



BMJ Open Recent HIV testing and associated factors among people who use drugs in Cambodia: a national cross-sectional study

Chee Wen Eng ¹, Sovannary Tuot,² Navy Chann,³ Pheak Chhoun,² Phalkun Mun,³ Siyan Yi ^{1,2}

To cite: Eng CW, Tuot S, Chann N, *et al.* Recent HIV testing and associated factors among people who use drugs in Cambodia: a national cross-sectional study. *BMJ Open* 2021;**11**:e045282. doi:10.1136/bmjopen-2020-045282

► Prepublication history and additional materials for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2020-045282>).

Received 26 September 2020
Revised 10 February 2021
Accepted 17 February 2021



© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Saw Swee Hock School of Public Health, National University of Singapore and National University Health System, Singapore

²KHANA Center for Population Health Research, Phnom Penh, Cambodia

³Surveillance Unit, National Center for HIV/AIDS, Dermatology and STD, Phnom Penh, Cambodia

Correspondence to

Dr Siyan Yi; siyan@doctor.com

ABSTRACT

Objective To estimate the prevalence of HIV testing and examine factors associated with recent HIV testing among people who use drugs (PWUD) in Cambodia.

Design Cross-sectional study.

Setting Twelve major provinces with a high burden of HIV and drug use in Cambodia.

Participants This study included 1677 PWUD recruited using a peer-based social network recruitment method. Participants' selection criteria included being at least 18 years old and using any illicit drugs via any administration routes in the past 12 months.

Primary outcome measure Recent HIV testing, defined as having an HIV test in the past 6 months.

Results The median age of the participants was 28 (IQR 22–34) years, and 56.6% were men. The prevalence of lifetime and recent HIV testing was 70.7% and 42.9%, respectively. After adjustment in multivariable logistic regression analysis, recent HIV testing remained positively associated with being female (adjusted OR (AOR) 1.55, 95% CI 1.18 to 2.04) or third gender identity (AOR 2.06, 95% CI 1.11 to 3.80), having ever been to a drug rehabilitation centre (AOR 1.60, 95% CI 1.13 to 2.29), having used any HIV services in the past 6 months (AOR 7.37, 95% CI 5.61 to 9.69), having received HIV education in the past 3 months (AOR 3.40, 95% CI 2.63 to 4.40) and having self-perception of higher HIV risk (AOR 1.81, 95% CI 1.19 to 2.73).

Conclusions Recent HIV test uptake among PWUD in Cambodia was suboptimal. This study highlights the roles of outreach HIV education and services in promoting regular HIV testing among PWUD. Strengthening the coordinated effort of government agencies and local civil society organisations to prioritise expanding community-based peer-driven interventions to reach out to this hidden population is warranted.

INTRODUCTION

Cambodia, a country with a population of over 16 million in Southeast Asia, has made remarkable progress in addressing its HIV epidemic over the past 25 years.^{1,2} However, although the HIV prevalence among the general adult population in Cambodia has declined from 1.7% in 1998 to 0.6% in 2015,

Strengths and limitations of this study

- This survey is the first national study in Cambodia that examines factors associated with HIV testing among people who use drugs (PWUD), including people who inject drugs (PWID) and non-PWID.
- This study included a large sample of PWUD recruited using a peer-based social network recruitment method across 12 major provinces with a high HIV and drug use burden in the country.
- We did not include PWUD from the other 13 provinces with a lower HIV and drug use burden and PWUD who were imprisoned or detained.
- HIV testing and behavioural data were self-reported and may be subjected to recall and social desirability bias.

the infection remains disproportionately affecting people who use drugs (PWUD). PWUD are defined as people who use psychotropic substances for non-medical purposes, regardless of any administration route.^{3–5} In 2017, the HIV prevalence was 15.2% among people who inject drugs (PWID) and 5.7% among people who use drugs via any route other than injection (non-PWID). The estimated national population size of PWID and non-PWID was 4136 and 22 374, respectively, in the same year.^{6,7} At the same time, the problems of illicit drug manufacture, trafficking, and use continue to expand in Cambodia and pose a significant challenge to public health and the control of the HIV epidemic. Evidence has shown that the PWUD populations, particularly the non-PWID, have been growing drastically and getting younger in the past decade.^{8,9}

PWUD have been identified as one of the HIV key populations due to their heightened risk and susceptibility to the infection as consequences of risky substance use behaviours and the complex legal and social

issues surrounding drug use. Drug injection among PWID is a major source of HIV infection and other blood-borne diseases, such as hepatitis C due to sharing injecting needles or other paraphernalia.^{3 10} In Cambodia, PWID constitute a key targeted group for HIV intervention and harm-reduction programmes. Although significant attention has been given to PWID in the past decade, expanding the coverage of HIV interventions and epidemiological studies to include non-PWID is of growing importance because of the rising burden of amphetamine-type stimulants consumption and increasing trend of the HIV prevalence in this population.^{11 12} In many studies, non-PWID exhibit high-risk behaviours for acquiring and transmitting HIV, such as having multiple sex partners, inconsistent condom use during sexual intercourse, polysubstance use and the potential to start injecting drugs.^{13–16} Also, sexual transmission of HIV among and between PWID and non-PWID is common because of the close relationships and overlapping sexual networks of these groups.^{17–19}

To curb the HIV epidemic, the Joint United Nations Programme on HIV/AIDS (UNAIDS) has committed to the HIV diagnosis, treatment and viral load goal of 95-95-95. The first target under this global goal stipulates that at least 95% of all people living with HIV should know their HIV status by 2030.²⁰ Therefore, testing and diagnosing HIV is the first most critical step in identifying and bridging individuals to HIV prevention or treatment cascades. This strategy will subsequently reduce the morbidity and mortality from HIV. HIV testing has also been recognised as a highly cost-effective measure that reduces HIV risk and transmission.^{21 22} A meta-analysis has shown that having received HIV testing was significantly associated with increased condom use after the test among those being diagnosed with HIV.²³ A study in the USA has estimated that sexual transmission of HIV is 3.5 times more likely to happen among individuals who are unaware of their HIV status.²⁴ However, the HIV testing coverage among key populations remains inadequate in many Southeast Asian countries.^{25 26} PWUD face unique challenges, including punitive or suppressive policies, high level of stigmatisation, and condemnation of illicit drug consumption and addiction, which often hamper their access to the continuum of care of HIV and mainstream public health services.^{27–30} Studies in the Asia-Pacific region indicated that HIV testing among PWUD was associated with sociodemographic characteristics, history of injection drug use, sexually transmitted infections (STIs), history of incarceration and HIV-related knowledge.^{31–33}

Under the Cambodian National Strategic Plan IV (2015–2020), individuals at high risk for HIV, including PWUD, are recommended to have an HIV test every 6 months to ensure early diagnosis and ongoing health literacy on HIV prevention.³⁴ However, currently, there is no published information about HIV testing among PWUD in Cambodia. Nationally, little is known about this key population's adherence to the testing recommendation.

Such data and strategic information on the HIV situation and response are crucial as comprehensive HIV services are continually being scaled up in Cambodia. The resources for HIV in Cambodia become scarcer owing to shrinking international funds as its economic status has advanced from a low-income to a lower middle-income nation.³⁵ Therefore, Cambodia needs to make strategic decisions based on up-to-date and reliable data to fully use the remaining resources in achieving its ambitious target in ending the HIV epidemic by 2025. This paper sought to estimate the HIV testing prevalence and examine factors associated with recent HIV testing among PWUD in Cambodia.

METHODS

Study design and sites

This cross-sectional study used data from the Cambodian National Integrated Biological and Behavioural Survey among People Who Use Drugs (IBBS-PWUD 2017).⁶ The details of the study have been published elsewhere.^{7 36–39}

We collected the data from June to December 2017 at 21 study sites across 12 provinces with a high HIV and drug use prevalence in Cambodia. We selected the sites according to the sample size needed in each province. Six out of the 21 sites were in the capital city of Phnom Penh and the remaining 15 in the other 11 provinces. These 12 provinces comprised about 70% of the Cambodian population out of 25 provinces in Cambodia.

Participants

We included individuals who: (1) were 18 years old or above, (2) had a valid study coupon, (3) had used any types of illicit drugs in the past 12 months, and (4) were willing and able to provide written informed consent. Participants were identified as PWUD if they had used any drugs, as stated in the Cambodian Law on Control of Drugs, through any administration route in the past 12 months. We excluded individuals who had participated in the study in any other study sites to prevent repetitive participation.

Sampling method and participant recruitment

A peer-based social network recruitment method was employed to recruit participants with assistance from relevant non-governmental organisations (NGOs) working in the provinces. First, we identified four PWUD who were eligible to participate in the study and had good social connections with other peers who use drugs as the initial seeds in each study site (ie, 84 seeds in 21 study locations). Upon enrolment, we allotted each seed a personal identification number. After that, each seed was given three uniquely coded referral coupons and requested to transfer that to their peers to come forward for the study. For each successful referral, the seed received US\$2 as an incentive. Meanwhile, each participant received an appreciation token of approximately US\$5 for compensating for their time and transportation cost. The subsequent

participants were given the same chance as the previous seeds to recruit additional PWUD, hence, establishing the recruitment waves. The process went on until we reached the desired sample size at each site.

Data collection procedures

All interviewers and field supervisors underwent thorough training on the study protocol and data collection methods. The data collection team leaders used an eligibility screening form to carefully determine an individual's eligibility to participate in the study. Before any procedure, participants were informed regarding the study protocol, including the data use and confidentiality, the voluntary nature of their participation, and the potential risks and benefits they may anticipate from this study. Every participant made their own voluntary decision and provided written informed consent. We conducted data collection in private rooms, and removed all personal identifiers from the study documents to protect the participants' privacy and confidentiality. All participants underwent pretest counselling and were screened for HIV and syphilis infections by using SD Bioline HIV/Syphilis Duo rapid test kit (Standard Diagnostic, Korea). In the case of an HIV reactive result from the rapid test, an immediate confirmatory test was conducted at the site using HIV 1/2 STAT-PAK Assay (Chembio Diagnostic Systems, USA). Regardless of the test results, all participants were counselled by counsellors for relevant HIV prevention or treatment measures after the screenings. For newly detected positive cases, adequate information and resources were provided for participants to present in an HIV/STI clinic for further treatment and care. Each case was closely followed up regarding his/her referral by a counsellor later.

Questionnaire development

We developed a structured questionnaire (online supplemental file 1) for face-to-face interviews based on standardised and validated tools adapted from previous studies among HIV key populations in Cambodia.^{4 6} We first developed the questionnaire in English, then translated it to Khmer, Cambodia's national language. Another translator back-translated it to English to ensure accuracy and quality. We tested the questionnaire in a pilot study involving 20 PWUD comprised of both non-PWID and PWID to ensure that the content and language were culturally appropriate and easily understood by the study participants.

Measures

The dependent variable was recent HIV testing, defined as having taken at least one HIV test in the past 6 months before the study. We also collected other HIV testing-related information, including lifetime HIV testing, the last HIV testing site, and whether those aware of HIV positive status before the study were on antiretroviral therapy. Other variables included sociodemographic characteristics, drug use history and patterns, history of criminal justice involvement, history of STIs,

sexual behaviours, HIV risk perception and exposure to HIV intervention programmes. We also asked the participants whether they received HIV education from sources other than HIV confidential counselling and testing. We collected information on participants' sexual behaviours with different types of partners in the past 3 months. The information included the number of sexual partners, whether they had sexual intercourse when a partner was intoxicated, and condom use in transactional and non-transactional sex. We defined 'sexually active' as having sexual intercourse with any partner in the past 12 months and 'transactional sex' as having sexual intercourse in exchange for money or gifts. Those who responded having an intercourse in the past 12 months would be further asked about their sexual behaviours in the past 3 months.

Data management and analyses

A data entry team coded and entered the data in a computerised database using Epi Data V.3.1 (Odense, Denmark) after completing field data collection. The study team cross-checked the data entries and stored them on a computer with a passcode.

We performed descriptive analyses to describe the prevalence of HIV testing and testing behaviours. We used Pearson's X^2 test or (Fisher's exact test for a cell value smaller than five) to compare the differences in characteristics and behaviours between participants with and without an HIV testing history in the past 6 months. Factors associated with recent HIV testing were identified using multivariable logistic regression analysis. We included variables associated with recent HIV testing at a significance level of $p < 0.05$ in bivariate analyses simultaneously for regression model building. A backward stepwise selection method was adopted to remove variables with the highest p value one by one from the model. We added age and the variable 'past 12 months injection drug use' (definition of PWID) back into the model despite being statistically insignificant, due to their epidemiological importance and potential confounding effects based on the existing literature.^{33 40} We refitted the model and computed adjusted ORs (AORs), 95% CIs and corresponding p values. We used Stata V.14 (StataCorp, Texas, USA) for all statistical analyses.

Patient and public involvement

No patients were involved in this study.

RESULTS

HIV testing behaviours

We included 1367 (81.5%) non-PWID and 310 (18.5%) PWID in this study. Overall, 70.7% reported having ever had tested for HIV, and 42.9% had tested in the past 6 months (table 1). The common places for recent HIV testing were NGO facilities (51.7%), the community where the test was provided by NGO outreach workers (18.9%), and public health facilities (18.1%). In subanalyses comparing HIV testing prevalence between PWID and non-PWID in this study (online supplemental table

Table 1 HIV testing behaviours among people who use drugs

HIV testing variables	People who use drugs (N=1677)		
	n	%	95% CI
Lifetime HIV testing	1185	70.7	68.4 to 72.8
HIV testing in the past 6 months	719	42.9	40.5 to 45.3
Testing places (n=719)			
Public health facilities	130	18.1	15.4 to 21.1
NGO facilities	372	51.7	48.1 to 55.4
Community based testing by NGO outreach workers	136	18.9	16.2 to 22.0
Drop-in centres	60	8.3	6.5 to 10.6
Private health facilities	16	2.2	1.4 to 3.6
Other	5	0.7	0.3 to 1.7
Screening results			
HIV positive	125	7.5	6.3 to 8.8
Syphilis positive	63	3.8	2.9 to 4.8
Aware of HIV positive status before the study (n=125)			
Had HIV testing in the past 6 months (n=69)	39	56.5	44.4 to 67.9
Currently receiving ART	63	91.3	81.6 to 96.1
Reported ART adherence	53	76.8	65.1 to 85.5

ART, antiretroviral therapy; n, count; NGO, non-governmental organisation.

S1), the rates of lifetime (80.7% vs 68.4%) and recent HIV testing (51.9% vs 40.8%) were significantly higher among PWID than that among non-PWID. In this study, 7.5% (n=125, 95% CI=6.3% to 8.8%) of the total study sample were confirmed HIV positive, and 3.8% (n=63, 95% CI=2.9% to 4.8%) were syphilis positive. Only 55.2% (n=69) PWUD tested positive for HIV were aware of their HIV status before the study. Of them, 56.5% had HIV testing in the past 6 months, 91.3% were receiving antiretroviral therapy and 76.8% reported adhering to the treatment.

Sociodemographic characteristics

Table 2 presents the sociodemographic characteristics of the participants. The participants' median age was 28 (IQR 22–34) years. When asked about gender identity, 56.6% self-identified as male, 39.1% as female and 4.3% as the third gender, described as neither man nor woman. Of the total, 53.6% had primary or no formal school education, with a median schooling duration of 6 years (IQR 3–9 years). Almost half (46.4%) had never been married, and 20.4% lived on the streets. Participants commonly worked as agricultural or fishery labourers (35.6%) and entertainment or sex workers (18.3%), while 11.8% were unemployed. About four in five participants (77.3%) earned less than US\$200 per month, with

a median monthly earning of US\$100 (IQR 60–170) in the past 6 months.

Substance use behaviours and history of criminal justice involvement

As presented in table 3, 79.0% of the participants reported using any illicit drugs in the past 3 months, with the median lifetime drug use duration of 18 (IQR 6–48) months. The most common drugs used in the past 3 months were methamphetamines (91.2%), followed by heroin (13.8%) and ecstasy (5.3%). Meanwhile, 15.0% of them reported using more than one type of drugs. Among PWID, 23.9% reported using needles or syringes that had been used by someone else in their most recent injection. About one in five participants (19.3%) reported having ever been arrested by the police or other authorities; 15.9% had ever been to a rehabilitation centre and 11.2% had ever been incarcerated in their lifetime. The proportion of participants using drugs in the past 3 months (82.1% vs 76.6%), using multiple drugs in the past 3 months (18.1% vs 12.5%), injecting drugs in the past 12 months (22.4% vs 15.6%) and having ever been to a rehabilitation centre (20.6% vs 12.3%) was significantly higher among participants who had a recent HIV test than that among participants who did not have a recent test.

STIs, sexual behaviours and perception of HIV risk

Table 4 illustrates that 32.6% of the study participants reported having experienced STI symptoms such as cuts, sores or swelling in the genital area, and unusual discharge from the penis or vagina in the past 1 year. Of them, 74.6% had sought treatment from healthcare facilities, including public clinics, private clinics, pharmacies and NGO facilities. Regarding sexual behaviours, 74.5% reported being sexually active in the past 3 months. The proportion of PWUD having more than one sex partner (55.6% vs 45.1%), always using condoms during sexual intercourse (30.8% vs 19.3%), having sexual intercourse when a partner was intoxicated (42.9% vs 36.5%), having non-transactional sex (58.9% vs 48.8%) and having transactional sex (45.5% vs 26.6%) was significantly higher among participants who had a recent HIV test than that among participants who did not have a recent test. When asked about their self-perception of HIV risk, 23.0% of the participants perceived that their risk was higher, and 47.7% thought they had a similar or lower risk than the general people. The proportion of participants perceiving that their HIV risk was higher than the general people was significantly higher among participants who had a recent HIV test than that among participants who did not have a recent test (32.1% vs 16.1%).

Access to HIV intervention and education

As shown in table 5, 36.7% had access to at least one form of community-based HIV services in the past 6 months. The services included condom and lubricant distribution and legal support. For PWID, the services also included sterile injection equipment and methadone

Table 2 Sociodemographic characteristics of PWUD who had and had not tested for HIV in the past 6 months

Sociodemographic variables	Total (N=1677)	HIV testing in the past 6 months (n, %)		P value*
		No (n=958)	Yes (n=719)	
Age group (years)				<0.001
<20	204 (12.2)	144 (15.0)	60 (8.3)	
20–29	754 (44.0)	408 (42.6)	346 (48.1)	
30–39	576 (34.4)	314 (32.8)	262 (36.4)	
>39	143 (8.5)	92 (9.6)	51 (7.1)	
Gender identity				<0.001
Male	950 (56.6)	652 (68.1)	298 (41.5)	
Female	655 (39.1)	284 (29.7)	371 (51.6)	
Third gender	72 (4.3)	22 (2.3)	50 (7.0)	
Marital status				0.006
Married	624 (37.3)	370 (38.8)	254 (35.4)	
Divorced/widowed/separated	271 (16.2)	131 (13.8)	140 (19.5)	
Never married	776 (46.4)	452 (47.4)	324 (45.1)	
Education				0.247
Primary school and below (0–6 years)	899 (53.6)	514 (53.7)	385 (53.6)	
Secondary school (7–9 years)	462 (27.6)	275 (28.7)	187 (26.0)	
High school and higher (≥10 years)	316 (18.8)	169 (17.6)	147 (20.4)	
Current living condition				<0.001
On the street	342 (20.4)	170 (17.7)	172 (23.9)	
With family or relatives	781 (46.6)	486 (50.7)	295 (41.0)	
In own place	382 (22.8)	229 (23.9)	153 (21.3)	
With friend(s)	172 (10.3)	73 (7.6)	99 (13.8)	
Main occupation				<0.001
Unemployed	197 (11.8)	131 (13.7)	66 (9.2)	
Hairdresser/beautician	82 (4.9)	26 (2.7)	56 (7.8)	
Agricultural/fishery labourer	597 (35.6)	417 (43.5)	180 (25.0)	
Sales worker	212 (12.6)	123 (12.8)	89 (12.4)	
Entertainment or sex worker	306 (18.3)	101 (10.5)	205 (28.5)	
Student	41 (2.4)	27 (2.8)	14 (2.0)	
Other	242 (14.4)	133 (13.9)	109 (15.2)	
Monthly income (US\$)				0.013
<200	1292 (77.3)	758 (58.8)	533 (41.3)	
≥200	380 (22.7)	196 (51.6)	184 (48.4)	

* χ^2 or Fisher's exact test was used.
PWUD, people who use drugs.

maintenance therapy (MMT). About half (46.9%) of the participants reported receiving HIV education in the past 3 months. The sources of HIV education were peer educators (66.0%), drop-in centres (25.9%), media (20.2%), printed materials such as posters and booklets (17.9%), campaigns or workshops (16.7%), and health facilities (11.4%). The proportion of the participants receiving community-based HIV services (68.3% vs 12.9%) and HIV education (73.9% vs 26.7%) was significantly higher among participants who had a

recent HIV test than that among the participants who did not have a recent HIV test.

Factors associated with recent HIV testing

The multivariable analysis results are presented in [table 6](#). After accounting for other covariates, recent HIV testing was significantly associated with gender identity groups of women (AOR 1.55, 95% CI 1.18 to 2.04) and the third gender (AOR 2.06, 95% CI 1.11 to 3.80), access to HIV services in the past 6 months (AOR=7.37, 95% CI 5.61 to

Table 3 Substance use behaviours and history of criminal justice involvement among PWUD who had and had not tested for HIV in the past 6 months

Variables	Total (n=1677)	HIV testing in the past 6 months		P value*
		No (n=958)	Yes (n=719)	
Duration of illicit drug use, median months (IQR)	18 (6–48)	18 (6–50)	16 (7–48)	0.655
Used illicit drugs in the past 3 months	1324 (79.0)	734 (76.6)	590 (82.1)	0.007
Type of drugs used†				
Yama/ice (methamphetamine)	1208 (91.2)	688 (93.7)	520 (88.1)	0.918
Heroin	183 (13.8)	71 (9.7)	112 (19.0)	<0.001
Ecstasy	70 (5.3)	26 (3.5)	44 (7.5)	0.001
Inhalant	53 (4.0)	27 (3.7)	26 (4.4)	0.357
Used more than one drug in the past 3 months	199 (15.0)	92 (12.5)	107 (18.1)	0.005
Ever injected drugs in the past 12 months	310 (18.5)	149 (15.6)	161 (22.4)	<0.001
Used needle/syringe used by someone else in the last injection (n=180)	43 (23.9)	29 (31.2)	14 (16.1)	0.018
Ever been arrested	323 (19.3)	175 (18.3)	148 (20.6)	0.234
Ever been sent to a rehabilitation centre	266 (15.9)	118 (12.3)	148 (20.6)	<0.001
Ever been imprisoned	188 (11.2)	104 (10.9)	84 (11.7)	0.595

*X² or Fisher's exact test was used.

†Multiple response variables.

PWUD, people who use drugs.

9.69), received HIV education in the past 3 months (AOR 3.40, 95% CI 2.63 to 4.40), a history of drug rehabilitation centre (AOR 1.60, 95% CI 1.13 to 2.29) and the self-perception of being at higher HIV risk than the general people (AOR 1.81, 95% CI 1.19 to 2.73).

DISCUSSION

This study estimated the prevalence of HIV testing and identified factors associated with recent HIV testing among PWUD in 12 major provinces of Cambodia. This study's findings indicated that both lifetime and periodic

Table 4 STIs, sexual behaviours, and self-perceived HIV risk among PWUD who had and had not tested for HIV in the past 6 months

Variables	Total (N=1677)	HIV testing in the past 6 months		P value*
		No (n=958)	Yes (n=719)	
Had STI symptom(s) in the past 1 year	540 (32.6)	269 (28.5)	271 (38.0)	<0.001
Sought treatment for the last STI symptoms (n=540)	403 (74.6)	189 (70.3)	214 (79.0)	0.020
Sexual behaviours in the past 3 months				
Sexually active†	1153 (74.5)	597 (70.2)	556 (79.7)	<0.001
Had more than one sex partner	578 (50.1)	269 (45.1)	309 (55.6)	<0.001
Always use condom with any partner	288 (24.9)	116 (19.3)	172 (30.8)	<0.001
Had sex when intoxicated	456 (39.6)	219 (36.5)	237 (42.9)	0.007
Had non-transactional	622 (53.7)	293 (48.8)	329 (58.9)	0.001
Had transactional sex	415 (35.8)	160 (26.6)	255 (45.5)	<0.001
Self-perceived HIV risk				<0.001
Lower	256 (15.3)	158 (16.5)	98 (13.6)	
Don't know	492 (29.3)	362 (37.8)	130 (18.1)	
Same	544 (32.4)	284 (29.7)	260 (36.2)	
Much higher	385 (23.0)	154 (16.1)	231 (32.1)	

*X² or Fisher's exact test was used.

†Having engaged in any sexual intercourse with one or more partners in the past 3 months.

PWUD, people who use drugs; STI, sexually transmitted infection.

Table 5 Access to HIV intervention programmes and education among PWUD who had and had not tested for HIV in the past 6 months

Variables	Total (N=1677)	HIV testing in the past 6 months		
		No (n=958)	Yes (n=719)	P value*
Received community-based HIV services in the past 6 months	615 (36.7)	124 (12.9)	491 (68.3)	<0.001
Received HIV education in the past 3 months	787 (46.9)	256 (26.7)	531 (73.9)	<0.001
Sources of HIV education†				
Media (TV/radio)	159 (20.2)	57 (22.3)	102 (19.2)	0.317
Printed material	141 (17.9)	46 (18.0)	95 (17.9)	0.979
HIV workshop/campaign	131 (16.7)	33 (12.9)	98 (18.5)	0.050
Peer educator/outreach worker	519 (66.0)	151 (59.0)	368 (69.3)	0.004
Drop-in centre	204 (25.9)	51 (19.9)	153 (28.8)	0.008
Health facility/VCCT	90 (11.4)	28 (10.9)	62 (11.7)	0.760

*X² or Fisher's exact test was used.

†Multiple response variables.

PWUD, people who use drugs; VCCT, voluntary HIV confidential counselling and testing site.

HIV testing rates among PWUD in Cambodia were suboptimal and need to be accelerated to meet the UNAIDS goal of diagnosing at least 95% of people living with HIV by 2030. The prevalence of recent HIV testing among PWUD (52%) was in between the prevalence rates reported in the corresponding country reports in other Southeast

Asian countries, including Malaysia (39%, IBBS 2017), Thailand (61%, IBBS 2014), Vietnam (62%, HIV sentinel surveillance, 2017) and Myanmar (28%, IBBS 2017).⁴¹ Of note, other than Cambodia, the recent HIV testing in the mentioned countries was defined as having an HIV test in the past 12 months. On the other hand, little is known about HIV testing among non-PWUD in this region. Overall, the prevalence of recent HIV testing of all PWUD in this study (42.9%) was much lower than a smaller study conducted in Phnom Penh in 2014 (83.3%), where the participants were only limited to PWUD in contact with a community-based HIV programme.⁴²

Our study also showed that nearly all (97%) of the recent HIV tests were performed in public and NGO facilities, including outreach in the community where testing services are provided free of charge. Several studies in other HIV key populations in Cambodia have consistently shown higher proportions of HIV tests being conducted in these settings and increasing trend in community-based peer-initiated testing.^{43–45} Individuals can also get an HIV test in private for-profit health settings. However, private HIV testing service is not common and much less than services provided by public and NGO facilities.^{34 46} Community-based approach with strong collaboration between the government and civil society organisations remains an essential user-friendly arm for bringing HIV services closer to the key populations. Meanwhile, a broader consideration of involving the potential private health facilities such as maternities and laboratories to introduce HIV testing services is warranted.

PWUD identifying themselves as female or the third gender were more likely to get an HIV test in the past 6 months. The higher testing rate among women who use drugs in this study is in line with that from a population-based survey among the general population in Cambodia where the proportion of participants who received an HIV test in the past 1 year was significantly higher in

Table 6 Multivariable logistic regression analysis of factors associated with HIV testing in the past 6 months among PWUD (n=1677)

Variables*	AOR (95% CI)	P value
Gender identity		
Male	Ref	
Female	1.55 (1.18 to 2.04)	0.001
Third gender	2.06 (1.11 to 3.80)	0.021
Been to a drug rehabilitation centre		
No	Ref	
Yes	1.60 (1.13 to 2.29)	0.009
Received HIV services in the past 6 months		
No	Ref	
Yes	7.37 (5.61 to 9.69)	<0.001
Received HIV education in the past 3 months		
No	Ref	
Yes	3.40 (2.63 to 4.40)	<0.001
Perceived HIV risk		
Lower	Ref	
Do not know	0.85 (0.57 to 1.27)	0.436
Same	1.33 (0.90 to 1.96)	0.148
Higher	1.81 (1.19 to 2.73)	0.005

*Other variables in the final model included age and injection drug use in the past 12 months.

AOR, adjusted OR; PWUD, people who use drugs; Ref, reference.

women than men (34.6% vs 25.3%).⁴⁷ These data also suggest the positive outcomes of implementing HIV initiatives in Cambodia that targeted female entertainment workers, transgender women and men who have sex with men communities due to the high HIV prevalence rates in these populations. Since 2013, the health provider-initiated testing and counselling model, which offers routine HIV testing, has been fully integrated into antenatal clinics in Cambodia.³⁴ However, compared with male PWUD, HIV is more prevalent among female PWUD, indicating the higher vulnerability to HIV infection among women attributed to various biological, social and cultural determinants.^{3 48} These findings indicate the vital importance of further exploration and understanding of the structural and cultural barriers, including gender difference in accessing HIV services in the Cambodian context, to better inform and engage all genders in HIV prevention programmes.

Although several studies indicated that injection drug use is positively associated with HIV test uptake,^{33 49 50} the higher odds of HIV testing among PWID were insignificant in this study after accounting for other covariates in the multivariable logistic regression analysis. This finding suggests that harm-reduction interventions that primarily target PWID, such as MMT and needle-and-syringe programmes, may not have been used effectively to increase the HIV testing rate among PWID. Meanwhile, criminalisation reinforces the marginalisation. A previous study in 2012 indicated that, despite the Cambodian government's recognition of the harm-reduction approach in controlling the HIV epidemic among PWUD, full implementation of harm-reduction interventions in the community was impeded owing to the lack of support from the law enforcement community operating on the ground and constrained budget.⁵¹ A following qualitative study in 2017 also revealed that negative experiences of PWUD, such as being arrested, discriminated or mistreated, have further discouraged and pushed them away from accessing harm-reduction and public health services.³⁰

In this study, 15.9% PWUD reported having ever been to a drug rehabilitation centre, which refers to the government and NGOs' compulsory detention. According to the standard operating procedures for HIV prevention, care, treatment, and support in prisons and correctional centres in Cambodia, voluntary HIV testing and counselling is provided at the correctional facilities every 6 months. However, even though a higher likelihood of getting an HIV test as accounted in this study, it was frequently reported that there is a lack of comprehensive services package and referral mechanism in the centres.³⁰ As a result, linkage to post-release services for HIV treatment, care, and prevention is often unclear or disrupted. Besides, human rights violations, including forced labour, physical abuse and sexual violence, and high levels of psychological distress were reported by PWUD, who had been to the mandatory rehabilitation centres.^{52 53} According to a study in 2010, it was

estimated that almost all PWUD (99%) in the compulsory drug detention centres were admitted involuntarily under coercive measures.⁵⁴ In the early 2010s, the United Nations agencies had advocated strongly to progressively shut down the compulsory centres and replaced them by implementing voluntary, rights-based, and evidence-informed drug dependence treatment and social support services in the community.⁵⁵ In the later stage, the Cambodian government acknowledged the need for a transition towards voluntary public health services and collaborated with local NGOs for the establishment of community-based drug treatment programmes in Phnom Penh and other provinces.⁵⁶

On the other hand, having access to HIV intervention programmes and receiving HIV-related education are strongly associated with recent HIV testing. Peer educators and community outreach workers familiar or close to PWUD are among the most effective channels in delivering HIV education. Peer-driven interventions, including HIV education, testing and counselling, are well-accepted and effective at raising awareness of HIV risk behaviours and increasing HIV testing rates in many other studies.^{57–59} Such strategies are also aligned with the mission of the Cambodia's Ministry of Health to decentralise HIV testing from health facilities to community-based settings.

The perception of personal HIV risk is often an essential component in HIV interventions to engage an individual in HIV prevention behaviour.⁶⁰ In this study, PWUD having a recent HIV test were more likely to perceive that their HIV risk was higher than that of the general people. One possible explanation is that PWUD with the correct HIV risk perception might be more vigilant about contracting HIV and could have prompted to take relevant precautionary measures such as HIV testing, as accounted in this study. However, most of the PWUD did not know about their HIV risk or have a false perception of lower HIV risk. This finding underlines the need for HIV risk perception assessment during outreach programmes. It also suggests that HIV interventions aiming to enhance or change HIV risk self-perception would be useful in promoting regular HIV testing behaviour among PWUD.

This national survey recruited a large sample of PWID and non-PWID from 12 provinces with a high HIV prevalence and drug use burden using a peer-based social network recruitment method. The method is a recommended methodology that uses the social networks of the target group to facilitate the recruitment of stigmatised and hidden populations.⁶¹ The research team had tried to attain the broadest possible generalisability while ensuring the study's feasibility.

However, several limitations need to be taken into consideration when interpreting the study findings. First, we could not rule out the recruitment bias because we did not include PWUD from the other 13 provinces with a lower HIV and drug use burden and those imprisoned or detained in compulsory rehabilitation centres. Second, this study provides only a snapshot of the HIV

testing scenarios among PWUD and its correlates, given the cross-sectional design. Nevertheless, it does not provide causal inferences. Third, one of the challenges in implementing peer-based social network recruitment is that the reliance on incentives could motivate individuals to participate in a study even if they do not meet the inclusion criteria. However, we anticipate that this bias was minimal as an individual's eligibility to participate in the study was carefully determined by data collection team leaders using an eligibility screening form. Furthermore, the incentive amount of US\$5 was sufficient only to compensate for the participants' time and transport cost. Lastly, given the self-reported data, the responses' validity was likely to be affected by social desirability and recall bias.⁶² For example, participants with better knowledge of HIV might have been aware of the social desirability of reporting more recent HIV testing. In contrast, some participants may have difficulty recalling their last HIV test. However, we minimised the bias by having thorough training of interviewers in dealing with sensitive questions and conducting the interviews in confidential and private settings.

CONCLUSIONS

This study provides valuable information and highlights the potential areas for the improvement of HIV screening programmes that could effectively address the needs of PWUD in Cambodia. The prevalence of HIV testing remained inadequate. Recent HIV testing was positively associated with being female or third gender identity, having been to a drug rehabilitation centre, having received recent HIV education and the self-perception of high HIV risk. Greater emphasis should be placed on these determinants for HIV testing when designing intervention strategies. In the context of scarce resources, our findings suggest the prioritisation of the expansion of user-friendly, community-based peer-driven interventions, including testing, counselling and education, to reaching out more hidden PWUD living with HIV to achieve the global and national strategic diagnosis goals of HIV.

Acknowledgements The National Integrated Biological and Behavioural Survey among People Who Use Drugs (IBBS-PWUD 2017) was conducted by the National Center for HIV/AIDS, Dermatology and STD (NCHADS) in collaboration with the National Authority for Combating Drugs (NACD) and KHANA. The authors would like to thank all the dedicated data collection teams and participants for their substantial efforts and time contributing to this study's success.

Contributors CWE and SY conducted the statistical analyses, interpretation and drafting of the manuscript. SY, ST, NC, PC and PM designed the study and tools, and oversaw the study's implementation. ST, NC, PC and PM were responsible for data collection and management. All authors contributed to the conceptualisation of the research questions, interpretation of the results and manuscript writing. All authors read and approved the final manuscript.

Funding The National Integrated Biological and Behavioural Survey among People Who Use Drugs (IBBS-PWUD 2017) was funded by the Global Fund to Fight AIDS, Tuberculosis, and Malaria through the National Center for HIV/AIDS, Dermatology and STD, Cambodia.

Competing interests None declared.

Patient and public involvement statement No patients were involved in this study.

Patient consent for publication Not required.

Ethics approval This study was approved by the National Ethics Committee for Health Research of Cambodia (062 NECHR, dated 27 July 2017).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data used for this study can be accessed upon request from the principal investigator (SY) at siyan@doctor.com.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Chee Wen Eng <http://orcid.org/0000-0002-0699-8743>

Siyan Yi <http://orcid.org/0000-0002-3045-5386>

REFERENCES

- 1 HIV/AIDS JUNPo. *Cambodia takes MDG prize for excellence in its AIDS response*. Geneva: UNAIDS, 2010.
- 2 Mills E, Singh S, Orbinski J, *et al*. The HIV/AIDS epidemic in Cambodia. *Lancet Infect Dis* 2005;5:596–7.
- 3 Sopheab H, Chhea C, Tuot S, *et al*. HIV prevalence, related risk behaviors, and correlates of HIV infection among people who use drugs in Cambodia. *BMC Infect Dis* 2018;18:562.
- 4 Chhea C, Heng S, Tuot S. *National population size estimation, HIV related risk behaviors and HIV prevalence among people who use drugs in Cambodia in 2012*. Phnom Penh: National Authority for Combating Drugs and KHANA, 2014.
- 5 World Health Organization. *Consolidated guidelines on HIV prevention, diagnosis, treatment and care for key populations—2016 update*, 2016.
- 6 Mun P, Yi S, Dousset J. *National integrated biological and behavioral survey and population size estimation among people who use and inject drugs in Cambodia: Ministry of Health, National Center for HIV/AIDS, Dermatology and STD*, 2017.
- 7 Tuot S, Mburu G, Mun P, *et al*. Prevalence and correlates of HIV infection among people who use drugs in Cambodia: a cross-sectional survey using respondent driven sampling method. *BMC Infect Dis* 2019;19:1–11.
- 8 Reid G, Devaney ML, Baldwin S. Drug production, trafficking and trade in Asia and Pacific Island countries. *Drug Alcohol Rev* 2006;25:647–50.
- 9 Yi S, Poudel KC, Yasuoka J, *et al*. Risk vs. protective factors for substance use among adolescents in Cambodia. *J Subst Use* 2011;16:14–26.
- 10 Degenhardt L, Peacock A, Colledge S, *et al*. Global prevalence of injecting drug use and sociodemographic characteristics and prevalence of HIV, HBV, and HCV in people who inject drugs: a multistage systematic review. *Lancet Glob Health* 2017;5:e1192–207.
- 11 Strathdee SA, Stockman JK. Epidemiology of HIV among injecting and non-injecting drug users: current trends and implications for interventions. *Curr HIV/AIDS Rep* 2010;7:99–106.
- 12 Vun MC, Fujita M, Rathavy T, *et al*. Achieving universal access and moving towards elimination of new HIV infections in Cambodia. *J Int AIDS Soc* 2014;17:18905.
- 13 Tavitian-Exley I, Vickerman P, Bastos FI, *et al*. Influence of different drugs on HIV risk in people who inject: systematic review and meta-analysis. *Addiction* 2015;110:572–84.

- 14 Des Jarlais DC, Arasteh K, McKnight C, *et al.* What happened to the HIV epidemic among non-injecting drug users in New York City? *Addiction* 2017;112:290–8.
- 15 Werb D, Kerr T, Buxton J, *et al.* Crystal methamphetamine and initiation of injection drug use among street-involved youth in a Canadian setting. *CMAJ* 2013;185:1569–75.
- 16 O’Keefe D, Horyniak D, Dietze P. From initiating injecting drug use to regular injecting: retrospective survival analysis of injecting progression within a sample of people who inject drugs regularly. *Drug Alcohol Depend* 2016;158:177–80.
- 17 Neaigus A, Miller M, Gyarmathy VA, *et al.* HIV heterosexual sexual risk from injecting drug users among HIV-seronegative noninjecting heroin users. *Subst Use Misuse* 2011;46:208–17.
- 18 Larney S, Mathers BM, Poteat T, *et al.* Global epidemiology of HIV among women and girls who use or inject drugs: current knowledge and limitations of existing data. *J Acquir Immune Defic Syndr* 2015;69:S100.
- 19 Nadol P, Tran H, Hammett T, *et al.* High HIV prevalence and associated risk factors among female sexual partners of male injection drug users (MWID) in Ho Chi Minh City, Vietnam. *AIDS Behav* 2016;20:395–404.
- 20 Joint United Nations Programme on HIV/AIDS. Fast-track: ending the AIDS epidemic by 2030. Geneva: joint United nations programme on HIV. *AIDS* 2014.
- 21 Sweat M, Gregorich S, Sangiwa G, *et al.* Cost-effectiveness of voluntary HIV-1 counselling and testing in reducing sexual transmission of HIV-1 in Kenya and Tanzania. *Lancet* 2000;356:113–21.
- 22 Li J, Gilmour S, Zhang H, *et al.* The epidemiological impact and cost-effectiveness of HIV testing, antiretroviral treatment and harm reduction programs. *AIDS* 2012;26:2069–78.
- 23 Tiwari R, Wang J, Han H, *et al.* Sexual behaviour change following HIV testing services: a systematic review and meta-analysis. *J Int AIDS Soc* 2020;23:e25635.
- 24 Marks G, Crepaz N, Janssen RS. Estimating sexual transmission of HIV from persons aware and unaware that they are infected with the virus in the USA. *AIDS* 2006;20:1447–50.
- 25 Pendse R, Gupta S, Yu D, *et al.* HIV/AIDS in the South-East Asia region: progress and challenges. *J Virus Erad* 2016;2:1–6.
- 26 World Health Organization, UNAIDS. *Global AIDS response progress reporting 2015*. Geneva, Switzerland, 2014.
- 27 Degenhardt L, Mathers BM, Wirtz AL, *et al.* What has been achieved in HIV prevention, treatment and care for people who inject drugs, 2010-2012? A review of the six highest burden countries. *Int J Drug Policy* 2014;25:53–60.
- 28 Islam MM, Topp L, Iversen J, *et al.* Healthcare utilisation and disclosure of injecting drug use among clients of Australia’s needle and syringe programs. *Aust N Z J Public Health* 2013;37:148–54.
- 29 Lan C-W, Lin C, Thanh DC, *et al.* Drug-related stigma and access to care among people who inject drugs in Vietnam. *Drug Alcohol Rev* 2018;37:333–9.
- 30 Tuot S, Ngin C, Pal K, *et al.* How understanding and application of drug-related legal instruments affects harm reduction interventions in Cambodia: a qualitative study. *Harm Reduct J* 2017;14:39.
- 31 Saw YM, Poudel KC, Kham NPE, *et al.* Assessment of HIV testing among young methamphetamine users in MUSE, Northern Shan state, Myanmar. *BMC Public Health* 2014;14:735.
- 32 Bazazi AR, Vijay A, Crawford FW, *et al.* HIV testing and awareness of HIV status among people who inject drugs in greater Kuala Lumpur, Malaysia. *AIDS Care* 2018;30:59–64.
- 33 Jiang Z, Xiu C, Yang J, *et al.* HIV test uptake and related factors amongst heterosexual drug users in Shandong Province, China. *PLoS One* 2018;13:e0204489.
- 34 Ministry of Health & The National Center for HIV/AIDS Dermatology and STDs. *National consolidated guidelines on HIV testing services in Cambodia*. Phnom Penh: NCHADS, 2017.
- 35 World Bank. “Cambodia overview”: the World Bank Group, 2015. Available: <https://www.worldbank.org/en/country/cambodia/overview>
- 36 Mburu G, Chhoun P, Chann N, *et al.* Prevalence and risk factors of HIV infection among people who inject drugs in Cambodia: findings from a national survey. *Subst Abuse Treat Prev Policy* 2019;14:1–10.
- 37 Saing CH, Prem K, Uk P, *et al.* Risk factors associated with HIV and hepatitis C virus co-infection among people who inject drugs in Cambodia. *Int J Drug Policy* 2020;86:102974.
- 38 Saing CH, Prem K, Uk P, *et al.* Prevalence and social determinants of psychological distress among people who use drugs in Cambodia. *Int J Ment Health Syst* 2020;14:1–10.
- 39 Yi S, Prem K, Chhoun P, *et al.* Syphilis infection among people who use and inject drugs in Cambodia: a cross-sectional study using the respondent-driven sampling method. *Int J STD AIDS* 2020;31:832–40.
- 40 Saw YM, Yasuoka J, Saw TN, *et al.* What are the factors associated with HIV testing among male injecting and non-injecting drug users in Lashio, Myanmar: a cross-sectional study. *BMJ Open* 2013;3:e002747.
- 41 HIV and AIDS Data Hub for Asia and the Pacific. HIV testing among people who inject drugs.
- 42 Mburu G, Ngin C, Tuot S, *et al.* Patterns of HIV testing, drug use, and sexual behaviors in people who use drugs: findings from a community-based outreach program in Phnom Penh, Cambodia. *Addict Sci Clin Pract* 2017;12:27.
- 43 Page K, Stein E, Sansothy N, *et al.* Sex work and HIV in Cambodia: trajectories of risk and disease in two cohorts of high-risk young women in Phnom Penh, Cambodia. *BMJ Open* 2013;3:e003095.
- 44 Yi S, Tuot S, Chhoun P, *et al.* The impact of a community-based HIV and sexual reproductive health program on sexual and healthcare-seeking behaviors of female entertainment workers in Cambodia. *BMC Infect Dis* 2015;15:221.
- 45 Yi S, Tuot S, Chhoun P, *et al.* Factors associated with recent HIV testing among high-risk men who have sex with men: a cross-sectional study in Cambodia. *BMC Public Health* 2015;15:743.
- 46 Johnson D, Cheng X. The role of private health providers in HIV testing: analysis of data from 18 countries. *Int J Equity Health* 2014;13:36.
- 47 Peltzer K, Pengpid S. Determinants of knowledge of HIV status in Cambodia: results from a population-based survey. *J Hum Ecol* 2014;47:27–33.
- 48 Türmen T. Gender and HIV/AIDS. *Int J Gynaecol Obstet* 2003;82:411–8.
- 49 Frimpong JA, Guerrero EG, Kong Y, *et al.* Correlates of HIV testing and receipt of test results in addiction health services in Los Angeles County. *Subst Abuse Treat Prev Policy* 2015;10:31.
- 50 Stein JA, Nyamathi A. Gender differences in behavioural and psychosocial predictors of HIV testing and return for test results in a high-risk population. *AIDS Care* 2000;12:343–56.
- 51 Chheng K, Leang S, Thomson N, *et al.* Harm reduction in Cambodia: a disconnect between policy and practice. *Harm Reduct J* 2012;9:30.
- 52 Yi S, Tuot S, Chhoun P, *et al.* Prevalence and correlates of psychological distress among drug users in Phnom Penh, Cambodia. *Int J Drug Policy* 2016;36:25–32.
- 53 Amon J, Pearshouse R, Cohen J, *et al.* Compulsory drug detention centers in China, Cambodia, Vietnam, and Laos: health and human rights abuses. *Health Hum Rights* 2013;15:124–37.
- 54 Amon J, Schleifer R. “Skin on the cable”: the illegal arrest, arbitrary detention and torture of people who use drugs in Cambodia: *Human rights watch (HRW)*, 2010.
- 55 Amon JJ, Pearshouse R, Cohen JE, *et al.* Compulsory drug detention in East and Southeast Asia: evolving government, UN and donor responses. *Int J Drug Policy* 2014;25:13–20.
- 56 Tanguay P, Stoicescu C, Cook C. *Community-based drug treatment models for people who use drugs: six experiences on creating alternatives to compulsory detention centers in Asia*. London: Harm Reduction International, 2015.
- 57 Ti L, Hayashi K, Kaplan K, *et al.* HIV testing and willingness to get HIV testing at a peer-run drop-in centre for people who inject drugs in Bangkok, Thailand. *BMC Public Health* 2012;12:189.
- 58 Markwick N, Ti L, Callon C, *et al.* Willingness to engage in peer-delivered HIV voluntary counselling and testing among people who inject drugs in a Canadian setting. *J Epidemiol Community Health* 2014;68:675–8.
- 59 Ti L, Hayashi K, Hattirat S, *et al.* ‘Drug users stick together’: HIV testing in peer-based drop-in centres among people who inject drugs in Thailand. *Sex Health* 2015;12:263–8.
- 60 Napper LE, Fisher DG, Reynolds GL. Development of the perceived risk of HIV scale. *AIDS Behav* 2012;16:1075–83.
- 61 Johnston L, Sabin K, Prybylski D. Update for sampling most-at-risk and hidden populations for HIV biological and behavioral surveillance. *JHASE* 2010;2.
- 62 Latkin CA, Vlahov D, Anthony JC. Socially desirable responding and self-reported HIV infection risk behaviors among intravenous drug users. *Addiction* 1993;88:517–26.