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Diverse HIV epidemics among people who inject drugs in Thailand: Evidence from respondent-driven sampling surveys in Bangkok and Chiang Mai☆

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Abstract

Background—Thailand's long-standing HIV sero-sentinel surveillance system for people who inject drugs (PWID) is confined to those in methadone-based drug treatment clinics and representative data are scarce, especially outside of Bangkok.

Methods—We conducted probability-based respondent-driven sampling (RDS) surveys in Bangkok (n = 738) and Chiang Mai (n = 309) to increase understanding of local HIV epidemics and to better inform the planning of evidence-based interventions.

Results—PWID had different epidemiological profiles in these two cities. Overall HIV prevalence was higher in Bangkok (23.6% vs. 10.9%, $p < 0.001$) but PWID in Bangkok are older and appear to have long-standing HIV infections. In Chiang Mai, HIV infections appear to be more recently acquired and PWID were younger and had higher levels of recent injecting and sexual risk behaviors with lower levels of intervention exposure. Methamphetamine was the predominant drug injected in both sites and polydrug use was common although levels and patterns of the specific drugs injected varied significantly between the sites. In multivariate analysis, recent midazolam injection was significantly associated with HIV infection in Chiang Mai (adjusted odds ratio = 8.1; 95% confidence interval: 1.2–54.5) whereas in Bangkok HIV

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Conflict of interest

All authors have no conflicts of interest with respect to the submitted manuscript.

status was not associated with recent risk behaviors as infections had likely been acquired in the past.

Conclusion—PWID epidemics in Thailand are heterogeneous and driven by local factors. There is a need to customize intervention strategies for PWID in different settings and to integrate population-based survey methods such as RDS into routine surveillance to monitor the national response.

Keywords

People who inject drugs; HIV; Risk behaviors; Respondent-driven sampling; Thailand

1. Introduction

Since the late 1980s, people who inject drugs (PWID) have been tracked as a key population in annual national HIV sentinel surveillance prevalence surveys conducted by the Thailand Ministry of Public Health (MOPH). These surveys have shown that HIV seroprevalence remained high at 30–50% over the last two decades (Brown et al., 1994; Thai National AIDS Committee, 2014). However, participants in these surveys have been recruited exclusively from drug treatment centers where the main service is methadone treatment for opiate users.

Studies among PWID in Thailand have been conducted mainly in Bangkok and have typically recruited participants enrolled in clinical trials (Martin et al., 2010; Pitisuttithum et al., 2006; van Griensven et al., 2005; Vanichseni et al., 2001) or from studies that used convenience-based sampling methods (Fairbairn et al., 2009; Hayashi et al., 2011; Kerr et al., 2009, 2010; Werb et al., 2009). Few community-based epidemiological studies have used methods appropriate to obtain data on representative samples of PWID such as respondent-driven sampling (RDS; Heckathorn, 1997, 2002; Johnston et al., 2010, Magnani et al., 2005). This situation exists despite the international recommendation to routinely implement such surveys among PWID populations (World Health Organization, 2012). An RDS survey was conducted in Bangkok in 2003–2004 but did not measure HIV seroprevalence and was carried out during an anti-drug campaign, commonly referred to as the “war on drugs”, that likely resulted in under-recruitment of out-of-treatment PWID (Wattana et al., 2007).

In Thailand, there has been a shift in the observed pattern of injection drug use away from heroin, which was the predominant drug during the 1980–1990s (Vanichseni et al., 2001; Weniger et al., 1991), to methamphetamine and midazolam (a short-acting benzodiazepine; Hayashi et al., 2011; Martin et al., 2010; van Griensven et al., 2005; Vongchak et al., 2005; Werb et al., 2009). The “war on drugs” in Thailand was launched in 2003 and the resulting intensified drug law enforcement, the declining demand and increased price of heroin all likely contributed to this trend (van Griensven et al., 2005; Vongchak et al., 2005). The shift away from heroin use over time has compromised the usefulness of surveillance data collected from methadone treatment clinics. For example, there is a lack of systematic data from both methamphetamine and midazolam injectors despite increasing use of these drugs

and the fact that both drugs are associated with increased HIV risk behavior (Fairbairn et al., 2007; Martin et al., 2010; van Griensven et al., 2005).

Outside Bangkok, epidemiologic data on PWID are even more limited. This is of concern because the characteristics and dynamics of HIV epidemics among PWID are often localized and heterogeneous (Mathers et al., 2008; Sharma et al., 2009). Chiang Mai is a major northern city with documented high HIV prevalence among in-treatment PWID (Thailand Ministry of Health, 2009). The city is located near the 'Golden Triangle', a major source of opium production in the past, and more recently an entry route for both heroin and methamphetamine from bordering countries. In the late 1990s, the pattern of drug use in Chiang Mai, and Northern Thailand more broadly, has shifted from opiates to methamphetamines (Razak et al., 2003). Early after its introduction methamphetamine was typically smoked, taken orally or inhaled (UNODC, 2012), but there is evidence that injecting is increasing (McKetin et al., 2008).

We conducted community-based RDS surveys in Bangkok and Chiang Mai to help fill gaps in the understanding of local HIV epidemics among PWID and to inform the planning of evidence-based prevention, treatment, and care interventions and a more robust national surveillance system.

2. Methods

2.1. Survey design

RDS is a type of chain-referral sampling designed to sample hard-to-reach populations not typically reached through venue-based sampling methods (Heckathorn, 1997, 2002). RDS uses a dual system of structured compensation and quota limits on each individual's ability to recruit members of their social network to reduce biases associated with other chain-referral methods. An initially selected group of participants ("seeds") are purposively recruited who in turn recruit and refer their peers, continuing in multiple 'waves' of recruitment. At both locations in this study, seeds were selected by study investigators and clinic staff, with careful attention to diversities such as sex, type of drug use, and age.

2.2. RDS sites

In Bangkok, we used the office of a non-governmental organization, O-zone, as the site where we implemented RDS. O-zone has extensive experience working with the drug user population in Bangkok, including conducting outreach, education, and prevention with drug users. In Chiang Mai, the survey site was an office of the Research Institute for Health Sciences (RIHES) which was used for a concurrent intervention trial with PWID. Both sites were in accessible neighborhoods that include private rooms for interviewing, counseling and specimen collection.

2.3. Inclusion criteria

Eligible PWID were 18 years old or older who injected illicit drugs in the last six months and were able and agreed to provide informed consent. Recruited participants in Bangkok

and Chiang Mai must have been living or working in the respective cities at the time of the survey and in possession of a valid referral coupon.

2.4. Survey procedures

Cross-sectional RDS surveys were conducted in Bangkok and Chiang Mai during March to October, 2009. Eligibility was assessed by trained survey staff in the nongovernmental survey sites (see Section 2.3) and participants were asked to show injection marks and were administered a list of screening questions to confirm that they met the PWID inclusion criteria. Consenting participants completed a survey questionnaire administered by interviewers, who were trained to make participants feel comfortable during the interview process and elicit and record accurate information, and resulting data were entered into handheld personal digital assistants (PDAs). Participants also provided blood specimens for on-site rapid HIV testing (Determine HIV-1/2 Abbott Japan Ltd, Tokyo, Japan). Two confirmatory tests were conducted for those screening HIV-positive according to the MOPH national laboratory testing guidelines (Thailand Ministry of Public Health, 2011). HIV-positive participants were referred for care at local public facilities and CD4 count testing was provided at no cost. Participants were given not more than three coupons to recruit their peers. They received compensation of 400 Thai Baht (USD 11.5) for their time in completing the questionnaire and serological specimen collection and 80 Thai Baht (USD 2.3) for each recruited peer up to a maximum of 240 Thai Baht (USD 6.9) for three peers.

2.5. Data management and analysis

Questionnaire data from the handheld PDAs was synched to a Microsoft Access database and linked and merged with laboratory data using a confidential 17-digit coupon ID number. Respondent-Driven Sampling Analysis Tool (RDSAT) Version 6.0.1 (Cornell University, NY, USA) was used to generate univariate estimates of key variables that were weighted by network size and recruitment patterns. A design effect of 2.0 was used in RDSAT to account for potential clustering among recruits (Volz et al., 2009). RDSAT-generated weights data were exported to STATA 11.0 (College Station, Texas, USA) for bivariate analysis of variables (i.e., sociodemographics, injecting and sexual risk behaviors, exposure to HIV interventions, and HIV infection status) comparing participants in Bangkok with those in Chiang Mai. The Marascuilo procedure was used to calculate *p*-values for inter-city comparison estimates using standard errors adjusted with RDSAT (Marascuilo, 1966). Characteristics that could not be assessed by RDSAT were tested crudely using the Pearson chi-square test or Fisher Exact test as appropriate. In addition, bivariate analyses were conducted to examine factors associated with HIV infection in both cities. Probabilities were calculated by *Z* tests and adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs) were generated. All statistical testing was two-tailed and a *p*-value <0.05 was considered statistically significant. Weighted data in STATA software were also used to conduct multiple logistic regression modeling to identify factors associated with HIV prevalence in both Bangkok and Chiang Mai. Only variables that were associated at a level of $p \leq 0.10$ in bivariate analysis were entered into the multivariate models to determine factors that were independently associated with HIV infection at $p < 0.05$.

2.6. Ethical considerations

No personal identifying data were collected as part of this study. All records and specimens were labeled using the coupon ID number. The survey was approved by the Ethical Review Committee, Thailand MOPH, and the Institutional Review Board, Centers for Disease Control and Prevention, Atlanta, USA.

3. Results

3.1. RDS seeds and survey flow

In Bangkok, ten seeds were purposively selected to initiate peer recruitment into the survey, six were men, three were less than 30 years of age and five were currently in methadone treatment. Eight of the ten seeds successfully recruited peers and among these eight seeds the number of propagated recruitment waves ranged from 2 to 15 per seed. A total of 808 individuals including seeds were screened for eligibility. Of these, 738 (91.3%) PWID met the eligibility criteria and agreed to participate in the survey.

Of the eight seeds selected in Chiang Mai, six were men, three were less than 30 years of age and three were undergoing treatment at a methadone treatment clinic. All eight seeds successfully recruited peers and the number of propagated recruitment waves per seed ranged from 2 to 17. A total of 397 individuals were screened and 309 (77.8%) eligible PWID agreed to participate.

3.2. Sociodemographic characteristics of participants

The characteristics of survey participants in the two cities are presented in Table 1. Over four-fifths of participants in both Bangkok and Chiang Mai were men; participants in Chiang Mai were much younger, less likely to be unemployed, and reported a lower monthly income. Similar proportions of participants reported being held in prison in the last 12 months, but Bangkok participants were more likely to have been detained in a police holding cell.

3.3. Injecting drug use behaviors

3.3.1. General drug use—Participants drug use behaviors are shown in Table 1. A higher proportion of participants in Bangkok reported injecting drugs in the last month than in Chiang Mai. Of those who reported injecting drugs in the last month, over twice the proportion of participants reported injecting multiple drugs in Bangkok than in Chiang Mai.

Reflecting the younger age of participants in Chiang Mai, participants in this city were nine times as likely to report that they first started injecting drugs in the last two years as those in Bangkok. Chiang Mai participants were also much more likely to report sharing needles during the last 6 months and during their last injection.

3.3.2. Heroin injecting drug use—Approximately one-third of participants reported injecting heroin in the last month in both cities. Among those who injected heroin in the last month, participants in Bangkok were more than twice as likely to inject one or more other

drugs as participants in Chiang Mai. Approximately one-third of heroin injectors reported injecting heroin at least daily within the last month in both cities.

3.3.3. Methamphetamine injecting drug use—Twice as many participants in Bangkok reported injecting methamphetamine in the last month as in Chiang Mai. Among those who injected methamphetamine in the last month, comparable proportions in both cities reported injecting at least one other type of drug. A higher proportion of participants in Bangkok reported injecting methamphetamine at least daily within the last month than in Chiang Mai.

3.3.4. Midazolam injecting drug use—Participants in Bangkok were more than ten times as likely (42.2%) to report having injected midazolam in the last month as in Chiang Mai (4.0%). Among those who injected midazolam in the last month, 86.0% and 70.8% of participants in Bangkok and Chiang Mai respectively reported injecting at least one other type of drug and injecting midazolam at least daily within the last month.

3.3.5. Opium injecting drug use—The prevalence of opium injection in the last month was low in both cities but higher in Chiang Mai. Cell sizes were too small to do meaningful statistical analyses for other opium-injecting characteristics.

3.3.6. Methadone injecting drug use—The prevalence of methadone injection in the last month was higher in Bangkok than Chiang Mai. Among those who injected methadone in the last month, comparable and high proportions of participants in Bangkok and Chiang Mai reported injecting at least one other type of drug.

3.4. Sexual risk behaviors

In both cities slightly less than half of participants reported having had sex with a regular partner in the last month, with only about one-fifth reporting condom use during their last sex with a regular partner (Table 2). Compared to their Bangkok counterparts, a higher proportion of Chiang Mai participants reported casual and commercial sex partners in the last month. Participants in Chiang Mai were also less likely to use condoms during last sex with both casual and commercial partners and were also more likely to report multiple sex partners in the last month.

There was substantial overlap of injecting and sexual risk behaviors in both cities, with approximately one-fifth of participants reporting at least one sex partner in the last month who injected drugs. Over one-third of participants in Chiang Mai reported both sharing injection needles and not using a condom during last sex and this figure (34.1%) was six times as high as the corresponding proportion (5.7%) in Bangkok. Among male participants, a higher proportion of participants in Chiang Mai (13.7%) than in Bangkok (4.5%) reported having sex with another man in the last six months. The sample size was too small to assess condom use with male partners.

3.5. Exposure to HIV prevention interventions

Participants in Chiang Mai reported lower levels of HIV testing than participants in Bangkok (Table 2). Only one-fifth of Chiang Mai participants received HIV testing with results in the last six months, compared to nearly sixty percent of Bangkok participants. Participants in Chiang Mai were also less likely to have been in drug treatment than participants in Bangkok (Table 3). While there were no peer outreach services available in Chiang Mai at the time of the survey, over 40% of participants in Bangkok reported access to peer outreach interventions in the last three months.

3.6. HIV prevalence

HIV prevalence was higher among participants in Bangkok than among participants in Chiang Mai (23.6% vs. 10.8%, $p < 0.001$).

3.6.1. Factors associated with HIV infection in Bangkok—Among Bangkok participants the following variables were associated with HIV infection in bivariate analysis (Table 3): having ever been in drug treatment, having used a condom during last sex with any partner and, having had an HIV test with test results in the last 6 months. In multivariate analysis, having ever been in drug treatment (AOR = 3.9, 95%CI: 1.4–9.7) and having had an HIV test with test results in the last 6 months (AOR = 0.2; 95%CI: 0.1–0.4) were the only significant independent factors associated with HIV prevalence.

3.6.2. Factors associated with HIV infection in Chiang Mai—In Chiang Mai, HIV prevalence was higher among participants who reported injecting drugs in the last month (15.7% vs. 1.2%, $p < 0.01$) and among participants who injected multiple drugs (34.5% vs. 10.4%, $p < 0.001$) in bivariate analysis (Table 3). HIV infection was also higher among participants who injected methamphetamine, midazolam or methadone in the last month. In multivariate analysis the only factor that was significantly associated with HIV infection was injecting midazolam in the last month (AOR = 8.1, 95% CI: 1.2–54.5).

4. Discussion

These RDS surveys are the first to our knowledge to measure HIV prevalence among representative community-based samples of PWID in Thailand. Findings indicate that PWID in Bangkok and Chiang Mai have markedly different epidemiological profiles. Participants in Chiang Mai were younger, poorer, had higher levels of recent injecting and sexual risk behaviors, with less exposure to risk reduction interventions such as contact with peer outreach workers, HIV testing and counseling or drug treatment.

While overall HIV prevalence was significantly higher among PWID in Bangkok than in Chiang Mai, HIV infections in Bangkok appear to be largely long-standing infections concentrated among older PWID who have been injecting drugs for many years. This corroborates previous results from Bangkok-based clinical trials but among a more representative sample of PWID (Martin et al., 2011; van Griensven et al., 2005). Indeed, HIV infection in Bangkok was not significantly associated with recent injecting risk behavior, which also suggests that these infections were acquired in the more distant past. In Bangkok, PWID who had a history of drug treatment were more likely to be HIV infected.

This is likely explained by the fact that the same illegal behaviors that led to increased risk of being detained in drug treatment (such as congregating with other PWID in public places and sharing needles) are risk factors for acquiring HIV. Similarly, the negative association between HIV infection and recent HIV testing is also likely explained by the fact that PWID who were HIV-infected in the past would not be expected to seek recent HIV-testing due to their awareness of their HIV-positive status. Historically, HIV testing has been mandatory in many drug treatment centers in Thailand and this involuntary HIV testing policy continues to pose an ethical dilemma. While knowledge of HIV status allows for potential linkage to HIV care and treatment services, HIV testing services should be voluntary. This finding further indicates that HIV prevalence estimated on the basis of PWID accessing methadone clinics may be biased in that HIV-infected PWID are more likely to be sampled than PWID in the general population, highlighting the importance of conducting representative community-based surveillance. We found that less than one-third of PWID in Bangkok were currently in drug treatment, a dramatic decline from two-thirds or higher reported in previous studies (Choopanya et al., 2013; Martin et al., 2011; Pitisuttithum et al., 2006; van Griensven et al., 2005; Wattana et al., 2007). This decline further demonstrates the inadequacy of the existing national sentinel surveillance system which is based on sampling PWID at public methadone clinics.

In our survey, PWID in Chiang Mai appear more likely to have been recently infected; HIV prevalence among young participants, a proxy measure of incidence, was twice as high in Chiang Mai compared to Bangkok. Chiang Mai participants were also more likely to be new injectors and to have shared needles. HIV infection in Chiang Mai was also clearly associated with recent injecting behavior, including the injection of a range of drug classes; methamphetamine, methadone, and particularly midazolam. Our finding that recent injecting midazolam use was independently associated with HIV infection in Chiang Mai is particularly important given reports of increasing midazolam injecting use in Thailand and the numerous health-related harms associated with its use including needle-sharing, overdose and injecting-related health problems (Hayashi et al., 2012; Kerr et al., 2010). Hayashi and colleagues found that in Bangkok midazolam use was associated with femoral vein injection and various risk factors for injected-related complications (Hayashi et al., 2012). Given that injecting midazolam use levels are still relatively low and emerging in Chiang Mai, a lack of knowledge and skills about how to inject safely may have increased HIV transmission risk compared to PWID where injectors are older and more experienced. In Bangkok, we corroborated the results of other studies that have found high levels of midazolam injecting use (Hayashi et al., 2012; Kerr et al., 2010; van Griensven et al., 2005; Werb et al., 2009). Midazolam distribution is focused in Bangkok and it is a cheaper and more accessible substitute for heroin, especially as heroin has become less available and more expensive (Kerr et al., 2010). There is an urgent need more research on this rapidly emerging problem. For example, it will be important to learn more about the injecting practices that may be leading to increased HIV and other blood-borne infection transmission (e.g., is femoral artery injection) to rapidly inform the implementation of customized educational and harm reduction interventions as part of a comprehensive combination prevention strategy.

While patterns of if injecting drug use were different in Bangkok and Chiang Mai, methamphetamine was the most commonly reported injecting drug in both cities. In Bangkok our results corroborate results from other studies in showing an increasing trend of methamphetamine use and decreasing heroin use (Hayashi et al., 2011; Kerr et al., 2010; Martin et al., 2010, 2011; Poshyachinda et al., 2005; van Griensven et al., 2005; Wattana et al., 2007; Werb et al., 2009). In Chiang Mai our results extend earlier findings of what was previously an emerging epidemic of mainly non-injecting methamphetamine use among young users with elevated levels of high risk sexual activity (Beyrer et al., 2004). Thailand has consistently been one of the leading countries for methamphetamine seizures, reporting the equivalent of ten million tons in 2012 (UNODC, 2014) and there is a strong need for clear and strategic policy recommendations on how to address the health-related harms among these injectors who are not traditionally served by the drop in centers that were designed in the past for heroin injectors. Our study findings also show that methadone injection was also higher in Bangkok than Chiang Mai. Methadone-based treatment sites in Thailand are concentrated in Bangkok but more research is needed here as few studies have reported on its non-therapeutic use. On the other hand, opium injection was more common in Chiang Mai, which is consistent with opium production and distribution being focused in Northern Thailand (Razak et al., 2003).

The low rates of needle sharing (14.5%) found in our Bangkok survey are similar to results reported previously (Wattana et al., 2007) and support a generally observed trend of lower needle sharing over time compared with 1994–1999 in Bangkok, when this figure was one-third or higher (Choopanya et al., 2013; Martin et al., 2010, 2011; Pitisuttithum et al., 2006; van Griensven et al., 2005; Vanichseni et al., 2001). On the other hand, in Chiang Mai we found that an alarming two-thirds of participants reported recent needle sharing, which is likely a reflection of their young age, recent initiation into drug injection practice, and lack of intervention programs available.

In our Bangkok survey, the prevalence of reported sex with multiple sex partners was similar to results from other studies in Bangkok (Choopanya et al., 2013; Martin et al., 2010, 2011). In Chiang Mai, we found high levels of sexual risk behavior, which is not surprising given the young age of PWID there and the low availability of HIV prevention interventions in the area. Most worrisome was the finding that one-third of PWID in Chiang Mai reported having at least one sexual partner who also injected drugs. Such high levels of overlapping risk behaviors at young ages are a volatile combination and could potentiate further HIV transmission to broader populations without expanded coverage of education and service delivery interventions for PWID. We found that nearly identical proportions of male participants in our Bangkok study and the Bangkok Tenofovir Study (Choopanya et al., 2013) reported having recent sex with a male partner (4–5%). In our Chiang Mai survey, this proportion was over twice as high. While we did not find recent sexual risk behaviors to be associated with HIV infection it will be important to monitor trends and patterns closely. Currently there is an HIV epidemic among men who have sex with men (MSM) in Thailand and monitoring MSM behavior should be incorporated as part of PWID surveillance (van Griensven et al., 2010).

Our surveys had a number of limitations. First, we cannot verify that all participants met the study inclusion criteria and it is possible that non-PWID participated because of the financial compensation available to participants. To reduce the possibility of recruiting non-eligible persons, we trained staff to ask participants to show injection marks and administered a comprehensive list of screening questions. Second, many findings were based on self-reported responses given by participants and was potentially subject to social desirability bias. However, interviewers were trained to make participants feel comfortable during the interview process and the high levels of sensitive risk behaviors disclosed suggest that this was not a major source of bias. Third, our survey results may not be generalizable to all PWID in Bangkok and Chiang Mai, respectively. Some PWID in both cities may not be socially networked or may have chosen not to participate due to the travel distance, fear that they might be arrested by the police, or a lack of confidence about the confidentiality of their personal information. Fourth, participants in Bangkok were recruited from a peer-based drop-in center while Chiang Mai participants were recruited from a research institute and this may have introduced participant selection bias. However, we believe our study findings in both sites are valid, in that the diverse seeds selected at both RDS sites were effective in recruiting peers and the multiple measurable assumptions were met in the RDSAT-based analysis (i.e., equilibrium was reached, sufficient waves of recruitment were reached, homophily was within expected limits; Salganick and Heckathorn, 2004; Volz and Heckathorn, 2008).

In conclusion, our findings show that PWID epidemics in Thailand are heterogeneous and driven by local factors. This geographical variation has also been found in other countries in the region (Degenhardt et al., 2010a) and means that a ‘one size fits all’ approach to the PWID epidemic in Thailand is likely to be ineffective. Given the diverse and high levels of polydrug injecting use documented it is recommended that a comprehensive and integrated combination intervention approach is developed. This is because no one specific intervention strategy encompasses all known HIV risk factors. An evidence-based systematic review of intervention strategies pointed to the need for combination approaches that combine individual and structural combination HIV prevention approaches with needle and syringe programs, opioid substitution treatment and antiretroviral treatment as approaches with the greatest potential effect (Degenhardt et al., 2010b). However, the high and growing prevalence of non-opioid injecting drug use in Thailand requires integration of novel approaches. For example, the recently concluded Bangkok Tenofovir Study (BTS), a randomized placebo-controlled double-bind trial, has shown that daily pre-exposure prophylaxis (PrEP) with tenofovir reduced the risk of HIV infection among PWID (Choopanya et al., 2013; Martin et al., 2011). Based on these results, PrEP should be considered as important additional strategic tool as part of a comprehensive package of effective HIV prevention interventions, particularly among PWID practicing high-risk behaviors.

At present, no approved pharmaocotherapies are available for methamphetamine or other amphetamine-type stimulants and the predominant treatment approach remains limited to psychosocial approaches. The Bangkok Metropolitan Administration and MOPH are now implementing the MATRIX program for methamphetamine dependence that includes components such as recovery skills, relapse prevention and family education. As these

services are further expanded, it is increasingly important that HIV prevention, care and treatment services are tightly integrated with drug treatment programs throughout Thailand. This scale-up will require close and rigorous monitoring of service quality such and the ongoing training of drug treatment service providers. Since our surveys were reported, the MOPH has begun conducting RDS surveys in additional geographical areas as part of routine surveillance and as a method to evaluate planned and ongoing intervention service packages targeting PWID.

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References

Beyrer C, Razak MH, Jittiwutikarn J, Suriyanon V, Vongchak T, Srirak N, Kawichai TS, Rungruengthanakit K, Sawanpanyalert P, Sripaipan T, Celentano DD. Methamphetamine users in northern Thailand: changing demographics and risks for HIV and STD among treatment-seeking substance abusers. Int J STD AIDS. 2004; 15:697–704. http://dx.doi.org/10.1258/0956462041944376. [PubMed: 15479508]

Brown T, Sittitrai W, Vanichseni S, Thisayakorn U. The recent epidemiology of HIV and AIDS in Thailand. AIDS. 1994; 8:S131–S141. [PubMed: 7857557]

Choopanya K, Martin M, Suntharasamai P, Sangkum U, Mock PA, Leethochawalit M, Chiamwongpaet S, Kitisin P, Natrujirote P, Kittimunkong S, Chuachoowong R, Gvetadze RJ, McNicholl JM, Paxton LA, Curlin ME, Hendrix CW, Vanichseni S. Antiretroviral prophylaxis for HIV infection in injecting drug users in Bangkok, Thailand (the Bangkok Tenofovir Study): a randomized, double-blinded, placebo-controlled phase 3 trial. Lancet. 2013; 381:2083–2090. http://dx.doi.org/10.1016/S0140-6736(13)61127-7. [PubMed: 23769234]

Degenhardt L, Mathers B, Guarinieri M, Panda S, Philips B, Strathdee SA, Tyndall M, Weissing L, Wodak A, Howard J. Reference Group to the United Nations on HIV and Injecting Drug Use. Meth/amphetamine use and associated HIV: implications for global policy and public health. Intl J Drug Policy. 2010a; 21:347–358. http://dx.doi.org/10.1016/j.drugpo.2009.11.007.

Degenhardt L, Mathers B, Vickerman P, Rhodes T, Latkin C, Hickman M. Prevention of HIV infection for people who inject drugs: why individual, structural, and combination approaches are needed. Lancet. 2010b; 376:285–301. http://dx.doi.org/10.1016/S0140-6736(10)60742-8. [PubMed: 20650522]

Fairbairn N, Kerr T, Buxton JA, Li K, Montaner JS, Wood E. Increasing use and associated harms of crystal methamphetamine injection in a Canadian setting. Drug Alcohol Depend. 2007; 88:313–316. [PubMed: 17141427]

Fairbairn N, Kaplan K, Hayashi K, Suwannawong P, Lai C, Wood E, Kerr T. Reports of evidence planting by police among a community-based sample of injection drug users in Bangkok, Thailand. BMC Int Health Hum Rights. 2009; 9:24. http://dx.doi.org/10.1186/1472-698X-9-24. [PubMed: 19811653]

Hayashi K, Suwannawong P, Ti L, Kaplan K, Wood E, Kerr T. High rates of midazolam injected and associated harms in Bangkok, Thailand. Addiction. 2012; 108:944–952. http://dx.doi.org/10.1111/add.12094. [PubMed: 23279598]

Hayashi K, Wood E, Suwannawong P, Kaplan K, Qi J, Kerr T. Methamphetamine injection and syringe sharing among a community-recruited sample of injection drug users in Bangkok, Thailand. Drug Alcohol Depend. 2011; 115:145–149. http://dx.doi.org/10.1016/j.drugalcdep.2010.10.018. [PubMed: 21130584]

Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. Soc Probl. 1997; 44:174–199.

Heckathorn DD. Respondent-driven sampling II: deriving valid population estimates from chain-referral samples of hidden populations. Soc Probl. 2002; 49:11–34. http://www.homelesshub.ca/resource/respondent-driven-sampling-ii-deriving-valid-population-estimates-chain-referral-samples.

Johnston LG, Sabin K, Prybylski D. Update for sampling most-at-risk and hidden populations for HIV biological and behavioral surveillance. J HIV/AIDS Surveill Epidemiol. 2010; 2:2. http://www.ieph.org/ojs/index.php/jHASE/article/viewArticle/%5BjHASE%202010,%202(1)%3A2%5D.

Kerr T, Fairbairn N, Hayashi K, Suwannawong P, Kaplan K, Zhang R, Wood E. Difficulty accessing syringes and syringe borrowing among injection drug users in Bangkok, Thailand. Drug Alcohol Rev. 2009; 29:157–161. http://dx.doi.org/10.1111/j.1465-3362.2009.00093.x. [PubMed: 20447223]

Kerr T, Kiatying-Angsulee N, Fairbairn N, Hayashi K, Suwannawong P, Kaplan K, Lai C, Wood E. High rates of midazolam injection among drug users in Bangkok, Thailand. Harm Reduct J. 2010; 7:7. http://dx.doi.org/10.1186/1477-7517-7-7. [PubMed: 20338062]

Magnani R, Sabin K, Saidel T, Heckathorn DD. Review of sampling hard to reach and hidden populations for HIV surveillance. AIDS. 2005; 19:S67–S72. [PubMed: 15930843]

Marascuilo LA. Large-sample multiple comparisons. Pyschol Bull. 1966; 65:280–290. http://dx.doi.org/10.1037/h0023189.

Mathers BM, Degenhardt L, Phillips B, Wiessing L, Hickman M, Strathdee SA, Wodak A, Panda S, Tyndall M, Toufik A, Mattick RP. Global epidemiology of injecting drug use and HIV among people who inject drugs: a systematic review. Lancet. 2008; 372:1733–1745. http://dx.doi.org/10.1016/S0140-6736(08)61311-2. [PubMed: 18817968]

Martin M, Vanichseni S, Suntharasamai P, Mock PA, van Griensven F, Pitisuttithum P, Tappero JW, Chiamwongpaet S, Sangkum U, Kitayaporn D, Gurwith M, Choopanya K. Drug use and the risk of HIV infection amongst injection drug users participating in an HIV vaccine trial in Bangkok, 1999–2003. Int J Drug Policy. 2010; 21:296–301. http://dx.doi.org/10.1016/j.drugpo.2009.12.002. [PubMed: 20079620]

Martin M, Vanichseni S, Suntharasamai P, Sangkum U, Chuachoowong R, Mock PA, Leethochawalit M, Chiamwongpaet S, Kittimunkong S, van Griensven F, McNicholl JM, Paxton L, Choopanya K. Enrollment characteristics and risk behaviors of injection drug users participating in the Bangkok Tenofovir Study, Thailand. PLoS ONE. 2011; 6:e251227. http://dx.doi.org/10.1371/journal.pone.0025127.

McKetin R, Kozel N, Douglas J, Ali R, Vicknasingam B, Lund J, Li JH. The rise of methamphetamine in Southeast and East Asia. Drug Alcohol Rev. 2008; 27:220–228. http://dx.doi.org/10.1080/09595230801923710. [PubMed: 18368602]

Pitisuttithum P, Gilbert P, Gurwith M, Heyward W, Martin M, van Griensven F, Hu D, Tappero JW, Choopanya K. Randomized, double-blind, placebo-controlled efficacy trial of a bivalent recombinant glycoprotein 120 HIV-1 vaccine trial among injection drug users in Bangkok, Thailand. J Infect Dis. 2006; 194:1671–1771.

Poshyachinda V, Sirivongse A, Aramrattana A, Kanato M, Assanangkornchai S, Jitpiromsri S. Illicit substance supply and abuse in 2000–2004: an approach to assess the outcome of the war on drug operation. Drug Alcohol Rev. 2005; 24:461–466. http://dx.doi.org/10.1080/09595230500285999. [PubMed: 16298841]

Razak MH, Jittiwutikarn J, Suriyanon V, Vongchak T, Srirak N, Beyrer C, Kawichai S, Tovanabutra S, Rungruengthanakit K, Sawanpanyalert P, Celentano DD. HIV prevalence and risks among injection and non-injection drug users in northern Thailand: need for comprehensive HIV prevention programs. J AIDS. 2003; 33:259–266.

Salganick MJ, Heckathorn DD. Sampling and estimation in hidden populations using respondent-driven sampling. Sociol Methodol. 2004; 34:193–240. http://dx.doi.org/10.1111/j.0081-1750.2004.00152.x.

Sharma M, Oppenheimer E, Saidel T, Loo V, Garg R. A situation update on HIV epidemics among people who inject drugs and national responses in south-east Asia region. AIDS. 2009; 23:1405–1413. [PubMed: 19579290]

Thailand Ministry of Public Health. HIV Prevalence and Incidence in Thailand, B.E. 2552. Bureau of Epidemiology, Department of Disease Control; Nonthaburi, Thailand: 2009.

Thailand Ministry of Public Health. National guidelines on HIV/AIDS diagnosis and treatment: Thailand 2010. Department of Disease Control; Nonthaburi: 2011.

Thai National AIDS Committee. Thailand Ending AIDS: 2014 Thailand AIDS Response Progress Report. Ministry of Public Health; Nonthabhuri, Thailand: 2014. http://www.unaids.org/sites/default/files/en/dataanalysis/knowyourresponse/countryprogressreports/2014countries/THA_narrative_report_2014.pdf

UNODC – United Nations Office of Drug Crime Use. Patterns and Trends of Amphetamine-Type Stimulants and Other Drugs: Asia and the Pacific. United Nations; Vienna: 2012. http://www.unodc.org/documents/southeastasiaandpacific/2012/12/ats-2012/2012_Regional_ATS_Report_FINAL_HQPDF_3_Dec_2012_low.pdf

UNODC – United Nations Office of Drug Crime Use. World Drug Report. United Nations; Vienna: 2014.

van Griensven F, Pitisuttithum P, Vanichseni S, Wichienkuera P, Tappero JW, Sangkumd U, Kitayapornc D, Phasithiphold B, Orelinde K, Choopanya K. Trends in the injection of midazolam and other drugs and needle sharing among injection drug users enrolled in the AIDSVAX B/E HIV-1 vaccine trial in Bangkok, Thailand. Int J Drug Policy. 2005; 16:171–175. http://dx.doi.org/10.1016/j.drugpo.2005.02.003.

van Griensven F, Varangrat A, Wimonsate W, Tanpradech S, Kladsawad K, Chemnasiri T, Suksripanich O, Phanuphak P, Mock P, Kanggarnrua K, McNicholl J, Plipat T. Trends in HIV prevalence, estimated HIV incidence, and risk behaviors among men who have sex with men in Bangkok, Thailand, 2003–2007. J AIDS. 2010; 53:234–239.

Vanichseni S, Kityaporn D, Mastro TD, Mock PA, Raktham S, Des Jarlais DC, Sujarita S, Srisuwanvilai LO, Young NL, Wasi C, Subbarao S, Heyward WL, Esparza L, Choopanya K. Continued high HIV-1 incidence in a vaccine trial preparatory cohort of injection drug users in Bangkok, Thailand. AIDS. 2001; 15:397–405. [PubMed: 11273220]

Volz E, Heckathorn DD. Probability-based estimation theory for respondent-driven sampling. J Off Stat. 2008; 24:79–97. http://www.jos.nu/articles/abstract.asp?article=241079.

Volz, E.; Wejnert, C.; Degani, I.; Heckathorn, DD. Respondent-Driven Sampling Analysis Tool (RDSAT) Version 6.0. Cornell University; Ithaca, NY: 2009. http://www.respondentdrivensampling.org/

Vongchak T, Kawichai S, Sherman S, Celentano DD, Sirisanthana T, Latkin C, Wiboonnatakul K, Srirak N, Jittiwutikarn J, Aramrattana A. The influence of Thailand's 2003 'war on drugs' policy on self-reported drug use among injection drug users in Chiang Mai, Thailand. Int J Drug Policy. 2005; 16:115–121. http://dx.doi.org/10.1016/j.drugpo.2004.11.003.

Wattana W, van Griensven F, Rhucharoenpornpanich O, Manopaiboon C, Thienkruab W, Bannathama R, Fox K, Mock PA, Tappero JW, Levine WC. Respondent-driven sampling to assess characteristics and estimate the number of injection users in Bangkok, Thailand. Drug Alcohol Depend. 2007; 90:228–233. http://dx.doi.org/10.1016/j.drugalcdep.2007.03.013. [PubMed: 17507180]

Weniger BG, Limpakarnjanarat K, Ungchusak K, Thanprasertsuk S, Choopanya K, Vanichseni S, Uneklabh T, Thongcharoen P, Wasi C. The epidemiology of HIV infection and AIDS in Thailand. AIDS. 1991; 5(Suppl 2):S71–S85. [PubMed: 1845063]

Werb D, Hayashi K, Fairbairn N, Kaplan K, Suwannawong P, Lai C, Kerr T. Drug use patterns among Thai illicit drug injectors amidst increased police pressure. Subst Abuse Treat Prev Policy. 2009; 4:16. http://www.pubfacts.com/detail/19622171/Drug-use-patterns-among-Thai-illicit-drug-injectors-amidst-increased-police-presence. [PubMed: 19622171]

WHO – World Health Organization (WHO). WHO, UNODC, UNAIDS Technical Guide for Countries to Set Targets for Universal Access to HIV Prevention, Treatment and Care for Injecting Drug Users – 2012 revision. United Nations; Geneva: 2012. http://apps.who.int/iris/bitstream/10665/77969/1/9789241504379_eng.pdf

Table 1

Sociodemographic characteristics and injecting drug use risk behaviors of PWID participants in RDS surveys in Bangkok and Chiang Mai, Thailand.

	Bangkok (*N* = 738)		Chiang Mai (*N* = 309)		*p* value[†]
	***N* (RDSAT-adjusted %)**	**95% CI of RDSAT-adjusted %**	***N* (RDSAT-adjusted %)**	**95% CI of RDSAT-adjusted %**	
Sociodemographic characteristics					
Sex, male	627 (84.5)	81.0–87.6	253 (82.9)	77.9–87.0	0.58
Highest education					
<Secondary education (9 school years)	274 (39.1)	34.3–43.9	128 (46.3)	36.7–55.3	0.18
≥ Secondary education (>9 school years)	464 (60.9)	56.1–65.7	181 (53.7)	44.7–63.3	
Age					
<25 years	22 (3.3)	1.9–5.0	106 (42.6)	31.5–50.8	<0.001[a]
25–35 years	335 (43.9)	39.3–49.1	141 (37.3)	31.1–46.9	
>35 years	380 (52.8)	47.7–57.0	62 (20.1)	13.8–26.5	
Marital status					
Single (never married)	388 (51.9)	46.8–56.3	142 (48.3)	40.2–55.7	0.44[b]
Married	305 (42.3)	38.1–47.1	139 (43.0)	36.0–51.3	
Divorced/widowed/other	44 (5.9)	4.0–8.0	28 (8.7)	5.1–12.4	
Currently unemployed	271 (34.9)	30.4–39.1	75 (24.9)	17.9–32.2	0.02
Monthly income					
≤5000 Thai baht	347 (46.3)	42.2–51.0	197 (63.5)	57.2–70.3	.001[c]
5001–7500 Thai baht	128 (16.3)	13.4–19.6	72 (24.2)	18.5–29.1	
>7500 Thai baht	263 (37.4)	32.9–41.2	40 (12.3)	7.5–18.2	
Detained in a prison in last 12 months	130 (18.6)	13.1–22.0	51 (15.1)	9.4–21.6	0.36
Detained in police holding cell in last 12 months	165 (24.3)	19.1–28.4	30 (10.2)	5.8–15.8	<0.001
General drug use					
Injected any drug in the last month	666 (88.0)	84.8–90.9	212 (61.4)	50.9–71.6	<0.001
Of those, injected any drug in the past month					
Single	258 (43.2)	37.4–48.3	161 (73.6)	63.2–83.6	<0.001
Multiple	408 (56.8)	51.7–62.6	51 (26.4)	16.4–36.8	
Age first injected a drug					

	Bangkok (*N* = 738)		Chiang Mai (*N* = 309)		*p* value[†]
	***N* (RDSAT-adjusted %)**	**95% CI of RDSAT-adjusted %**	***N* (RDSAT-adjusted %)**	**95% CI of RDSAT-adjusted %**	
<25 years	623 (82.4)	78.9–85.7	229 (68.8)	62.4–76.1	<0.001[a]
25–35 years	101 (16.0)	12.9–19.4	60 (23.7)	16.7–30.5	
>35 years	13 (1.5)	0.7–2.7	20 (7.5)	3.5–12.0	
First started injecting drugs ≤ 2 years ago	27 (4.5)	2.7–6.6	97 (40.5)	31.9–49.5	<0.001
Ever experienced a drug overdose	201 (24.0)	20.2–27.8	64 (17.5)	12.3–23.8	0.06
Needle sharing in the last six month	108 (14.5)	11.4–17.8	197 (66.0)	56.8–74.2	<0.001
Needle sharing during last injection	42 (6.1)	4.0–8.7	141 (48.1)	39.1–56.8	<0.001
Heroin use					
Ever used heroin	666 (87.4)	84.4–90.9	228 (73.6)	63.1–83.5	0.01
Last time used heroin					
≥ 6 months	447 (56.6)	51.4–61.6	200 (66.6)	56.8–76.4	0.08[a]
>6 months	219 (30.4)	26.4–34.9	28 (7.7)	4.5–11.3	
Never used	72 (13.0)	9.5–16.1	81 (25.7)	16.0–35.4	
Injected heroin in the last month	297 (33.3)	28.9–38.2	102 (35.4)	25.1–44.4	0.70
Heroin injectors who also injected ≥ 1 other drug in the last month	254 (86.2)	76.8–90.3	34 (38.4)	16.6–59.8	<0.001
Heroin injectors who injected heroin ≥ 1 daily in the last month	167 (50.4)	41.2–62.1	60 (56.0)	42.2–69.9	0.53
Methamphetamine use					
Ever used Methamphetamine	694 (94.3)	92.2–96.2	260 (81.5)	72.2–89.2	<0.001
Last time used Methamphetamine					
≤ 6 months	607 (83.7)	80.7–86.6	246 (67.6)	54.6–78.8	0.01[a]
>6 months	86 (10.1)	7.7–12.4	14 (6.5)	3.3–10.4	
Never used	45 (6.2)	4.3–8.4	49 (25.9)	15.9–37.4	
Injected Methamphetamine in the last month	468 (64.6)	60.2–69.0	107 (31.4)	22.8–41.3	<0.001
Methamphetamine injectors who also injected ≥ 1 other drug in the last month	300 (52.5)	43.6–60.1	44 (42.4)	22.7–64.9	0.38
Methamphetamine injectors who injected methamphetamine ≥1 daily in the last month	343 (74.3)	67.1–78.6	60 (49.3)	34.4–69.1	<0.01
Midazolam use					
Ever used midazolam	576 (73.7)	69.6–78.1	56 (14.6)	8.5–22.1	<0.001
Last time used midazolam					

	Bangkok (*N* = 738)		Chiang Mai (*N* = 309)		*p* value[†]
	***N* (RDSAT-adjusted %)**	**95% CI of RDSAT-adjusted %**	***N* (RDSAT-adjusted %)**	**95% CI of RDSAT-adjusted %**	
≤ 6 months	480 (61.2)	56.4–66.3	40 (9.0)	4.7–14.1	<0.001
>6 months	86 (12.8)	9.9–16.0	16 (4.7)	2.3–8.2	
Never used	163 (26.0)	21.4–29.9	253 (86.3)	79.4–91.6	
Injected midazolam in the last month	379 (42.2)	37.1–47.4	24 (4.0)	1.0–9.6	<0.001
Midazolam injectors who also injected ≥ 1 other drug in the last month	334 (87.6)	83.0–92.7	20 (90.3)	82.5–98.3	0.57
Midazolam injectors who injected midazolam ≥ 1 daily in the last month	322 (86.0)	77.0–89.8	17 (70.8)*	48.9–87.7*	0.07[f]
Opium use					
Ever used opium	252 (31.6)	27.4–36.1	129 (39.6)	30.0–49.2	0.14
Last time used opium					
≤6 months	14 (1.5)	0.7–2.8	74 (22.6)	14.1–31.7	<0.001[d]
>6 months	237 (30.1)	26.0–34.3	55 (15.6)	10.6–21.9	
Never used	487 (68.4)	64.0–72.4	180 (61.7)	51.7–71.2	
Injected opium in the last month	2 (0.3)*	0.03–1.0*	32 (14.8)	5.0–28.1	<0.001[e]
Opium injectors who also injected ≥ 1 other drug in the last month	2 (100.0)*	N/A	7 (21.9)*	9.3–40.0*	0.26[e]
Opium injectors who injected opium ≥ 1 daily in the last month	1 (50.0)*	1.2–98.7*	30 (93.7)*	79.2–99.2*	0.17[e]
Methadone use					
Ever used methadone	567 (70.9)	65.7–75.6	58 (13.8)	8.1–20.5	<0.001
Last time used methadone					
≤6 months	388 (42.6)	37.5–48.2	46 (10.6)	5.9–16.5	<0.001[a]
>6 months	178 (27.1)	23.3–31.3	12 (2.8)	1.1–5.8	
Never used	172 (30.3)	25.4–35.1	251 (86.6)	79.5–91.6	
Inject methadone in the last month	134 (14.3)	10.8–18.3	20 (6.3)	2.3–11.6	0.01
Methadone injectors who also injected ≥ 1 other drug in the last month	132 (98.5)*	94.7–99.8*	19 (95.0)*	75.1–99.9*	0.29[f]
Methadone injectors who injected methadone ≥ 1 daily in the last month	121 (96.6)	89.6–99.5	15 (75.0)*	50.9–91.3*	0.05[f]

[†] *p*-value for comparison between Bangkok and Chiang Mai participants.

[a] Comparison of the proportion <25 years of age.

[b] Comparison of the proportion single (never married).

[c] Comparison of the proportion of <5000 Thai baht.

[d] Comparison of the proportions ≤ 6 months.

[e] Chi-square Fisher exact test.

[f] Chi-square test.

[*] Unadjusted % (95% CI).

Table 2

Sexual risk behaviors and exposure to interventions of PWID participants in RDS surveys in Bangkok and Chiang Mai, Thailand.

	Bangkok (*N* = 738)		Chiang Mai (*N* = 309)		*p* value[†]
	***N* (RDSAT-adjusted %)**	**95% CI of RDSAT-adjusted %**	***N* (RDSAT-adjusted %)**	**95% CI of RDSAT-adjusted %**	
Sexual risk behaviors					
Sex with a regular partner in the past month	333 (46.7)	42.4–51.1	152 (44.4)	39.0–52.2	0.57
Of those having sex, condom used during last sex	77 (18.4)	12.5–27.1	25 (20.9)	9.8–35.8	0.74
Sex with a casual partner in the past month	133 (17.8)	14.6–20.8	98 (31.0)	24.2–37.4	<0.001
Of those having sex, condom used during last sex	99 (77.3)	55.5–94.7	37 (27.0)	6.5–57.6	<0.01
Sex with a commercial partner	45 (5.5)	3.8–7.6	56 (16.4)	10.6–22.4	.001
Of those having sex, condom used during last sex	36 (81.8)[*]	67.3–91.8[*]	25 (44.6)[*]	31.3–58.5[*]	<0.001[a]
Sex for goods or drugs in the past month	70 (9.3)	7.1–11.9	27 (8.6)	4.9–13.2	.78
Of those having sex, condom used during last sex	43 (55.0)	9.1–79.4	11 (40.7)[*]	22.4–61.2[*]	0.07[a]
Multiple sexual partners in the last month	123 (15.9)	12.9–19.1	117 (37.1)	29.3–44.8	<0.001
At least one sexual partner who also injected drugs in the last month	156 (21.6)	18.3–25.3	79 (18.9)	14.8–24.3	0.37
In the last six months, shared needles and did not use condom during last sex	40 (5.7)	3.6–7.8	121 (34.1)	27.4–41.0	<0.001
Had sex with another man in the last 6 months[b]	27 (4.5)	2.3–9.8	32 (13.7)	7.8–20.6	0.01
Exposure to interventions					
Ever had HIV testing in lifetime	598 (77.3)	73.2–81.2	130 (38.1)	29.3–47.1	<0.001
Had HIV testing in the last six months	447 (57.5)	53.2–62.1	60 (18.7)	9.8–28.54	<0.001
Had HIV testing in the last six months with known test result	432 (57.1)	52.6–61.6	52 (21.3)	10.3–33.6	<0.001
Ever been in drug treatment	551 (69.0)	63.8–73.7	103 (30.3)	21.2–40.4	<0.001
Currently in drug treatment	272 (29.1)	24.1–33.3	47 (12.6)	5.8–20.7	<0.01
Received peer outreach intervention in the last three months	350 (41.8)	37.4–46.7	NA	NA	

[†] *p*-value for comparison of characteristics between Bangkok and Chiang Mai participants.

[*] Unadjusted % (95% CI).

[a] Chi-square Fisher Exact test.

[b] Among male participants who has sex in the last 6 months (Bangkok *n* = 395; Chiang Mai *n* = 216).

NA = data not available, at the time of the survey there was no peer outreach interventions in Chiang Mai.

Table 3

HIV prevalence stratified by characteristics of PWID participants (bivariate analysis) and results of multivariate modeling of the factors associated with HIV prevalence in bivariate analysis, RDS survey in Bangkok and Chiang Mai, Thailand.

	Bivariate results		Multivariate modeling results‡		
	***n*/*N* (RDSAT-adjusted HIV prevalence %)**	**95% CI of RDSAT-adjusted HIV prevalence %**	***p* value†**	**Adjusted odds ratio (AOR)**	**95% CI of AOR**
Bangkok (*N*= 738)					
Current age			0.12		
<25 years	3/22 (4.6)	1.5–16.1			
≥ 25 years	197/715 (23.7)	20.3–28.4			
Injected multiple drugs in the last month					
Yes	125/408 (26.3)	21.1–32.2	0.71		
No, injected single drug	56/258 (18.9)	13.6–24.8	0.58		
No, not injected any drug in the last month	20/72 (23.0)	12.9–33.4	Reference group		
Needle sharing in the last injection			0.23		
Yes	17/42 (35.7)	17.4–55.4			
No	184/695 (23.2)	19.4–27.5			
Injected heroin in the last month			0.49		
Yes	92/297 (25.3)	19.4–32.4			
No	108/440 (21.7)	17.8–27.0			
Injected methamphetamine in the last month			0.29		
Yes	117/468 (21.5)	17.2–26.6			
No	84/270 (27.6)	21.5–34.8			
Injected midazolam in the last month			0.07		
Yes	122/379 (29.1)	23.4–35.6		1.5	0.7–3.1
No	78/358 (18.3)	13.6–23.4		Reference group	
Injected opium in the last month			N/A		
Yes	0/2 (0.0)*	N/A			
No	202/736 (27.4)*	24.2–30.8*			
Inject methadone in the last month			0.05		
Yes	55/134 (35.1)	24.5–46.0		1.7	0.7–4.6

	Bivariate results		Multivariate modeling results‡		
	***n/N* (RDSAT-adjusted HIV prevalence %)**	**95% CI of RDSAT-adjusted HIV prevalence %**	***p* value†**	**Adjusted odds ratio (AOR)**	**95% CI of AOR**
No	145/602 (20.7)	16.9–24.9		Reference group	
Condom use at last sex with any partner			0.04		
Yes	67/187 (35.4)	26.2–49.9		1.7	0.7–3.8
No/No sex partner in the past 6 months	134/551 (20.3)	16.4–24.9		Reference group	
Ever been in drug treatment			0.02		
Yes	180/551 (29.2)	24.8–34.8		3.7	1.4–9.7
No	21/187 (9.7)	5.2–15.1		Reference group	
Had HIV testing in last 6 months with known test result			<0.001		
Yes	64/432 (13.2)	9.4–17.5		0.2	0.1–0.4
No	137/306 (38.9)	32.8–47.0		Reference group	
> 1 Sexual partner in the past month			0.62		
Yes	30/123 (22.0)	13.7–31.3			
No/no sexual partner	171/615 (24.8)	20.9–30.0			
Had sex with another man in the past 6 months**					
Yes	14/27 (50.3)	27.5–72.7	0.08	4.1	0.8–20.9
No	187/711 (24.0)	21.1–30.2	Reference group		
Chiang Mai (*N*= 309)					
Current age			0.81		
<25 years	9/106 (11.4)	4.5–21.2			
≥ 25 years	35/103 (10.2)	4.7–16.1			
Injected multiple drugs in the last month					
Yes	20/51 (34.5)	17.0–50.0	<0.001		
No, injected single drug	22/161 (10.4)	5.3–17.2	0.04		
No, not injected any drug in the last month	2/97 (1.3)	0.4–4.2	Reference group		
Needle sharing in the last injection			0.39		
Yes	10/141 (7.7)	2.4–13.3			
No	34/166 (14.5)	8.3–23.2			
Injected heroin in the last month			0.19		
Yes	18/102 (17.4)	8.3–26.6			

	Bivariate results		Multivariate modeling results‡		
	***n/N* (RDSAT-adjusted HIV prevalence %)**	**95% CI of RDSAT-adjusted HIV prevalence %**	***p* value†**	**Adjusted odds ratio (AOR)**	**95% CI of AOR**
No	26/207 (8.1)	4.0–14.3			
Injected methamphetamine in the last month			<0.01		
Yes	26/107 (22.6)	12.3–33.5		2.0	0.6–7.2
No	18/202 (5.2)	2.6–10.0		Reference group	
Injected midazolam in the last month			<0.01		
Yes	14/24 (61.5)	35.9–87.6		8.1	1.2–54.5
No	30/285 (8.8)	4.8–13.3		Reference group	
Injected opium in the last month			0.45		
Yes	2/32 (6.2)**	0.8–20.8**			
No	42/277 (15.2)**	11.1–19.9**			
Inject methadone in the last month			<0.01		
Yes	12/20 (57.8)	34.6–80.8		2.8	0.4–22.1
No	32/289 (9.4)	5.7–15.4		Reference group	
Condom use at last sex with any partner			0.69		
Yes	16/91 (14.2)	6.3–23.3			
No/no sex partner in the past 6 months	28/218 (9.6)	5.0–14.5			
Ever been in drug treatment			0.90		
Yes	26/103 (18.6)	7.6–32.7			
No	18/206 (6.8)	3.5–11.9			
Had HIV testing in last 6 months with known test result			0.10		
Yes	5/52 (2.9)	0.4–9.2			
No	39/257 (12.8)	7.7–19.2			
> 1 Sexual partner in the past month			0.93		
Yes	16/117 (11.9)	4.3–20.7			
No/no sexual partner	28/192 (10.8)	5.4–18.7			
Had sex with another man in the past 6 months***			0.11		
Yes	7/32 (22.6)	8.1–39.2			
No	31/237 (10.2)	5.2–16.5			

† *p*-value for bivariate comparison of participant characteristics and HIV status.

‡ Variables shown in this column are statistically significant in multivariate modeling and independently associated with HIV status.

* Peer outreach programs were not available in Chiang Mai at the time of the implementation of the survey.

** Unadjusted % (95% CI).

*** Among male participants who has sex in the past 6 months (Chiang Mai $n = 216$).