

# HIV Prevalence and Correlates of Needle Sharing Behavior Among people who inject drugs in 10 sentinel provinces in Vietnam

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Received date: 03 Dec 2016; Accepted date: 19 Dec 2016; Published date: 21 Dec 2016.

Citation: Thuy TC LE, Nguyen QC, Tran TTH, Mills S, Schwandt M, Lim HJ (2016) HIV Prevalence and Correlates of Needle Sharing Behavior Among people who inject drugs in 10 sentinel provinces in Vietnam. *J Epidemiol Public Health Rev* 1(6): doi <http://dx.doi.org/10.16966/2471-8211.134>

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## Abstract

People who inject drugs (PWID) are among populations at greatest risk for HIV infection primarily via the sharing of contaminated needles and syringes. In Vietnam, injecting drug use is the major driving force of the HIV epidemic, and HIV infection is predominantly transmitted among PWID through needle sharing. This study was based on the '2009 HIV/STI Integrated Biological and Behavioral Surveillance's study to examine the correlates of needle sharing behavior among male residents of Vietnam who inject drugs. Data collected from 3,037 male PWID across 10 provinces in Vietnam were analyzed using descriptive statistics, bivariate, and multivariate logistic regression analysis. The mean age of PWID was 30.5 years (SD= ± 8.4 years) with a mean duration of injection of 5.8 years. Nine hundred and thirty PWID were HIV positive with the pooled HIV prevalence of 30.6% (95% CI 29.0%-32.3%). HIV prevalence among PWID varied widely across the 10 study provinces, ranging from 1.0% (95% CI 0.0%-2.2%) (n=3) in Da Nang to 55.7% (95% CI 50.0%-61.3%) (n=167) in Quang Ninh province. Lifetime needle sharing was reported by 46% (n=1,399) of the participants. Factors independently associated with lifetime needle sharing included sharing of drugs/drug mixing equipment, injection at a shooting gallery, duration of injection, lack of access to needles/syringes, having sexual partners who injected drugs, mobility, and self-perception of HIV risk. This study underscores the need for focused HIV prevention interventions to discourage needle sharing among PWID in Vietnam.

**Keywords:** HIV/AIDS; Needle sharing; Injecting drug users; PWID

## Introduction

People who inject drugs (PWID) are among populations at greatest risk for HIV [1,2]. Although PWID account for an estimated 0.2–0.5% of the world's population, they make up approximately 5–10% of all people living with HIV [3]. The primary mechanism for HIV transmission among PWID is via the sharing of contaminated needles and syringes [1,4–8]. Throughout the rest of this paper, the term 'needle sharing' is used to refer to the sharing of both needles and syringes. Although awareness and fear of HIV infection have decreased needle sharing practice over time, substantial numbers of PWID still engage in such risky behavior [9–12].

In Vietnam, injecting drug use is the major driving force of the HIV epidemic, and HIV infection is predominantly transmitted among PWID through needle sharing [12]. Needle sharing practice has been widespread among PWID population, especially in the early stage of the HIV epidemic [13]. The result from a rapid assessment of the drug injecting situation in Hanoi and Ho Chi Minh City in 1993 revealed that more than 80% of the PWID interviewed shared syringes with another person who injects drugs in their last injection at a shooting gallery, generally defined as a place where PWID often congregate for drug injection [7,14]. Another study conducted in 1997 among 630 PWID in Ho Chi Minh City also found that 37% of the study population reported lifetime needle sharing, though the figure dropped to 14% when needle sharing in the past six months was reported [15]. As the HIV epidemic progressed, needle sharing has generally decreased. Results from the national HIV sentinel surveillance system revealed that the pooled prevalence of needle sharing in the past month among PWID across 29 provinces in Vietnam (with a total sample

size of 6,106 and sample sizes varying between 150 and 300 PWID for individual provinces) reduced from 36% in 2011 to 17% in 2012 [12]. However, the prevalence varied across provinces and stayed high at over 30% in some southern provinces, including Ho Chi Minh City, the biggest city in Vietnam and also the major commercial center of the country [12].

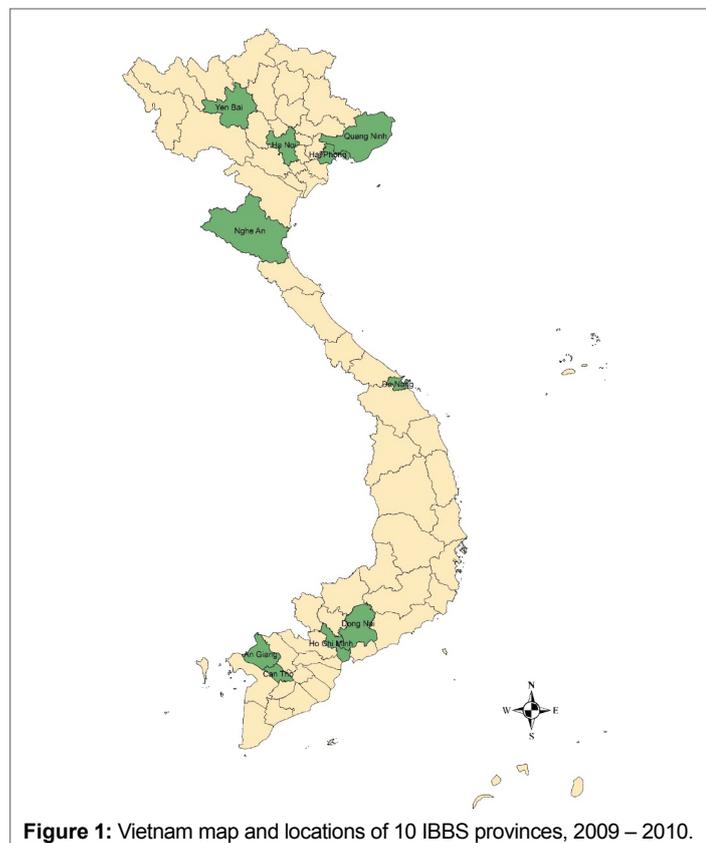
Literature has identified a number of correlates of needle sharing among PWID in different contexts. Socio-demographic characteristics such as age [13,16,17], gender [10,18,19], education [5,13,18,19], marital status [13,18], employment status [10,13,16,18] and income [13] have commonly been documented as associated with needle sharing among PWID, though the direction of the association might vary across studies. The level of needle sharing has also been reported to be linked with the frequency of injection [1,5,17], places of injection [10,16,17,19] and history of being arrested [5,20]. Multiple sexual partners [17,21], the frequency of unprotected sex [22], having sexual partners who inject drugs [23] are sexual behaviors that have frequently been associated with the likelihood of needle sharing among PWID. Other correlates of needle sharing among PWID included perceived the risk of HIV infection [23], perceived the utility of AIDS risk avoidance [5], being tested for HIV [10], and access to sterile needles and syringes [17,19,20,24–26]. However, little research evidence comes from Vietnam. In a study by Hien et al. [27] injecting on the street and at shooting galleries, and past history of needle sharing were identified as predictors for current needle sharing behavior. Limited evidence on the correlates of needle sharing among PWID in Vietnam underscores a need for large-scale research to obtain reliable and representative estimates of associations and to identify characteristics that may lead to rational HIV prevention interventions.

## Methods

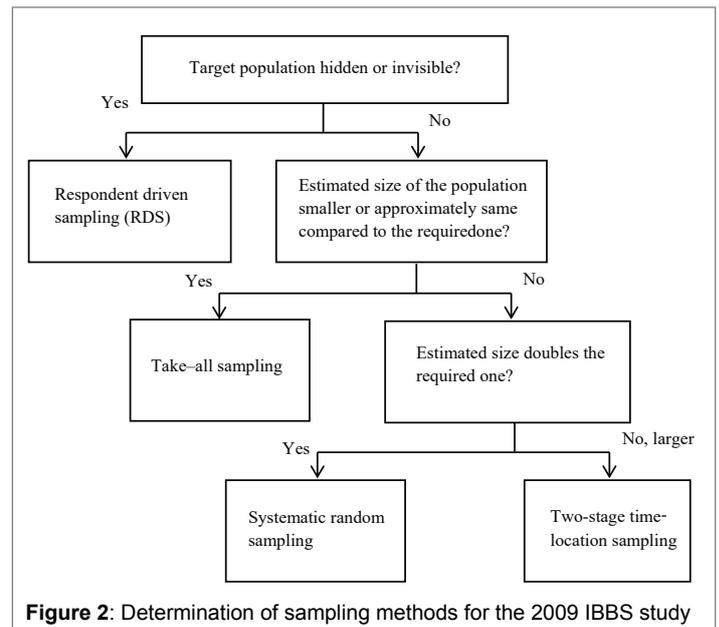
This study was a part of the ‘2009 HIV/STI Integrated Biological and Behavioral Surveillance’ (IBBS) study to identify factors associated with needle sharing behavior among male PWID in Vietnam. Full details of the IBBS study have been reported elsewhere [28]. In brief, the IBBS study is a series of cross-sectional surveys jointly conducted by the Vietnam Ministry of Health and the U.S. President’s Emergency Plan for AIDS Relief (PEPFAR) program since 2005. It is the first community-based systematic surveillance study that provides prevalence estimates of HIV and other sexually transmitted infections (STIs), risk behaviors and exposure to HIV care and prevention services among high-risk groups for HIV including PWID.

### Study population and sampling strategies

The IBBS study recruited male residents of Vietnam aged 18 years and older who reported illicit injecting drug use at least once within 30 days prior to the survey. The inclusion of PWID in the IBBS study was limited to male given evidence that up to 90% of drug injectors in Vietnam are male [14]. During September 2009-February 2010, a total of 3,037 male PWID were sampled across 10 geographically diverse provinces, including four provinces in the North (Hanoi, Hai Phong, Quang Ninh, Yen Bai), two provinces in the Middle (Nghe An, Da Nang), and four provinces in the South (Ho Chi Minh City, Can Tho, An Giang, Dong Nai) (Figure 1). These provinces were considered sentinel socio-economic provinces of the country, with major transportation routes for not only within the country, but also cross-border traveling, which may facilitate the supply and access to heroin and thus the growth of heroin injection [14]. Figure 2 demonstrates the strategies used to sample, the study population based upon population characteristics. PWID was sampled using respondent driven sampling in four provinces and two-staged time-location sampling in six provinces based on formative mapping exercises conducted by the study team as detailed in the previous report [28].



**Figure 1:** Vietnam map and locations of 10 IBBS provinces, 2009 – 2010.



**Figure 2:** Determination of sampling methods for the 2009 IBBS study

### Data collection

Potential participants were offered invitation coupons to participate in the IBBS study at pre-selected study centers and participants provided verbal voluntary informed consent. Consenting participants completed individual face-to-face interviews using semi-structured questionnaires. Participants’ blood samples were also collected for HIV and syphilis testing. Participation in the IBBS study was anonymous and participants were compensated between 50,000-100,000 VND (US\$ 2.70 – 5.40) depending on location. The IBBS protocol was approved by the National Institute of Hygiene and Epidemiology Ethics Review Board and Institutional Review Board of the U.S. Centers for Disease Control and Prevention. Permission for the use of IBBS data for this study has also been granted by FHI 360 Vietnam and the Biomedical Research Ethics Review Board of the University of Saskatchewan.

### Measures

The study outcome was lifetime needle sharing. It was assessed with the question ‘Have you ever used needles/syringes that had previously been used by someone else, or given needles/syringes that you had already used to someone else?’, and analyzed as a dichotomous variable. Socio-demographic data included: age, educational attainment, employment, monthly income, and marital status. Alcohol consumption and drug use behavior data included: level of alcohol consumption, age at first injecting drug use, duration of injecting drug use, mobility, history of being detained in a drug rehabilitation center, frequency of injecting drug use in the past month, sharing of drugs or drug mixing equipment in the past six months, and place of the last injection. Mobility was assessed by asking the participants, whether they injected drugs in provinces other than study province in the past 12 months. Sexual risk behavior data included: aggregated number of sexual partners in the past 12 months, condom use with last sexual encounter, consistent condom use (use of a condom every time having sexual intercourse) in the past 12 months with different types of sexual partners, having any types of sexual partners who injected drugs in the past 12 months. Total number of sexual partners in the past 12 months was calculated by a sum of the number of different types of sexual partners, including regular sexual partners (wife/girlfriends), female sex workers, casual sexual partners (any other sexual partners not including wife/girlfriends or female sex workers), and male sexual partners. STI data included: a self-reported history of abnormal discharge, genital pain

or ulcers in the past 12 months and laboratory confirmed test results for syphilis. HIV knowledge and perception data included: knowledge of HIV risk and prevention methods and self-perception of HIV risk. Knowledge of HIV risk and prevention methods was assessed by the ability of participants to accurately identify ways of preventing HIV infection and rejecting misconception regarding HIV transmission. Variables related to exposure to HIV care and prevention services included exposure to HIV testing and access to sterile needles/syringes.

### Statistical analysis

Descriptive statistics for the study population involved calculation of key indicators of interest, stratified by needle sharing status. Simple frequencies were calculated for categorical variables and mean or medians were calculated for continuous variables. Comparisons for each of the categorical indicators were performed using a chi-square test for categorical variables, t-test for continuous symmetric variables and Mann-Whitney test for continuous asymmetrically distributed variables. Prevalence estimates for HIV infection with 95% confidence intervals were calculated.

Analysis for correlates of needle sharing was first done with bi-variate logistic regression. Variables indicating an association with needle sharing behavior ( $p < 0.20$ ) in the bi-variate analysis were included in the initial multivariate logistic regression model, along with variables of known biologic importance regardless of their  $p$ -values. For highly correlated variables (Pearson correlation coefficient  $> 0.9$  with  $p$ -value  $< 0.05$ ), only one representative variable was selected to avoid the potential collinearity. Backward step-wise selection process and Wald test were used to determine final variable inclusion in the model. Only variables with  $p$ -value  $< 0.05$  were retained in the final multivariate model. Interactions between covariates were also examined the final multivariate model. Statistical tests were significant at a level of  $p < 0.05$ . STATA v10.0 was used for data analysis.

## Results

### Socio-demographic and behavioral characteristics

The mean age of PWID in Vietnam was 30.5 years ( $SD = \pm 8.4$  years). They started injecting drugs at an average age of 24.6 years with a mean duration of drug injection of 5.8 years. Lifetime needle sharing was reported by 46% ( $n=1,399$ ) of the participants and this reduced to 23% ( $n=695$ ) for needle sharing in the past six months. Half of the participants also reported sharing drugs and/or drug mixing equipment in the past six months. Consistent condom use practice was uncommon among PWID with 32% of those who had sexual intercourse with their regular sexual partners reported using condoms consistently in the past 12 months. Eleven percent of the participants reported having sexual partners of any kinds who also injected drugs.

Table 1 summarizes key socio-demographic and behavioral characteristics of the study population by needle sharing status. There were notably significant differences between PWID who reported lifetime needle sharing and those who did not. Compared with non-sharing PWID, those who ever shared needles and syringes were significantly older and injected drugs for a longer period of time. Needle sharers were more likely to be mobile, to be detained in a drug rehabilitation center, to share drugs and/or drug mixing equipment, and to inject drugs at shooting galleries. Needle sharers were also more likely to report having at least three sexual partners, and to visit a female sex worker in the past 12 months. They were more likely to use a condom with regular sexual partners, but less likely to use a condom with casual sexual partners, more likely to have sexual partners who also injected drugs and to report previously being tested for HIV.

### Prevalence of HIV infection

HIV test results were available for 3,036 study participants. Nine hundred and thirty PWID were HIV positive with the pooled HIV prevalence of 30.6% (95% CI 29.0-32.3). HIV prevalence among PWID varied widely across 10 study provinces, ranging from 1.0% (95% CI 0.0-2.2) ( $n=3$ ) in Da Nang to 55.7% (95% CI 50.0-61.3) ( $n=167$ ) in Quang Ninh.

Stratified by needle sharing status, there was a significant difference in HIV prevalence among needle sharers and non-sharers ( $p < 0.001$ ). The prevalence of HIV infection among PWID who reported lifetime needle sharing was 40.5% (95% CI 38.0-43.1) ( $n=1,399$ ), almost doubled the prevalence of 22.2% (95% CI 20.2-24.2) ( $n = 1,636$ ) among PWID who did not report such behavior.

### Correlates of needle sharing behavior

Results of bi-variate logistic regression analysis to identify significant correlates of needle sharing among the overall PWID population in Vietnam are presented in Table 2. A sizeable number of factors were significantly associated with needle sharing, including: socio-demographic characteristics (age, marital status), drug use behaviors (duration of injecting drug use, mobility, history of being detained in a drug rehabilitation center, sharing of drugs and/or drug mixing equipment, place of last injection), sexual behaviors (age at first sex, number of sexual partners, visiting female sex workers, having sexual partners who also injected drugs), knowledge of HIV risks and prevention methods, self-perception of HIV risk, self-reported STI symptoms, HIV testing, ability to get needles/syringes whenever needed, and receiving of free needles/syringes in the past six months. Seven variables retained statistical significance after controlling for other variables in multivariate analysis (Table 3). Sharing drugs and/or drug mixing equipment was most strongly associated with needle sharing with the odds of needle sharing increased by almost four times if a PWID reported such behavior in the past six months (AOR = 3.89, 95% CI 3.09-4.89,  $p < 0.001$ ). Injecting at a shooting gallery in the last injection was associated with a double increase in the odds of needle sharing, as compared to injecting drug use in other places (AOR=2.24, 95% CI 1.62-3.08,  $p < 0.001$ ). Having sexual partners who injected drugs was the single sexual behavior significantly associated with needle sharing (AOR= 1.73,95 and CI 1.19-2.49,  $p=0.004$ ). PWID who were unable to get sterile needles/syringes when injected drugs were twice as likely to share as those who did not experience difficulty in obtaining needles/syringes (AOR= 2.08; 95% CI 1.16-3.72,  $p=0.01$ ). Other variables associated with a higher odds of needle sharing included longer duration of injection, having ever injected drugs in other provinces in the past 12 months, and high self-perception of HIV risk.

## Discussion

PWID are among HIV high-risk populations that require specific targeted interventions to curtail the HIV epidemic in Vietnam. Our study indicates that the prevalence of HIV infection was high among male PWID in Vietnam, albeit unevenly across geographic regions. The observed wide variation in HIV prevalence across provinces is in line with national HIV sentinel surveillance data and probably reflects differences in epidemic start times, PWID characteristics, sizes of pools of existing infections and availability of HIV prevention and care services [12]. The level of lifetime needle sharing among PWID stayed high and also varied by province, ranging between 28.1% and 70.3% (data not shown). It is noteworthy that provinces with a high level of needle sharing among PWID were also the ones with high level of HIV infection. Quang Ninh, for example, was the province with the highest HIV prevalence (55.7%) and also the highest prevalence of needle sharing among PWID among 10 study provinces. These findings further confirm the well-established association between needle sharing and HIV risk among PWID [14-

Variables	No needle sharing	Needle sharing	P-value <sup>b</sup>
	N=1,399 (n, %; Mean, $\pm$ SD)	N=1,637 (n, %; Mean, $\pm$ SD)	
<b>Socio-demographic characteristics</b>			
Age in years	29.9 ( $\pm$ 8.4)	31.1 ( $\pm$ 8.4)	0.0001
Educational level			
No formal schooling	64 (3.9)	56 (4.0)	0.16
Primary school (1-5)	262 (16.2)	188 (13.5)	
Secondary school (6-9)	641 (39.5)	569 (41.0)	
High school (10-12)	576 (35.5)	522 (37.6)	
College/University	79 (4.9)	53 (3.8)	
Currently unemployed	1,315 (80.7)	1,099 (78.8)	0.18
Monthly income in million VND <sup>d</sup>	2,400,000 ( $\pm$ 1,000,000)	3,400,000 ( $\pm$ 3,800,000)	0.31
Marital status			
Had never been married	1,032 (63.1)	782 (55.9)	<0.001
Currently married	386 (23.6)	413 (29.5)	
Divorced/Separated/Widowed	218 (13.3)	203 (14.5)	
<b>Alcohol consumption and drug use behaviors</b>			
Alcohol consumption			
Daily	261 (16.0)	258 (18.4)	0.17
At least once a week	444 (27.1)	368 (26.3)	
Less than once a week	385 (23.5)	295 (21.1)	
No consumption	546 (33.4)	478 (34.2)	
Age at first injection in years	24.7 ( $\pm$ 7.5)	24.3 ( $\pm$ 7.3)	0.16
Duration of injecting drug use in years	5.1 ( $\pm$ 4.9)	6.7 ( $\pm$ 5.6)	<0.001
Ever injected drugs in other provinces in the past 12 months	169 (10.3)	224 (16.1)	<0.001
Had ever been detained in a drug rehabilitation center	475 (29.1)	532 (38.2)	<0.001
Frequency of drug injection in the past month			0.46
4 times or more/day	54 (3.3)	41 (3.0)	
2-3 times/day	817 (50.2)	663 (47.7)	
Once/day	439 (27.0)	402 (28.9)	
Less than once/day	318 (19.5)	284 (20.4)	
Had shared drugs/drug mixing equipment in the past 6 months	575 (35.2)	970 (69.3)	<0.001
Place of last injection			<0.001
At home	623 (38.1)	425 (30.4)	
Openly public places	585 (35.8)	494 (35.4)	
Shooting gallery	171 (10.4)	300 (21.5)	
Others	256 (15.7)	178 (12.7)	
<b>Sexual behaviors</b>			
Number of sexual partners in the past 12 months			
None	576 (35.9)	383 (28.5)	<0.001
1 partner	533 (33.2)	462 (34.3)	
$\geq$ 2 partners	495 (30.9)	500 (37.2)	
Had visited female sex workers in the past 12 months	345 (21.4)	393 (28.9)	<0.001
Condom use in the last sex with:			
Regular sexual partner	399 (46.1)	448 (55.9)	<0.001
Female sex worker	301 (82.2)	329 (76.7)	0.05
Casual sexual partner	110 (67.9)	91 (51.1)	0.002
Male sexual partner	11 (52.4)	8 (42.1)	0.52
Consistent condom use in the past 12 months with:			
Regular sexual partner	245 (28.3)	287 (35.8)	0.001
Female sex worker	231 (62.6)	253 (59.0)	0.30
Casual sexual partner	74 (44.6)	55 (30.6)	0.01
Male sexual partner	9 (42.9)	8 (42.1)	0.96
Had sexual partners who injected drugs in the past 12 months:			
Regular sexual partner	38 (4.4)	63 (7.9)	0.003
Female sex worker	37 (10.1)	57 (13.3)	0.16
Casual sexual partner	18 (10.9)	29 (16.2)	0.15
Male sexual partner	5 (22.7)	8 (42.1)	0.18
Anytime of sexual partners	85 (8.0)	135 (13.4)	<0.001
<b>HIV testing</b>			
Ever had a HIV test	558 (34.2)	614 (44.2)	<0.001

**Table 1:** Socio-demographic and behavioral characteristics of people who inject drugs in Vietnam by needle sharing<sup>a</sup> status, 2009-2010

<sup>a</sup> Needle sharing was defined as lifetime needle sharing.

<sup>b</sup> P-value regarding the differences between non-sharing and sharing PWID.

<sup>c</sup>SD=Standard deviation.

<sup>d</sup> One U.S dollar was roughly equivalent to VND 18,500 at the time of IBBS data collection in 2009-2010.

Variables	aOR	9% CI	p-value
<b>Socio-demographic characteristics</b>			
Age ≥ 30 years	1.32	1.14, 1.52	<0.001
Up to secondary schooling	0.96	0.83, 1.11	0.56
Currently unemployed	1.13	0.94, 1.35	0.19
Monthly income ≤ 2.9 million VND	1.05	0.88, 1.25	0.61
Had ever been married	1.35	1.16, 1.56	<0.001
<b>Alcohol consumption and drug use behaviors</b>			
Daily alcohol consumption	1.19	0.99, 1.44	0.07
Duration of injecting ≥ 5 years	1.95	1.68, 2.25	<0.001
Ever injected drugs in other provinces in the past 12 months	1.66	1.34, 2.05	<0.001
Ever been detained in a drug rehabilitation center	1.51	1.30, 1.76	<0.001
Injecting drugs ≥ 2 times/day	0.89	0.77, 1.03	0.12
Had shared drugs/drug mixing equipment in the past 6 months	4.17	3.58, 4.86	<0.001
Last injection at shooting gallery	2.34	1.91, 2.87	<0.001
<b>Sexual behaviors</b>			
Age at first sex <20 years	0.83	0.71, 0.97	0.02
>2 sexual partners in the past 12 months	1.30	1.09, 1.54	0.003
Had visited female sex workers in the past 12 months	1.49	1.26, 1.76	<0.001
Consistent condom use with any types of sexual partners in the past 12 months	0.85	0.71, 1.02	0.08
Had any type of sexual partners who injected drugs	1.77	1.33, 2.35	<0.001
<b>HIV/AIDS knowledge and perception</b>			
Accurately identifying ways of preventing HIV infection and rejecting misconception of HIV transmission	0.73	0.62, 0.86	<0.001
Self-perceived as a thigh risk for HIV	5.19	4.40, 6.12	<0.001
<b>Sexually transmitted infections</b>			
Self-reported STI symptoms in the past 12 months	2.23	1.53, 3.26	<0.001
Syphilis sero positive by clinical examination	1.07	0.47, 2.44	0.87
<b>HIV testing</b>			
Had never tested for HIV	0.65	0.56, 0.76	<0.001
<b>Needle and syringe availability</b>			
Not being able to get needles/syringes whenever needed	4.84	3.15, 7.44	<0.001
Had not received free needles/syringes in the past six months	0.53	0.45, 0.63	<0.001

**Table 2:** Bivariate logistic regression analysis of factors associated with needle sharing behavior among people who inject drugs in Vietnam, 2009-2010.

<sup>a</sup> OR: Crude odds ratio

Variables	AOR <sup>a</sup>	95%CI	p-value
<b>Drug use behaviors</b>			
Duration of injecting ≥ 5 years	1.86	1.49, 2.34	<0.001
Had ever injected drugs in other provinces in the past 12 months	1.40	1.03, 1.89	0.03
Had shared drugs/drug mixing equipment in the past 6 months	3.89	3.09, 4.89	<0.001
Last injection at a shooting gallery	2.24	1.62, 3.08	<0.001
<b>Sexual behaviors</b>			
Had sexual partners who injected drugs	1.73	1.19, 2.49	0.004
<b>HIV self-perception</b>			
Self-perceived as at high risk for HIV	4.38	3.49, 5.49	<0.001
<b>Needle and syringe availability</b>			
Not being able to get needles/syringes whenever needed	2.08	1.16, 3.72	0.01

**Table 3:** Multivariate logistic regression analysis of factors associated with needle sharing behavior among people who inject drugs in Vietnam, 2009-2010.

<sup>a</sup> AOR: Adjusted odds ratio (Estimates were adjusted for other variables in the model)

8]. In our study, HIV prevalence was almost double for needle sharers compared with non-sharers, which is consistent with studies conducted among PWID from both international and local research suggesting that the odds of HIV for needle sharers could range from a few times to several hundred times higher than that for non-sharers [29-36]. Among various risk behaviors, sharing drugs and/or drug mixing equipment was found to be strongly associated with needle sharing among PWID in Vietnam. Our study also indicated that half of the study population reported sharing drugs and/or drug mixing equipment in the past six months, which is in agreement with evidence from local studies suggesting that up to two-thirds of PWID involved in indirect sharing of drug paraphernalia such as common drug containers, rinse water and cotton-wool [37,38]. Findings from our study highlight the importance of strategies to address coupled injecting behaviors: sharing needles and syringes and sharing drug paraphernalia in HIV prevention efforts targeting PWID in Vietnam.

In our study, shooting gallery attendance was independently linked to more needle sharing, providing further support for prior research that injecting at a shooting gallery is an important context for needle sharing [15,10]. Research has shown that injecting with someone else in comparison to injecting alone is linked to more opportunity for needle sharing [39,40]. Thus, a higher level of needle sharing at shooting galleries is possibly due to the fact that a PWID has more chance to find other PWID for needle sharing at such places. Another possibility could be the unavailability of sterile needles/syringes at shooting galleries. In Vietnam, shooting galleries for poor PWID, who constitute a significant part of the PWID population, are often located in public or semi-public places [15]. In such open settings, many PWID is reluctant to carry needles/syringes, which may lead to an arrest on charges of engaging in illegal activities [15]. The need for hurried injections in open settings also fosters the use of previously used needles/syringes [41,42]. This explanation fits observed results from our study and prior research that lack of access to sterile needles/syringes and a non-supportive environment for safe injection contribute to continued needle sharing [19,20,24,27]. In Vietnam, it is generally difficult to implement HIV prevention interventions in shooting galleries since PWID are highly mobile to avoid police campaigns. However, in some IBBS provinces, the research team did not experience problems recruiting PWID at shooting galleries, suggesting that it may still be possible to introduce interventions which include components such as needle exchange program and distribution of bleach for disinfecting needles/syringes in these settings.

The association between long duration of injection and heightened odds of needle sharing found in our study possibly reflects the increased chance of involvement in injecting risk behaviors due to long exposure to injecting drug use. It indicates that HIV prevention efforts to discourage needle sharing among PWID in Vietnam should include strategies to discourage transition from non-injecting to injecting drug use as well as to encourage the transition from injecting to non-injecting routes by providing access to drug substitution programs [10,43].

Having sexual partners who also injected drugs was the only sexual risk behavior associated with needle sharing among PWID in our study. In a study conducted among young PWID in U.S, Bailey et al. came up with a related finding that the likelihood of needle sharing was higher among those who injected drugs with their sexual partners [23]. Such findings together highlight the importance of HIV prevention efforts in targeting not only PWID but also their injecting sexual partners.

In our study, PWID who perceived themselves at high risk of HIV infection were significantly more likely to report needle sharing. There are two possibilities that explain for our observed result. First, PWID who believe that their past behavior has already made them highly vulnerable to HIV infection are prone to continuing their needle sharing behavior [44]. Second, needle sharers may simply be indicating their realistic

awareness of their heightened risk for HIV [44]. In whichever case, since feelings of hopelessness about getting HIV may inhibit risk reduction, a part of efforts to expand access to sterile needles/syringes to PWID, emphasis should also be placed on educating needle sharers about the potential benefits of behavioral change [44].

Our study has several limitations. First, the cross-sectional design of the IBBS study does not allow the establishment of temporal associations between needle sharing and key variables, preventing identification of causal risk factors. Second, since respondent-driven sampling was used in four provinces, network analysis is important for this sampling method and weighted analysis that takes into account the PWID network size to compensate for the fact that the sample was collected in a non-random way would have facilitated representative estimates at the population level. However, several assumptions for respondent-driven sampling to be valid were not appropriately met with the situation in Vietnam resulting in the possibility that the study sample might not represent the whole PWID population [28]. Weighted analysis was thus not performed in our study. Limitations also exist in the way the study outcome was assessed. Receptive and distributive needle sharing were combined in the assessed outcome. Given HIV risks and associated factors may differ between receptive and distributive needle sharing [45,46] separate analysis of these behaviors should be considered for future research. Despite the limitations, our study provides important insights into the profile and the burden of HIV as well as the correlates of needle sharing behavior among PWID in Vietnam. Such information is important to inform future HIV prevention interventions and policies in Vietnam and in countries with a similar environment. Needle exchange program, distribution of bleach to disinfect injecting equipment and risk reduction education could promote safer injecting practice among PWID and their sexual partners.

### Acknowledgements

This study was supported by the United States Agency for International Development (USAID) in Vietnam through the HIV/AIDS Prevention, Care, and Treatment project, Cooperative Agreement number 486-A-00-06-00009-00, and the Sustainable Management of the HIV/AIDS Response and Transition to Technical Assistance Project – or “SMART TA”, Cooperative Agreement No. 486-A-11-00011, both managed by FHI 360, as part of the United States President Emergency Plan for AIDS Relief (PEPFAR). The authors are indebted to FHI 360 Vietnam for their permission to use the IBBS dataset for this study.

### Author’s Contributions

All authors have made a substantial contribution to the concept and design, acquisition of data or analysis and interpretation of data, drafted the manuscript or revised it critically for important intellectual content and approved the version to be published, the final manuscript.

### Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this manuscript.

### Funding Acknowledgement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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**Citation:** Thuy TC LE, Nguyen QC, Tran TTH, Mills S, Schwandt M, Lim HJ (2016) HIV Prevalence and Correlates of Needle Sharing Behavior Among people who inject drugs in 10 sentinel provinces in Vietnam. *J Epidemiol Public Health Rev* 1(6): doi <http://dx.doi.org/10.16966/2471-8211.134>

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