



# A community-based intervention to decrease the prevalence of HIV viremia among people who inject drugs in Vietnam

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## Summary

**Background** In most low-to-middle-income countries, HIV control at the population level among people who inject drugs (PWID) remains a major challenge. We aimed to demonstrate that an innovative intervention can identify HIV-positive PWID in the community who are not treated efficiently, and get them treated efficiently.

**Methods** Between 2016 and 2020, we implemented an intervention consisting of mass HIV screening of PWID using three annual respondent-driven sampling surveys (RDSS) and a post-intervention evaluation RDSS in community-based organisation (CBO) sites, coupled with peer support to facilitate/improve access to antiretroviral and methadone therapy in Haiphong, Vietnam. The primary outcome was the proportion of identified uncontrolled HIV-positive PWID who achieved viral control. We also estimated the potential effect of the intervention on the proportion of PWID with HIV RNA >1000 copies/mL among all PWID during the study period.

**Findings** Over the three RDSS, 3150 different PWID were screened, i.e. two-thirds of the estimated population size. They all injected heroin, their median age was of 39 years, 95% were male, 26.5% were HIV-infected, and 78.6% of the latter had HIV RNA ≤1000 copies/mL. Among the 177 PWID identified with an unsuppressed viral load, 73 (41.2%) achieved viral suppression at the final visit. HIV viremia decreased from 7.2% at baseline to 2.9% at the final RDSS ( $p < 0.001$ ). Up to 42% of this observed reduction may be explained by the intervention, in the absence of any external intervention targeting PWID during the study period.

**Interpretation** Mass community-based screening using RDSS coupled with CBO support is a powerful tool to rapidly identify untreated HIV-positive PWID and (re)link them to care.

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**Keywords:** People who inject drugs; Linkage to care; Testing; Viral suppression; Community based organization; HIV elimination

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## Research in context

### *Evidence before this study*

We did a literature review to capture the effectiveness of community-based interventions designed to identify HIV-infected undiagnosed or unsuccessfully treated PWID, to improve linkage to HIV care or opioid substitution therapy, or improve retention in HIV care, or improve successful ART rate in Low-Middle income countries. For this purpose, we used combinations of keywords on PubMed including people who inject drugs, HIV, antiretroviral, interventions, linkage to care, methadone, opioid substitution therapy, low resources setting, low-middle income countries. We also assessed whether the level of coverage of some of these interventions were reported. We retrieved 35 articles and reviewed them all, with last update on the 15<sup>th</sup> of February 2022. We found several interventions addressing one or several of the above aspects, all with successful outcomes. Among the intervention reports retrieved with the highest evidence level, cluster-randomised controlled trials showed the effectiveness of multi-level (including structural) interventions and stigma reduction, integrated System Navigation and Psychosocial Counseling or integrated HIV services. In LMIC, no intervention encompassing all objectives described above was found, and none had a goal of reaching a high coverage of the PWID population. A similar search in high-income country yielded a convincing report meeting all criteria above. A strategy consisting of repeated respondent-driven sampling surveys to capture undiagnosed HIV-infected PWID and link them to care was associated with a full control of a remerging HIV outbreak in Athens.

### *Added value of this study*

Our multicomponent strategy included a community-based organisation (CBO)-led mass screening based on sequential respondent-driven sampling surveys, CBO support using a case-management approach to access ART and MAT, and training of HIV physicians on ART optimisation. The evaluation of such large interventions at the level of a 2-million city is unique in Low-Middle Income Countries. Designed to cover a large proportion of the local PWID population, our strategy proved, for the first time in LMIC, efficient to reach this high coverage (67%), to find HIV-positive PWID with unsuppressed viral load and to (re) engage 41% of them in efficacious HIV care (i.e. viral suppression). The high coverage of the PWID population together with the success rate of viral suppression likely contributed to a marked decreased in the prevalence of viremia during the study period.

This study also highlights the great potential of CBO to host and implement RDSS, support PWID for (re) engagement and maintenance in OST and HIV care.

### *Implications of all the available evidence*

We designed our strategy to build on the existing local resources that are common in many LMIC countries, namely CBO, MAT services and universal ART. It is therefore scalable, particularly suited to Asian countries, and

relevant to other LMIC countries. Of note, our strategy was implemented in a setting where HIV was already controlled among PWID, with a cascade of HIV care beyond 90/90/90. In large cities where HIV is not controlled among PWID, this strategy has the potential to speed up the elimination of HIV transmission.

## Introduction

People who inject drugs (PWID), along with men who have sex with men and sex workers, remain one of the most stigmatized and hardest-to-reach key populations, with a 29-fold risk of acquiring HIV compared to the general population.<sup>1</sup> PWID contributed to 12% of new HIV infections worldwide in 2018, and up to 41% in Central Asia and Eastern Europe, without taking into account non-PWID sexual partners.

In Asia, drug injection is a major determinant for HIV transmission. For HIV-positive PWID, access to diagnosis and care remains difficult. In a recent review, HIV testing coverage for PWID ranged between 7% and 40% in Europe and Asia.<sup>2</sup> A clustered randomised trial showed that HIV services integrated in opioid agonist treatment centres improved HIV testing.<sup>3</sup> However, merely 40% of PWID from intervention cities were tested for HIV, highlighting the need for alternative community strategies in order to reach a more exhaustive coverage rate of this target population. Reliable data on HIV services and antiretroviral treatment (ART) coverage for PWID in other low-to-middle-income countries (LMIC) are scarce,<sup>2,4</sup> and when available, report sparse coverage rates.<sup>5,6</sup> Some of the barriers in accessing diagnosis and treatment for PWID include stigma,<sup>7</sup> the medical staff and government healthcare providers' attitudes,<sup>5,8</sup> confidentiality,<sup>8</sup> absence of identification documents or of a permanent place of residence, cost,<sup>9</sup> insufficient and incorrect knowledge of ART,<sup>5,9</sup> distance and waiting times at care facilities,<sup>5,9</sup> and a lack of family support.<sup>5,9</sup> Facilitating access to diagnosis and treatment for PWID is therefore essential as it could strengthen the efforts made towards preventing the spread of HIV.

Innovative strategies are needed to overcome these barriers and increase access to HIV diagnosis and treatment among PWID,<sup>10</sup> particularly in LMIC where HIV remains largely uncontrolled in this population. Combined individual and structural intervention,<sup>3,11</sup> or system navigation and psychological counselling showed promising results in a randomised trial (HPTN 074) implemented in Indonesia, Ukraine and Vietnam.<sup>12</sup> However, this approach seems demanding in terms of skilled human resources (skills in psychology) which may restrict its application to resource-limited contexts. Peer support, a resource more widely available, has the potential to overcome issues related to access to HIV

care, through counselling and a problem-solving approach.<sup>13,14</sup>

Importantly, the above interventions address linkage and retention to HIV care at the individual level, among identified HIV-infected PWID. How to reach a greater coverage of the PWID population at a city level remains a key issue, given many PWID do not actively seek testing or care. Finally, we have reached a point of the epidemic where finding undiagnosed HIV-infected PWID and linking them to care is likely no longer enough to reach elimination. Many HIV-infected PWID have been on ART for several years, which may result in ART adherence fatigue, drop-outs, or the emergence of first-line antiretroviral resistance leading to unsuccessful ART. It is therefore crucial to capture these HIV-infected PWID who are not appropriately treated, and to reengage them in efficient ART. The latter may require supportive training of physicians providing HIV care in optimising treatment and prescribing second-line ART when necessary. These PWID would likely also benefit from peer support with a case-management approach through CBO to improve retention in HIV care.

Several countries have been using community-based organisation (CBO) services to provide harm reduction activities and counselling. CBOs can build public trust; reduce stigma and discrimination; and remove structural, social, and logistic barriers to care. We previously showed that CBO involvement can lead to reach considerably low HIV-incidence (0.08/100 person-years) among a PWID population estimated at 5000 +/-1000 individuals in Haiphong,<sup>15</sup> a two million inhabitant city with a context of universal access to ART and methadone treatment.<sup>16</sup> This demonstration of a particularly low HIV incidence relied on both longitudinal data originating from four respondent-driven sampling surveys (RDSS) implemented sequentially and annually, and a cohort of HIV-negative PWID. Beyond their use for epidemiological purposes, the first three RDSS represented the mass screening component of an intervention that aimed to identify HIV-positive PWID capable of HIV transmission, i.e. those with a detectable viral load. The community component of the intervention was the CBO involvement for conducting the RDSS and assisting PWID in (re)access to HIV care and methadone program. Repeated RDSS have been previously used to successfully control an HIV outbreak in Athens, Greece, following the 2008 economic crisis.<sup>17</sup> This strategy showed promise in reaching undiagnosed HIV-infected PWID with wide coverage of the PWID population at a large city scale.

In this paper, we aim to assess the efficiency of this intervention in identifying untreated, or unsuccessfully treated, HIV-positive PWID, and getting them (re)engaged in care through CBOs to achieve HIV viral suppression (defined as HIV RNA  $\leq$ 1000 copies/mL). Our goal was that our intervention reach two-thirds of the PWID population of Haiphong, Vietnam.

## Methods

### Study design

We carried out an interventional case study in Haiphong, Vietnam for which we implemented three annual RDSS (RDSS<sub>1</sub> (October 2016–January 2017), RDSS<sub>2</sub> (September–December 2017), RDSS<sub>3</sub> (October 2018–January 2019) for mass screening purposes, according to standard methods.<sup>16,18</sup> After each RDSS, all identified HIV-infected PWID were allocated to a CBO member who used a case-management approach as described below in the section “Peer support: CBO case management of PWID”. In addition to regular meetings with their CBO member, PWID were invited to the community site for bi-annual follow-up visits in order to document attendance of HIV care or methadone program, and their HIV viral load measure. A fourth RDSS (October 2019–January 2020) was implemented to estimate HIV viremia prevalence, and to consider a possible trend since baseline. Prevalence of viremia is the indicator the most correlated with HIV incidence and stands as a useful measure of program efficiency.<sup>19</sup>

### Study population

PWID who reported currently injecting heroin were eligible to participate in one or more RDSS, provided they were at least 18 years of age. Drug injection was confirmed by both a rapid test on urine sample (that can detect heroin, methamphetamine, amphetamines, cocaine and cannabis) and the presence of injection marks. Those not injecting heroin, and those unable or unwilling to sign the informed consent form were excluded. After enrolment, the digital print of each participant was recorded to prevent a second participation to the same RDSS, and to identify participation to subsequent RDSS.

### Outcomes

Our primary outcome was the proportion of HIV-positive PWID with an unsuppressed viral load identified during any of the three RDSS who achieved viral control by their final follow-up. The follow-up (RDSS<sub>4</sub>) ended 12 months after RDSS<sub>3</sub>. Secondary outcomes included the intervention coverage and the contribution of the intervention in the reduction of HIV viremia prevalence (i.e. the proportion of PWID with an unsuppressed viral load among all PWID regardless of their HIV status) between baseline (RDSS<sub>1</sub>) and the final RDSS (RDSS<sub>4</sub>). Viremia prevalence stands as an excellent proxy for the HIV transmission potential of a population.<sup>19–21</sup> Finally, we also assessed the proportion of HIV-positive PWID identified during the three RDSS who have been initiated on methadone.

### Intervention description

The intervention was comprised of three components: mass screening to detect all those that were HIV-positive

with an unsuppressed viral load, case-management by CBO members, and technical HIV care support.

#### **Mass screening using serial community-based RDSS.**

Three RDSS were implemented in two CBO facilities across the city, over a two-year period. For each RDSS, seeds and PWID received coupons to recruit new participants, as heretofore described.<sup>16</sup> Recruited PWID were eligible to participate in more than one RDSS, but only once per round. Participants received 6.5 USD honorarium for participation and 2 USD for each returned coupon.

**Peer support: CBO case management of PWID.** As a means to foster trust and confidence between the participants and the research team, all study activities took place in the two CBO offices. CBO members are usually former drug injectors or persons affected by drugs, who provide harm reduction counselling and injection materials. Once tested, untreated HIV-positive PWID were notified that they would be contacted to discuss their enrolment in outpatient clinics (OPC) for ART initiation. These participants benefited from continuous CBO support using a case management approach, which includes harm reduction activities, the provision of information on methadone, and assistance in attending methadone clinic for those that were willing. All PWID may have access to Methadone which is available in governmental clinics that use a directly-observed therapy approach, for a monthly cost of 14 USD. Buprenorphine was scarcely available in the country, but not in Haiphong. A minority of methadone clinics are complemented with HIV services. CBO members also assisted HIV-positive PWID to access their district's HIV clinic for ART initiation, or provided counselling to re-attend HIV clinics when they had dropped out from care. Moreover, all other RDSS participants were informed about the possibilities to join the methadone program, and those interested were contacted. The research program supported the capacity building and scaling-up of five CBOs within the city. Before the study, their activities consisted of harm reduction, counselling, mainly through outreach activities, but at a much smaller scale than that provided during the intervention. During the study, about 60 part-time CBO employees were involved and provided similar individual support to PWID, with the addition of ART adherence support and hepatitis C counselling. The main difference during the study was that CBO implemented the RDSS, which dramatically increased the number of 'clients' they were able to admit. Participating CBO were coordinated by a national CBO-supporting non-governmental organisation (Supporting Community Development Initiatives) which provided financial compensation for their work.

**HIV care support.** For those already under ART, viral load results were transmitted to patients in to the interest of

keeping their HIV physician informed, particularly when the viral load was unsuppressed. At the city level, refreshment training on ART second line initiation was organised by expert HIV physicians from the study group for physicians from all HIV OPC, in close collaboration with the regional HIV control program.

#### **Intervention evaluation**

The efficiency of the intervention was assessed by estimating the proportion of HIV-positive PWID screened with an unsuppressed viral load who were able to achieve a suppressed viral load, either through ART initiation or optimisation of their adherence to ART. We also monitored the trend in HIV viremia prevalence in the PWID population between baseline (RDSS1) and a post-intervention evaluation survey (RDSS4). Relying on RDS surveys before and after intervention to compare the population estimates of interest has been successfully used in a clustered randomised trial targeting PWID in India.<sup>3</sup> Of note, RDSS1 served both as a baseline measurement of viremia prevalence and as mass screening (part of the intervention).

#### **Data collection**

At each RDSS, urine testing (Drug-screen Multi 7A carte, Nal von Minden, Germany) results were recorded. Then, face-to-face structured and standardised interviews, which included declarative information concerning drug use, sexual behaviours, and involvement in drug-related and HIV-related services, were administered by trained CBO members. After providing information on HIV and hepatitis C virus (HCV) testing, blood samples were collected and tested for HIV serology (using national guidelines) and HCV serology (SD BIOLINE HCV rapid test, SD Standard Diagnostic Inc, South Korea) by nurses on site. For all HIV-seropositive participants, these collected blood samples were also used for HIV viral load quantification (COBAS Taqman HIV-1 test v2.0, Roche diagnostics, Vietnam), at the HIV control program reference laboratory and for lamivudine detection among all PWID with HIV RNA >1000 cp/mL using high pressure liquid chromatography with ultraviolet detection, as previously described.<sup>22</sup>

#### **Sample size and statistical analysis**

We aimed to reach and screen about two-thirds of all people who currently inject drugs in Haiphong, i.e. an estimated 3300 distinct PWID. In order to account for PWID participating in several RDSS, we planned to implement three RDSS of 1500 participants each. Based on an expected 15% viremia prevalence at RDSS1,<sup>23</sup> the recruitment of 1500 participants for both RDSS1 and RDSS4 enabled us to detect a change of  $\pm 4.5\%$  at RDSS4, with power set at 80% and a two-tailed alpha risk set at 0.05.

Due to frequent under-reporting of ART status, participants were considered to be on ART either if their viral load was under 250 copies/mL or if lamivudine (a component of nearly all first and second line ART regimens in Vietnam, with very few exceptions) was detected at a threshold of 25ppm in plasma.

Towards the end of the surveys, we had to increase the number of allocated coupons up to 15 for a few participants (<20) in order to attain the expected recruitment numbers (more details in Des Jarlais et al.<sup>16</sup>). We, thereby, did not fully comply with the RDS principles. However, rapid equilibria and low homophily were reached for major variables (i.e. HIV, gender),<sup>16</sup> which allow us to confidently analyse these RDSS as representative samples of the general population.

We report crude estimates for viremia prevalence as well as adjusted (weighted) estimates to account for RDS design.<sup>24</sup> The scope of the intervention was calculated as the number of distinct RDSS participants divided by 5000, i.e. the estimated sample size of the current PWID population in Haiphong.<sup>15</sup> The intervention efficiency was calculated using the number of all distinct HIV-positive RDSS participants with a viral load >1000 copies/mL as the denominator, and among the latter, those who had a viral load ≤1000 copies/mL at their last follow-up visit or subsequent RDS (whichever was the latest) as the numerator. PWID who did not initiate ART or who had no viral load data post-ART initiation were considered as unsuppressed. Finally, HIV viremia prevalence was estimated at baseline (RDDS1) and at RDSS4, and compared using a binomial generalised linear mixed model.

Data were analysed using SAS software (Version 9.4, SAS Institute Inc., USA), RStudio (Version 1.4.1717, R. RStudio, Inc., Boston, MA) and R (Version 4.1.1, R. Foundation for statistical computing, Vienna, Austria). Viremia was calculated using the RDS package with Gile's Successive Sampling (SS) estimator.

### Ethics committee approval

The research protocol was approved by the Institutional Ethical Committees of Haiphong University of Medicine and Pharmacy in Vietnam, and of Icahn School of Medicine at Mount Sinai (New York City, USA). Individual written informed consent was obtained from participants prior to participation to each RDSS and the follow-up study.

### Role of the funding source

This work was supported by grants from the National Institute on Drug Abuse (NIDA – USA; #R01DA0419780 and #R01DA003574) and by the Agence Nationale de Recherches sur le Sida et les Hépatites Virales (ANRS – France; #12353). The funding agencies had no role in study design, data collection,

analysis, interpretation, nor in the writing of the report or in the decision to submit it for publication.

## Results

Overall, 3150 distinct PWID participated in the three RDSS, and among the 1268 RDS4 participants, 243 (19%) participated in RDS1.

### Baseline characteristics of the participants

Most PWID were male (95%) and all injected heroin. Most of them (77%) have been injecting for at least five years and 45% had smoked methamphetamine in the last 30 days (Table 1). Overall, 51% had methadone detected in urine. Finally, 833 (26.5%) participants were HIV seropositive of which 177 (21.4%) had an unsuppressed viral load, including 96 that were not under ART (Table 1; Figure 1). Among those not under ART, 40% reported knowing they were HIV-positive. All of the others reported that they were not aware of their HIV-positive status. PWID with an unsuppressed viral load tended to be younger, to have been injecting for fewer years, and to smoke methamphetamine more frequently (Table 2). In addition, methadone was detected much less frequently in their urine (37.9%) than HIV-positive PWID with suppressed viral loads (66.7%).

### Participant outcomes

Overall, 82.2% ( $N = 2724/3315$ ) of the expected visits were completed. Median follow-up of HIV-positive participants was of 22.6 months (IQR:10.3–33.2), with obvious differences related to which of the serial RDSS constituted their initial recruitment.

Among the 329 HIV-positive participants not already on methadone, 59% ( $n = 146$ ) could be initiated, as ascertained by the detection of methadone in urine during follow-up visits.

Among the 177 HIV-positive PWID with an unsuppressed viral load, 96 were not engaged in HIV care (Figure 1 and Supplementary Figures 1–3). With CBO support, we were able to initiate 56 (58%) of them on ART, and 39 achieved a suppressed viral load. Of note, five PWID with an unsuppressed viral load had their final visit less than six months after ART initiation. Moreover, 81/177 were already on ART. Ultimately, 341 achieved a viral load ≤1000 copies/mL after re-engagement in care, or optimisation of adherence or of their ART regimen. Overall, 73 (41%) of these 177 identified PWID had a suppressed viral load at the end of the intervention. The main reason for not initiating ART was the inability to contact participants or their refusal.

### HIV viremia prevalence over time

Using crude estimates, HIV viremia with a threshold at 1000 copies/mL decreased from 7.2% at baseline to

Category	Sub-category	N (%)
Participants		3150
<b>Participants characteristics</b>		
Age, median (IQR)		39 (33–45) <sup>a</sup>
Gender	Female	154 (4.9) <sup>b</sup>
	Male or transgender	2992 (95.1)
Marital status	Single, divorced/separated, widowed	1868 (59.4) <sup>b</sup>
	In a relationship	1278 (40.6)
Salaried/employed		2563 (81.5) <sup>c</sup>
<b>Drug use behaviour</b>		
Use of methamphetamine <sup>g</sup>	Ever injected	34 (1.1) <sup>c</sup>
	Ever smoked	2186 (69.5) <sup>b</sup>
	Smoked during the past 30 days	1408 (44.8) <sup>c</sup>
	Smoked during the past 30 days (taking MET in the urine)	1534 (48.7) <sup>d</sup>
Duration of heroin injections	<5 years	727 (23.1) <sup>b</sup>
	≥5 years	2419 (76.9)
Other drugs used during the past six months <sup>g</sup>	Cannabis	411 (13.1) <sup>c</sup>
	Ketamine	145 (4.6) <sup>c</sup>
	Cocaine	24 (0.8) <sup>c</sup>
	Others	203 (6.5) <sup>c</sup>
Methadone in urine		1595 (50.7) <sup>e</sup>
Injection with a shared needle/syringe		138 (4.4) <sup>b</sup>
<b>Illness status</b>		
HCV positive serology		2125 (67.6) <sup>b</sup>
HIV positive serology		833 (26.5) <sup>b</sup>
	Unsuppressed viral load (>1000 copies/mL)	177 (21.4) <sup>f</sup>

**Table 1: Baseline characteristics of distinct PWID participants enrolled in the three RDSS.**

Abbreviations: HCV, hepatitis C virus; HIV, human immunodeficiency virus; IQR, interquartile range; MET, methamphetamine.

<sup>a</sup> 2 missing values.

<sup>b</sup> 4 missing values.

<sup>c</sup> 5 missing values.

<sup>d</sup> 3 missing values.

<sup>e</sup> 1 missing value.

<sup>f</sup> 7 missing values.

<sup>g</sup> These sub-categories are not mutually exclusive.

2.9% at RDSS4 ( $p < 0.001$ ). It was of 5.4% at RDSS2 and 3.1% at RDSS3. Estimates accounting for the RDS design (with weighing) showed a similar reduction in viremia, going from 8.3% (95% confidence interval (CI):7.6–9.0) to 3.2% (95%CI:2.9–3.5), i.e. a 61% reduction.

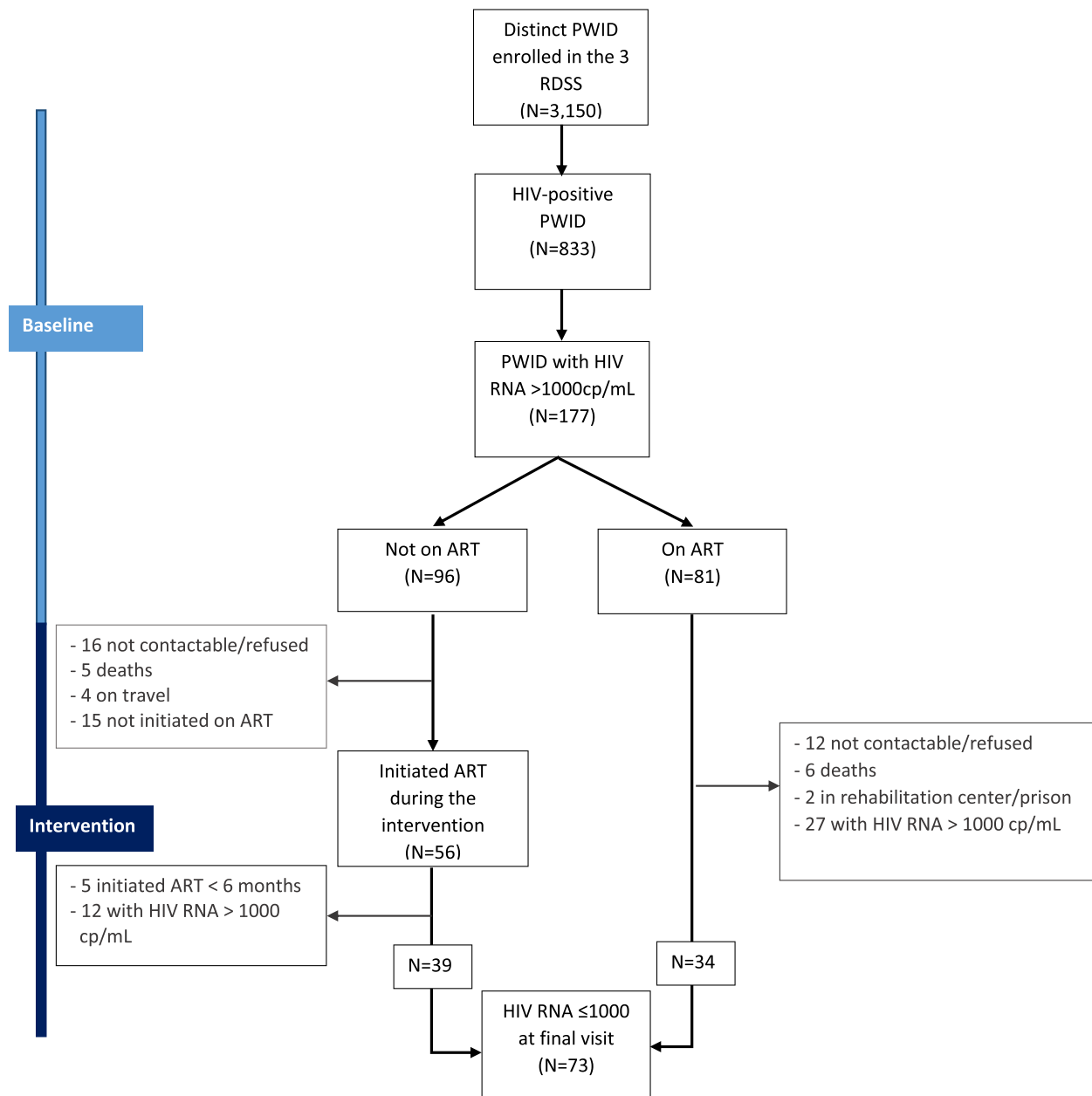
### Estimated potential contribution of the intervention on the reduction of viremia prevalence

Over the course of the three RDSS rounds, 3150 distinct PWID participated and were screened for HIV, representing about two-thirds of the estimated population size of current injectors in Haiphong ( $N = 5000$ ).<sup>15</sup> Assuming a stable PWID population size, the viremia’s evolution from RDSS1 (8.3%) to RDSS4 (3.2%) corresponds to 415 and 160 PWID with an unsuppressed viral load in the population, respectively. Among these 415 at RDSS1 with an unsuppressed viral load, we estimate that 7% died per year,<sup>25</sup> leaving 334 alive at

RDSS4. Since we estimated that only 160 PWID with an unsuppressed viral load remained at RDSS4, about 174 (= 334–160) PWID were able to achieve a suppressed viral load in the population over the course of the study period. The 73 PWID identified and supported by our intervention correspond to 42% (73/174) of the observed reduction in viremia prevalence. When using weighted estimates of the lower and upper bounds of the viremia confidence intervals at RDSS1 and RDSS4, this contribution ranged from 34% to 56%. Finally, we estimate our intervention was able to (re)link to care 18% (73/415) of those with unsuppressed viral load in the whole population

### Discussion

Our three-year community-based intervention proved very efficient for rapidly reaching a wide coverage of the PWID population for mass HIV screening and linkage to HIV care. Over a 2.5-month period for each survey



**Figure 1. Participants flow-chart.** Abbreviations: ART, antiretroviral therapy; HIV, human immunodeficiency virus; PWID, people who inject drugs; RDSS, respondent-driven sampling survey; RNA, ribonucleic acid.

round, 1500 PWID could be screened. Over the three RDSS approximately two thirds of the overall active PWID population in Haiphong was reached and screened. Overall, about 40% of those initially diagnosed with HIV RNA >1000 copies/mL could achieve HIV control at the end of the intervention. To our knowledge, this is the first report of an intervention that can i) achieve broad coverage of the PWID target population, and ii) encompass all issues of identification of PWID with a detectable viral load, linkage to care and

retention in effective care. Such efficient and easily scalable interventions may contribute to achieve HIV micro-elimination among PWID in Southeast Asia.

This intervention was implemented in a context of HIV control<sup>16</sup> with high ART coverage at baseline: 78.6% of all HIV-positive participants had a suppressed viral load, outperforming the targeted 90/90/90 values of the HIV cascade, and which result in 72% of all HIV-infected PWID having a suppressed viral load. In this PWID population with an HIV prevalence of 26.5% and

N (%)	Suppressed HIV viral load N = 649	Unsuppressed HIV viral load N = 177	p-value
<b>Male or transgender</b>	617 (95.1)	164 (92.7)	0.21 <sup>a</sup>
<b>Age &lt;39 years old</b>	263 (40.5)	87 (49.2)	0.04 <sup>a</sup>
<b>Middle/High school or university</b>	365 (56.2)	97 (54.8)	0.73 <sup>a</sup>
<b>Currently having an ID card</b>	516 (79.5)	110 (62.2)	<0.01 <sup>a</sup>
<b>Illegal source of income</b>	62 (9.6)	11 (6.2)	0.17 <sup>a</sup>
<b>Duration of injection in years</b>			<0.01 <sup>a</sup>
<5 years	35 (5.4)	24 (13.6)	
5 to <10 years	149 (23.0)	45 (25.4)	
10 to <15 years	173 (26.7)	47 (26.6)	
≥15 years	292 (45.0)	61 (34.5)	
<b>Frequency of heroin injections in the last 30 days</b>			0.08 <sup>a</sup>
≤15 days	70 (10.8)	11 (6.2)	
Between 16 and 29 days	74 (11.4)	15 (8.5)	
Every day	505 (77.8)	151 (85.3)	
<b>Frequency of heroin injections per day in the last 30 days</b>			<0.01 <sup>a</sup>
1 time/day	182 (28.0)	27 (15.3)	
2 times/day	276 (42.5)	88 (49.7)	
3 times/day	156 (24.0)	53 (29.9)	
≥4 times/day	35 (5.4)	9 (5.1)	
<b>Frequency of smoke ice</b>			0.01 <sup>b</sup>
Never	262 (40.4)	49 (27.7)	
Ever but frequency unknown	1 (0.2)	-	
Ever but not last month	167 (25.7)	53 (29.9)	
Used last month	219 (33.7)	75 (42.4)	
<b>Consumption of other non-injecting drugs</b>			
Consumption of cannabis only	80 (12.3)	11 (6.2)	0.02 <sup>a</sup>
Consumption of other drugs	42 (6.5)	16 (9.0)	0.24 <sup>a</sup>
<b>At risk consumption of alcohol<sup>c</sup></b>	196 (30.2)	47 (26.6)	0.35 <sup>a</sup>
<b>Binge drinking<sup>d</sup></b>	53 (8.2)	17 (9.6)	0.54 <sup>a</sup>
<b>Methadone in urine</b>	433 (66.7)	67 (37.9)	<0.01
<b>Overdoses to the point where the participant lost consciousness (in the last six months)</b>	14 (2.2) <sup>e</sup>	7 (4.0)	0.18 <sup>b</sup>
<b>Sharing drugs using a used needle/syringe</b>	30 (4.6)	13 (7.3)	0.15 <sup>a</sup>
<b>Injection with a shared needle/syringe</b>	40 (6.2)	6(3.4)	0.15 <sup>a</sup>
<b>Frequency of using water/novocaine already used by someone else</b>			0.78 <sup>b</sup>
Never	527 (81.3) <sup>e</sup>	146 (82.5)	
Occasionally	102 (15.7)	28 (15.8)	
Frequently	19 (2.9)	3 (1.7)	
<b>Sexual intercourse with primary partner<sup>f</sup></b>			0.13 <sup>a</sup>
No sexual intercourse	391 (60.3)	111 (62.7)	
Safe sexual intercourse	189 (29.1)	56 (31.6)	
Unsafe sexual intercourse	69 (10.6)	10 (5.7)	
<b>Sexual intercourse with casual partner<sup>f</sup></b>			0.57 <sup>b</sup>
No sexual intercourse	621 (95.7)	167 (94.4)	
Safe sexual intercourse	16 (2.5)	5 (2.8)	
Unsafe sexual intercourse	12 (1.9)	5 (2.8)	
<b>Depression and anxiety (PHQ4)<sup>g</sup></b>			0.34 <sup>b</sup>
Mild	103 (15.9)	35 (19.8)	
Moderate	30 (4.6)	12 (6.8)	
Normal	503 (77.5)	127 (71.8)	
Severe	13 (2.0)	3 (1.7)	

**Table 2: Baseline characteristics of HIV-positive participants according to their HIV viral load.**

Percentages are rounded and sometimes do not add to 100%.

<sup>a</sup> Chi square test<sup>2</sup>

<sup>b</sup> Fisher exact test.

<sup>c</sup> Defined as an AUDIT-C score of 4 and above for men, and 3 and above for women.

<sup>d</sup> Defined as consumption of 5 or more drinks on one occasion at least once per month.

<sup>e</sup> i missing value.

<sup>f</sup> Unsafe sex was defined when a condom was not always used during sexual intercourse with a primary partner with unknown or positive HIV status and during sexual intercourse with casual partner.

<sup>g</sup> Mild for PHQ4 score between 3 and 5, Moderate for a score between 6 and 8, and Severe when the score was above 8.



a low rate of needle/syringe sharing, the low baseline viremia prevalence – translating to a low potential of transmission – is consistent with the end of HIV transmission we demonstrated in this population.<sup>16</sup> This impressive achievement results from efficient HIV and harm reduction programs targeting PWID. These findings are also coherent with the excellent outcomes from the HIV program reported in the general population in Vietnam.<sup>27,28</sup>

In this context, those HIV-positive participants that are not yet engaged in care have characteristics close to those of the most-at-risk group identified earlier in the same population: young, injecting for a few years, not on methadone, and smoking methamphetamine.<sup>29</sup> These young PWID will certainly require CBOs to adapt their interventions to these characteristics, perhaps by focusing on regular HIV testing and the risks associated with sharing injection materials. Hence, our intervention's ability to efficiently treat more than 40% of those who, at baseline, could potentially transmit HIV to others is a major achievement. As a result, our community-based intervention likely contributed to the 60% reduction in viremia prevalence at the end of the study period. Under most plausible assumptions to explain the remaining contributors to this reduction, our intervention may also have had an indirect effect: many of the PWID who received support from CBO in accessing HIV care and methadone may have, in turn, provided assistance, support, counselling, and administrative solutions to other PWID from their network who were not reached by any of the three RDSS.

In the HPTN 074 trial, 72% of untreated HIV-positive PWID were initiated on ART at one year, combined with motivational interviews provided by psychosocial counsellors and system navigators, who could be the same person.<sup>12</sup> However, the proportion of PWID initiated on ART who reached viral suppression was not reported. Furthermore, the ability of this strategy to reach large-scale coverage of the target population is not addressed. Baseline ART coverage was much lower in HPTN 074 sites than in Haiphong. CBOs are on the front line of harm reduction activities and HIV prevention in the vast majority of Southeast Asian countries in which a dedicated program targeting PWID is operating. In our approach, they provided a somewhat similar assistance tailored to each PWID's specific needs and situation. Furthermore, CBOs proved capable to conduct a RDSS both on their premises as well as in a rented neutral place according to DRIVE guidelines. In places where HIV is far less controlled among PWID than in Haiphong, we believe that our strategy could have an even more pronounced impact. Achieving a high coverage rate of PWID population within a city could contribute to rapid engagement of those in need in the necessary care and, as a result, advance HIV elimination. This strategy can be widely implemented, and seems particularly well adapted to the Southeast Asian context.<sup>30</sup> It is noteworthy that this strategy also allows

us to calculate precise estimates of HIV outcomes in the target PWID population, and thus provides valuable information on the potential of HIV transmission within the population.<sup>16</sup> Furthermore, the first RDS survey also allows to more accurately estimate the target PWID population in the city through a capture-recapture approach.<sup>15</sup> This estimation is crucial for estimating the scope of the intervention.<sup>31</sup>

Our study has several limitations. Firstly, Vietnam is a middle-income country that has allocated substantial means to increase access to HIV care. Second, our community-based intervention can only be successful in areas with active CBOs and providing universal access to HIV care and to methadone or buprenorphine. Moreover, we have not been able to estimate the knowledge in ART management gained from the HIV physicians' training. In addition, although each subsequent round of RDS surveys recruited more new PWID than those already having attended a previous RDSS, we cannot exclude that the RDS strategy may have failed to reach some PWID with particular characteristics. Furthermore, the RDS principles were not fully met, but we previously showed that this had a limited impact on the parameter estimates.<sup>32</sup> The absence of a control city is another limitation. HIV-infected PWID identified with detectable HIV RNA in the study could have been tested had the study not taken place, been initiated on ART and successfully treated. However, this scenario is unlikely given that these untreated PWID have been infected for a while (as there is virtually no new HIV infection) and have either never initiated ART before, or had initiated and quit ART. Finally, during the intervention period, no additional interventions targeting PWID, regarding access to methadone, HIV care or harm reduction were reported by neither CBO nor the local HIV control program. The only change in the HIV care system was the OPC's transition from prevention medicine to medical care (hospitals) within the Ministry of Health, coupled with a management of HIV care costs by the national health insurance system.<sup>26</sup> This change implied that a few PWID who do not benefit from a full insurance scheme needed to pay out of pocket for their ART. This may have increased viremia prevalence, but was highly unlikely to have contributed to the observed reduction in viremia prevalence.

## Conclusions

A CBO-led mass screening strategy based on sequential RDSS, coupled with support in accessing ART, methadone, in combination with the training of HIV physicians on ART optimisation, could be a powerful tool to rapidly control the HIV epidemic among PWID. Although our findings need to be confirmed in other settings, this strategy could easily be generalised in Southeast Asia where CBO are already widely involved in harm reduction counselling.

### Contributors

N.N., D.D.J., H.T.D., O.T.H.K. and J.P.M. conceived and designed the study.  
G.T.H., C.Q. and D.R. supervised the fieldwork.  
R.V. and D.Q.N. coordinated the data entry.  
R.V., N.N., P.V.D.P., J.F., L.M., J.C. and D.L. contributed to the design of the data analysis.  
R.V. conducted the data and statistical analyses.  
K.M.P., V.H.V. and T.T.T.N. implemented the fieldwork.  
J.C. and N.N. did the literature review and wrote the manuscript which was then reviewed and approved by all authors.

### Data sharing statement

De-identified participant data and a data dictionary will be made available on request addressed to the corresponding author.

### Declaration of interests

The authors declare no competing interest.

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### Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.lanwpc.2022.100538.

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