

Risk Behaviors for HIV and HCV Infection Among People Who Inject Drugs in Hai Phong, Viet Nam, 2014

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Abstract We examined the potential for HIV and hepatitis C (HCV) transmission across persons who inject drugs (PWID), men-who-have-sex-with-men (MSM) and female commercial sex workers (CSW) PWID and the potential for sexual transmission of HIV from PWID to the general population in Hai Phong, Viet Nam. Using respondent driven and convenience sampling we recruited 603 participants in 2014. All participants used heroin; 24% used non-injected methamphetamine. HIV prevalence was 25%; HCV prevalence was 67%. HIV infection was associated with HCV prevalence and both infections were associated with length of injecting career. Reported injecting risk behaviors were low; unsafe sexual behavior was high among MSM-PWID and CSW-PWID. There is strong possibility of sexual transmission to primary partners facilitated by methamphetamine use. We would suggest

future HIV prevention programs utilize multiple interventions including “treatment as prevention” to potential sexual transmission of HIV among MSM and CSW-PWID and from PWID to the general population.

Keywords HIV · Persons who inject drugs (PWID) · Vietnam · Respondent driven sampling (RDS) · Sex workers · Men who have sex with men (MSM)

Introduction

In many countries, HIV/AIDS and Hepatitis C (HCV) are concentrated in certain “key populations,” notably female commercial sex workers (CSW), men-who-have-sex-with-men (MSM) and people who inject drugs (PWID) [1–3]. While these key populations are often considered separately in research and for prevention programming, there can be substantial overlap among them—such as CSW who also inject drugs and MSM who also inject drugs [4, 5]. There is also the possibility that male PWID may utilize the services of female CSW [6]. PWID who engage in MSM behaviors or who engage in commercial sex work may or may not be at higher risk of acquiring and transmitting HIV to other (“regular”) PWID particularly through sexual transmission. Continuous transmission of HIV across the key populations may limit the overall effectiveness of prevention efforts for any specific key population [7].

Hai Phong, Viet Nam experienced a widespread HIV epidemic among PWID beginning in the 1990s. In the integrated bio-behavioral surveys (IBBS), HIV prevalence among male PWID had reached 66% in 2005 and then decreased to 48% in 2009 [8]. HIV prevalence is also substantial in the other key populations in Hai Phong,

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though much lower than among male PWID. In 2005, prevalence was 5% among venue-based female commercial sex workers (CSWs) and 23% among street-based female CSW; in 2009, HIV prevalence was 12% and 23%, respectively. HIV prevalence was 16% among MSM in Hai Phong in 2009 [9]. Hai Phong also has high prevalence of HCV among PWID; studies have documented prevalence as high as 66% among drug users [10].

These studies provide extremely useful information on HIV/HCV prevalence and risk behaviors among key populations (PWID, MSM, and female commercial sex workers) in Viet Nam. However, the IBBS studies have important limitations for examining overlap and potential HIV transmission across the key populations. The populations were defined separately—only males were included in the PWID studies and female CSW were studied separately from male commercial sex workers. Different recruitment strategies were used—generally respondent-driven sampling was used for MSM, and time-location sampling was used for commercial sex workers and PWID. There were only modest numbers of persons who were members of more than one key population (female commercial sex workers who injected drugs and MSM who injected drugs) preventing in-depth analyses by site. These limitations make it difficult to assess the likelihood of overlap among the different key populations and of HIV transmission across the populations. While there have been studies conducted in Vietnam to examine the overlap between different at risk populations who use drugs, these studies have been limited to drug users and sex worker populations, with limited geographic coverage of Vietnam [11, 12]. Additionally, as HCV infection is not measured as part of the IBBS survey, there is a lack of information on HCV prevalence and incidence and related behaviors among high risk populations in Viet Nam.

We conducted a large study of HIV and HCV prevalence and risk behaviors among PWID in late 2014, in which CSW-PWID and MSM-PWID were oversampled (as MSM and CSW are at elevated risk for HIV, we wanted to oversample from these sub populations). This allowed us to assess the extent to which engaging in MSM or CSW behavior adds to the risk of being HIV and/or HCV seropositive among PWID, and to examine the potential for sexual transmission of HIV and injecting transmission of HIV/HCV within and across the three key populations in Hai Phong.

Persons who recently began injecting drugs often engage in very risky behaviors. We also examine “new injectors” (persons who had been injecting for <5 years) among “majority” PWID (those PWID who did not identify as MSM or CSW), MSM-PWID, and CSW-PWID to assess the potential similarities and differences of HIV/

HCV infection among these three subgroups of PWID in Hai Phong.

Methods

We involved three peer support groups who were fully integrated into the research team, participating in all research decisions and in data collection and assisting in identification of seeds and recruitment of initial participants for the study [13]. Respondent-driven sampling (RDS) [14] was used as the primary method of recruiting participants. In general, we followed standard RDS procedures for recruiting and training “seeds,” aiming for a diverse group with different ages, genders, and HIV statuses. The seeds were recruited by peer support group members, participated in all study procedures, and were then instructed on how to recruit new study participants using the RDS coupons. The study name, logo and research site were printed on the RDS coupons. The seeds selected for the initial round of recruitment were chosen by community based organization (CBO) members who worked with persons who inject drugs in Haiphong. The CBO members selected seeds who had moderate to large PWID networks and who had good working relationships with CBO members in Haiphong. All of the seeds were pre-screened by the research team and their networks and their ability to recruit new participants were discussed by staff prior to being selected.

We included three seeds each from community support groups. We did not offer higher incentives for recruiting MSM-PWID or CSW-PWID, as we did not want to create problems with subjects misrepresenting themselves as members of these groups. The RDS procedures did not produce the desired oversampling of MSM-PWID and CSW-PWID, so that additional MSM-PWID and CSW-PWID were recruited directly by the peer support groups until we had at least 40 MSM-PWID and 40 CSW-PWID. We used community support groups to directly recruit MSM and CSW into the sample in order to oversample these subgroups. CBO members with knowledge of MSM and CSW who inject drugs recruited these participants from the community support groups directly, without using any RDS procedures. The targets sample sizes for MSM-PWID and CSW-PWID represent oversampling at approximately twice the estimated percentages of these groups in the overall PWID population in Haiphong. For the analyses, MSM and CSW were identified based on behaviors reported in the month preceding the interview (including reporting male sexual contact for MSM, and paid sex work with clients for CSW).

Eligibility Criteria

Persons were eligible to participate in the study if they were 18 or older, capable of giving informed consent, and were currently injecting heroin and/or methamphetamine. Staff visually inspected participants' arms for indications of injecting and an on-site urine test was used to confirm recent drug use. For those identified as MSM-PWID, they had to report sex with a male regular, casual, or sex work partner in the last month. For those identified as CSW-PWID, they had to report money or drugs for sex in the previous month.

Questionnaire

After eligibility had been confirmed and written informed consent obtained, a structured interview lasting approximately 40 min was administered by a trained interviewer. The questionnaire was based on questionnaires previously used by the research team, with adaptation and pre-testing for use in Hai Phong.

HIV and HCV Counseling and Testing

After completing the interview, each participant received counseling and testing for HIV and HCV. HIV antibody and HCV antibody testing were conducted at the laboratory of the Hai Phong Provincial AIDS Committee, using Alere Determine 12.0 (Abbott) and HCV ELISA 3.0 (SD Bioline). HIV confirmation tests were done according to the National guidelines and used HIV1/2 3.0 rapid test (SD Bioline) plus the MUREX HIV Ag/Ab Combination test (Diasorin).

Honoraria

Each participant received VND 150,000 (Vietnamese dong, approximately US \$7.50) plus VND 50,000 (approximately USD \$2.50) for each peer they successfully recruited. These honoraria included compensation for time and effort to participate in the study and for transportation expenses to travel to the study site. Participants received an additional VND 50,000 for transportation to return to the study site to obtain their HIV and HCV test results.

Data Analyses

We used basic univariate statistics (percentages, means with standard deviations) to describe the sample, Chi square and *t* tests to test for differences between different sub-groups, and multivariable logistic regression to identify factors associated with HIV and HCV serostatus and with engaging in unsafe sex (defined as sex without using

condoms) with primary partners. We grouped participants into MSM-PWID, CSW-PWID and majority PWID based on whether they reported MSM behavior, were females who reported engaging in commercial sex work, or reported neither of these behaviors. In order to avoid the possibility of “reverse causation” (where HIV/HCV seropositives reduce their risk behavior so being seropositive for either infection is associated with lower rates of risk behavior), we did not include recent risk behaviors in the analysis of factors potentially associated with being HIV or HCV seropositive. The RDS Analysis Tool (RDSAT) was used for comparison of weighted and unweighted results [15] and STATA 12 [16] were used for data analysis.

Results

We distributed a total of 909 coupons in Hai Phong among PWID utilizing RDS, and of the coupons distributed, 594 coupons were returned (65%), leading to recruitment of 603 subjects (Fig. 1); Table 1 shows demographic characteristics, recent drug use, recent sexual activities, HIV and HCV status of the participants. The participants were predominantly heterosexual males, with average age of 37 and an average of 9 years of injecting drug use. The majority PWID were older (average age of 37 vs. 32 and 33 for MSM-PWID and CSW-PWID respectively) and had longer injecting careers (time since first injection) (9 vs. 7 years for MSM-PWID and CSW-PWID, respectively). All used heroin and 24% reported non-injected methamphetamine use—with significantly higher methamphetamine use among MSM-PWID (33%) and CSW-PWID (38%) compared to majority PWID (22%) ($p < 0.05$ by Chi square test). Recent sexual activity was low among majority PWID (31% during the last 3 months) compared to 100% among MSM-PWID and CSW-PWID. HIV and HCV prevalence were 25% and 67% respectively with a significantly lower HCV prevalence among MSM-PWID (49%) compared to majority PWID (68%) and CSW-PWID (67%) ($p < 0.05$ by Chi square test). We also calculated HIV and HCV prevalence using RDSAT; when we utilized RDSAT to estimate weights for HIV and HCV in the RDS sample, the prevalence rates for HIV (23%) and HCV (68%) were nearly identical to the unadjusted HIV prevalence (25%) and HCV prevalence (67%).

Table 2 presents reported recent drug injecting and sexual risk behaviors. Risky injection behaviors were quite low (with the possible exception of receptive sharing among CSW-PWID) and there were no statistically significant differences across the three transmission groups. There were consistent significant differences in sexual activity and unsafe sexual activity across sexual risk

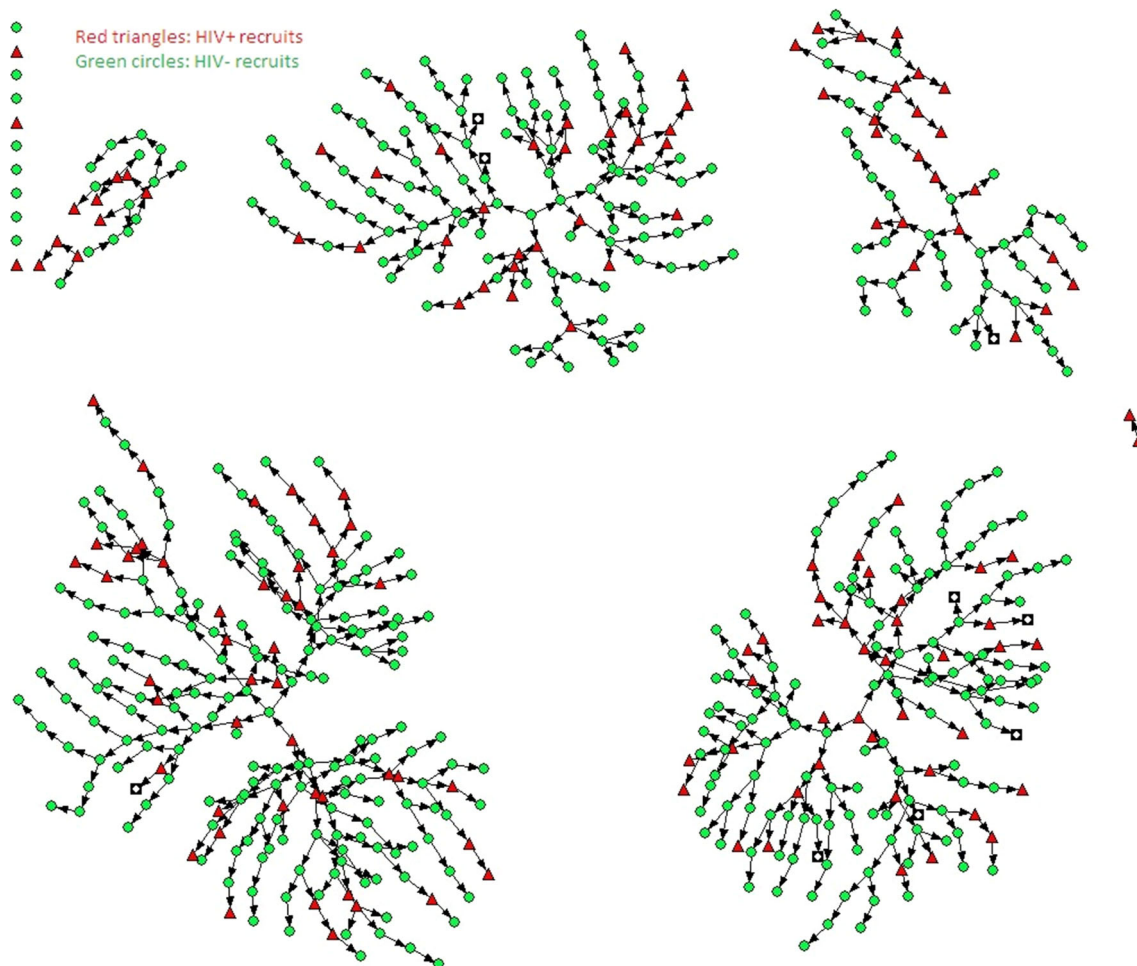


Fig. 1 Recruitment tree by HIV status for DRIVE-IN PWID 2014

behaviors, with the majority PWID reporting the lowest percentages of being sexually active during the last 3 months and the lowest percentages of unsafe sexual behaviors (vaginal or anal intercourse without 100% condom use). The MSM-PWID, however, did report the highest percentage of unsafe sex with a sex worker (regardless of the gender of the sex worker) (36% vs. 20% for CSW-PWID and 0% for majority PWID, $p < 0.05$ by Chi square test).

Tables 3, 4, and 5 shows demographic and drug use among new injectors (injecting <5 years) and long-term injectors (injecting $\geq 5+$ years) among the three groups of majority PWID, MSM-PWID and CSW-PWID. As expected, the long-term injectors were generally older, had longer injection histories and were more likely to be HCV seropositive. Among the regular injectors, HIV prevalence (1% among new injectors vs. 33% among long term injectors, $p < 0.05$), and the percentage injecting daily or more frequently was significantly lower among new injectors (77% among new injectors vs. 85% among long term injectors, $p < 0.05$), while the percentage reporting

being sexually active and being sexually active with a primary partner were higher among the new injectors (40% among new injectors vs. 30% among long term injectors, $p < 0.05$). There were no statistically significant differences in HIV prevalence or risk behaviors among new versus long-term injectors among the MSM- and CSW-PWID, though the sample sizes ($n = 45$ total in each group) did not provide much statistical power.

Factors associated with being HIV and HCV seropositive

Inspection of Tables 3, 4, and 5 suggests that the new injectors were less likely to be HIV seropositive when compared to long-term injectors. We used multivariable logistic regression, with demographic and drug use factors (but not recent HIV risk behavior variables, see Methods) in Tables 1 and 2 and with backwards elimination to identify factors independently associated with being HIV seropositive. In the final model, only years injecting—new vs. long term injector status (AOR = 0.2, 95% CI 0.1–0.3)

Table 1 Demographic characteristics, drug use and sexual activity and HIV and HCV serostatus by among “regular” PWID, MSM-PWID, and CSW-PWID in Hai Phong, Viet Nam, 2014

	“Regular” PWID**	MSM-PWID**	CSW-PWID**	Total sample
Total N (%)	513	45	45	603
Avg. Age(SD)*	37 (8)	32 (7)	33 (7)	37 (8)
Avg. Years injecting (SD)*	9 (6)	7 (6)	7 (5)	9 (6)
Gender*				
Male	97%	100%	0%	90%
Female	3%	0%	100%	10%
Drug use behaviors				
Heroin (injected)	100%	100%	100%	100%
Methamphetamine (injected)	<1%	2%	0%	<1%
Methamphetamine (non-injected)*	22%	33%	38%	24%
Sexually active*	37%	100%	100%	47%
HIV seropositive	25%	24%	33%	25%
HCV seropositive*	68%	49%	67%	67%

* Significant difference ($p < 0.05$) by Chi square test (continuous variables were tested using ANOVA)

** “Regular” PWID males who reported neither MSM behavior nor commercial sex work, MSM-PWID males who reported male-with-male sexual behavior, including some who reported commercial sex work, CSW-PWID females who reported commercial sex work

Table 2 Injecting and sexual risk behavior among “Regular” PWID, MSM-PWID, and CSW-PWID in Hai Phong, Viet Nam, 2014

	“Regular” PWID (%)	MSM-PWID (%)	CSW-PWID (%)	Total sample (%)
Total N (%)	513	45	45	603
Injecting daily or more frequently	83	73	91	83
Receptive sharing ^a	5	4	13	2
Distributive sharing ^b	3	2	2	3
Sex with primary partner*	33	69	58	38
Unsafe sex with primary partner*	25	51	47	29
Sex with casual partner*	2	29	13	5
Unsafe sex with casual partner*	1	16	2	2
Exchanged sex for money*	0	67	100	12
Unsafe sex with client*	0	36	20	4
Exchanged money for sex*	6	20	0	6.6
Unsafe sex with sex worker*	1	4	0	1

^a Defined as receiving used needles/syringes from other PWID

^b Defined as giving used needles/syringes to other PWID

* Significant difference by Chi square test ($p < 0.05$)

and being HCV seropositive (AOR = 6.0, 95% CI 3.0–10.7) were significantly associated with being HIV seropositive (see Table 6). The great majority, 139/152 (86%) of the HIV seropositives were also HCV seropositive, while only 13/187 (7%) of the HCV seronegatives were HIV seropositive. There was no statistically significant relationship between type of PWID (majority-PWID vs. MSM-PWID vs CSW-PWID) and HIV in the final model.

We conducted a similar multivariable logistic modeling for being HCV seropositive. Being HIV seropositive,

transmission group (MSM-PWID less likely to be HCV seropositive compared to CSW-PWID and majority-PWID), and length of injecting career were independently associated with being HCV seropositive (see Table 7).

Factors associated with HIV sexual risk behavior

Unsafe sex with a primary partner was by far the most frequently reported risk behavior among the subjects (see Table 2). There are two components to this risk behavior—first being sexually active with a primary partner, and

Table 3 Demographics and drug use among new and long-term “Regular” PWID in Hai Phong, Viet Nam, 2014

	Long-term injectors**	New injectors**
Total N	372	139
Avg. age (SD)*	39 (8)	34 (8)
Avg. years injecting (SD)*	12 (5)	2 (2)
Gender		
Male	97%	98%
Female	3%	2%
Drug use behaviors		
Heroin (injected)	100%	100%
Methamphetamine (injected)	<1%	0%
Methamphetamine (non-injected)	23%	20%
Sexually active*	34%	45%
HIV seropositive*	33%	1%
HCV seropositive*	78%	45%
Injecting daily or more frequently*	85%	77%
Receptive sharing ^a	4%	7%
Distributive sharing ^b	3%	4%
Sex with primary partner*	30%	40%
Unsafe sex with primary partner	23%	31%
Sex with casual partner	2%	3%
Unsafe sex with casual partner	1%	1%
Exchanged sex for money	0%	0%
Unsafe sex with client	0%	0%
Exchanged money for sex	5%	8%
Unsafe sex with sex worker	1%	1%

^a Defined as receiving used needles/syringes from other PWID

^b Defined as giving used needles/syringes to other PWID

* Significant difference ($p < 0.05$) by Chi square test (for continuous variables t test was used)

** Long term injectors, injecting 5+ years, new injectors, injecting <5 years

second, not always using condoms in vaginal or anal intercourse with a primary partner. There were very substantial differences among the three transmission groups in reporting sexual activity with a primary partner in the 6 months prior to the interview and moderately high prevalence of sexual activity: 33% of majority PWID were sexually active with primary partners, while 69% of MSM-PWID and 58% of CSW-PWID were sexually active with primary partners ($p < 0.001$ by Chi square test) (see Table 2).

The second component of unsafe sex with a primary partner is not always using condoms when engaging in vaginal or anal intercourse with a primary partner. We used multivariable logistic regression with backwards elimination to identify demographic and drug use factors (taken from Tables 1, 2) associated with not always using condoms when engaging in sex with primary partners. Results are presented in Table 8. Failing to always use condoms was associated with being HIV seronegative, transmission category (MSM-PWID and CSW-PWID) and using non-injected methamphetamine.

Not only were the MSM-PWID and CSW-PWID groups more likely to report sexual activity with a primary partner and less likely to always use condoms in sexual activity with a primary partner, but they were more likely to report higher risk primary sexual partners. Among subjects reporting sexual activity with a primary partner, 26% of MSM-PWID and 50% of CSW-PWID reported that their primary partner had injected drugs, compared to 9% for regular PWID ($p < 0.001$). Similarly among subjects reporting sexual activity with a primary partner, 31% of MSM-PWID and 29% of CSW-PWID reported that they had a HIV seropositive primary partner compared to 10% for regular PWID ($p = 0.001$ by Chi square test) (full data available from author K. Arasteh).

As noted above, we did not find statistically significant differences in HIV prevalence among the three transmission groups as a whole. However, among the new injectors, who would presumably represent recent HIV infections, HIV prevalence was 1% among majority PWID new injectors, 14% among MSM-PWID new injectors, and 22% among CSW-PWID new injectors (the comparison of HIV prevalence among majority new injectors versus prevalence

Table 4 Demographics and drug use among new and long-term MSM-PWID in Hai Phong, Viet Nam, 2014

	Long-term injectors	New injectors
Total N	24	21
Avg. age (SD)*	36 (8)	28 (4)
Avg. years injecting (SD)*	11 (5)	1 (1)
Drug use behaviors		
Heroin (injected)	100%	100%
Methamphetamine (injected)	4%	0%
Methamphetamine (non-injected)	42%	24%
Sexually active	100%	100%
HIV seropositive	33%	14%
HCV seropositive*	67%	29%
Injecting daily or more frequently	83%	62%
Receptive sharing ^a	0%	10%
Distributive sharing ^b	0%	5%
Sex with primary partner	58%	81%
Unsafe sex with primary partner	42%	62%
Sex with casual partner	25%	33%
Unsafe sex with casual partner	13%	19%
Exchanged sex for money	71%	62%
Unsafe sex with client	42%	29%
Exchanged money for sex	21%	19%
Unsafe sex with sex worker	4%	5%

^a Defined as receiving used needles/syringes from other PWID

^b Defined as giving used needles/syringes to other PWID

* Significant difference ($p < 0.05$) by Chi square test (for continuous variables t test was used)

among the combined MSM-and CSW-PWID was statistically significant, Chi square = 17.3, $p < 0.001$).

Discussion

Most research on key populations at risk for HIV and HCV have treated PWID, MSM and female CSW as distinct groups, even though it is well known that both MSM and CSW may also inject drugs and that female PWID and MSM PWID may also engage in sex work. In this study we were able to compare “majority” PWID (those who do not engage in MSM behavior or commercial sex work) with two groups likely to be at higher sexual risk for HIV/HCV—MSM-PWID and CSW-PWID in Hai Phong, Viet Nam.

There were very few statistically significant differences in injecting behaviors and HIV across the three groups of PWID. They all injected heroin, very few injected methamphetamine, large majorities (from 73% to 91%) were injecting daily or more frequently, they had similar (and very low) rates of syringe sharing behaviors, and differences in HIV prevalence (from 24% to 33%) were not statistically significant. These similarities suggest that the

great majority of the HIV positives became infected through syringe sharing in the past, but that the PWID population in Hai Phong is now well aware of the dangers of HIV transmission through sharing syringes and are making attempts to avoid these risks.

We documented a lower HCV prevalence among MSM-PWID (49%) compared to regular PWID (68%) and CSW-PWID (67%). While these differences in HCV prevalence may be a result of lower levels of risky injection behavior among MSM-PWID, the small sample size of MSM in our study means these results should be interpreted with caution.

Comparisons of the new injectors to the long-term injectors show the expected differences in HIV and HCV prevalence—the new injectors have lower HIV and HCV prevalence. While many studies have found higher rates of injecting risk behavior among new injectors compared to long-term injectors [17, 18], we observed relatively few differences, which suggests that the general concern about avoiding injecting risk behavior has diffused to new injectors as well. There is also evidence that access to needles and syringes has increased and that new injectors regularly access pharmacy locations for new needles/syringes on a regular basis, although acquisition during nighttime hours still remains problematic [19].

Table 5 Demographics and drug use among new and long-term female CSW-PWID in Hai Phong, Viet Nam, 2014

	Long-term injectors	New injectors
Total N	26	18
Avg. age (SD)	34 (6)	31 (7)
Avg. years injecting (SD)*	10 (4)	2 (2)
Drug injection characteristics		
Heroin (injected)	100%	100%
Methamphetamine (injected)	0%	0%
Methamphetamine (non-injected)	38%	39%
Sexually active	100%	100%
HIV seropositive	38%	38%
HCV seropositive*	81%	44%
Injecting daily or more frequently	89%	94%
Receptive sharing ^a	12%	11%
Distributive sharing ^b	4%	0%
Sex with primary partner	50%	67%
Unsafe sex with primary partner	46%	44%
Sex with casual partner	12%	17%
Unsafe sex with casual partner	0%	6%
Exchanged sex for money	100%	100%
Unsafe sex with client*	8%	33%
Exchanged money for sex	0%	0%
Unsafe sex with sex worker	0%	0%

^a Defined as receiving used needles/syringes from other PWID

^b Defined as giving used needles/syringes to other PWID

* Significant difference ($p < 0.05$) by Chi square test (for continuous variables t test was used)

Table 6 Logistic models of HIV serostatus among PWID in Hai Phong, Viet Nam, 2014

Outcome variable	Exposure variables	AOR	95% CI	p value
HIV serostatus	HCV serostatus			
	Negative	1.0		
	Positive	6.0	3.0–10.7	<0.001
	Injection status			
	Long-term injector	1.0		
	New injector	0.2	0.1–0.3	<0.001
	Exposure group			
	“Regular” PWID	1.0		
	MSM-PWID	1.8	0.8–4.1	0.16
	CSW-PWID	1.99	0.9–4.3	0.08
	Age	1.0	1.0–1.0	0.5
	Non-injectable ice			
	Did not use	1.0		
	Used	0.9	0.6–1.4	0.6
	Frequency of injection			
Less than daily	1.0			
Daily	0.9	0.5–1.5	0.6	

While the three groups were quite similar in terms of injecting risk behaviors, there were pronounced differences in sexual risk behaviors and in non-injecting drug use.

First, the MSM- and CSW-PWID were much more likely to report being sexually active in the 3 months prior to the interview compared to regular PWID. The differences in

Table 7 Logistic models of HCV serostatus among PWID in Hai Phong, Viet Nam, 2014 outcome

Outcome variable	Exposure variables	AOR	95% CI	p value
HCV serostatus	HIV serostatus			
	Negative	1.0		
	Positive	6.0	3.1–11.3	<0.001
	Exposure group			
	“Regular” PWID	1.0		
	MSM-PWID	0.5	0.2–0.9	<0.05
	CSW-PWID	0.9	0.4–1.8	n.s.
	Injection status			
	Long-term injector	1.0		
	New injector	0.3	0.2–0.5	<0.001
	Age	1.0	1.0–1.0	0.6
	Non-injectable ice			
	Did not use	1.0		
	Used	1.3	0.9–2.1	0.2
	Frequency of injection			
Less than daily	1.0			
Daily	0.7	0.4–1.2	0.2	

Table 8 Logistic models of unsafe sex with primary partners among PWID in Hai Phong, Viet Nam, 2014

Outcome variable	Exposure variables	AOR	95% CI	p value
Unsafe sex w/primary partner	HIV serostatus			
	HIV–	1.0		
	HIV+	0.3	0.2–0.5	<0.001
	Transmission category			
	“Regular” PWID	1.0		
	MSM-PWID	3.1	1.6–5.9	0.001
	CSW-PWID	2.8	1.4–5.3	0.002
	Non-injected ice			
	Not used	1.0		
	Used	2.1	1.4–3.1	0.001
	Injection status			
	Long-term injector	1.0		
	New injector	1.2	0.8–1.8	0.5
	Age	1.0	1.0–1.0	0.4
	Frequency of injection			
	Less than daily	1.0		
	Daily	0.8	0.5–1.2	0.3
	Injected w/used needles			
	No	1.0		
Yes	0.6	0.3–1.6	0.3	

being sexually active were reflected in higher percentages of MSM-PWID and CSW-PWID reporting unsafe sex with primary or casual partners. MSM-PWID and CSW-PWID also reported higher risk regular partners (partners who injected drugs and/or were HIV seropositive). Finally, MSM-PWID and CSW-PWID were more likely to report

using non-injected methamphetamine, and non-injected methamphetamine use was associated with failure to consistently use condoms with regular sexual partners. This is of particular concern given the strong associations between methamphetamine use and sexual transmission among MSM populations in many different countries [20, 21] and

the difficulties in reducing the sexual risk-taking associated with methamphetamine use [22, 23]. Finally, we noted that non-condom use was associated with being HIV negative. This could be due to participants with knowledge of their HIV status not using condoms as they would not have to worry about transmitting HIV to others. There may also be HIV negative participants in the sample that are in seroconcordant monogamous relationships, where transmission of HIV would not be an issue [24]. As many of our participants were male and were in partnerships with females who did not inject drugs, male PWID would be extremely unlikely to acquire HIV through sexual transmission of their regular partner.

Limitations

Although we utilized RDS sampling for the study, there are strengths and limitations to RDS methodology [25]. Most of the behavioral data are based on self-report, and the possibility of social desirability bias must be considered. The rates of self-reported injecting risk behaviors were particularly low. However, HIV prevalence among PWID in Hai Phong has been declining sharply—from 66% in 2006 to 25% in the present study (data collected in late 2014), which would be consistent with low rates of injecting-related HIV transmission.

The study utilized a cross-sectional design so that considerable caution is needed in making any causal inferences.

Even though we oversampled MSM-PWID and CSW-PWID, we did have only modest numbers of subjects in these groups (45 in each). The differences in the comparisons of sexual risk behaviors among the regular PWID versus MSM- and CSW-PWID were substantial and statistically significant, but much larger samples of MSM-PWID and CSW-PWID would be needed to adequately explore similarities and differences in sexual risk behavior between these two groups. Additionally, while differences in HCV prevalence were observed among the three PWID risk groups, these prevalence figures should be interpreted with caution due to the small sample size of MSM-PWID in the study.

The use of RDS and peer recruitment both have limitations. For our RDS recruitment, the pace at which the participants presented to the study site was much more rapid than we had anticipated, and for this reason, we were forced to modify the number of coupons that were distributed to participants in order to reduce the burden on staff members. Perhaps the largest limitation with respect to RDS in this study was the lack of CSW and MSM participants that were recruited through RDS; leading to the use of other recruitment strategies to recruit enough participants from these at risk groups.

With respect to peer recruitment, the most important limitation is that those recruited through peer referral may not be representative of the population as a whole, particularly if the peer recruitment focuses on particular risk groups such as CSW-PWID and MSM-PWID. However, due to the often hidden nature of certain risk groups, it is necessary to employ peers in recruiting sufficient participants from these populations.

Conclusions

We used RDS recruitment with oversampling of MSM- and CSW-PWID in order to compare HIV prevalence, HCV prevalence and risk behaviors among the three groups of PWID in Hai Phong, Viet Nam: regular PWID, MSM- and CSW-PWID. HIV prevalence has declined from previous studies, but is still high at 25%, while HCV prevalence remains high at 67%. Reported injecting risk behaviors and the very low HIV prevalence among the new injectors suggests continuing decline in injecting related HIV transmission but continued HCV transmission among PWID in Hai Phong.

We did, however, find very substantial differences in sexual risk behaviors, with MSM-PWID and CSW-PWID reporting higher levels of sexual risk behavior. The higher rates of methamphetamine use and the association of methamphetamine use among HIV seropositives with failure to consistently use condoms with primary partners is of particular concern for further sexual transmission of HIV among MSM- and CSW-PWID.

We would suggest that future HIV and HCV prevention in Hai Phong should utilize multiple interventions (“combined prevention and care”) to accelerate the decline in injecting related HIV transmission in the PWID population as a whole and implement additional interventions to reduce potential sexual transmission of HIV among the MSM- and CSW-PWID groups and to the general population [21]. Treatment as prevention (TasP) with the UNAIDS goals of 90% of the key populations HIV tested, 90% of HIV seropositives on ART, and 90% of those on ART at viral suppression has been adopted as a national goal by Viet Nam and should both protect the health of current HIV seropositives and greatly reduce further HIV transmission. Continued monitoring of HCV infections should be implemented in Viet Nam, with increased availability of HCV treatment, particularly for those with late stage HCV infection.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the Institutional Review Boards of the Hai Phong University of Medicine and Pharmacy and Mount Sinai Beth Israel.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

1. Aceijas C, Stimson GV, Hickman M, Rhodes T. Global overview of injecting drug use and HIV infection among injecting drug users. *AIDS*. 2004;18(17):2295–303.
2. Baral S, Sifakis F, Cleghorn F, Beyrer C. Elevated risk for HIV infection among men who have sex with men in low- and middle-income countries 2000–2006: a systematic review. *PLoS Med*. 2007;4(12):e339.
3. Ghys PD, Jenkins C, Pisani E. HIV surveillance among female sex workers. *AIDS*. 2001;15:S33–40.
4. Strathdee SA, Lozada R, Martinez G, Vera A, Rusch M, Nguyen L, et al. Social and structural factors associated with HIV infection among female sex workers who inject drugs in the Mexico-US border region. *PLoS ONE*. 2011;6(4):e19048.
5. Stall R, Purcell DW. Intertwining epidemics: a review of research on substance use among men who have sex with men and its connection to the AIDS epidemic. *AIDS Behav*. 2000;4(2):181–92.
6. Lowndes CM, Alary M, Platt L. Injection drug use, commercial sex work, and the HIV/STI epidemic in the Russian Federation. *Sex Transm Dis*. 2003;30(1):46–8.
7. Grassly NC, Garnett GP, Schwartländer B, Gregson S, Anderson RM. The effectiveness of HIV prevention and the epidemiological context. *Bull World Health Org*. 2001;79(12):1121–32.
8. National Institute of Hygiene and Epidemiology FV, United States Agency for International Development (USAID). Results from the HIV/STI Integrated Biological and Behavioral Surveillance (IBBS) in Vietnam. 2011.
9. García MC, Meyer SB, Ward P. Elevated HIV prevalence and risk behaviours among men who have sex with men (MSM) in Vietnam: a systematic review. *BMJ Open*. 2012;2(5):e001511.
10. Tanimoto T, Cuong NH, Ishizaki A, et al. Multiple routes of hepatitis C virus transmission among injection drug users in Hai Phong, Northern Vietnam. *J Med Virol*. 2010;82(8):1355–63.
11. Le L-VN, Nguyen TA, Tran HV, et al. Correlates of HIV infection among female sex workers in Vietnam: injection drug use remains a key risk factor. *Drug Alcohol Depend*. 2015;150:46–53.
12. Tran T, Detels R, Long H, Lan H. Drug use among female sex workers in Hanoi, Vietnam. *Addiction*. 2005;100:619–25.
13. Des Jarlais DC, Duong HT, Pham Minh K, Khat OH, Nham TT, Arasteh K, et al. Integrated respondent-driven sampling and peer support for persons who inject drugs in Haiphong, Vietnam: a case study with implications for interventions. *AIDS Care*. 2016;13:1–4.
14. Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. In: *Social problems*. Ewing: University of California Press; 1997.
15. Ahmed T, Long TN, Huong PT, Stewart DE. Drug injecting and HIV risk among injecting drug users in Hai Phong, Vietnam: a qualitative analysis. *BMC Public Health*. 2015;15(1):32.
16. StataCorp. 2011. *Stata Statistical Software: Release 12*. College Station, TX: StataCorp LP.
17. Chitwood D, Sanchez J, Comerford M, Page J, McBride D, Kitner K. First injection and current risk factors for HIV among new and long-term injection drug users. *AIDS Care*. 2000;12(3):313–20.
18. Chitwood D, Comerford M, Kitner K, Palacios W, Sanchez J. A comparison of HIV risk behaviors between new and long-term injection drug users. *Subst Use Misuse*. 2001;36:91–111.
19. Ahmed T, Long TN, Huong PT, Stewart DE. Drug injecting and HIV risk among injecting drug users in Hai Phong, Vietnam: a qualitative analysis. *BMC Public Health*. 2015;15(1):1.
20. Koblin BA, Murrill C, Camacho M, Xu G, K-l Liu, Raj-Singh S, et al. Amphetamine use and sexual risk among men who have sex with men: results from the National HIV Behavioral Surveillance study—New York City. *Subst Use Misuse*. 2007;42(10):1613–28.
21. McNall M, Remafedi G. Relationship of amphetamine and other substance use to unprotected intercourse among young men who have sex with men. *Arch Pediatr Adolesc Med*. 1999;153(11):1130–5.
22. Frosch DL, Shoptaw S, Huber A, Rawson RA, Ling W. Sexual HIV risk among gay and bisexual male methamphetamine abusers. *J Subst Abuse Treat*. 1996;13(6):483–6.
23. Halkitis PN, Green MKA, Mourgues MP. Longitudinal investigation of methamphetamine use among gay and bisexual men in New York City: findings from Project BUMPS. *J Urban Health*. 2005;82(1):i18–25.
24. Macaluso M, Demand MJ, Artz LM, Hook EWI. Partner type and condom use. *AIDS*. 2000;14(5):537–46.
25. McCreesh N, Frost S, Seeley J, et al. Evaluation of respondent-driven sampling. *Epidemiology*. 2012;23(1):138.