCV) care. However, little is known about HCV communication patterns among PWID and if these patterns vary by gender.

Methods: Egocentric network data collected at baseline from HCV-infected PWID enrolled in a randomized HCV treatment intervention trial in Baltimore, Maryland was analyzed. Logistic generalized estimating models were conducted to identify predictors of HCV communication.

Results: Among 227 PWID, the mean age was 43.8 (SD=10.3), 28.2% (n=64) were women and 71.8% (n=163) were men. Female participants reported 516 dyadic relationships and male participants 1139 dyadic relationships. While there were significant gender differences based on socio-demographics, risk behavior and network composition, there were few differences in HCV communication patterns. Both men and women had increased odds of HCV communication with alters who are currently enrolled in drug treatment (AOR 1.7, 95% CI: 1.3–2.4), alters with whom participants share drug preparation equipment (AOR 3.0, 95% CI: 1.9–4.6), alters who are sex partners compared to kin (AOR 3.0; 95% CI: 1.9–4.9) and alters with whom respondents have increased trust (AOR 1.1; 95% CI: 1.11.2) and daily/weekly interactions (AOR 1.7; 95% CI 1.3–2.1).

Conclusion: PWID engaged with trusted alters about HCV disclosure and information, highlighting the important role network interventions could play in this vulnerable population.

Corresponding Author: Marisa Felsher, Division of Infectious Diseases, Johns Hopkins University School of Medicine, 5200 Eastern Avenue, MFL Center Tower, Suite 381, Baltimore, MD 21224.

Contributors: Marisa Felsher, Karin E. Tobin, Mark Sulkowski, M.D, Carl Latkin, Oluwaseun Falade-Nwulia

Keywords

Social networks; Hepatitis C; people who inject drugs; gender; interpersonal communication

Background

In 2017, the United States Department of Health and Human Services declared the opioid crisis a public health emergency. In addition to significant increases in overdose related morbidity and mortality (Hedegaard et al. 2017), there have been marked increases in incident hepatitis C (HCV) infection among people who inject drugs (PWID) (Holtzman et al., 2021; Zibbell et al., 2018). HCV infection is an important preventable public health problem. Over time, chronic infection can lead to substantial liver disease, including cirrhosis and hepatocellular carcinoma. Temporally, in PWID, HCV infection almost always precedes HIV infection. For instance, reports of HCV foreshadowed the recent HIV outbreaks in Indiana (Conrad et al., 2015) and, more recently, in West Virginia and Massachusetts (Centers for Disease Control and Prevention, 2011; Evans et al., 2018; Page et al., 2019; Zibbell et al., 2015).

Up until 2014, HCV treatment required the use of interferon, which was associated with severe side effects and low rates of HCV cure (Feld & Foster, 2016; Pawlotsky, 2016;Mushtaq et al., 2020). The recent availability of safe, effective direct-acting antiviral (DAA) agents, which are shown to cure over 95% of those who have access to these treatments, put the elimination of HCV as a public health challenge within reach (Falade-Nwulia et al., 2017). In 2016, the World Health Organization set laudable goals for hepatitis elimination by 2030 (WHO). However, awareness of HCV serostatus, testing, and cure remain low among PWID (Collier et al., 2015; Falade-Nwulia, Gicquelais, et al., 2020; Grebely et al, 2017; Kåberg et al., 2017), who comprise the core of the HCV epidemic in many high-income countries including the United States (Grebely & Dore, 2017; Hajarizadeh et al., 2013; Nelson et al., 2011; Shepard et al., 2005). HCV testing and treatment barriers for PWID have been extensively reported (Strauss et al., 2008; Swan et al., 2010; Treloar et al., 2013). Barriers include the perception that HCV is benign, concerns about lack of affordability, and stories of negative experiences with liver biopsy and HCV treatment-related side effects from the inferferon era that continue to be shared within peer networks of PWID (Christiani et al., 2008; Kurtz et al., 2005; Miller-Lloyd et al., 2020; Neale et al., 2008; Strauss et al., 2008; Swan et al., 2010; Treloar et al., 2013; Zeremski et al., 2013). PWID also face significant barriers to navigating and accessing healthcare in traditional settings due to competing priorities and stigmatization of PWID in healthcare interactions (Motavalli et al., 2020), further deterring HCV testing and treatment with oral DAA therapies. These barriers, as well as vulnerability to HCV, is heightened for women who inject drugs (WWID) due to biological factors and gender-based norms (Carr & Gramling, 2004; Falade-Nwulia et al., 2020; Malinowska-Sempruch, 2015). Compared to male counterparts, WWID report more frequent sharing of drug preparation equipment, which introduces greater opportunities for exposure to HCV (Meyers et al., 2020; Toro-Tobón et al., 2019; Bogart et al., 2005; Davey-Rothwell & Latkin, 2007; Des Jarlais et al., 2012; El-Bassel et al., 2014a, 2014b; Esmaeili et al., 2017). There is also greater stigma

towards drug use for women than men due to women being stereotyped as promiscuous and unable to fulfill traditional gender roles as primary caregivers (El-Bassel et al., 2014a; Gibson & Hutton, 2021). These representations hinder healthcare access for WWID as they may hide their drug use for fear of being judged negatively and of having their children removed from their care (Meyers et al., 2020; Myers, Fakier, & Louw, 2009).

Given PWID's barriers to navigating traditional healthcare systems, alternative strategies are needed to increase PWID's awareness of and access to HCV testing and treatment. One successful strategy may be to leverage existing social networks to increase interpersonal communication about HCV testing and treatment. Interpersonal communication among network members is a critical source of information sharing, advice seeking and support (Goldsmith, 2004; Rogers Everett, 1995) and can contribute to uptake of harm reduction innovations (Rogers Everett, 1995). This strategy is especially important among marginalized and stigmatized populations who may have medical mistrust (Abadie et al., 2018). For example, interventions have successfully incentivized PWID to recruit network members into HCV care (Falade-Nwulia, Ward, et al., 2020) and act as peer mentors to provide support and advice as participants navigate HCV care (Crawford & Bath, 2013; Janda & Mergenhagen, 2017; Lafferty et al., 2018). However, little is known about how HCV is discussed within PWID networks outside the scope of an intervention. Understanding with whom PWID talk about HCV can provide insight into the types of interventions needed to increase awareness and uptake of HCV testing and treatment. Furthermore, despite WWID's increased vulnerability to HCV, they are understudied within the larger drug-using population and there is a dearth of analyses that disaggregate data by gender (Malinowska-Sempruch, 2015). As a consequence, gender-specific needs of WWID are frequently overlooked in HCV prevention and treatment services (Iversen et al 2015; United Nations Office on Drugs Crime, 2014). Therefore the objective of this analysis is to identify how interpersonal characteristics impact HCV communication among PWID, with a focus on exploring differences between men and women.

Methods

Study Design and Sample

Data come from the baseline surveys of a randomized trial to enhance Hepatitis C and HIV prevention and care among people using substances in Baltimore, Maryland (Dayton et al., 2019). Inclusion criteria for enrollment included being age 18 years or older and having a positive HCV antibody test. Participants were also encouraged to recruit network members who were drug and/or sexual partners to join the study. The present analysis was restricted to participants who reported injection drug use in the prior 6 months.

Measures

Survey items assessed respondents' own attributes and behaviors, as well as elicited characteristics of respondents' personal social networks. Personal social networks were elicited by asking participants to define their social support network, which is the network of family, friends, neighbors, and community members that is available in times of need to give psychological, physical, and financial help (Lin et al., 1979). For the personal network

inventory, participants enumerated the first names of network members who provided them advice, pitched in to help do things, loaned them money, whom they entrust with their money, and with whom they socialize, all within the prior 6 months. Once this list was established, respondents answered a series of questions about each network member (hereafter referred to as “alter”).

The outcome of interest was whether or not the respondent had discussed HCV with alters (a dyadic variable). This variable was a composite variable where communication included talking with an alter about the following HCV-related topics in the prior 6 months: respondent’s HCV status, alter’s HCV status, getting tested for HCV, the cure for HCV, or where to go for HCV medical care.

Predictor Variables

Respondent-level socio-demographics were obtained from participant baseline surveys and included measures of age (measured in years), race (Black, White or Other), education level (categorized as less than high school, high school/GED, and some college or more), relationship status (categorized as married/in a committed relationship vs separated/divorced/widowed/single), and whether or not the respondent had ever been diagnosed with HCV or HIV. Network compositional variables were aggregated from their social network survey and included network size (the total number of alters listed per respondent), average age of alters within networks, and the percent of their network that was comprised of alters who were Black, White or Other race/ethnicity, alters who were sex partners, kin, non-kin, and the percent of the network where respondents and alters were of the same race or gender (homophily).

Alter-level data were obtained from the social network survey and included measurement of alter’s race (Black, White, Other), gender (male or female), and whether the alter had ever had an STI or was enrolled in drug treatment at the time of the survey. Measures corresponding to the relationship between the respondent and alter (i.e. dyadic measures) included behaviors that occurred within the relationship, such as whether or not the respondent and alter drink alcohol together, share needles/cookers, and the frequency of their interactions (daily/weekly vs. monthly or less often). Relationship types were categorized based on previous work (Yang, Davey-Rothwell, & Latkin, 2013) and used to classify relationships as sexual partnerships, kin or non-kin. *Sexual partnerships* included spouse, boy/girlfriend, fiancé, and sex partner. *Kin* included any family member, such as parent, child, or sibling. *Non-kin* included friends, acquaintances, NA/AA program sponsors, and spiritual leaders. Other dyadic measures included trust (measured as a continuous variable with 1 indicating no trust and 10 indicated complete trust) and racial homophily, which is when both the respondent and alter report the same race (McPherson et al., 2001). Research suggests that people tend to associate with others who are similar, and that this shared identity facilitates communication (McPherson et al., 2001).

Analytic Approach

Differences in the distribution of socio-demographic and network compositions between men and women were assessed with chi-square and t-tests. The subsequent analytic aim was

to examine variables at the level of the alter and dyad that predicted HCV communication within dyads. Because of our interest in comparing men and women, analyses were conducted separately by male and female gender. We subsequently conducted interaction analyses assessing for a differential impact of ego gender on HCV communication patterns by alter attribute within dyads. Logistic generalized estimating equations (GEE) models were fit using 'xtgee' in Stata version 14.2 (Rabe-Hesketh & Skrondal, 2008) to examine the bivariate relationship between each predictor variable and the primary outcome. The GEE approach is a general modeling strategy to adjust for the correlated (i.e. dependent) structure of social network data wherein alters were clustered around egos.

Factors were considered for inclusion in multivariable analysis if they demonstrated an association with the outcome at level of $p<0.1$ in bivariate analyses for either male or female respondents or if they were conceptually relevant. Correlation matrices among predictor variables were used to identify collinearity. Variables conceptually related to one another or with correlation threshold of $r>0.30$ were excluded from multivariable analyses. This led to the exclusion of the variable *injects drugs with* because it was highly correlated with sharing needles/cookers. We controlled for the following respondent-level variables: respondent HCV status, HIV status, age, race, and educational level.

Results

There were a total of 227 respondents, 71.8% of whom were men (n=163), and 28.2% were women (n=64) (Table 1). In comparing men and women, there was a higher proportion of women with less than a high school education compared to men (50.0% vs 33.7%; p=0.007). Fewer women were in committed relationships (62.5% vs 81.6%, p=0.002) compared to men. Women were also more likely to have ever received an HCV diagnosis (89.1% vs 74.9%; p=0.02). Related to network composition, women had larger networks than men (8.0 vs 6.9; p=0.08), and a higher proportion of their network comprised of kin, (0.3 vs 0.2; p=0.001) and a smaller proportion of non-kin (0.5 vs 0.6; p=0.001). On average, women and men both discussed HCV with four alters.

Respondents' personal networks comprised a total of 1,655 dyads: 516 dyads among the 64 female respondents and 1139 dyads among the 163 male respondents (Table 2). Both men and women discussed HCV within over half of all dyads elicited. Women disclosed their HCV status within 47.8% of dyads (n=246), discussed alters' HCV status within 9.3% of dyads (n=47), getting tested for HCV within 13.4% of dyads (n=69), HCV cure within 19% of dyads (n=98) and where to go for HCV medical care within 13.6% of dyads (n=69). Men disclosed their HCV status within 47.8% of dyads (n=544), discussed alters' HCV status within 6.5% of dyads (n=74), getting tested for HCV within 16.6% of dyads (n=189), HCV cure within 19.8% of dyads (n=222) and where to go for HCV medical care within 14.6% of dyads (n=166).

Men and women had many significant predictors of HCV communication in common: Women and men both had had increased odds of HCV communication with alters currently enrolled in drug treatment (UOR 2.0, 95% CI: 1.1–3.0 and UOR 2.0; 95% CI: 1.4–2.7 respectively), alters who ever had an STI (UOR 2.2; 95% CI: 1.1–4.6 and UOR 1.9, 95% CI: 1.3–3.0 respectively), alters with whom they inject drugs (UOR 1.7, 95% CI: 1.0–2.9

and UOR 2.2, 95% CI: 1.6–3.1 respectively), alters with whom they share drug preparation equipment (UOR 1.9; 95% CI: 1.0–3.5; UOR 3.3, 95% CI: 2.2–4.9 respectively), alters who are sex partners compared to kin (UOR 4.0, 95% CI: 1.9–8.7 and UOR 3.8, 95% CI: 2.3–6.6 respectively), alters with increased levels of trust (UOR 1.1, 95% CI: 1.0–1.2 and UOR 1.1, 95% CI: 0.0–1.1 respectively and alters with whom they interact daily/weekly compared to monthly or less (UOR 1.9, 95% CI: 1.2–3.0 UOR 1.7, 95% CI: 1.4–2.2 respectively). Men and women also both had increased odds of communicating HCV related information with alters who were White, compared to Black. We found no evidence of gender specific differences in these communication patterns based on interaction analyses assessing for a differential effect of gender (Table 2).

Related to differences between men and women, men had significantly increased odds of discussing HCV with alters who were female (UOR 1.6; 95% CI: 1.3–2.0), an effect which was not found among female egos. The p-value for the interaction effect of ego gender on HCV communication by alter gender was statistically significant (p=0.001) consistent with differences in HCV communication with female alters depending on the egos gender.

Given the few differences in HCV communication between men and women, one multivariable model was conducted among all 1655 male and female dyads (table 3). In multivariable analysis, alters who are currently enrolled in drug treatment (AOR 1.7, 95% CI: 1.3–2.4), alters with whom participants share drug preparation equipment (AOR 3.0, 95% CI: 1.9–4.6), alters who are sex partners compared to kin (AOR 3.0; 95% CI: 1.9–4.9) and alters with whom respondents have increased trust (AOR 1.1; 95% CI: 1.11.2) and daily/weekly interactions (AOR 1.7; 95% CI 1.3–2.1) remained independently associated with having an HCV conversation.

Discussion

The current study assessed similarities and differences between men and women who inject drugs as it relates to socio-demographics, risk behaviors, network composition, and patterns of HCV communication within dyads. Despite differences in socio-demographics, risk behaviors and network composition, few differences were observed between men and women's HCV communication patterns. Across both genders, many characteristics related to relational closeness, such as trust, frequency of interaction, sexual partnership and sharing of drug preparation equipment were key determinants of discussing HCV in relationships. One possible interpretation is that the social stigma of having these conversations may constrain HCV conversations to emotionally close relationships. Peer interventions that leverage social ties may therefore be successful when focused on relationally close relationships such as sexual and injection drug use partnerships of PWID. Couples-based interventions have been previously endorsed as an effective way of improving PWID engagement in HIV-related interventions, such as HIV testing and antiretroviral therapy adherence (Jiwatram-Negrón & El-Bassel, 2014; Reddon, Marshall, & Milloy, 2019), though remain less explored as it relates to HCV care (Jiwatram-Negrón & El-Bassel, 2014). Additionally, HCV conversations within relationships where drug preparation equipment is shared could also be an indication of serosorting, that is, to selectively share injection equipment with persons of like HCV status, which has been reported to occur within PWID

populations (Burt et al., 2009; Smith et al., 2013). If prevalent, the practice of serosorting would provide further rationale to encourage and support HCV testing and treatment within networks of PWID.

In addition to HCV conversations within close relationships, conversations also were more likely to occur with alters currently enrolled in drug treatment. Alters enrolled in drug treatment may be able to act as "network bridges," which are social network members that occupy a position between groups that are not otherwise connected (Kadushin, 2012). As such, PWID enrolled in drug treatment may be well positioned to accelerate the spread of new ideas and behaviors related to HCV across loosely or non-connected regions of PWID networks (Kadushin, 2012). For this reason, PWID enrolled in drug treatment may be particularly effective as peer mentors in targeted interventions to diffuse information about infectious disease innovations, such as HCV treatment or HIV Pre-exposure Prophylaxis (PrEP) for HIV prevention, to peers in their networks.

While interventions have successfully incentivized PWID to recruit network members into and provide support throughout HCV care (Falade-Nwulia, Ward, et al., 2020, Crawford & Bath, 2013; Janda & Mergenhagen, 2017; Lafferty et al., 2018), our finding that PWID discussed HCV within over half of social network relationships highlights the important role of social networks in disseminating HCV-related information outside the confines of a research study. Turning to trusted peers for HCV disclosure and information may be a way of compensating for PWID's limited interactions with health care providers in traditional medical settings (Motavalli et al., 2020). It is therefore critical to ensure that information shared within these networks is accurate. Additionally, programs are needed to support PWID to enhance already existing HCV communication with tools to engage and support network members through all the stages of HCV care continuum from testing to HCV cure. Despite our study finding few gender differences in HCV communication, it is likely that there may be gender differences in how men and women who inject drugs access HCV care and treatment, which should be explored in future studies.

There are study limitations that should be considered. First, the cross-sectional design does not provide information on temporality, and causal claims cannot be made. Additionally, the sample consisted of participants in a randomized control trial of an intervention to enhance Hepatitis C and HIV prevention care. Therefore, findings from this analysis may not be generalizable to the broader population of men and women who inject drugs. These data were however collected prior to the study intervention and thus represent communication patterns prior to intervention. Additionally, based on the way survey items were asked, we cannot assess if respondents initiated HCV related conversations or if the alters did. Understanding who initiates these conversations would be valuable for understanding the nuance of information dissemination and should be explored in follow up studies. Despite these limitations, findings provide some of the first data to examine patterns of HCV related communication within social networks of men and women who inject drugs and have important implications to the design of peer and network based interventions seeking to increase PWID engagement in HCV care.

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Conflicts of Interest:

Mark Sulkowski has been the principal investigator for research grants, with funds paid to Johns Hopkins University, from AbbVie, Assembly Bio, Gilead Sciences, and Janssen; and has served as a scientific advisor and consultant for AbbVie, Arbutus, Assembly Bio, and Gilead (the terms of these arrangements are being managed by Johns Hopkins University in accordance with its conflicts of interest policies). Marisa Felsher, Karin Tobin, Carl Latkin and Oluwaseun Falade-Nwulia declare no conflict of interest.

References

Abadie R, Goldenberg S, Welch-Lazoritz M, & Fisher CB, 2018. Establishing trust in HIV/HCV research among people who inject drugs (PWID): insights from empirical research. PloS one. 13(12).

Agadjanian V, 2002. Men's Talk About "Women's Matters" Gender, Communication, and Contraception in Urban Mozambique. Gender Soc. 16(2), 194–215.

Agadjanian V, & Menjívar C, 2008. Talking about the "Epidemic of the Millennium": religion, informal communication, and HIV/AIDS in sub-Saharan Africa. Soc. Probl 55(3), 301–321.

Azim T, Bontell I, & Strathdee SA, 2015. Women, drugs and HIV. Int. J. Drug Policy, 26, S16–S21. [PubMed: 25277726]

Bogart LM, Kral AH, Scott A, Anderson R, Flynn N, Gilbert ML, & Bluthenthal R, 2005. Condom attitudes and behaviors among injection drug users participating in California syringe exchange programs. AIDS Behav. 9(4), 423–432. [PubMed: 16249946]

Burt RD, Thiede H, & Hagan H, 2009. Serosorting for hepatitis C status in the sharing of injection equipment among Seattle area injection drug users. Drug Alcohol Depen. 105(3), 215–220.

Carr RL, & Gramling LF, 2004. Stigma: a health barrier for women with HIV/AIDS. J. Assoc. Nurse. AIDS C 15(5), 30–39.

Centers for Disease Control and Prevention, 2011. Notes from the field: risk factors for hepatitis C virus infections among young adults--Massachusetts, 2010. MMWR. 60(42), 1457. [PubMed: 22031220]

Christiani A, Hudson AL, Nyamathi A, Mutere M, & Sweat J, 2008. Attitudes of homeless and drug-using youth regarding barriers and facilitators in delivery of quality and culturally sensitive health care. J. Child and Adolesc. Psych. Nursing 21(3), 154–163.

Collier MG, Bhaurla SK, Cuevas-Mota J, Armenta RF, Teshale EH, & Garfein RS, 2015. Awareness of HCV infection among persons who inject drugs in San Diego, California. Am J Public Health Res. 105(2), 302–303.

Conrad C, Bradley HM, Broz D, Buddha S, Chapman EL, Galang RR, … Patel MR, 2015. Community outbreak of HIV infection linked to injection drug use of oxymorphone—Indiana, 2015. MMWR. 64(16), 443. [PubMed: 25928470]

Craddock JB, Barman-Adhikari A, Combs KM, Fulginiti A, & Rice E, 2020. Individual and Social Network Correlates of Sexual Health Communication Among Youth Experiencing Homelessness. AIDS Behav. 24(1), 222–232. [PubMed: 31471815]

Crawford S, & Bath N, 2013. Peer support models for people with a history of injecting drug use undertaking assessment and treatment for hepatitis C virus infection. Clin. Infect. Dis 57(suppl_2), S75–S79. [PubMed: 23884070]

Davey-Rothwell MA, & Latkin CA, 2007. Gender differences in social network influence among injection drug users: perceived norms and needle sharing. J. Urban Health 84(5), 691–703. [PubMed: 17682947]

Dayton L, Gicquelais RE, Tobin K, Davey-Rothwell M, Falade-Nwulia O, Kong X, … Latkin C. (2019). More than just availability: Who has access and who administers take-home naloxone in Baltimore, MD. PloS one, 14(11).

Des Jarlais DC, Feelemyer JP, Modi SN, Arasteh K, & Hagan H, 2012. Are females who inject drugs at higher risk for HIV infection than males who inject drugs: an international systematic review of high seroprevalence areas. Drug Alcohol Depen. 124.

El-Bassel N, Shaw SA, Dasgupta A, & Strathdee SA, 2014a. Drug use as a driver of HIV risks: re-emerging and emerging issues. Curr. Opin. HIV AIDS 9(2), 150. [PubMed: 24406532]

El-Bassel N, Shaw SA, Dasgupta A, & Strathdee SA, 2014b. People who inject drugs in intimate relationships: it takes two to combat HIV. Curr. HIV-AIDS Rep 11(1), 45–51.

Esmaeili A, Mirzazadeh A, Carter GM, Esmaeili A, Hajarizadeh B, Sacks HS, & Page KA, 2017. Higher incidence of HCV in females compared to males who inject drugs: a systematic review and meta-analysis. J. Viral Hepatitis 24(2), 117–127.

Evans ME, Labuda SM, Hogan V, Agnew-Brune C, Armstrong J, Karuppiah ABP, … Cibrik S, 2018. Notes from the field: HIV infection investigation in a rural area—West Virginia, 2017. MMWR. 67(8), 257. [PubMed: 29494569]

Falade-Nwulia O, Hackman J, Mehta SH, McCormick SD, Kirk GD, Sulkowski M, … Ray SC, 2020. Factors associated with phylogenetic clustering of hepatitis C among people who inject drugs in Baltimore. BMC Infect. Dis 20(1), 1–9.

Falade-Nwulia O, Suarez-Cuervo C, Nelson DR, Fried MW, Segal JB, & Sulkowski MS, 2017. Oral direct-acting agent therapy for hepatitis C virus infection: a systematic review. Ann. Intern. Med 166(9), 637–648. [PubMed: 28319996]

Falade-Nwulia O, Gicquelais RE, Astemborski J, McCormick SD, Kirk G, Sulkowski M, … Mehta SH, 2020. Hepatitis C treatment uptake among people who inject drugs in the oral direct-acting antiviral era. Liver Int. 40(10), 2407–2416. [PubMed: 32770638]

Falade-Nwulia O, Ward KM, McCormick S, Mehta SH, Pitts SR, Katz S, … Latkin CA, 2020. Network-based recruitment of people who inject drugs for hepatitis C testing and linkage to care. J. Viral Hepatitis

Feld JJ, & Foster GR, 2016. Second generation direct-acting antivirals–Do we expect major improvements? J. Hepatol 65(1), S130–S142. [PubMed: 27641983]

Felsher MK, Emmanuel; Lankenau S; Bellamy S; Brady K; Roth A, 2021. Motivations for PrEP-Related Interpersonal Communication among Women Who Inject Drugs: A Qualitative Ego-Centric Network Study. Qual. Health Res 31(1)86–89. [PubMed: 32869694]

Gibson K, & Hutton F, 2021. Women Who Inject Drugs (WWID): Stigma, Gender and Barriers to Needle Exchange Programmes (NEPs). Contemporary Drug Problems.

Goldsmith DJ, 2004. Communicating social support: Cambridge University Press. Cambridge, United Kingdom.

Grebely J, & Dore GJ, 2017. Treatment of HCV in persons who inject drugs: treatment as prevention. Clinical Liver Disease. 9(4), 77. [PubMed: 30992964]

Grebely J, Dore GJ, Morin S, Rockstroh JK, & Klein MB, 2017. Elimination of HCV as a public health concern among people who inject drugs by 2030–What will it take to get there? J. int. AIDS Soc 20(1), 22146. [PubMed: 28782335]

Hajarizadeh B, Grebely J, & Dore GJ, 2013. Epidemiology and natural history of HCV infection. Nat. Rev. Gastro. Hepat 10(9), 553.

Hedegaard H, Warner M, & Miniño AM, 2017. Drug overdose deaths in the United States, 1999–2015.

Holtzman D, Asher AK, & Schillie S, 2021. The Changing Epidemiology of Hepatitis C Virus Infection in the United States During the Years 2010 to 2018. Am J Public Health Res. 111(5), 949–955.

Iversen J, Page K, Madden A, & Maher L, 2015. HIV, HCV and health-related harms among women who inject drugs: Implications for prevention and treatment. JAIDS. (1999), 69(0 1), S176–S181. [PubMed: 25978485]

Janda M, & Mergenhagen KA, 2017. The effect of psychosocial factors on success rates of hepatitis C treatment. Psychosomatics. 58(6), 624–632. [PubMed: 28870488]

Jiwatram-Negrón T, & El-Bassel N, 2014. Systematic review of couple-based HIV intervention and prevention studies: advantages, gaps, and future directions. AIDS Behav. 18(10), 1864–1887. [PubMed: 24980246]

Kåberg M, Hammarberg A, Lidman C, & Weiland O, 2017. Prevalence of hepatitis C and pre-testing awareness of hepatitis C status in 1500 consecutive PWID participants at the Stockholm needle exchange program. Infect. Dis 49(10), 728–736.

Kadushin C, 2012. Understanding social networks: Theories, concepts, and findings: Oxford University Press. New York, NY.

Kurtz SP, Surratt HL, Kiley MC, & Inciardi JA, 2005. Barriers to health and social services for street-based sex workers. J. Health Care Poor U 16(2), 345–361.

Lafferty L, Rance J, Grebely J, Lloyd AR, Dore GJ, Treloar C, & Group SCS, 2018. Understanding facilitators and barriers of direct-acting antiviral therapy for hepatitis C virus infection in prison. J. Viral Hepatitis 25(12), 1526–1532.

Lin N, Ensel WM, Simeone RS, & Kuo W, 1979. Social support, stressful life events, and illness: A model and an empirical test. J. Health Soc. Behav 108–119. [PubMed: 479524]

Malinowska-Sempruch K, 2015. What interventions are needed for women and girls who use drugs? A global perspective. JAIDS. 69, S96–S97. [PubMed: 25978489]

McPherson M, Smith-Lovin L, & Cook JM, 2001. Birds of a feather: Homophily in social networks. Annu. Rev. Sociol 27(1), 415–444.

Meyers SA, Smith LR, & Werb D, 2020. Preventing transitions into injection drug use: A call for gender-responsive upstream prevention. Int. J. Drug Policy 83, 102836. [PubMed: 32679459]

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. Subst. Use Misuse 55(6), 896–899. [PubMed: 31902293]

Motavalli D, Taylor JL, Childs E, Valente PK, Salhaney P, Olson J, … Marshall BD, 2020. "Health Is on the Back Burner:" Multilevel Barriers and Facilitators to Primary Care Among People Who Inject Drugs. J. Gen. Internn. Med 1–9.

Mushtaq U, Mushtaq S, Afzal M, Ali Q, & Malik A, 2020. Role of modern technology for treatment of HCV. Bio. Clin. Sci Research J 2020(1), e001–e001.

Myers B, Fakier N, & Louw J, 2009. Stigma, treatment beliefs, and substance abuse treatment use in historically disadvantaged communities. Afr. J. Psychiatry 12(3).

Neale J, Tompkins C, & Sheard L, 2008. Barriers to accessing generic health and social care services: a qualitative study of injecting drug users. Health Soc. Care. Comm 16(2), 147–154.

Nelson PK, Mathers BM, Cowie B, Hagan H, Des Jarlais D, Horyniak D, & Degenhardt L, 2011. Global epidemiology of hepatitis B and hepatitis C in people who inject drugs: results of systematic reviews. The Lancet. 378(9791), 571–583.

Page K, Evans JL, Hahn JA, Vickerman P, Shiboski S, & Morris MD, 2019. HCV incidence is associated with injecting partner age and HCV serostatus mixing in young adults who inject drugs in San Francisco. PloS one. 14(12), e0226166. [PubMed: 31821365]

Pawlotsky JM, 2016. Hepatitis C drugs: is next generation the last generation? Gastroenterology. 151(4), 587–590. [PubMed: 27590791]

Rabe-Hesketh S, & Skrondal A, 2008. Multilevel and longitudinal modeling using Stata: STATA press.

Reddon H, Marshall BDL, & Milloy MJ, 2019. Elimination of HIV transmission through novel and established prevention strategies among people who inject drugs. The Lancet. HIV, 6(2), e128–e136. [PubMed: 30558843]

Rogers Everett M, 1995. Diffusion of innovations. The Free Press. New York, New York.

Shepard CW, Finelli L, & Alter MJ, 2005. Global epidemiology of hepatitis C virus infection. The Lancet. 5(9), 558–567. [PubMed: 16122679]

Smith BD, Jewett A, Burt RD, Zibbell JE, Yartel AK, & DiNenno E, 2013. "To share or not to share?" Serosorting by hepatitis C status in the sharing of drug injection equipment among NHBS-IDU2 participants. J Infect. Dis 208(12), 1934–1942. [PubMed: 24136794]

Strauss SM, Munoz-Plaza C, Tiburcio NJ, Astone-Twerell J, Des Jarlais DC, Gwadz M, … Rosenblum A, 2008. Barriers and facilitators to undergoing hepatitis C virus (HCV) testing through drug treatment programs. J Drug Issues. 38(4), 1161–1185.

Swan D, Long J, Carr O, Flanagan J, Irish H, Keating S, … McKiernan S, 2010. Barriers to and facilitators of hepatitis C testing, management, and treatment among current and former injecting drug users: a qualitative exploration. AIDS Patient Care STD. 24(12), 753–762.

Toro-Tobón D, Berbesi-Fernández D, Trejos-Castillo E, & Arbelaez SG, 2019. Gender differences in risky injection practices among people who inject drugs in Colombia. Add. Dis. Treat 18(3), 140–148.

Treloar C, Rance J, & Backmund M, 2013. Understanding barriers to hepatitis C virus care and stigmatization from a social perspective. Clin Infect. Dis 57(suppl_2), S51–S55. [PubMed: 23884066]

United Nations Office on Drugs Crime, 2014. Women who inject drugs and HIV: Addressing specific needs.

World Health Organization, 2016. Draft Global Health sector strategies viral hepatitis 2016–2021. 2016. In: Report.

Yang C, Davey-Rothwell M, & Latkin C, 2013. “Drinking buddies” and alcohol dependence symptoms among African American men and women in Baltimore, MD. Drug Alcohol Depen. 128(1–2), 123–129.

Zeremski M, Zibbell JE, Martinez AD, Kritz S, Smith BD, & Talal AH, 2013. Hepatitis C virus control among persons who inject drugs requires overcoming barriers to care. WJG. 19(44), 7846. [PubMed: 24307778]

Zibbell JE, Asher AK, Patel RC, Kupronis B, Iqbal K, Ward JW, & Holtzman D, 2018. Increases in acute hepatitis C virus infection related to a growing opioid epidemic and associated injection drug use, United States, 2004 to 2014. Am J Public Health Res. 108(2), 175–181.

Zibbell JE, Iqbal K, Patel RC, Suryaprasad A, Sanders KJ, Moore-Moravian L, … Holtzman D, 2015. Increases in hepatitis C virus infection related to injection drug use among persons aged≤ 30 years—Kentucky, Tennessee, Virginia, and West Virginia, 2006–2012. MMWR. 64(17), 453. [PubMed: 25950251]

Highlights

- Communication about HCV within social networks was similar for men and women
- PWID had higher odds of HCV communication with alters enrolled in drug treatment
- PWID had higher odds of HCV communication with sex partners
- PWID had higher odds of HCV communication with alters they trust
- PWID had higher odds of HCV communication with alters they interact with frequently

Table 1.

Differences in Socio-demographics, Risk Behaviors and Network Composition between Women and Men who Inject Drugs

Variable	Total (n=227)	Women who Inject Drugs (n=64)	Men who Inject Drugs (n=163)	
	N(%)	N(%)	N(%)	p-value
Age (mean, SD)	43.8 (10.3)	44.0 (10.3)	43.7 (11.3)	0.8 0.4
Race				
Black	104 (45.8)	31(48.4)	73 (44.8)	
White	113 (49.8)	32 (50.0)	81 (49.7)	
Other	10 (4.1)	1 (1.6)	9 (5.2)	
Education level				**0.007**
Less than HS	87 (38.3)	32 (50.0)	55 (33.7)	
HS/GED	92 (40.5)	20 (31.3)	72 (44.2)	
College or more	48 (21.2)	12 (18.8)	36 (22.1)	
Married/in committed relationship	173 (76.2)	40 (62.5)	133 (81.6)	**0.002**
Homeless	142 (62.6)	35 (52.7)	107 (65.6)	0.1
Total sex partners[a] (mean, SD)	1.7 (0.2)	3.0 (0.6)	1.1 (0.1)	**0.0**
Transactional sex[a]	63 (39.4)	33 (62.3)	30 (28.0)	**0.00**
Shared cookers/cottons[a]	144 (63.4)	37 (57.8)	107 (65.6)	0.27
Ever received HCV diagnosis	179 (78.9)	57 (89.1)	122 (74.9)	**0.02**
HIV positive	30 (13.2)	8 (12.5)	22 (13.5)	0.8
Personal Network Characteristics	7.3 (4.1)	8.0 (4.1)	6.9 (4.1)	**0.08**
Network size (mean, SD)				
Percent Network Race				
Black	0.6 (0.4)	0.6 (0.41)	0.5 (0.42)	0.7
White	0.4 (0.4)	0.3 (0.4)	0.5 (0.4)	0.3
Other	0.0 (0.1)	0.1 (0.09)	0.0 (0.1)	0.5
Percent network relationship type				
Sex partners	0.1 (0.1)	0.1 (0.12)	0.1 (0.12)	0.14
Kin	0.3 (0.2)	0.3 (0.2)	0.2 (0.2)	**0.001**
Non-kin	0.6 (0.2)	0.5 (0.2)	0.6 (0.3)	**0.001**
Percent Network PWID	0.4 (0.2)	0.4 (0.23)	0.4 (0.24)	0.97
Percent Race homophily	0.8 (0.3)	0.8 (0.2)	0.8 (0.3)	0.16
Percent Gender homophily	0.6 (0.2)	0.5 (0.2)	0.6 (0.2)	**0.09**
Average age difference within personal networks (mean, SD)	11.3 (4.5)	10.8 (4.7)	12.3 (3.8)	**0.00**
Total number of alters with whom respondent discussed HCV (mean, SD)	3.9 (3.5)	4.2 (3.9)	3.8 (3.4)	0.44
number sex partners discussed HCV (mean, SD)	0.7 (0.7)	0.7 (0.7)	0.6 (0.8)	0.32
number drug partners discussed HCV (mean, SD)	1.4 (1.8)	1.5 (2.0)	1.4 (1.8)	0.3
number kin discussed HCV (mean, SD)	1.1 (1.4)	1.3 (1.3)	1.1 (1.3)	0.3

Variable	Total (n=227)	Women who Inject Drugs (n=64)	Men who Inject Drugs (n=163)	
	N(%)	N(%)	N(%)	p-value
number non kin discussed HCV (mean, SD)	2.1 (2.7)	2.2 (3.0)	2.1 (2.6)	0.4

[a] In prior 90 days

Table 2.

Distribution of Alter and Dyadic Attributes by Infectious Disease Care and Prevention Conversations Within Dyads of Women and Men who Inject Drugs

	Total PWID (n=1655)	**Women (n=516 dyads)**			**Men (n=1139 dyads)**			**Total PWID (n=1655)**
Characteristic		**No discussion 247 (47.9) N%**	**Discussion 269 (52.1) N%**	**UOR (95%CI)**	**No discussion 519 (45.6) N%**	**Discussion 620 (54.4) N%**	**UOR (95%CI)**	**P value for interaction term with ego gender[b]**
Alter Characteristics								
Age (mean std)	45.2 (15.2)	44.4 (18.2)	47.9 (13.7)	1.0 (1.0–1.0)	44.2 (15.8)	45.5 (13.8)	1.0 (1.0–1.0)	0.3
Race								
Black	915 (55.5)	162 (65.9)	151 (56.1)	REF	306 (59.2)	296 (48.1)	REF	REF
White	664 (40.3)	72 (29.3)	105 (39.0)	1.3 (0.8–2.3)	198 (38.3)	289 (46.9)	**1.4 (1.1–1.8)** *	0.8
Other	69 (4.2)	12 (4.9)	13 (4.8)	0.9 (0.4–2.0)	13 (2.5)	31 (5.0)	1.2 (0.7–19)	0.5
Gender								
Male	870 (52.7)	105 (43.2)	127 (47.2)	REF	311 (60.0)	327 (52.7)	REF	REF
Female	780 (47.3)	138 (56.8)	142 (52.8)	0.8 (0.6–11)	207 (40.0)	293 (47.3)	**1.6 (1.3–2.0)** *	**0.001**
Sexual								
Orientation								
Homosexual	175 (10.9)	49 (21.8)	40 (14.9)	REF	31 (6.3)	55 (8.9)	REF	REF
Heterosexual	1426 (89.1)	176 (78.2)	228 (85.1)	1.3 (0.9–2.0)	462 (93.7)	560 (91.1)	0.8 (0.5–1.1)	0.1
Currently enrolled in drug treatment	343 (20.8)	40 (16.3)	72 (26.8)	**2.0 (1.1–3.0)** *	72 (13.9)	159 (25.7)	**2.0 (1.4–2.7)** *	0.5
Ever had an STI	111 (6.7)	11 (4.5)	24 (8.9)	**2.2 (1.1–4.6)** *	19 (3.7)	57 (9.2)	**1.9 (1.3–3.0)** *	0.8
Dyadic Characteristics								
Race homophily	1355 (81.9)	208 (84.2)	48 (17.8)	1.2 (0.7–2.1)	447 (86.1)	479 (77.3)	0.8 (0.6–1.0) +	0.1
Drinks alcohol with alter	226 (13.7)	27 (11.0)	31 (11.5)	1.3 (0.9–2.1)	79 (15.3)	89 (14.4)	1.0 (0.7–1.5)	0.3
Injects drugs with alter	313 (18.9)	23 (9.4)	67 (24.9)	**1.7 (1.0–2.9)** *	59 (11.4)	164 (26.5)	**2.2 (1.6–3.1)** *	0.9
Has shared needles/cookers with alter[a]	206 (12.5)	17 (6.9)	39 (14.5)	**1.9 (1.0–3.5)** *	33 (6.4)	117 (19.9)	**3.3 (2.2–4.9)** *	0.2
Relationship types								
Sex Partner	185 (112)	14 (5.7)	47 (17.5)	**4.0 (1.9–8.7)** *	22 (4.3)	102 (16.5)	**3.8 (2.3–6.6)** *	0.9
Kin	516 (31.2)	97 (39.4)	80 (29.7)	REF	166 (32.2)	173 (27.9)	REF	REF

	Total PWID (n=1655)	Women (n=516 dyads)			Men (n=1139 dyads)			Total PWID (n=1655)
Characteristic		**No discussion 247 (47.9) N%**	**Discussion 269 (52.1) N%**	**UOR (95%CI)**	**No discussion 519 (45.6) N%**	**Discussion 620 (54.4) N%**	**UOR (95%CI)**	**P value for interaction term with ego gender[b]**
Non kin	949 (57.3)	135 (54.9)	142 (52.8)	1.0 (0.7–15)	327 (63.5)	345 (55.7)	0.9 (0.7–12)	0.7
Trust (mean, std)	7.1 (3.1)	6.8 (3.1)	7.3 (3.0)	**1.1 (1.0–1.2)** *			**1.1 (1.0–1.1)** *	0.4
Relationship length, months (mean std) Frequency of interaction	17.9 (16.9)	16.8 (16.6)	16.5 (15.6)	1.0 (1.0–10)	18.4 (17.1)	18.7 (17.3)	1.0 (1.0–10)	0.8
Daily/weekly	1128 (68.2)	152 (61.8)	203 (75.5)	**1.9 (1.2–3.0)**	320 (61.8)	453 (73.1)	**1.7 (1.4–2.2)** *	0.4
Monthly less	525 (31.8)	94 (38.2)	66 (24.5)	REF	198 (38.2)	167 (26.9)	REF	REF

[a] In prior 90 days;

[b] interaction of ego gender and alter/dyadic characteristic;

** significance at p<0.01;

* significance at p<0.05;

+ significance at p=0.10

Table 3.

Adjusted Odds Ratios (AOR) of Alter Attributes and Dyadic Attributes that Predict Health Communication Within Dyads

Characteristic	**(n=1665 dyads)**
	AOR (95% CI)
Alter Race	
Black	REF
White	1.2 (0.9–1.7)
Other	1.1 (0.6–1.8)
Alter Female	1.2 (0.9–1.5)
Currently enrolled in drug treatment	**1.7 (1.3–2.4)** **
Racial Homophily	0.8 (0.5–1.1)
Ever had an STI	1.3 (0.8–2.1)
Has shared needles/cookers with alter[a]	**3.0 (1.9–4.6)** **
Relationship type	
Sex Partner	**3.0 (1.9–4.9)** **
Kin	REF
Non kin	0.9 (0.7–1.2)
Trust	**1.1 (1.1–1.2)** **
Frequency of interaction	
Daily/weekly	**1.7 (1.3–2.2)** **
Monthly less	REF

[a]In prior 90 days;

controlling for HIV and HCV status, respondent age and education;

** significance at p<0.01;

* significance at p<0.05