



**UNODC**

United Nations Office on Drugs and Crime



# Systematic Literature Review on Stimulant use and HIV (A)

Part 2/5

ATS and HIV  
Risk and Transmission

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*The literature review was conducted by UNODC consultant Dr Anna V. Williams (King's College London, Addictions Department), under the supervision of Fabienne Hariga, UNODC HIV Senior adviser. Riku Lehtovuori, UNODC HIV Monitoring & Evaluation Adviser provided comments on the different drafts.*

This report is part of a series of five documents:

**A. Stimulant use: HIV risk and transmission**

1. Systematic Literature Review on HIV and Stimulant use: Methodology and summary of the findings of
2. Systematic Literature Review on HIV and Stimulant use: ATS and HIV Risk and Transmission
3. Systematic Literature Review on HIV and Stimulant use: Cocaine use and HIV Risk and Transmission
4. Systematic Literature Review on HIV and Stimulant use: NPS and HIV Risk and Transmission

**B. Prevention of HIV, HCV & HBV and treatment**

5. Systematic Literature Review on HIV and Stimulant use: Treatment and Prevention of HIV, HCV & HBV and treatment

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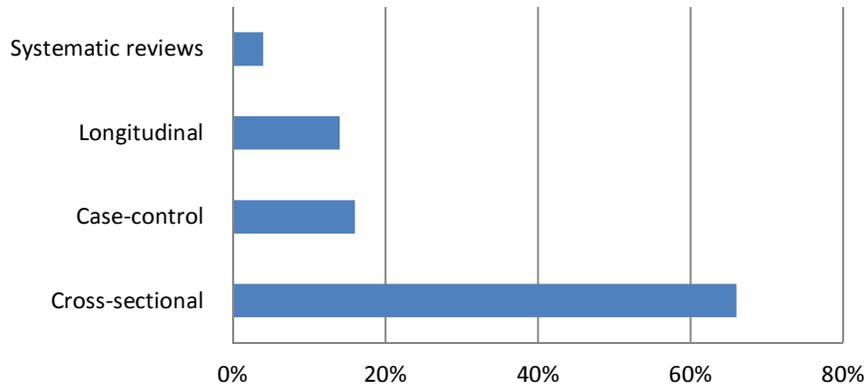
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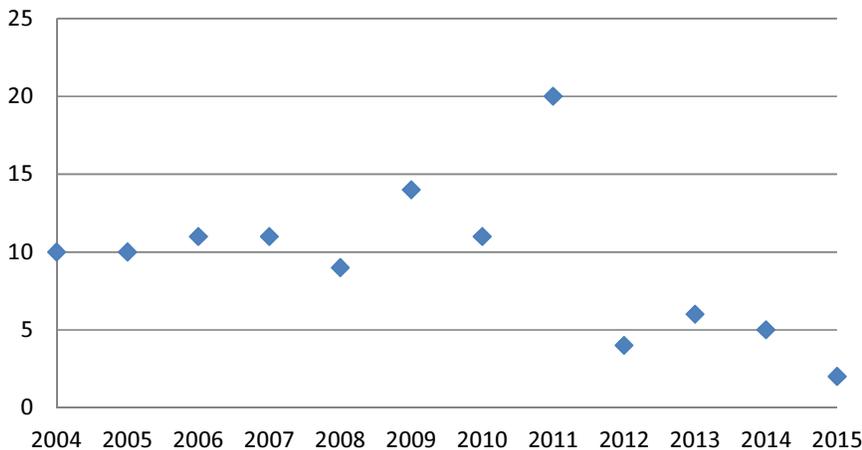
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## 1. Overview

Out of 1,048 full-texts examined, a total of 119 studies on ATS and HIV, HCV and HBV risk and transmission were initially included in the present review. Eight studies were excluded: five due to low quality (under 3 points), one due to ethical issue (all participants recruited from a compulsory isolation centre) and two were repeated publications of studies already included. A total final of **111** were included in this review. The great majority of the studies were cross-sectional surveys (74), followed by case-control studies (17), longitudinal cohort studies (15) and systematic literature reviews (5) (Figure). Most studies were published between 2004 and 2011 (Figure).

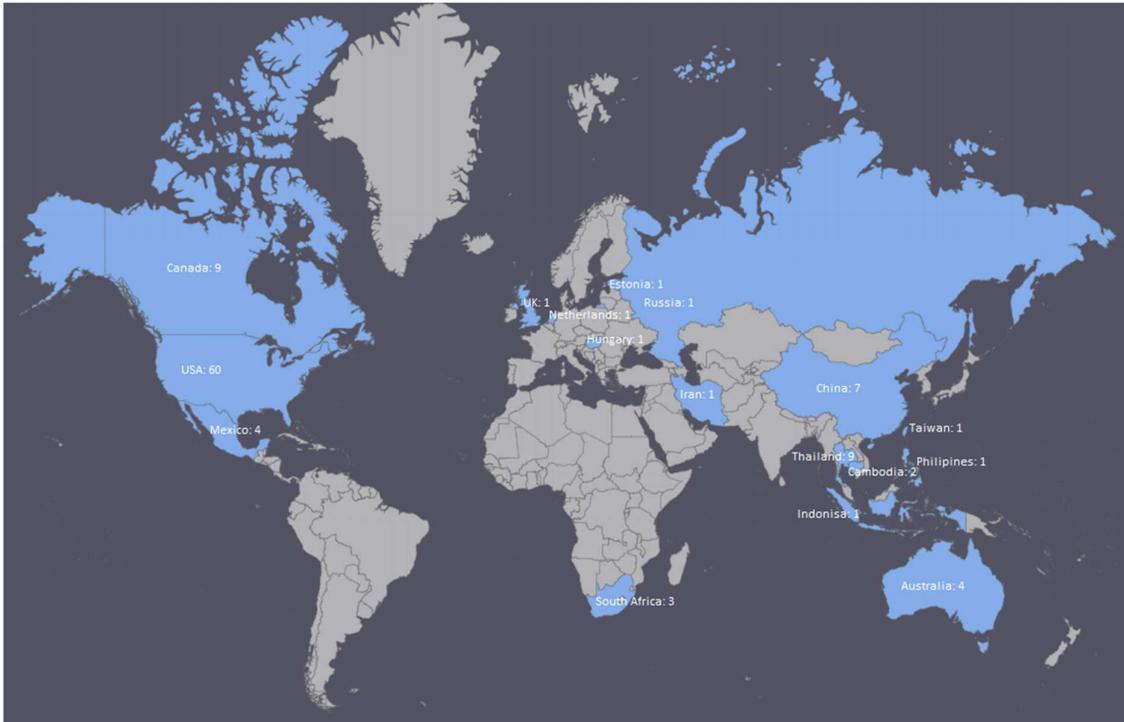


**Figure 1: Study Designs**



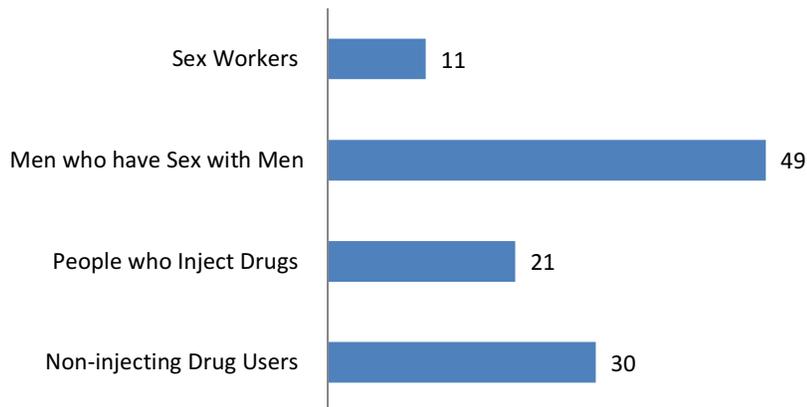
**Figure 2: Year of Publication**

The figure below shows in which countries the studies took place. There are 17 countries represented. About a third of the studies took place in nine countries with low to upper-middle income economies and other two-thirds took place in 8 countries with high income economies (Figure). Four systematic literature reviews with a worldwide focus were also included. Over half of all studies (54%) were conducted in the United States.



**Figure 3: Countries in which the studies took place**

In order to analyse the evidence in more detail, the studies were divided into subcategories in accordance to the type of population they targeted. The categories are: non-injecting drug users (NIDUs), people who inject drugs (PWID), men who have sex with men (MSM) and sex workers (SWs). Most of the studies focused on MSM, followed by non-injecting drug users.



**Figure 4: Target Populations**

The quality of cross-sectional, case-control and longitudinal studies were assessed, as described in the methodology section. Only studies with a quality score above 3 were retained. The loss of quality of the included studies was mostly due to sampling method being non-probabilistic,

response rate being below 70%, rate of non-respondents not being mentioned and potential confounders not being addressed adequately (Tables 1, 2, 3, 4).

## 2. Non-Injecting Drug Users

There were 30 studies focused mostly on non-injecting ATS users. The average age distribution of the participants was around 29 years old (mean or median ranging from 16 to 39.1). Four studies included women only and two included men only. The remaining studies included an average of 68% of men. The quality of the methodology of these studies is presented on the table below.

**Table 1: Quality Assessment of the Studies among Non-injecting ATS Users**

+ Reported and adequate; - Not reported or inadequate

Studies	1. Population	2. Sampling	3. Representativeness	4. Response rate	5. Data Collection	6. Measure validity	7. Measure Time	8. Statistical Method	9. Confounders	10. Follow-up rate	11. Follow-up time	Total (%)
Wechsberg, 2014	+	+	+	+	+	+	+	+	+			100%
Bao, 2012	+	-	+	+	+	+	+	+	-			77.8%
Ding, 2013	+	-	+	-	+	-	+	+	+			66.7%
Jia, 2010	+	-	+	-	+	-	-	-	+			44.4%
Liu, 2013	+	-	+	-	+	-	+	-	-			44.4%
Lai, 2007	+	-	-	+	+	+	-	+	-			55.5%
Celentano, 2008	+	-	+	+	-	+	+	+	+			77.8%
Beyrer, 2004	+	-	+	+	+	+	+	+	-			77.8%
Srirak, 2005	+	-	+	+	+	+	+	+	-			77.8%
Sutcliffe, 2009	+	-	+	-	-	+	+	+	+	+	-	63.6%
Sherman, 2009	+	-	+	-	+	+	-	+	+			66.7%
McKetin, 2008	+	-	+	+	+	+	+	+	+			88.9%
Zule, 2007	+	-	+	-	+	-	+	+	+			66.7%
Truong, 2011	+	+	-	+	+	+	+	+	+			88.9%
Fisher, 2011	+	-	+	+	+	+	+	+	+			88.9%
Cartier, 2008	-	-	+	+	-	+	+	+	+			88.9%
Gonzales, 2006	+	-	-	-	+	-	+	+	-			44.4%
CDC, 2006	+	+	+	+	+	-	+	+	+			88.9%
Cheng, 2009	+	-	+	-	+	+	+	+	+			77.8%
Semple, 2009	+	-	+	-	+	+	+	-	-			55.5%
Semple, 2005	+	-	+	-	+	+	+	-	-			55.5%
Semple, 2006	+	-	+	-	+	+	+	-	-			55.5%
Semple, 2004a	-	-	+	-	+	+	+	-	-			44.4%
Semple, 2004b	+	-	+	-	+	+	+	+	-			66.7%
Semple, 2011	+	-	+	-	+	+	+	+	+			77.8%
Zapata, 2008	+	+	+	+	+	+	+	+	+			100%
Springer, 2007	+	+	+	+	+	+	+	+	+			100%
Deiss, 2011	+	-	+	-	+	+	+	+	+			77.8%
Uhlmann, 2014	+	-	+	-	-	+	+	+	+	-	+	63.6%

In a systematic literature review, Colfax et al. (2010) found that most studies showed an association between ATS and HIV infection. However, it was not possible to quantify the contribution of ATS

to the HIV epidemic in this review. The authors found that most of the literature was focused on MSM from developed countries and suggested that future studies should try to quantify poly-substance among ATS users and to focus on non-injecting ATS users, particularly from developing countries (Colfax et al. 2010). Another review looking at MA use among youths concluded that the evidence on increased risk of infectious disease was inconclusive (Marshall and Werb 2010). In this review, only four studies reported HIV prevalence rates among young MA users and two of these studies reported null results.

**South Africa (3 studies):** A review published in 2011 on MA use and sexual risk behaviour in Cape Town identified eight studies (Parry et al. 2011). MA use was consistently associated with early vaginal sex, condom use during sex, and having casual sex. Mixed findings were noted for the association between MA use and anal sex, STI symptoms, having multiple partners and forced sex. A cross-sectional survey assessing MA use and HIV prevalence in a South African community did not identify associations between MA use and HIV infection at the individual level nor at the neighbourhood level (Wechsberg et al. 2014). The prevalence of HIV infection among MA users was 18.5%. A cross-sectional survey with out-of-school girls compared 261 MA users (recent use) with 188 non-MA users (Wechsberg et al. 2010). MA use was greater among Coloured (mixed-race ancestry) (87%) than among Black females (11%). Coloured female who reported MA use were over six times more likely than other participants to report not using a condom the last time they had sex (OR = 6.21; 95% CI = 1.21, 31.94).

**China (5 studies):** A large cross-sectional survey in 6 Chinese provinces found 4.5% (95% CI: 3.4%, 5.6%) HIV infection prevalence among MA users (Bao et al. 2012)<sup>1</sup>. HCV exposure was 43.5% (95% CI: 40.8%, 46.2%). HIV and HCV co-infection was present in 3.6% of the sample. HIV infection was independent associated with: living in Yunnan province, polydrug use, increased frequency of sexual behaviour, history of sex with sexually transmitted infection-positive persons and HCV infection. HCV was associated with study site, marital status, unemployment, a longer duration of ATS use, and history of injection use of ATS. Injection use of ATS was associated with HCV but not HIV. Injection drug use was not measured or controlled in the data analysis, despite 30% of the sample having a history of injecting heroin.

Another cross-sectional survey among 398 non-injecting heterosexual MA users from Cheng Yang District, Qingdao and Shandong Province looked at gender differences and high-risk behaviours (Liu et al. 2013). This study found that males, more frequently than females, had sex with multiple partners and exchanged sex partners during MA use. Among males who had had sex with SWs, 72.2% had never used condoms. About 96.4% of the females reported having had sex with partners for MA or money.

An exploratory analysis of data from the National Institute on Drug Dependence (NIDD), Peking University, looked at the association between new-type drug use and sexual transmission of HIV in China (Jia et al. 2010). The findings indicated that type of drug use was directly associated with the mode of HIV/AIDS transmission. HIV infection among ATS users had a stronger association with sexual transmission of HIV (R=5.5), while HIV infection by drug use mode mainly results from heroin use (R = .5). A study by Jia et al. (2013) concurred with these findings. The study compared sexual behaviour between ATS users and heroin users from detoxification treatment centres in Beijing, Shenzhen, Guangzhou, Xi'an, and Taiyuan and found significant differences between these two groups (Jia et al. 2013). The rate of ever-infecting sexually transmitted disease (STD) was high in both the groups (ATS, 20.5%; heroin, 30.9%). But ATS users presented a

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<sup>1</sup> 51.8% of the sample was recruited from compulsory detoxification centres

number of sexual risk behaviours, such as intercourse after taking drug, multiple sexual intercourse, casual sex partners and inconsistent condom use.

A study with 276 club drug users in Shanghai, found that MA was used in the past month by over half of the sample (Ding et al. 2013). The study also identified in a multivariate level analysis, that MA was the only club drug significantly correlated with having multiple sex partners.

**Taiwan (1 study):** A case-control study compared 285 amphetamine-inhaling males from one prison in Taiwan with 285 age-matched healthy men (Lai et al. 2007). Prevalence of HBV-positive persons was significantly lower in cases than in the control subjects (15.8 vs 22.8%,  $P = 0.034$ ). The overall prevalence of HCV+ persons was significantly higher in cases than in the control subjects (22.5 vs 2.1%,  $P < 0.001$ ).

**Thailand (6 studies):** A longitudinal cohort study with young and recent MA users ( $N=519$ ) in Northern Thailand found an HIV incidence rate of 0.6% over 12 months (Sutcliffe et al. 2009). Overall, 13% of the participants acquired at least one STI over the year. Chlamydia was the most common infection acquired (10.6%), followed by HSV-2 (4.0%), gonorrhoea (2.9%) and HIV (0.6%). Risk factors included self-reported incarceration and having a casual sex partner during follow-up, and having a prevalent STI at baseline. Among women, having two or more heterosexual partners, and among men, having a greater frequency of drunkenness were risk factors for STI acquisition.

A cross-sectional survey in Chiang Mai with 568 young adults who recently consumed MA found a low HIV prevalence of 1.1 (Celentano et al. 2008). Over a third of the sample (38%) tested positive for one type of STI; however, frequency of MA use or drunkenness was not independently associated with STI prevalence. HCV prevalence was 2.5% and HBV was 8.5%. Nearly two thirds of the sample (62.6%) did not use condom at the last intercourse.

Another study in Northern Thailand surveyed young drug users seeking detoxification and found that 3.2% of MA users were HIV positive (Beyrer et al. 2004). This rate was much higher among opioid users (15.1%). MA use by injection was rare. MA users had lower rates of syphilis and higher rates of chlamydia prevalence than persons admitted for opiate or mixed drug treatment.

Srirak et al, (2005) assessed 200 women admitted for detoxification treatment. Thirty percent of the sample was heroin dependent and 70% was opium or methamphetamine dependent. HIV prevalence was significantly higher among heroin injectors (25%) than among opium or methamphetamine smokers (4.1%) (Srirak et al. 2005). Another study with young females from Chiang Mai who recently used MA found that women with multiple male partners used MA more frequently than compared to women with only one male partner or with only female partners (German et al. 2008). A large cross-sectional survey with young and recent MA smokers recruited in the streets of Chiang Mai found that over half of males and females reported engaging in sex in the context of MA use (Sherman et al. 2009).

**USA (11 studies):** A sentinel Surveillance of HIV-1 in San Francisco Municipal STI clinic detected that 11.7% of the sample had used amphetamines (Truong et al. 2011). HIV prevalence among amphetamine users was 9.60% (95% CI: 7.96, 11.45). Amphetamine use was reported by 27.8% of HIV long-term infections, 41.4% of HIV recent infections, 27.6% of HIV acute infections and 25.5% of antiretroviral drug-resistant cases.

Gonzales et al. (2006) recruited 723 MA-dependent seeking outpatient treatment and found 15% of the total sample were infected with HCV. About 20% of the sample were injectors, and 44% of

them were HCV positive (Gonzales et al. 2006). HCV infection was also associated with older age and female sex.

The Centres for Disease, Control & Prevention (2006) coordinated a large cross-sectional survey among heterosexual men in five northern California counties and found a positive association between MA use and number of HIV risk behaviour. In comparison with people who never used MA, recent MA users had more anal sex, casual sex, multiple partners, a partner who injects drugs, ever exchanging sex or drugs for money (Centers for Disease and Prevention 2006). Other studies with MA heterosexual users (men and women) also identified increased sexual risk behaviour among this group (Semple et al. 2004b, Semple et al. 2004c). Semple et al. (2009) also investigated ethnic differences and sexual risk behaviour among MA heterosexual users and recorded a larger percentage of African Americans reporting anonymous sex partners in the past two months (Semple et al. 2009a). Another study by Semple et al. (2005) suggested that negative self-perception could be associated with greater sexual risk behaviour. Negative self-perceptions predicted intensity of methamphetamine use and depressive symptoms (Semple et al. 2005). However, neither of these variables mediated the relationship between negative self-perceptions and sexual risk behaviour.

Cartier et al. (2008) assessed HIV risk behaviour among 812 offenders before or nine months after incarceration. A third of the sample reported MA use. MA users were more likely to engage in unprotected sex, have unprotected sex with casual partners, and have unprotected sex while they, their partner, or both, were under drugs or alcohol at both baseline and follow-up (Cartier et al. 2008). This study indicates that the association of MA use and HIV risk continues even after a period of incarceration and treatment.

Steinberg et al. (2011) surveyed incarcerated female adolescents with a diagnosed STD from California juvenile detention facility. Of the 539 women, 16% reported regular MA use. Those who reported inconsistent condom use had over twice the odds of MA use (OR=2.7) compared with consistent condom users. Methamphetamine use was significantly associated with regular use of any drug (Steinberg et al. 2011). Another study with 98 HIV-negative, heterosexually-identified, meth-using females residing from San Diego reported high levels of sexual risk behaviour, most sexual activity were unprotected (Semple et al. 2004a). Twenty-two percent of the sample indicated that they had partners with whom they exchanged money for sex.

A national survey among high school students identified 7.6% of lifetime MA use (Zapata et al. 2008). The study identified an important independent association between MA use and recent sexual behaviour and pregnancy among students.

**Mexico (1 study):** A cross-sectional survey among 503 non-injecting drug users (over 80% reporting MA use in the last 6 months or as their most commonly used drug) found a HIV prevalence rate of 3.7% (Deiss et al. 2011). HIV prevalence among NIDUs was similar to that of PWID. Women were significantly more likely than men to have unprotected sex with PWID.

**Canada (1 study):** A longitudinal study 1,019 street-involved youth, where 31.4% female and 44.6% had used crystal methamphetamine found that less than 1% of participants (who reported MA use in the past 6 months) were HIV-positive at baseline (Uhlmann et al. 2014). This figure was much higher for HCV infection (12.8%). In an adjusted analysis, active crystal methamphetamine use was independently associated with Caucasian ethnicity, homelessness, injection drug use, non-fatal overdose, being a victim of violence, involvement in sex work and drug dealing. HIV positivity and unsafe sex, being a victim of violence and incarceration were not associated with prior crystal methamphetamine use.

### 3. People who Inject Drugs

There were 22 studies focused on people who inject ATS. The average age distribution of the participants was around 30 years old (mean or median ranging from 23 to 38). One study included women only and two included men only. The remaining studies included an average of 73% of male participants. The quality of the methodology of these studies is presented on the table below.

**Table 2: Quality Assessment of the Studies with people who inject ATS**

+ Reported and adequate; - Not reported or inadequate

Study	1. Population	2. Sampling	3. Representativeness	4. Response rate	5. Data Collection	6. Measure validity	7. Measure Time	8. Statistical Method	9. Confounders	10. Follow-up rate	11. Follow-up time	Total (%)
<b>PWID</b>												
McKetin, 2008	+	-	+	+	+	+	+	+	+			88.9%
Zule, 2007	+	-	+	-	+	-	+	+	+			66.7%
Cheng, 2009	+	-	+	-	+	+	+	+	+			77.8%
Kral, 2011	+	-	+	+	-	+	+	+	+			77.8%
Marshall, 2011	+	-	+	-	+	+	+	+	+	+	+	81.8%
Braine, 2005	+	+	+	+	+	-	-	+	+			77.8%
Vogt, 2006	+	-	+	-	+	+	+	+	+			77.8%
Racz, 2007	+	-	-	-	-	+	-	+	+			44.4%
Mehrjerdi, 2014	+	-	+	-	+	-	+	+	+			66.7%
Fairbairn, 2007	+	-	+	+	+	+	+	+	+	-	+	81.8%
Hayashi, 2011	+	-	+	-	+	+	+	+	+			77.8%
Lorvick, 2006	+	-	+	-	+	+	+	+	+			77.8%
Semple, 2004	+	-	+	-	+	+	+	+	-			66.7%
Talu, 2010	+	-	+	-	+	+	+	+	+			77.8%
Van Den Berg, 2007	+	-	+	+	+	+	+	+	+	+	+	90.9%
Robertson, 2004	+	+	+	+	+	+	+	+	+			100%

A systematic review conducted by Degenhardt and colleagues looked at MA use and its association with HIV. This comprehensive study concluded that MA injectors may be more likely than those who injecting other drugs to engage in risky injecting practices. However there are conflicting findings related to the association of MA injection and HIV infection, because of concurrent sexual HIV risks (Degenhardt et al. 2010).

Another important systematic review and meta-analyse looked at the influence of different drugs on HIV risk in people who inject drugs (Tavitian-Exley et al. 2015). The risks of HIV acquisition among PWID varied by drug type, but differences were not statistically significant. Compared to non-injectors, the risk of acquiring HIV was 3.6 (95% CI=2.8–4.7) times higher for cocaine injectors; it was 3.0 (95% CI=2.2–4.1) for ATS injectors and 3.5 (95% CI=2.3–5.2) for heroin injectors in Asia and Europe. Cocaine and ATS injectors had a consistently high risk of HIV acquisition. In Eastern Europe, risk of HIV seroconversion from ATS injection was high, alongside high levels of reported sexual risk behaviour.

**Australia (1 study):** A cross-sectional survey MA treatment entrants in Sydney and Brisbane compared MA smokers (N= 73), MA injectors (N=195) and those who used MA by both routes of administration (N=90) (McKetin et al. 2008). In comparison to injectors, smokers had similarly high levels of sexual risk behaviour. Injectors who smoked had comparable levels of needle sharing to injectors only, but they used methamphetamine more often. Smokers were younger and had less severe methamphetamine dependence than injectors, but they had more intense use patterns and similar levels harms.

**Thailand (2 studies):** A longitudinal analysis of 2,546 HIV-uninfected IDUs in Bangkok identified an increase in the proportions of methamphetamine injecting during the 4-year study period (16.2–19.6%) (Martin et al. 2010). HIV incidence was highest amongst participants injecting methamphetamine, 7.1 (95% CI, 5.4–9.2) per 100 person years. Injecting heroin and injecting methamphetamine were independently associated with HIV infection incident. The proportion of participants who shared needles was higher amongst methamphetamine injectors (33.0%) than heroin injectors (21.0%) or midazolam injectors (28.1%). Controlling for heroin use and other risk factors, participants injecting methamphetamine were 1.7 times more likely to become HIV-infected during the trial than participants not injecting methamphetamine.

A cross-sectional interviewed 311 individuals who injected drugs from the Mitsampan Community Research Project in Bangkok about syringe sharing practices (Hayashi et al. 2011). Over one-third reported more than weekly injection of methamphetamine and MA injection was independently associated with syringe sharing. In multivariate analyses, after adjustment for confounders, syringe sharing remained independently associated with injecting methamphetamine more than once per week (AOR=2.86, 95%CI: 1.59–5.15).

**Iran (1 study):** The first report from Iran investigated correlates of shared methamphetamine injection among 209 treatment seekers in the south of Tehran (Mehrjerdi et al. 2014). The study found a self-reported HIV infection rate of 2.9%, self-reported HCV infection rate was 26.7% and self-reported HBV infections was 9.6%. Over half of the sample (52.6%) reported current MA injection without any shared injection behaviour and 47.4% reported current shared methamphetamine injection. Shared methamphetamine injection was found to be primarily associated with living with sex partners (AOR 1.25, 95% CI 1.13–1.98), reporting 3 years of dependence on methamphetamine injection (AOR 1.61, 95% CI 1.27–2.12), injection with pre-filled syringes in the past 12 months (AOR 1.96, 95% CI 1.47–2.42), homosexual sex without condom use in the past 12 months (AOR 1.85, 95% CI 1.21–2.25), and positive hepatitis C status (AOR 1.98, 95% CI 1.67–2.83).

**Russia (1 study):** A cohort study followed 520 individual who inject drugs in St. Petersburg to identify factors associated with HIV acquisition (Kozlov et al. 2006). HIV incidence/100 person-years among stimulant injectors (ephedrine-based and/or amphetamines) was 7.7 (95% CI: 4.1–13.1) compared to 2.6 (95% CI: 1–5.3) among non-stimulant injectors ( $p=0.020$ ). Hazard ratio 3.61 (95% CI: 1.08–11.17). There were 13 new HIV cases among stimulants injectors (N=191), compared to 7 new HIV cases among the non-stimulant injectors (N=329) during a 12-month period. Those injecting stimulants more than 3 times a week had an incidence/100 person-years of 20.0 (95% CI: 6.5–46.7) compared to 5.5 (95% CI: 2.4–10.9) among those injecting stimulants two or less times a week ( $p=0.032$ ). Hazard Ratio 3.61 (95% CI: 1.08–11.17). In the multivariate analysis, stimulant use three or more times per week was the only factor associated with HIV seroconversion.

**Estonia (1 study):** A study with 350 current IDUs in Tallinn looked at HIV infection and risk behaviour of primary fentanyl and amphetamine injectors (Talu et al. 2010). The overall HIV prevalence in the study population was 54%. HIV prevalence among fentanyl injectors was 62% (95% CI: 56.97–67.03), which is significantly higher (at  $p < 0.001$  level) than the HIV prevalence among amphetamine users 27% (95% CI: 18.45–35.51).

**Hungary (1 study):** A cross-sectional survey with 186 IDUs in Budapest identified that 64.9% of amphetamine-only injectors had one type of hepatitis and 13.5% had one type of STI (Gyarmathy et al. 2009). Amphetamine-only injectors were more likely to have a higher number of drug-related infections, compared to those who injected heroin only, both heroin and amphetamines or other drugs.

**Netherlands (1 study):** 714 ever-injecting drug users from the Amsterdam Cohort Studies (ACS) (Van Den Berg et al. 2007) found that, among those who mainly injected amphetamines in the past 6 months, HIV IRR was 4.92 (95% CI: 1.54–15.7) and HIV incidence per 100 person-years was 1.87. Also among this group, HCV IRR was 7.45 (95% CI: 1.63–34.0).

**Canada (2 studies):** A longitudinal cohort study among 384 young individuals who injected drugs from Vancouver found a HIV prevalence among MA IV users of 10.8%, compared to 15.1% non-MA drug users (non-significant difference) (Marshall et al. 2011a). Injecting MA was independently associated with syringe sharing. Difficulty accessing sterile syringes partially mediated the association between injecting MA and syringe sharing. MA injectors were significantly more likely to report syringe sharing (AOR = 2.60,  $P < 0.001$ ) and difficulty accessing sterile syringes (AOR = 2.19,  $P < 0.001$ ) over the study period.

A large cross-sectional survey investigated increase use and associated harms of crystal methamphetamine injection in a Canadian setting (Fairbairn et al. 2007). The study identified that elevated HIV risk behaviour and younger age were independently associated with crystal methamphetamine injection. In multivariate analysis, crystal methamphetamine injection was independently associated with younger age, Caucasian ethnicity, syringe borrowing and syringe lending.

**USA (10 studies):** A cross-sectional survey compared HIV risk behaviour among amphetamine injectors (N= 854) across U.S. syringe exchange programmes (SEP) with others SEP users (Braine et al. 2005). They recorded a self-reported HIV rate of 3.6% among amphetamine injectors and 2.4% among other SEP users. Amphetamine injection was an independent risk factor for injection risk behaviour among SEP participants. However, there were similar levels of high sexual risk behaviour between the groups.

A large cross-sectional survey in California (N= 1,306) assessed HIV prevalence and risk among heterosexual methamphetamine injectors in California (Kral et al. 2011) and found a 3% HIV prevalence rate among MA injectors. Sexual and injection risk behaviours were highly prevalent among MA injectors (ranging from 21% to 72%). MA injectors had higher odds than non-MA injectors of unprotected vaginal intercourse and sex with five or more sexual partners in the past 6 months and of distributive and receptive syringe sharing in the past 30 days.

Cheng et al. (2010) evaluated drug use and STI risk among HIV-seronegative heterosexual 452 MA users (a third of the sample were injectors). Compared to non-IDU, IDU were more likely to report a recent STI, but no other significant differences were observed on sexual risk behaviour (Cheng et al. 2010). Another study with this same sample (Cheng et al. 2009) found that women

were more likely to report using MA “to lose weight”, while men were more likely to engage in sex marathons while under the effects of MA and to use MA “to enhance sexual pleasure”.

Zule et al. (2007) looked at methamphetamine use and risky sexual behaviours during heterosexual encounters among 703 injecting drug users in North Carolina. HIV prevalence among those who used MA in the last 30 days was 3.9% (Zule et al. 2007). Methamphetamine use by both partners was significantly associated with unprotected intercourse with a new partner and unprotected anal intercourse.

Another American study assessed HIV seroprevalence among 2,508 homeless and marginally housed adults in San Francisco (Robertson et al. 2004). Nearly a third of the sample ever injected ATS and 15.9% of those were HIV positive: OR 2.1 (95% CI: 1.6, 2.7). About half of the IDUS who were not MSM reported ever injecting ATS, and 7.2% of those were HIV positive: OR 0.85 (95% CI: 0.51, 1.4). Among all participants who reported to be MSM, 46.4% ever injected ATS and about a third of those were HIV positive (95% CI: 1.1, 2.4). At the bivariate level, HIV infection among MSM was higher among stimulant and heroin injectors, but not among syringe sharers.

Semple et al. (2004) compared injection and non-injection methamphetamine-using HIV positive MSM from San Diego (Semple et al., 2004b). Injectors reported more years of methamphetamine use, greater frequency and amount of methamphetamine use, more social and health problems, including higher prevalence of STDs and Hepatitis C, and more sexual risk behaviours. No significant differences in CD4+ cell count were found between injectors and non-injectors. Nearly half of injection methamphetamine users (45%) reported sharing needles with other users during the past 2 months. Eighteen percent indicated that they had shared needles without cleaning them. Thirty-seven percent injected with a borrowed needle and 28% loaned their needle to another user. Only 14% of the sample reported using a borrowed needle in a shooting gallery. Twenty-three percent of those who injected methamphetamine also reported injecting another drug in the past two months (heroin and cocaine). In terms of sexual risk behaviour IV and NIV differed only in terms of their partner types and number of partners. Men in the injection group had significantly more HIV-positive partners over the previous 2-month period as compared to men who did not inject. Twice as many men in the injection group reported having sexual partners with whom they exchanged sex for drugs or money as compared to men who did not inject.

Kral et al. (2005) assessed 357 MSM-IDU in San Francisco between 1998 and 2002. HIV prevalence was 28% there was high prevalence of risky sexual and injection behaviours (Kral et al. 2005). The only drug-related variable significantly associated with HIV status in bivariate analyses was amphetamine injection (76% HIV-negative and 86% HIV-positive,  $p=.044$ ). HIV status varied greatly by self-identified sexual orientation: 46% among gay, 24% among bisexual, and 14% among heterosexual MSM-IDU. There was little difference in risk behaviours between HIV-negative and HIV-positive MSM-IDU. A third of HIV-positive MSM-IDU reported distributive syringe sharing, compared to 40% of HIV negatives. Unprotected anal intercourse was frequent among the great majority of positives (70%) and HIV negatives (66%).

Sexual and injection risk among women who inject methamphetamine in San Francisco was reported by Lorvick et al. (2012). There were 158 MA injectors (past 6 months) among 477 street-recruited female IDUs (Lorvick et al. 2012). HIV prevalence was 9% among MA injectors and 11% among other IDUs. The study also found that women who inject MA engage in a range of sexual and injection behaviours. In a multivariate analysis, MA use among female injectors was significantly associated with anal sex, more than five sexual partners, receptive syringe sharing, and more than one syringe-sharing partner in the past six months. Injection risk seems to be higher

among female MA injectors than non-MA injectors. There were no differences on self-reported HCV rate: 75% among MA injectors and 74% among other IDUS.

An outbreak of hepatitis B virus infection among methamphetamine injectors in Natrona County (Wyoming) was reported in a case-control study by Vogt et al. (2006): 18 case-patients (symptomatic or confirmed HBV) and 49 controls (susceptible to HBV infection) were enrolled in the study (Vogt et al. 2006). All participants were MA injectors. The study found that sharing water used to prepare injections and/or rinse syringes was associated with HBV infection, as was sharing cotton filters (89% of case-participants versus 52% of controls). But sharing syringes was not statistically associated.

#### ***4. Men who have Sex with Men (MSM) Only***

There were 46 studies focused on men who have sex with men. The average age distribution of the participants was around 34 years old (mean or median ranging from 19 to 48). Only one study included women (58% lesbians and bisexuals). The quality of the methodology of these studies is presented on the table below.

**Table 3: Quality Assessment of the Studies with Men who have Sex with Men (MSM)**  
 + Reported and adequate; - Not reported or inadequate

Study	1. Population	2. Sampling	3. Representativeness	4. Response rate	5. Data Collection	6. Measure validity	7. Measure Time	8. Statistical Method	9. Confounders	10. Follow-up rate	11. Follow-up time	Total (%)
<b>MSM</b>												
Fernandez, 2006	+	+	+	-	+	-	+	+	+			77.8%
Freeman, 2011	+	-	+	-	+	-	-	+	+			55.5%
Patterson, 2005	+	-	+	-	+	+	+	-	-			55.5%
Nakamura, 2011	+	-	+	-	+	+	+	+	+			77.8%
Kral, 2005	+	-	+	+	+	+	+	+	-			77.8%
Nakamura 2011	+	-	+	-	+	+	+	-	+			66.7%
Lyons, 2013	+	-	-	-	+	-	+	+	+			55.5%
Pappas, 2011	+	-	+	-	+	+	+	+	-			66.7%
Halkitis, 2008	+	-	+	-	+	+	+	-	-			55.5%
Halkitis, 2005	+	-	+	+	+	+	+	-	+			77.8%
Peck, 2015	+	-	+	-	+	+	+	+	-			66.7%
Semple, 2009	+	-	+	-	+	+	+	-	-			55.5%
Buchacz, 2005	+	-	-	-	+	+	+	+	+	-	+	63.6%
Drumright, 2009	+	-	+	+	+	+	+	+	+			88.9%
Wohl, 2008	+	-	+	+	+	+	+	+	-			77.8%
Carey, 2009	+	-	+	-	+	-	+	+	+			66.7%
Macdonald, 2008	+	-	+	-	+	-	+	+	+			66.7%
Ackers, 2012	+	-	+	-	+	+	+	+	+	-	+	72.7%
Buchbinder, 2005	+	-	+	-	+	+	+	+	+	-	+	72.7%
Harawa, 2004	+	+	+	+	+	-	+	+	+			88.9%
Chariyalertsak, 2011	+	-	+	-	+	+	-	-	-			44.4%
Colfax, 2004	+	-	+	-	+	+	+	+	+			77.8%
Rusch, 2004	+	-	-	+	+	-	+	+	+	-	+	63.6%
Prestage, 2009	+	-	+	+	+	+	+	+	+	+	+	90.9%
Hirshfield, 2004	+	-	-	+	+	-	+	-	+			55.5%
Morineau, 2011	+	+	+	-	+	+	+	+	+			88.9%
Szwarcz, 2007	+	+	-	+	+	-	+	+	+			77.8%
Thiede, 2009	+	-	+	+	-	+	+	-	+			66.7%
Bousman, 2009	+	-	+	-	+	+	-	+	-			55.5%
Rawstorne, 2007	+	-	+	-	-	+	+	+	+	-	+	63.6%
Marshall, 2011	+	-	+	-	+	+	+	+	+	+	+	81.8%
Halkitis, 2005	+	-	+	-	+	+	+	+	+	+	+	81.8%
Semple, 2009	+	-	+	-	+	+	+	-	-			55.5%
Semple, 2010	+	-	+	-	+	+	+	+	-			66.7%
Semple, 2006	+	-	+	-	+	+	+	+	-			66.7%
Semple, 2004	+	-	+	-	+	+	+	+	-			66.7%
Semple, 2008	+	-	+	-	+	+	+	-	+			66.7%
Semple, 2010	+	-	+	-	+	+	+	-	-			55.5%
Plankey, 2007	+	-	-	+	+	+	+	+	+	-	+	72.7%

Vu et al.2015 published a review on Amphetamine-type stimulants (MA and ecstasy) and HIV infection among men who have sex with men (Vu et al. 2015). The review included 35 studies and

concluded that MA use was significantly associated with HIV infection among MSM in high-income countries in all study designs, but the evidence of the role of ecstasy in HIV infection was lacking in cross-sectional studies. 25 cross-sectional studies (out of 29) reported high HIV prevalence (9-34%) among MSM. In cross-sectional studies, MSM who reported ever using ATS were 1.70 times more likely to be infected with HIV than non-users. Longitudinal studies included in that review found HIV incidence between 1.90 and 2.55 per 100 person years among MSM.

Drumright et al. (2006) published a systematic literature review looking at club drugs as causal risk factor for HIV acquisition among men who have sex with men (Lydia N. Drumright et al. 2006). The review included nine studies examining methamphetamine and five examining amphetamine. Of these 14 studies, 4 were longitudinal, 1 was a case-control and 9 were cross-sectional. In three of the longitudinal studies, amphetamine use over the follow-up period was associated with at least a twofold increased risk of HIV seroconversion. The remaining longitudinal analysis demonstrated associations between methamphetamine use and UAI at a particular sexual encounter, providing evidence for temporality, as drug use occurred before UAI. All but two of the nine cross-sectional studies demonstrated that either methamphetamine or amphetamine were consistently associated with the majority of risk behaviours or disease outcomes measured. Of the seven studies demonstrating positive associations, most had risk ratios above 1.5 with confidence intervals that excluded one. A study included in that review (Chesney et al., 1998) demonstrated some evidence of dose-response relationships. In this longitudinal study, long-term amphetamine use was associated with HIV seroconversion (RR = 2.89, 95% CI, 1.36–6.16); however, a similar association was not observed for recent adoption of amphetamine use, suggesting that the longer one uses the drug, the more likely they are to seroconvert. A number of studies demonstrate that cessation of methamphetamine use results in a reduction in risky sexual behaviours.

**Canada (3 studies):** a longitudinal cohort study assessed pathways to HIV risk and vulnerability among 248 sexual minorities methamphetamine users (Marshall et al. 2011b). Over half of the sample (62.1%) reported recently using MA. The findings suggested that crystal MA use was not associated with HIV status at baseline (40.4% of the males and 28.5% of the females were HIV-positive). MA use was associated with different sets of HIV risks and vulnerabilities. MA use among sexual minority males was associated with unprotected intercourse (AOR = 1.62, p = 0.048). Among females, MA use was associated with injection drug use (AOR = 2.49, p = 0.002), and unprotected intercourse with sex trade clients (AOR = 2.62, p = 0.027), female MA users more likely to have multiple regular or casual sex partners (OR = 1.55, p = 0.029).

Another Canadian longitudinal study looked at unprotected anal intercourse associated with recreational drug use among 261 young MSM (Rusch et al. 2004). UAI was significantly associated with sexual situation-specific use of marijuana (OR, 1.43), crystal methamphetamine (OR, 1.75), ecstasy (OR, 1.88), and ketamine (OR, 2.17). Methamphetamine was associated with receptive unprotected anal intercourse with casual partners.

A cross-sectional survey compared HIV risk profiles among HIV-positive, methamphetamine-using men who have sex with both men and women (Nakamura et al. 2011). The study found that HIV-positive MA users MSMW differ significantly from MSM in their HIV risk behaviours: Factors independently associated with MSMW were acquiring HIV through injection drug use, being an injection drug user, using hallucinogens, using crack, being less likely to have sex at bath house, being less likely to be the receptive partner when under the effects of methamphetamine, having greater intentions to use condoms for oral sex, and having more negative attitudes about HIV disclosure. MSMW were also more likely to use methamphetamine frequently in the past 30

days, inject methamphetamine use, and use cocaine and crack in the past 2 months. MSMW and MSM did not differ significantly in their number of reported unprotected anal or oral sex acts.

**Thailand (1 study):** a cross-sectional in Northern Thailand assessed HIV Incidence and risk factors among 551 MSM (11.1% ever used MA) (Chariyalertsak et al. 2011). Use of methamphetamine and heroin was rare in the overall sample, but more common among HIV positive men, with methamphetamine reaching borderline significance (OR 1.78; 95% CI: 0.81-3.65).

**Indonesia (1 study):** a cross-sectional survey on sexual risk taking assessed 1,450 MSM, among whom 749 were tested for HIV and syphilis and 738 for gonorrhoea and Chlamydia (Morineau et al. 2011). 15% of MSM used MA before having sex in the 3 months prior to the survey. Multivariate analyses revealed an association with recent methamphetamine use and HIV infection (OR = 2.69; 95% CI = 1.33–5.43).

**United Kingdom (1 study):** Macdonald et al. (2008) reported on factors associated with HIV seroconversion in gay men in England, 75 cases (recent HIV positive test following a negative test within the past 2 years) and 157 controls (recent HIV negative test following a previous negative test within the past 2 years) (Macdonald et al. 2008). 21.3% of cases reported MA use and 8.28% of controls. MA use and association with HIV seroconversion (OR 1.30; 95%CI: 0.60, 2.83). This study found no evidence of methamphetamine's association with seroconversion despite being reported by over 10% of participants. Use of nitrite inhalants was more problematic in this study sample.

**Australia (3 studies):** a cross-sectional survey looked at MA use in an online sample of 1135 HIV-positive and HIV-negative gay-identified men aged 40 years and older (Lyons et al. 2013). 13% reported using methamphetamine in the past 12 months. Self-reported HIV rate was 17% of total sample. The adjusted odds of HIV-positive men reporting methamphetamine use were 2.5 times those of HIV-negative men. Reported methamphetamine use was considerably more prevalent among HIV-positive (24%) than HIV-negative men (11%).

Rawstorne et al. (2007) conducted a longitudinal study among 448 MSM and who reported Crystal MA in the past 6 months. The study looked at associations between MA use and unsafe sexual activity (Rawstorne et al. 2007). Compared to non-users, crystal users reported having more sex partners, looking for sex in more types of venues, and being more likely to engage in unprotected anal intercourse with casual partners (UAIC) and in esoteric sex. Crystal users were also more likely to be using other recreational drugs and sildenafil than non-users. The study suggests that crystal use does not necessarily drive unsafe sexual behaviour, taken that the prevalence of crystal use among Australian MSM increased between 2002 and 2005, but the prevalence of UAIC remained stable or decreased, as did the prevalence of other sex-related behaviours.

Another Australian longitudinal study with a larger sample of 1,427 HIV-negative homosexually active men looked at use of illicit drugs and erectile dysfunction medications and subsequent HIV infection (Prestage et al. 2009). In multivariate analysis, use of methamphetamine (HR = 1.34, CI = 1.01–1.78, p= 0.041) and amyl nitrite (HR = 1.30, CI = 1.02– 1.67, p = 0.037) were both independently associated with HIV seroconversion. The risk of infection was substantially increased when both oral erectile dysfunction medications and methamphetamine were used. When adjusted for each other, a significant effect remained for methamphetamine, amyl nitrite, and oral erectile dysfunction medications. When further adjusted for detailed measures of HIV risk behaviour, the increased risk remained significant only for oral erectile dysfunction medications and amyl nitrite. Among those who used MA once a month HIV incidence was 2.71 per 100 person-

years; Hazard ratio (HR) 5.21 (1.85–14.65). Among those who used MA more than once a month HIV incidence was 1.75 per 100 person-years; HR 3.50 (0.87–13.99).

**USA (35 studies):**

*HIV Prevalence/Incidence*

Halkitis et al. (2005) conducted a longitudinal cohort investigation of methamphetamine use among MSM in New York City (project BUMPS) and found that MA use at baseline was unrelated to HIV status (Halkitis et al. 2005a). HIV prevalence among 293 MA users was 38% (N=111) and 35% (N=33) among non-MA users. At both baseline and the 12-month follow-up, HIV status was associated with the context of methamphetamine use at sex clubs and sex parties. Many participants indicated using methamphetamine in combination with alcohol, MDMA, ketamine, marijuana, and sildenafil.

Plankey et al. (2007) conducted an important multicentre longitudinal cohort study with very large sample of seronegative men to determine the relationship between methamphetamine and amyl nitrite use and risk of HIV seroconversion (Plankey et al. 2007). The study findings showed a significant association between methamphetamine use and HIV seroconversion after adjusting for other important risk factors. There was a 1.46 (95%CI: 1.12 to 1.92) increased relative hazard of HIV seroconversion associated with methamphetamine use. The relative hazard associated with amyl nitrite use was 2.10 (95% CI: 1.63 to 2.70). The relative hazard of HIV seroconversion increased with the number of unprotected receptive anal sexual partners. The joint relative hazard for methamphetamine and amyl nitrite use was 3.05 (95% CI: 2.12 to 4.37).

Another important prospective cohort study with 2,991 MSM who tested anonymously for HIV in San Francisco identified that amphetamine use is associated with an increased HIV incidence (Buchacz et al. 2005). HIV incidence among 290 amphetamine users was 6.3% per year (95% CI 1.9–10.6%), compared with 2.1% per year (95% CI 1.3–2.9%) among 2701 non-users (RR 3.0, 95% CI 1.4–6.5), the HIV incidence was 7.7% per year (95% CI 2.4–13.0) among those who had sex while using amphetamine. After adjusting for several factors, amphetamine use was still associated with HIV seroconversion (OR 2.4, 95% CI 0.9–6.3). When also controlled for the use of marijuana and alcohol in the past year, amphetamine use remained associated with HIV seroconversion (OR 2.5, 95% CI 0.9–6.9). Compared with non-users, amphetamine users were more likely to report either unprotected anal sex in the past year or 10 or more sex partners in the past year. They were also more likely to be younger, but no differences were found in regards to ethnicity.

Koblin et al. (2006) followed 4,295 HIV-negative MSM (12.3% of them reported MA use in the past 6 months) (Koblin et al. 2006). 67 of 527 amphetamine users seroconverted during the study. The HIV hazard rate of amphetamine users was 3.98 (CI 3.06-5.16) in the univariate analysis and 1.96 in the multivariate analysis. The HIV attribute risk of amphetamine use was 16.3%. In multivariate analysis, men reporting amphetamine or heavy alcohol use and alcohol or drug use before sex were at increased risk of HIV infection. The overall HIV incidence was 2.1 per 100 person-years (95% CI, 1.9–2.4).

Results from the National HIV behavioural surveillance study in New York City assessed amphetamine use and sexual risk among MSM (Koblin et al. 2007). The study found that men who used amphetamines were significantly more likely to be HIV infected: 29.8% of men reporting amphetamine use were HIV positive compared to 16.6% who did not use amphetamines (p =

0.029). Amphetamine-using men were also more likely to be polydrug users, to be HIV infected and to engage in unprotected receptive anal intercourse with non-main partners.

High and persistent HIV seroincidence was reported in MSM across 47 U.S. Cities (Ackers et al. 2012). This study included 4,684 high-risk MSM and found high seroincidence rates among men who reported baseline drug use: amphetamines: IRR 5.0/100 py (95% CI 3.8, 6.4) and HR 2.9 (2.2–3.9). Overall, HIV incidence was 2.7/100 person-years. HIV incidence was highest among young men and men reporting unprotected sex, recreational drug use, and a history of a sexually transmitted infection. Amphetamine and amyl nitrite use were significantly linked to higher risks of seroconversion.

Carey et al. (2009) conducted a case-control study to assess drug use, sex behaviours, HIV infection among MSM in Chicago and Los Angeles (Carey et al. 2009). The study included 111 cases with recent HIV infection, and 333 HIV-negative controls. Nearly a third of cases (28.8%) had used MA in the past 6 months in comparison to 11.4% of the controls (OR 3.13; 95% CI: 1.78–5.52). Cases more frequently used sildenafil, amyl nitrite, and methamphetamine during UAI compared with controls. MA use was a proxy marker for persons engaged in high risk sexual activities.

In another longitudinal study 3,257 MSM in six cities from 1995 to 1997 found annual seroincidence of 4.4 (OR 3.3; 95%CI 1.9-5.7) among those who reported MA use in the past 6 months (Buchbinder et al. 2005). Several drugs were also associated with HIV seroconversion, including nitrite inhalants, amphetamines, cocaine, hallucinogens, and injection drugs. MA use was not significant in the multivariable analysis.

A phone survey of 1976 adult MSM in San Francisco found that MA was used by 26% of HIV-positive men compared with 13.6% of HIV-negative men (Schwarcz et al. 2007). Crystal methamphetamine use was high overall and was independently and strongly predictive of high-transmission sexual risk behaviour among the non-HIV-infected men. Methamphetamine was independently predictive of high-transmission-risk sexual intercourse among the men who were HIV infected (odds ratio=1.9; 95% CI=1.1, 3.3.).

Hirshfield et al. (2004) assessed 2,943 gay and bisexual men recruited online. Men with STD were more likely than men without an STD to report drug use (OR 3.8; 95% CI 2.1-6.7). In the multivariate analysis, crystal methamphetamine use (adjusted OR 2.0; 95% CI 1.1-3.8) was significant independent predictors associated with incident STD (Hirshfield et al. 2004).

Peck et al. (2005) assessed 263 MA-dependent, treatment-seeking MSM in Los Angeles. HIV positive sero-status was reported by 61% of the total sample (Peck et al. 2005). HIV infection status was strongly associated with prior treatment for methamphetamine dependence; unprotected receptive anal intercourse; history of sexually transmitted infections; and health insurance status. HIV-infected participants were more than twice as likely (48.0% vs. 21.9%) as their HIV-uninfected peers to report unprotected receptive anal intercourse in the 30 days prior to intake. Reports of HIV infection corresponded closely with severity of drug dependence as nearly 2.5 times more HIV-infected participants (51.1%) reported prior methamphetamine treatment episodes as HIV-uninfected participants (18.3%). There was a trend that approached significance with HIV-infected participants (37.8%) more likely to report injection use of methamphetamine than HIV non-infected participants (23.4%). While injection users reported histories of more sexually transmitted infections than non-injection users they were equally likely to engage in sexual risk behaviours in the past 30 days.

### *HIV Risk Behaviour*

Negative mood and sexual behaviour in the context of methamphetamine and HIV were explored in study including 175 non-monogamous MSM from San Diego area (Bousman et al. 2009). The sample was divided into four groups: METH+/HIV, METH+/HIV-, METH-/HIV+, HIV-/METH-. METH+/HIV+ group reported significantly greater negative mood and sexual risk behaviour when compared to controls. This group presented greater likelihood of unprotected sex and more than twice the number of partners in the previous year than the other groups. METH-/HIV+ group reported significantly greater use of condoms. Among those in HIV+ groups, METH use is a critical in the frequency of condom use: among METH+ individuals, frequency of condom use is 6–25% and among METH- individuals it is at 51–75%.

Halkitis et al. (2008) assessed 311 MSM attending gyms in NYC. About a third of those who used MA use in the past 6 months self-reported to be HIV-positive (Halkitis et al. 2008). Seropositive men were more likely to report methamphetamine use than seronegative men (32.4 vs 20.9%;  $p=0.02$ ).

Vaudrey et al. (2007) conducted a time series analysis during 2003–2006 which including 4,602 MSM from San Francisco (Vaudrey et al. 2007). Reported use of methamphetamine significantly decreased among HIV-negative MSM. However, methamphetamine and alcohol use during sex was associated with unprotected potentially HIV serodiscordant sex.

Colfax et al. (2004) assessed whether substance use during sex was independently associated with sexual risk during recent sexual episodes. In the participant-level analysis, use of amyl nitrite, amphetamines and sniffed cocaine, as well as heavy alcohol use in the prior 6 months, were independently associated with serodiscordant unprotected anal sex (Colfax et al. 2004).

Determinants of recent HIV infection among MSM from Seattle area were assessed by comparing 32 HIV-positive MSM (cases) and 110 HIV-negative MSM (controls) (Thiede et al. 2009). Drug use, particularly use of methamphetamine and amyl nitrite, during unprotected anal intercourse was significantly more prevalent among case participants compared with control participants. Prevalence MA use during UAI was 34.4% among cases and 12.7% among controls.

### *HIV risk behaviour among HIV-positive*

Nakamura et al. (2011) assessed sexual risk behaviour among 297 HIV-positive MSM from San Diego, California. The authors found that negative condom attitudes moderate the relationship between methamphetamine use and unprotected sex (Nakamura et al. 2011). The relation between methamphetamine frequency and unprotected sex was significant for individuals who had more negative attitudes toward condoms, while among participants with less negative attitudes toward condoms, no significant association was found.

Halkitis et al. (2005) assessed 49 MSM MA users from New York City. Over half of the sample (57.1%) self-reported to be HIV-positive (Halkitis et al. 2005b). The authors argue that MA attracts a hypersexual risk-taking group of men who engage in unprotected sexual behaviours regardless of their methamphetamine use. Participants reported equivalent rates of unprotected anal insertive and receptive intercourse when comparing their sexual acts while under the effects of methamphetamine, of other drugs and sober. More frequent risky sexual behaviours among HIV positive men when compared with HIV negative men were found.

Drumright et al. (2006) assessed 194 MSM who were recently infected with HIV and identified an association between unprotected anal intercourse and the use of methamphetamine (L. Drumright et al. 2006).

Semple et al. (2009) assessed sexual risk behaviour associated with co-administration of methamphetamine and other drugs in a large sample of HIV-positive MSM. Those who reported methamphetamine co-administration in the past two months (65%) reported significantly more unprotected anal and oral sex and a greater number of casual, anonymous, and paid sex partners in this time frame compared to men who used methamphetamine alone. Two primary patterns of drug co-administration were identified: 1) drug combinations motivated by sexual performance and enhancement (e.g., methamphetamine, amyl nitrite, sildenafil) and 2) "party drug" combinations (e.g., methamphetamine, GHB, ketamine) (Semple et al. 2009b).

The prevalence of sexual marathons practice was assessed in a sample of 341 HIV-positive MSM (Semple et al. 2009c). The authors found that this practice was common and those engaging in sexual marathons also showed other sexual risk behaviours. The vast majority (84%) engaged in marathon sex while under the effect of methamphetamine. Men who engaged in marathon sex used significantly more illicit drugs, sildenafil and amyl nitrates, and scored higher on a sexual compulsivity scale compared to men who did not engage in marathon sex.

A cross-sectional study with 261 HIV-positive meth-using MSM identified that the intensity of methamphetamine use and sexual risk behaviour were significantly correlated (Semple et al. 2006a). In a multiple regression analysis, more education, greater intensity of methamphetamine use and higher levels of impulsivity predicted more unprotected sex. A plot of the interaction revealed that the relationship between intensity of methamphetamine use and total unprotected sex was strongest among participants who had higher levels of impulsivity.

Semple et al. (2006) looked at sexual risk behaviour of HIV-positive methamphetamine-using MSM and identified the importance of the role of partner serostatus and partner type (Semple et al. 2006c). HIV-positive meth-using MSM engaged in significantly fewer acts of anal sex with serodiscordant partners as compared to seroconcordant partners. There were high rates of unprotected sex in the sample and rates of serostatus disclosure to unknown serostatus partners were low.

Another cross-sectional survey with 217 HIV-positive MSM revealed the role of sexual compulsivity in a sample of HIV-positive methamphetamine-using gay and bisexual men (Semple et al. 2006b). Sexual compulsivity was positively associated with high-risk sexual behaviours. In multivariate analyses, higher scores on sexual compulsivity were associated with older age, methamphetamine use before or during sex, visits to sex clubs and street corners to find sex partners, lower self-efficacy for condom use, lower levels of self-esteem, higher scores on a measure of disinhibition, and a greater number of HIV-negative or unknown serostatus partners.

Semple et al. (2010) studied 321 MA-using HIV-positive MSM in San Diego and identified factors associated with sex in the context of methamphetamine use in different sexual venues among HIV-positive MSM (Semple et al. 2010a). Respondents were classified according to their preference of sexual venue: private, commercial or public. The commercial venue group was younger, better educated, more likely to identify as gay, and significantly more likely to have used "club drugs" as compared to the other two groups. Men in the commercial-and public-venue groups reported more high-risk sex compared to the private-venue group. The public-venue group reported heavier drug

and alcohol use, had significantly higher Beck depression scores, reported more experiences of stigma, and scored higher on a measure of sexual compulsivity than did the other two groups.

Wohl et al. (2008) compared 455 MSM and 228 non-MSM diagnosed with AIDS in Los Angeles County and found that compared to MSM with no history of methamphetamine use, MSM methamphetamine users were more likely reported more than 10 sexual partners in the previous 12 months (OR = 3.1, 95% CI: 1.7, 5.6) (Wohl et al. 2008).

#### *Poly-drug use and Sildenafil use*

Patterson et al. (2005) assessed correlates of polydrug use among 261 HIV-positive individuals. The sample was divided into three groups: MA use only, MA and light polydrug users, MA and heavy polydrug users. Heavy polydrug users reported more sex partners who were HIV negative or of unknown serostatus. They also reported more unprotected sex with these partners. Just 5% of the participants used methamphetamine only (Patterson et al. 2005).

Rudy et al. (2009) interviewed 6435 MSM from sexually transmitted disease (STD) clinic in Los Angeles and found a difference in relation to HIV status and risk behaviour between MA users and users of other club drug use (Rudy et al. 2009). Newly recognized HIV status (OR: 3.02 95% CI: 2.30, 3.99) was associated with methamphetamine use compared with nondrug users, an association not found among other club drug users.

Fisher et al. (2011) investigated the relationship between MA and Sildenafil use among 1,794 men (52.2% were heterosexual) (Fisher et al. 2011). Participants were divided into three groups: Methamphetamine alone, sildenafil alone, both drugs combined. Men who used both MA and sildenafil showed a significantly higher prevalence of hepatitis B, syphilis, and HIV compared to those who used only one or neither drug. The MA-only group was also more likely to report being positive for HIV than the reference group. The proportion of those using MA immediately before or during sex in the MA-only group was lower (24%) than in the group using both MA and sildenafil (33%), indicating that the use of MA was more closely associated with sexual activity for those who used both methamphetamine and sildenafil. Gay men who take both sildenafil and MA engaged in higher levels of risky sex had a significantly higher prevalence of hepatitis B, untreated syphilis, and HIV. Sildenafil is associated with insertive, and methamphetamine is associated with receptive, anal intercourse. A very strong association between the use of GHB and the use of both MA and sildenafil was found.

Drumright et al. (2009) conducted a case-control study to assess the associations between substance use, erectile dysfunction medication and recent HIV infection among MSM (Drumright et al. 2009). Cases were 86 recently HIV-infected MSM and controls were 59 MSM who recently tested HIV-negative. Cases were more likely than controls to report methamphetamine or nitrite use, in the previous 12 months and with their last three sexual partners.

#### *Age categories*

Freeman et al. (2011) assessed HIV risk among 595 adolescent boys and young MSM from eight US cities young MSM (64 MA users; 87 hard drugs other than MA). Recent methamphetamine use was associated with history of sexually transmitted diseases (51.6%), two or more sex partners in the past 90 days (85.7%), sex with an injection drug user (51.6%), and sex with someone who has HIV (32.8%) compared with individuals reporting no recent hard drug use. This particular population seem to be at high risk for HIV infection (Freeman et al. 2011).

Pappas and Halkitis (2011) examined sex risk behaviour among different age categories among of 166 New York City-based seropositive, club drug-using, MSM; 67.5% recently used methamphetamine (Pappas and Halkitis 2011). UAI and club drug use was common. The likelihood of engaging in UAI with seronegative casual partners was greater among those in their 20s than those in their 30's or 40+. With regard to number of years living with HIV, those living longer with the disease were more likely to report UAI with casual partners with a seropositive status than with a negative or unknown serostatus.

### *Ethnic Minorities*

Halkitis and Jerome (2008) interviewed 293 gay and bisexual men MA users from New York City (32 were Black). About half had used MA recently and 40.6% of Black MA users were HIV positive. Black methamphetamine users tended not to reside in neighbourhoods considered traditionally gay, were more likely to be HIV-positive, have lower educational attainment, and have lower levels of income than other methamphetamine users (Halkitis and Jerome 2008). Poly-drug use was common among Black men with almost all methamphetamine users also reporting use of cocaine, but cocaine users not necessarily reporting methamphetamine use.

A cross-sectional survey with Hispanic MSM from South Florida assessed the added risk of crystal MA use (Fernandez et al. 2007). The sample was divided into non-drug users (N= 325), non-crystal drug users (N= 184) and crystal users (N=57). Crystal users were not significantly different from non-crystal drug users in number of sex partners; however, differences in unprotected receptive anal sex approached significance. Findings suggest that crystal may be contributing to additional risk of URAS. Poly-drug use was present among the vast majority of crystal users and this could be a major confounding factor in the study.

Associations of ethnicity with HIV prevalence and among young MSM were measured in seven urban centres in the United States (Harawa et al. 2004). In a multiple logistic regression analysis, positive associations with HIV included older age, being out of school or work, sex while on crack cocaine, and anal sex with another male regardless of reported condom use level. Differences in these factors did not explain the racial/ethnic disparities in HIV prevalence.

## ***5. Sex Workers***

There were 12 studies focused on sex workers. The average age distribution of the participants' was around 30 years old (mean or median ranging from 21 to 39). Nine studies included women only, one included MSM and in two studies about half of the sample was male. The quality of the methodology of these studies is presented on the table below.

**Table 4: Quality Assessment of the Studies with Sex Workers**

+ Reported and adequate; - Not reported or inadequate

Study	1. Population	2. Sampling	3. Representativeness	4. Response rate	5. Data Collection	6. Measure validity	7. Measure Time	8. Statistical Method	9. Confounders	10. Follow-up rate	11. Follow-up time	Total (%)
<b>SW</b>												
Couture, 2012	+	-	+	-	+	+	+	+	+	+	+	81.8%
Couture, 2011	+	-	+	+	+	+	+	+	-	+	+	81.8%
Deering, 2013	+	-	+	+	+	+	+	+	+			88.9%
Goldenberg, 2013	+	-	+	-	+	+	+	-	+			66.7%
Liao, 2011	+	+	+	-	+	+	+	-	+			77.8%
Kang, 2011	+	+	+	-	+	+	+	-	+			77.8%
Munoz, 2010	+	-	+	-	+	-	+	-	+			55.5%
Robertson, 2014	+	-	+	-	+	+	+	-	+			66.7%
Urada, 2014	+	+	+	+	+	+	+	-	+			88.9%
Shannon, 2011												
Semple, 2011												

**Cambodia (2 studies):** a Longitudinal study followed 160 young women engaged in sex work in Phnom Penh found 63.7% of lifetime ATS use and for 26.5% ATS use in the past 3 months (Couture et al. 2012). HIV prevalence (tested at baseline only) among 42 SW who reported recent ATS use was 28% (N=12). HIV prevalence in non-ATS users was 21% (N=25 out of 118). HIV incidence in this sample was reported in a separate study (Couture et al. 2011): HIV Prevalence rate (for the whole sample) was 23% (95% CI, 20.0%–26.7%); HIV estimated incidence (for the whole sample) was 3.6 per 100 py (95% CI, 1.2%–11.1%). Recent Yama use was associated with STI incident (Adj. HR 3.9; 95% CI 1.5-10.3). HIV was prevalent in 30% of those who used Yama in the last 3 months. HIV was prevalent in 19% in those who used crystal in the last 3 months.

**Philippines (1 study):** A cross-sectional survey assessed sex work and its associations with alcohol and methamphetamine use among 498 female working in bars and spas (35% engaged in sex work) (Urada et al. 2014). 9% used methamphetamines (shabu). Sex work was independently associated with methamphetamine use (19% vs 4%; AOR2.9; 95% CI 1.3–6.2).

**China (2 studies):** A large cross-sectional survey (N= 1,187) evaluated commercial sex venues, syphilis and methamphetamine use among female sex workers (Kang et al. 2011, Liao et al. 2011). 30.2% used MA in last 6 months, 1.6% ever injected. The study found that MA users who frequent commercial sex venues engaged in high-risk behaviours and were at risk for syphilis and other sexually transmitted diseases. Among the syphilis-infected participants, 50% ever used MA in the last six months. Among all participants, MA users were more likely to be younger, single, younger at first lifetime sex act, have ever had unprotected sex with clients and have syphilis.

**Canada (2 studies):** 255 street-based female SWs were followed: 32% reported lifetime crystal MA use and 24% used crystal MA during the two-year follow-up period (Shannon et al. 2011). Injection was the primary mode of administration of crystal MA during follow-up (for 85%). HIV prevalence among SWs was 23%, with no statistically significant difference in likelihood of crystal MA use by HIV status (p=0.83). No significant associations between methamphetamine use and

sexual risk patterns were found. In a multivariate model, FSWs who used crystal methamphetamine had a higher proportional odds of dual heroin injection, having a primary male sex partner who procures drugs for them, and working and living in marginalized public spaces.

Cross-sectional survey with 510 SWs investigated clients' demands for unsafe sex (Deering et al. 2013). More frequent drug use (e.g., use of speedballs, non-injection crystal methamphetamine) was strongly associated with being offered or accepting more money for sex without a condom.

**USA (2 study):** a cross-sectional survey 342 HIV-negative heterosexual recent MA users to identify correlates of trading sex for methamphetamine (Shannon et al. 2011). A quarter of the sample (21% of males and 31% of females) reported trading sex for methamphetamine in the past two months. Multiple logistic regression analysis revealed that recently trading sex for methamphetamine was independently associated with being female, homeless, binging on MA, sexual victimization in the past two months, engaging in anal sex 24 or more times in the past two months, and higher sexual compulsivity scores.

Semple et al. (2010) assessed social and behavioural characteristics of 155 HIV-positive MSM who trade sex for methamphetamine. Forty-three percent of the sample reported trading sex for methamphetamine in the past 2 months (Semple et al. 2010b). Trading sex for methamphetamine was associated with being a binge user, homelessness, having an income of less than \$20,000 per year, being less assertive at turning down drugs, engaging in more anal sex without a condom, and seeking out risky sex partners when under the effects of methamphetamine.

**Mexico (3 studies):** a cross-sectional survey looked at associations with consistent condom use among 924 female sex workers (21% used MA) in two northern border cities of Mexico (Muñoz et al. 2010). Factors inversely associated with consistent condom use included poor financial status, methamphetamine use, alcohol use and recent injection drug use.

Another cross-sectional looked at correlates of involuntary sex exchange among 214 female sex workers in two Mexico-U.S. border cities (Goldenberg et al. 2013). MA use in the past 6 months was reported by a third of the sample. Among these, 48.3% reported involuntary sex exchange and 31.5% reported no involuntary sex exchange (difference not significant).

Robertson et al. (2014) reported prevalence and correlates of HIV and sexually transmitted infections among 212 female sex workers and their non-commercial male partners in two Mexico-USA border cities. A third of the sample reported MA use in the past 6 months (Robertson et al. 2014). Among men, those who recently used methamphetamine were 6% more likely to have HIV/STIs ( $p<0.05$ ).

## *6. Summary of the Findings*

The present review identified a substantial amount of evidence on the link between HIV risk and ATS use. This association has been most commonly researched in North America, Eastern Europe, East and South East Asia. Most of the studies included in the present review had a cross-sectional design and were conducted in developed countries, particularly in the United States. The majority of the evidence focused on men who have sex with men. There is a dearth of evidence on other vulnerable groups, such as prison-based populations and sex workers. Most of the studied samples had an average age of 30 years old and were generally made by two-thirds of male participants. Nevertheless, women, younger and older adults who use ATS might still be vulnerable to HIV and other sexually transmitted diseases and infections.

### *HIV Prevalence and Incidence*

It is difficult to quantify the exact role of ATS use in increasing HIV infection. But the evidence seems to point towards a positive association between these two factors. Of the six systematic literature reviews included in the present document (Colfax et al. 2010; Degenhardt et al. 2010; Tavitian-Exley et al. 2015; Vu et al. 2015; Drumright et al. 2006) only one review, which focused on young MA users, concluded that the evidence was unclear (Marshall and Werb 2010).

There was great variability on HIV prevalence rates among non-injecting ATS users, ranging from <1% (Uhlmann et al. 2014, Canada) up to 18.50% (Wechsberg et al. 2014, South Africa). But most of the prevalence rates were between 1% and 4.5% (Bao et al. 2012; Celentano et al. 2008; Beyrer et al. 2004; Srirak et al. 2005; Deiss et al. 2011). Two out of eight studies included in the table below did not identify an association between HIV prevalence and non-injecting ATS use (Uhlmann et al. 2014; Wechsberg et al. 2014). This could be due to the low and high HIV prevalence in those countries (Canada and South Africa). In Thailand, HIV prevalence rates among non-injecting ATS users were significantly lower than those reported among opioid users (Beyrer et al. 2004, Srirak et al. 2005).

An association between ATS use and HIV also seem to be present among injectors. But it is unclear if the association is due to engaging in riskier injecting practices or due to concurrent sexual HIV risk (Degenhardt et al. 2010). Prevalence rates among ATS injectors ranged from 2.9% (Mehrjerdi et al. 2014, Iran) up to 28% (Kral et al. 2005, USA), but most studies reported rates between 3% and 15.9% (Marshall et al. 2011; Braine et al. 2005; Kral et al. 2011; Zule et al. 2007; Robertson et al. 2004; Lorvick et al. 2012). Please see the table below.

In general, studies among injecting ATS users appear to report HIV prevalence rates greater than those reported in studies among people who take ATS via non-injecting routes. This difference probably reflects the added risk of contamination involved in injecting behaviour. However, in a Mexican study, HIV prevalence did not differ between amphetamine injectors and non-injectors (Deiss et al. 2011), suggesting that HIV transmission might have occurred outside of traditional groups at HIV risk.

**Table 5: Studies reporting HIV prevalence by types of ATS user population**

<b>Studies</b>	<b>Country</b>	<b>HIV Prevalence Rate</b>
<i>Non-injecting ATS users</i>		
Uhlmann 2014	Canada	<1%
Celentano 2008	Thailand	1.10%
Beyrer 2004	Thailand	3.20%
Deiss 2011	Mexico	3.70%
Srirak 2005	Thailand	4.10%
Bao 2012	China	4.50%
Truong 2011	USA	9.60%
Wechsberg 2014	South Africa	18.50%
<i>People who inject ATS</i>		
Mehrjerdi 2014	Iran	2.9%*
Kral 2011	USA	3%
Braine 2005	USA	3.6%*
Zule 2007	USA	3.90%
Lorvick 2012	USA	9%
Marshall 2011a	Canada	10.80%
Robertson 2004	USA	15.90%
Talu 2010	Estonia	27%
Kral 2005	USA	28%
<i>Men who have sex with men</i>		
Lyons 2013	Australia	17%*
Halkitis 2005	USA	38%
Peck 2005	USA	61%
<i>Sex-workers</i>		
Shannon 2011	Canada	23%
Couture 2012	Cambodia	28%

\* Self-reported

Incidence rates provide better information on the rate of infection over a certain period of time. However, longitudinal cohort studies were scarce with ATS users. Among non-injectors, annual HIV incidence was 2.1% in a Russian study (Kozlov et al. 2006) and 0.6% in a Thai study (Sutcliffe et al, 2009). Among injectors, a study in Thailand (Martin et al. 2010) and another in Russia (Kozlov et al. 2006) reported a similar incidence of 7.1 and 7.7 per 100 person-years, respectively. But a longitudinal study in Amsterdam reported a lower incidence of 1.87 per person-years (Van den Berg et al. 2007). Kozlov et al. 2006 compared HIV incidence among ATS non-injectors and injectors and found a greater HIV incidence among the latter group. In Tavitian-Exley et al. (2015) meta-analysis, the risk of acquiring HIV was 3.0 higher for ATS injectors when compared to non-injectors.

**Table 6: Studies reporting HIV incidence by types of ATS user population**

<b>Studies</b>	<b>Country</b>	<b>HIV Incidence</b>
<i>Non-injecting ATS users</i>		
Kozlov, 2006	Russia	2.6 per 100 py
Kozlov, 2006	Russia	2.1% per year
Sutcliffe, 2009	Thailand	0.6% per year
<i>People who inject ATS</i>		
Van den Berg, 2007	Netherlands	1.87 per 100py
Martin, 2010	Thailand	7.1 per 100 py
Kozlov, 2006	Russia	7.7 per 100 py
Kozlov, 2006	Russia	6.8% per year
<i>Men who have sex with men</i>		
Prestage, 2009	Australia	2.71 per 100 py
Ackers, 2012	USA	5.0 per 100 py
Buchbinder, 2005	USA	4.4% per year
Buchacz, 2005	USA	6.3% per year
Koblin, 2006	USA	12.7% per year

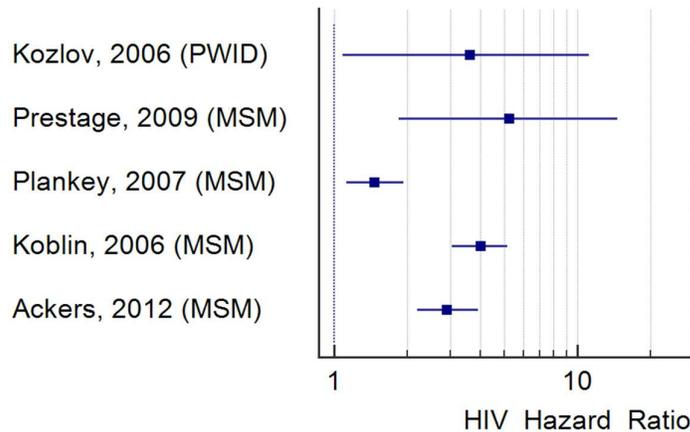
Differences in HIV prevalence and incidence seem less evident when ATS-injectors are compared to other injecting drug users. This was the case for studies in Vancouver (Marshall et al. 2011a), in the USA (Braine et al. 2005; Lorvick et al. 2012) and in one meta-analysis (Tavitian-Exley et al. 2015). However, one study found that MA injectors were 1.7 times more likely to become HIV-infected during the study period than other injectors.

Two studies suggested the existence of a dose-response effect in between MA use and HIV infection. Injectors who used MA more frequently had greater associated risk (Mehrjerdi et al. 2014) and significantly higher HVI incidence (Kozlov et al. 2006). In a multivariate analysis Kozlov et al. (2006) identified, that stimulant use three or more times per week was the only remaining factor associated with HIV seroconversion in their study.

The evidence on the risk of HIV infection among men who have sex with men (MSM) and use ATS seems to point towards clear association. Two systematic literature reviews and meta-analyses assessed the evidence among MSM. Vu et al. (2015) reviewed 35 studies and concluded that MA use was significantly associated with HIV infection among MSM in high-income countries. Most studies in that review reported high HIV prevalence rates (9-34%) and HIV incidence between 1.90 and 2.55 per 100 person years. The study concluded that MSM who reported ever using ATS were 1.70 times more likely to be infected with HIV than non-users. A review by Drumright et al. (2006) concurred with that finding by reporting that amphetamine was associated with at least a two-fold increased risk of HIV seroconversion among MSM.

Several studies identified an independent positive association between methamphetamine use and HIV infection among MSM (Morineau et al. 2011; Prestage et al. 2009; Plankey et al. 2007; Buchacz et al. 2005; Koblin et al. 2006; Koblin et al. 2007; Ackers et al. 2012; Peck et al. 2005). But only three studies included in the present document reported HIV prevalence rates among

MSM individuals who used MA. HIV prevalence rates were 17% (Lyons et al. 2013), 38% (Halkitis et al. 2005) and 61% (Peck et al. 2005). HIV incidence among MSM-ATS users was 2.71 per 100 person-years in Prestage et al. (2009) study, 4 per 100 person-years in Buchbinder et al. (2005) study and 5 per 100 person-years in Ackers et al. (2012) study. High relative hazard of HIV seroconversion were also associated with methamphetamine use among MSM: between 1.46 (Plankey et al. 2007) and 5.21 (Prestage et al. 2009).



**Figure 5: HIV Hazard Ratios among ATS users**

Other studies compared MA use levels among MSM HIV-positive and MSM HIV-negative groups (Chariyalertsak et al. 2011; Macdonald et al.2008; Lyons et al. 2013; Carey et al.2009; Schwarcz et al. 2007) and identified that MA use was significantly increased in HIV-positive groups. For example, in Lyons et al. (2013) the adjusted odds ratio of HIV-positive men reporting methamphetamine use was 2.5 times those of HIV-negative men.

MA use was not associated with HIV positivity or seroconversion in a small number of studies among MSM (Marshall et al. 2011b; Macdonald et al.2008; Halkitis et al. 2005a, Buchbinder et al. 2005). For example, in one study HIV prevalence among MSM MA users was 38% (N=111) and 35% (N=33) among MSM non-MA users (Halkitis et al. 2005a).

There was limited evidence on the risk of ATS use among sex workers (SW). HIV rates reported by two studies were high among this group. But differences between ATS users and non-ATS users appear less salient among sex workers. Couture et al. (2012) reported HIV prevalence among a small group of SW to be 28% among recent ATS users and 21% among non-ATS users. This study also found greater HIV prevalence among Yama users, compared to crystal MA users<sup>2</sup>. Another study found that HIV prevalence among female SWs was 23%, with no statistically significant difference in likelihood of crystal MA use by HIV status (Shannon et al. 2011).

### *HCV and HBV Prevalence*

Prevalence of HCV infection among ATS users was reported by six studies only. There was a large variability in the reported rates: HCV prevalence among non-injecting MA users was between 2.5% and 43.5%. In the Bao et al. (2012) study in China, injecting ATS was associated with HCV but

<sup>2</sup> “Yama” (in Cambodia) or “Yaba” (in Thailand) is a pill form containing about 25% of methamphetamine. “Crystal” (or “ice”) is the crystalline form of higher purity methamphetamine. Yama and crystal are usually melted and the vapors inhaled (Couture et al. 2011).

not with HIV. In Taiwan, a higher prevalence of HCV was identified among amphetamine-inhaling male prisoners when compared to non-ATS users (Lai et al. 2007). A Canadian study found 12.8% HCV prevalence among participants reporting MA use in the past 6 months (Uhlmann et al. 2014). The HCV prevalence rate was 15% in a large survey with MA-dependents in America. In this same study, one fifth of the sample were injectors, and HCV prevalence among those individuals was much higher (44%) (Gonzales et al. 2006).

HCV prevalence rates appear to be elevated among ATS-injectors. In Mehrjerdi et al (2014) study, 26.7% of the sample self-reported to be HCV-positive. A cross-sectional survey with IDUs in Budapest identified that 64.9% of amphetamine-only injectors had one type of hepatitis (Gyarmathy et al. 2009). In this same study, amphetamine-only injectors were more likely to have a higher number of drug-related infections, compared to those who injected heroin only, or both heroin and amphetamines or other drugs.

HCV incidence rate was reported only in one study. The Amsterdam Cohort Studies (ACS) recorded HCV incidence rate ratio of 7.45 (95% CI: 1.63–34.0) among those who mainly injected amphetamines in the past 6 months (Van den Berg et al. 2007).

**Table 7: Studies reporting HCV prevalence by types of ATS user population**

Studies	Country	HCV Prevalence
<i>Non-injecting ATS users</i>		
Celentano, 2008	Thailand	2.50%
Uhlmann, 2014	Canada	12.80%
Gonzales, 2006	USA	15%
Lai, 2007	Taiwan	22.50%
Bao, 2012	China	43.50%
<i>People who inject ATS</i>		
Mehrjerdi, 2014	Iran	26.7%*

\* Self-reported

There was very limited evidence on HBV prevalence among MA users. In Taiwan, a lower prevalence of HBV was identified among amphetamine-inhaling male prisoners when compared to controls (Lai et al. 2007). HBV was self-reported by 9.6% of MA injectors in Iran (Mehrjerdi et al. 2014). A case-control in Wyoming, where an outbreak of HBV virus infection among methamphetamine injectors was reported, compared MA injectors who were HBV-positive with MA injectors who were HBV-negative and found that sharing water used to prepare injections and/or rinse syringes was associated with HBV infection, as was sharing cotton filters (Vogt et al.2006). However, sharing syringes was not statistically associated.

**Table 8: Studies reporting HBV prevalence by types of ATS user population**

Studies	Country	HBV Prevalence
<i>Non-injecting users</i>		
Lai, 2007	Taiwan	15.80%
Celentano, 2008	Thailand	8.50%
<i>People who inject ATS</i>		
Mehrjerdi, 2014	Iran	9.6% *

\* Self-reported

### *Associations between MA use and STI and STD*

STI and STD prevalence among MA users were not the focus of this review, but it was reported by several studies included in this report. Higher prevalence rates of STI, in particular of chlamydia, were found among MA users in Thailand (Beyrer et al. 2004, Sutcliffe et al. 2009). But *frequency* of MA use was not independently associated with STI prevalence in another Thai study (Celentano et al. 2008). In a study in Budapest, 13.5% of the sample had one type of STI (Gyarmathy et al. 2009). One study in San Diego, identified that injecting ATS users were more likely to report a recent STI in comparison to non-injecting ATS users (Cheng et al. 2010).

Among sex workers in Cambodia, recent Yama use was associated with STI incidence (Couture et al. 2012). This study also reported that half of syphilis-infected participants had used MA in the last six months. Hirshfield et al. (2004) reported that MSM with STD were more likely than men without an STD to report drug use (crystal MA OR 3.8; 95% CI: 2.1-6.7). This study also found in the multivariate analysis that crystal MA use was a significantly independent predictor associated with incident STD.

### *Sexual Risk Behaviour*

The association between sexual risk and MA use has been extensively investigated in the scientific literature. The evidence points towards a consistent and robust association between use of ATS and engagement in HIV sexual risk behaviours (Drumright et al. 2006). This association was found in studies from East and South East Asia (Ding et al. 2013; Celentano et al. 2008; German et al. 2008) and in several studies from the United States (Centers for Disease and Prevention 2006; Semple et al. 2004a; Semple et al. 2004b; Semple et al. 2004c).

In comparison to heroin users, ATS users seem to show more frequent sexual risky behaviours (Jia et al. 2013). One study suggested that HIV transmission through sexual activity is more associated with ATS use, while HIV transmission through injecting drug use is more associated with heroin use (Jia et al. 2010).

Among injecting ATS users, it is difficult to discern the amount of the HIV infections caused by risk injecting behaviour and the amount caused by risk sexual behaviour, particularly as sexual risk behaviours are also highly prevalent among ATS injectors (Zule et al. 2007; Tavitian-Exley et al. 2015). ATS injectors presented similar or higher levels of sexual risk behaviour when compared to

other injectors (Lorvick et al. 2012; Semple et al. 2004b; Braine et al. 2005; Peck et al. 2005) and similar levels when compared to non-injecting ATS users (McKetin et al. 2008; Semple et al. 2004b).

ATS use among sex workers seems to put this already vulnerable group in even greater risk of HIV infection. ATS use might also be driving individuals to engage in sex work. Some studies reported sex work to be associated with MA use (Urada et al. 2014; Marshall et al. 2011b; Goldenberg et al. 2013). Trading sex for methamphetamine has also been reported by some studies (Shannon et al. 2011; Semple et al. 2010b). Sex workers who report MA use tend to present high levels of sexual risk behaviour (Muñoz et al. 2010). Deering et al. (2013) found that more frequent ATS use was strongly associated with being offered or accepting more money for sex without a condom.

The evidence on increased sexual risk behaviours among MSM who use MA is strong. MA use among MSM and other sexual minorities is associated with sexual risk behaviours, including unprotected intercourse, unprotected anal intercourse with casual partners and increased number of partners (Marshall et al. 2011b; Nakamura et al. 2011; Rawstorne et al. 2007; Buchacz et al. 2005; Plankey et al. 2007; Carey et al. 2009). In Carey et al. (2009) study, MA use was a proxy marker for persons engaged in the highest risk sexual activities. Schwarcz et al. (2007) reported that crystal methamphetamine use independently and strongly predictive of high-transmission sexual risk behaviour among the non-HIV-infected men (Schwarcz et al. 2007).

MA use also tends to be reported in sexual contexts among MSM (Sherman et al. 2009). MA use during sex has been associated with sexual risk behaviour, in particular unprotected receptive anal intercourse (Vaudrey et al. 2007; Colfax et al. 2004; Rusch et al. 2004; Buchacz et al. 2005). But it is important to bear in mind that this association has also been reported for alcohol and other drugs, especially for amyl nitrite. Methamphetamine and amyl nitrite, during unprotected anal intercourse has been found to be significantly more prevalent among HIV-positive individuals than compared to HIV-negative individuals (Thiede et al. 2009).

Rawstorne et al. (2007) also found in a longitudinal cohort study that crystal MA users showed more risky sexual behaviour compared to non-users. Nevertheless, they argue that crystal use does not necessarily drive unsafe sexual behaviour, given that the prevalence of crystal use among Australian MSM increased between 2002 and 2005, but the prevalence of unprotected anal intercourse remained stable or decreased over time in various study subgroups. In fact, the evidence is not sufficient to confirm whether sexual risk behaviour leads to MA use or vice-versa. Importantly, other factors such as impulsivity, personality traits, sexual compulsivity and attitudes towards condom use might be mediating or moderating this complex relationship.

### *HIV risk behaviour among HIV-positive Individuals*

In order to assess the role of MA use in increasing risk of HIV transmission, several studies assessed sexual risk behaviour among HIV-positive MSM who use methamphetamines. Some studies found that HIV-positive MSM who reported methamphetamine use also reported high levels of risk sexual behaviour, such as unprotected anal sex, greater number of casual and anonymous partners and greater numbers of partners (Drumright et al. 2006; Semple et al. 2009b; Semple et al. 2006c; Wohl et al. 2008; Bousman et al. 2009; Halkitis et al. 2005).

Some evidence also suggests that the intensity of methamphetamine use and sexual risk behaviour are significantly correlated (Semple et al. 2006a) and that higher scores on sexual compulsivity are

associated with methamphetamine use before or during sex (Semple et al. 2006c). Studies also reported that the sero-status of the sexual partner (Semple et al. 2006c) and negative attitudes towards condom use (Nakamura et al. 2011) have an effect in the relationship between methamphetamine use and unprotected sex.

Engaging in sexual marathons sessions have also been reported among HIV-positive MSM (Semple et al. 2009c). The vast majority of those who engaged in marathon sex did so while under the effect of methamphetamine and other drugs. These individuals also engaged in other sexual risk behaviours. Halkitis et al. (2005) argued that MA attracts a hypersexual risk-taking group of men who engage in unprotected sexual behaviours regardless of their methamphetamine use. In Halkitis et al. (2005) study, participants reported equivalent rates of unprotected sex when comparing their sexual acts while under the effects of methamphetamine, of other drugs and sober.

### *Injecting Risk Behaviour*

Another important question is whether MA injectors engage in more injecting risk behaviours than other injecting drug users. High prevalence of risk injecting behaviour among MA users, such as syringe borrowing and syringe lending, has been reported (Kral et al. 2011; Fairbairn et al. 2007; Martin et al. 2010; Hayashi et al. 2011; Mehrjerdi et al. 2014; Semple et al., 2004b; Lorvick et al. 2012). MA use has been found to be independently associated with injection risk behaviour in some studies (Marshall et al. 2011a; Braine et al. 2005).

Martin et al. (2010) found that the proportion of participants who shared needles was higher amongst methamphetamine injectors than heroin injectors or midazolam injectors. McKetin et al. (2008) also found that injectors who smoked MA had comparable levels of needle sharing to injectors-only, but the former group used methamphetamine more often (McKetin et al. 2008). In Braine et al. (2005) study MA injectors were also significantly more likely to report syringe sharing and difficulty accessing sterile syringes compared to other injectors. The authors concluded that difficulty accessing sterile syringes partially mediated the association between injecting MA and syringe sharing.

### *Polydrug use (including Sildenafil)*

The use of other drugs among people who use amphetamines is common (Halkitis et al. 2005a). The use of these drugs might also have an effect in increasing the risk of acquiring HIV (Buchbinder et al. 2005; Patterson et al. 2005). Consequently, it is difficult to isolate the contribution of MA use in HIV risk. Nevertheless, it is important to consider whether studies control and adjust analysis for the use of other substances, including alcohol. Koblin et al. (2006) identified in multivariate analysis that men reporting amphetamine or heavy alcohol use and alcohol or drug use before sex were at increased risk of HIV infection.

The use of erectile dysfunction medications is often reported among MSM who also consume methamphetamines. The combination of MA and sildenafil has been identified as substantially increasing infection risk (Prestage et al. 2009; Rawstorne et al. 2007). Fisher et al. (2011) investigated the relationship between MA and sildenafil use among men (52.2% were heterosexual) (Fisher et al. 2011). Participants were divided into three groups: Methamphetamine alone, sildenafil alone, both drugs combined. Men who used both MA and sildenafil showed a significantly higher prevalence of hepatitis B, syphilis, and HIV compared to those who used only

one or neither drug. The proportion of those using MA immediately before or during sex in the MA-only group was lower than in the group using both MA and sildenafil, indicating that the use of MA was more closely associated with sexual activity for those who used both methamphetamine and sildenafil. Sildenafil is associated with insertive anal intercourse, and methamphetamine is associated with receptive anal intercourse. A very strong association between the use of GHB and the use of both MA and sildenafil was found.

The use of amyl nitrite has also been commonly reported among MSM and typically used during sexual contact. Some studies included in the present review have reported amyl nitrite to be associated with HIV risk (Prestage et al. 2009; Macdonald et al. 2008; Plankey et al. 2007; Drumright et al. 2009). Ackers et al. (2012) found that amphetamine and amyl nitrite use were significantly linked to higher risks of seroconversion. Plankey et al. (2007) reported that the HIV relative hazard risk associated with amyl nitrite use was 2.10 (95% CI: 1.63, 2.70) and the joint relative hazard for methamphetamine and amyl nitrite use was 3.05 (95% CI: 2.12, 4.37).

### *Other Factors*

Other variables worth mentioning have also been considered in the studies included in the present review. In a study among non-injecting MA users, Semple et al. (2005) found that negative self-perceptions predicted intensity of methamphetamine use and depressive symptoms. Semple et al. (2006a) also identified the role of impulsivity in predicting unprotected sex among MA users. The findings of this study revealed that the relationship between intensity of methamphetamine use and unprotected sex was strongest among participants who had higher levels of impulsivity.

### *Prison-based Populations*

Studies among prison based populations were rare. One of these few studies, identified that a third of a sample of prisoners reported MA use and that these prisoners were more likely to engage in a number of sex risk behaviours, including use of MA in the context of sex (Cartier et al. 2008). This study also indicated that MA use continued after incarceration and treatment. Another study with incarcerated female adolescents identified that inconsistent condom use was more common among those reporting MA use (Steinberg et al. 2011).

### *Young People*

Three studies focused on populations under 20 years old. A national survey found that 7.6% of American high school students reported MA uses (Zapata et al. 2008) and identified an independent association between MA use and recent sexual behaviour and pregnancy. Freeman et al (2011) reported that recent methamphetamine was associated with a history of sexually transmitted diseases and sexual risk taking among adolescent boys and young MSM from eight US cities. Pappas and Halkitis (2011) examined sexual risk behaviour among different age categories among seropositive MSM who used ATS and identified that the likelihood of engaging in UAI with seronegative casual partners was greater among those in their 20s than those in their 30s or 40+.

### *Ethnic Minorities*

There were few studies comparing individuals with different ethnicity. In the Halkitis and Jerome (2008) study, 40.6% of Black MA users were HIV positive. Black methamphetamine users were more likely to be HIV-positive than other methamphetamine users. Associations of ethnicity with HIV prevalence and among young MSM were measured in 7 urban centres in the United States (Harawa et al. 2004). This study showed that factors positively associated with HIV did not explain racial/ethnic disparities in HIV prevalence. One study in South Africa reported that individuals with mixed-race ancestry tended to use more methamphetamines and also report more unprotected sex, compared to Black females (Wechsberg et al. 2010).

## 7. References

- Ackers, M.-L., Greenberg, A. E., Lin, C. Y., Bartholow, B. N., Goodman, A. H., Longhi, M. and Gurwith, M. (2012) High and Persistent HIV Seroincidence in Men Who Have Sex with Men across 47 U.S. Cities. *PLoS ONE*, 7(4), pp. e34972.
- Bao, Y. P., Liu, Z. M., Lian, Z., Li, J. H., Zhang, R. M., Zhang, C. B., Hao, W., Wang, X. Y., Zhao, M., Jiang, H. F., Yan, S. Y., Wang, Q. L., Qu, Z., Zhang, H. R., Wu, P., Shi, J. and Lu, L. (2012) Prevalence and correlates of HIV and HCV infection among amphetamine-type stimulant users in 6 provinces in China. *Journal of Acquired Immune Deficiency Syndromes: JAIDS*, 60(4), pp. 438-46.
- Beyrer, C., Razak, M. H., Jittiwutikarn, J., Suriyanon, V., Vongchak, T., Srirak, N., Kawichai, S., Tovanabutra, S., Rungruengthanakit, K., Sawanpanyalert, P., Sripaipan, T. and Celentano, D. D. (2004) Methamphetamine Users in Northern Thailand: Changing Demographics and Risks for HIV and STD among Treatment-Seeking Substance Abusers. *International Journal of STD & AIDS*, 15(10), pp. 697-704.
- Bousman, C. A., Cherner, M., Ake, C., Letendre, S., Atkinson, J. H., Patterson, T. L., Grant, I. and Everall, I. P. (2009) Negative mood and sexual behaviour among non-monogamous men who have sex with men in the context of methamphetamine and HIV. *Journal of Affective Disorders*, 119(1-3), pp. 84-91.
- Braine, N., Des Jarlais, D. C., Goldblatt, C., Zadoretzky, C. and Turner, C. (2005) HIV risk behaviour among amphetamine injectors at U.S. syringe exchange programs. *AIDS Education and Prevention*, 17(6), pp. 515-524.
- Buchacz, K., McFarland, W., Kellogg, T. A., Loeb, L., Holmberg, S. D., Dilley, J. and Klausner, J. D. (2005) Amphetamine use is associated with increased HIV incidence among men who have sex with men in San Francisco. *Aids*, 19(13), pp. 1423-1424.
- Buchbinder, S. P., Vittinghoff, E., Heagerty, P. J., Celum, C. L., Seage, G. R. I., Judson, F. N., McKirnan, D., Mayer, K. H. and Koblin, B. A. (2005) Sexual Risk, Nitrite Inhalant Use, and Lack of Circumcision Associated With HIV Seroconversion in Men Who Have Sex With Men in the United States. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 39(1), pp. 82-89.
- Carey, J., Mejia, R., Bingham, T., Ciesielski, C., Gelaude, D., Herbst, J., Sinunu, M., Sey, E., Prachand, N., Jenkins, R. and Stall, R. (2009) Drug Use, High-Risk Sex Behaviours, and Increased Risk for Recent HIV Infection among Men who Have Sex with Men in Chicago and Los Angeles. *AIDS and Behaviour*, 13(6), pp. 1084-1096.
- Cartier, J. J., Greenwell, L. and Prendergast, M. L. (2008) The Persistence of HIV Risk Behaviours Among Methamphetamine-Using Offenders. *Journal of Psychoactive Drugs*, 40(4), pp. 437-446.
- Celentano, D. D., Sirirojn, B., Sutcliffe, C. G., Quan, V. M., Thomson, N., Keawvichit, R., Wongworapat, K., Latkin, C., Taechareonkul, S., Sherman, S. G. and Aramrattana, A.

- (2008) Sexually transmitted infections and sexual and substance use correlates among young adults in Chiang Mai, Thailand. *Sexually Transmitted Diseases*, 35(4), pp. 400-5.
- Centers for Disease, C. and Prevention (2006) Methamphetamine use and HIV risk behaviours among heterosexual men--preliminary results from five northern California counties, December 2001-November 2003. *MMWR - Morbidity & Mortality Weekly Report*, 55(10), pp. 273-7.
- Chariyalertsak, S., Kosachunhanan, N., Saokhieo, P., Songsupa, R., Wongthanee, A., Chariyalertsak, C., Visarutratana, S. and Beyrer, C. (2011) HIV Incidence, Risk Factors, and Motivation for Biomedical Intervention among Gay, Bisexual Men, and Transgender Persons in Northern Thailand. *PLoS ONE*, 6(9), pp. e24295.
- Cheng, W. S., Garfein, R. S., Semple, S. J., Strathdee, S. A., Zians, J. K. and Patterson, T. L. (2009) Differences in sexual risk behaviours among male and female HIV-seronegative heterosexual methamphetamine users. *American Journal of Drug and Alcohol Abuse*, 35(5), pp. 295-300.
- Cheng, W. S., Garfein, R. S., Semple, S. J., Strathdee, S. A., Zians, J. K. and Patterson, T. L. (2010) Increased drug use and STI risk with injection drug use among HIV-seronegative heterosexual methamphetamine users. *Journal of Psychoactive Drugs*, 42(1), pp. 11-18.
- Colfax, G., Santos, G. M., Chu, P., Vittinghoff, E., Pluddemann, A., Kumar, S. and Hart, C. (2010) Amphetamine-group substances and HIV. *The Lancet*, 376(9739), pp. 458-474.
- Colfax, G., Vittinghoff, E., Husnik, M. J., McKirnan, D., Buchbinder, S., Koblin, B., Celum, C., Chesney, M., Huang, Y., Mayer, K., Bozeman, S., Judson, F. N., Bryant, K. J., Coates, T. J. and Team, t. E. S. (2004) Substance Use and Sexual Risk: A Participant- and Episode-level Analysis among a Cohort of Men Who Have Sex with Men. *American Journal of Epidemiology*, 159(10), pp. 1002-1012.
- Couture, M. C., Evans, J. L., Sothy, N. S., Stein, E. S., Sichan, K., Maher, L. and Page, K. (2012) Correlates of amphetamine-type stimulant use and associations with HIV-related risks among young women engaged in sex work in Phnom Penh, Cambodia. *Drug and Alcohol Dependence*, 120(1-3), pp. 119-126.
- Couture, M. C., Sansothy, N., Saphon, V., Phal, S., Sichan, K., Stein, E., Evans, J., Maher, L., Kaldor, J., Vun, M. C. and Page, K. (2011) Young women engaged in sex work in Phnom Penh, Cambodia, have high incidence of HIV and sexually transmitted infections, and amphetamine-type stimulant use: new challenges to HIV prevention and risk. *Sexually Transmitted Diseases*, 38(1), pp. 33-9.
- Deering, K. N., Lyons, T., Feng, C. X., Nosyk, B., Strathdee, S. A., Montaner, J. S. and Shannon, K. (2013) Client demands for unsafe sex: the socioeconomic risk environment for HIV among street and off-street sex workers. *Journal of Acquired Immune Deficiency Syndromes: JAIDS*, 63(4), pp. 522-31.

- Degenhardt, L., Mathers, B., Guarinieri, M., Panda, S., Phillips, B., Strathdee, S. A., Tyndall, M., Wiessing, L., Wodak, A. and Howard, J. (2010) Meth/amphetamine use and associated HIV: Implications for global policy and public health. *International Journal of Drug Policy*, 21(5), pp. 347-358.
- Deiss, R. G., Lozada, R. M., Burgos, J. L., Strathdee, S. A., Gallardo, M., Cuevas, J. and Garfein, R. S. (2011) HIV prevalence and sexual risk behaviour among non-injection drug users in Tijuana, Mexico. *Global Public Health*, 7(2), pp. 175-183.
- Ding, Y., He, N., Zhu, W. and Detels, R. (2013) Sexual risk behaviours among club drug users in Shanghai, China: Prevalence and correlates. *AIDS and Behaviour*, 17(7), pp. 2439-2449.
- Drumright, L., Gorbach, P., Little, S. and Strathdee, S. (2009) Associations Between Substance Use, Erectile Dysfunction Medication and Recent HIV Infection Among Men Who have Sex with Men. *AIDS and Behaviour*, 13(2), pp. 328-336.
- Drumright, L., Little, S., Strathdee, S., Slymen, D., Araneta, M., Malcarne, V., Daar, E. and Gorbach, P. (2006) Unprotected Anal Intercourse and Substance Use Among Men Who Have Sex With Men With Recent HIV Infection. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 43(3), pp. 344-350.
- Drumright, L. N., Patterson, T. L. and Strathdee, S. A. (2006) Club Drugs as Causal Risk Factors for HIV Acquisition Among Men Who Have Sex with Men: A Review. *Substance Use & Misuse*, 41(10-12), pp. 1551-1601.
- Fairbairn, N., Kerr, T., Buxton, J. A., Li, K., Montaner, J. S. and Wood, E. (2007) Increasing use and associated harms of crystal methamphetamine injection in a Canadian setting. *Drug and Alcohol Dependence*, 88(2-3), pp. 313-316.
- Fernandez, M. I., Bowen, G. S., Warren, J. C., Ibanez, G. E., Hernandez, N., Harper, G. W. and Prado, G. (2007) Crystal methamphetamine: A source of added sexual risk for Hispanic men who have sex with men? *Drug and Alcohol Dependence*, 86(2-3), pp. 245-252.
- Fisher, D. G., Reynolds, G. L., Ware, M. R. and Napper, L. E. (2011) Methamphetamine and Viagra use: relationship to sexual risk behaviours. *Archives of Sexual Behaviour*, 40(2), pp. 273-279.
- Freeman, P., Walker, B. C., Harris, D. R., Garofalo, R., Willard, N., Ellen, J. M. and Adolescent Trials Network for, H. I. V. A. I. b. T. (2011) Methamphetamine use and risk for HIV among young men who have sex with men in 8 US cities. *Archives of Pediatrics & Adolescent Medicine*, 165(8), pp. 736-40.
- German, D., Sherman, S. G., Latkin, C. A., Sirojnj, B., Thomson, N., Sutcliffe, C. G., Aramrattana, A. and Celentano, D. D. (2008) Young Thai women who use methamphetamine: Intersection of sexual partnerships, drug use, and social networks. *International Journal of Drug Policy*, 19(2), pp. 122-129.

- Goldenberg, S. M., Rangel, G., Staines, H., Vera, A., Lozada, R., Nguyen, L., Silverman, J. G. and Strathdee, S. A. (2013) Individual, interpersonal, and social-structural correlates of involuntary sex exchange among female sex workers in two Mexico-U.S. border cities. *Journal of Acquired Immune Deficiency Syndromes: JAIDS*, 63(5), pp. 639-46.
- Gonzales, R., Marinelli-Casey, P., Shoptaw, S., Ang, A. and Rawson, R. A. (2006) Hepatitis C virus infection among methamphetamine-dependent individuals in outpatient treatment. *Journal of Substance Abuse Treatment*, 31(2), pp. 195-202.
- Gyarmathy, V. A., Neaigus, A. and Ujhelyi, E. (2009) Vulnerability to drug-related infections and co-infections among injecting drug users in Budapest, Hungary. *Eur J Public Health*, 19(3), pp. 260-5.
- Halkitis, P., Moeller, R., Siconolfi, D., Jerome, R., Rogers, M. and Schillinger, J. (2008) Methamphetamine and Poly-Substance Use Among Gym-Attending Men Who Have Sex with Men in New York City. *Annals of Behavioural Medicine*, 35(1), pp. 41-48.
- Halkitis, P. N., Green, K. A. and Mourgues, P. (2005a) Longitudinal investigation of methamphetamine use among gay and bisexual men in New York City: Findings from project BUMPS. *Journal of Urban Health*, 82(SUPPL. 1), pp. i18-i25.
- Halkitis, P. N. and Jerome, R. C. (2008) A comparative analysis of methamphetamine use: Black gay and bisexual men in relation to men of other races. *Addictive Behaviours*, 33(1), pp. 83-93.
- Halkitis, P. N., Shrem, M. T. and Martin, F. W. (2005b) Sexual behaviour patterns of methamphetamine-using gay and bisexual men. *Substance Use and Misuse*, 40(5), pp. 703-719.
- Harawa, N. T., Greenland, S., Bingham, T. A., Johnson, D. F., Cochran, S. D., Cunningham, W. E., Celentano, D. D., Koblin, B. A., LaLota, M., MacKellar, D. A., McFarland, W., Shehan, D., Stoyanoff, S., Thiede, H., Torian, L. and Valleroy, L. A. (2004) Associations of Race/Ethnicity With HIV Prevalence and HIV-Related Behaviours Among Young Men Who Have Sex With Men in 7 Urban Centers in the United States. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 35(5), pp. 526-536.
- Hayashi, K., Wood, E., Suwannawong, P., Kaplan, K., Qi, J. and Kerr, T. (2011) Methamphetamine injection and syringe sharing among a community-recruited sample of injection drug users in Bangkok, Thailand. *Drug and Alcohol Dependence*, 115(1-2), pp. 145-149.
- Hirshfield, S., Remien, R. H., Humberstone, M., Walavalkar, I. and Chiasson, M. A. (2004) Substance use and high-risk sex among men who have sex with men: a national online study in the USA. *AIDS Care*, 16(8), pp. 1036-1047.

- Jia, Z., Wang, W., Dye, C., Bao, Y., Liu, Z. and Lu, L. (2010) Exploratory analysis of the association between new-type drug use and sexual transmission of HIV in China. *American Journal of Drug & Alcohol Abuse*, 36(2), pp. 130-3.
- Jia, Z. J., Yan, S. Y., Bao, Y. P., Lian, Z., Zhang, H. R. and Liu, Z. M. (2013) Sexual behaviour differences between amphetamine-type stimulants users and heroin users. *Journal of Addiction Medicine*, 7(6), pp. 422-7.
- Kang, D., Liao, M., Jiang, Z., Zhang, X., Mao, W., Zhang, N., Tao, X., Huang, T., Bi, Z., Aliyu, M., Wu, P., Jiang, B. and Jia, Y. (2011) Commercial sex venues, syphilis and methamphetamine use among female sex workers. *AIDS Care*, 23 Suppl 1, pp. 26-36.
- Koblin, B. A., Husnik, M. J., Colfax, G., Huang, Y., Madison, M., Mayer, K., Barresi, P. J., Coates, T. J., Chesney, M. A. and Buchbinder, S. (2006) Risk factors for HIV infection among men who have sex with men. *Aids*, 20(5), pp. 731-739.
- Koblin, B. A., Murrill, C., Camacho, M., Xu, G., Liu, K.-l., Raj-Singh, S. and Torian, L. (2007) Amphetamine Use and Sexual Risk Among Men Who Have Sex With Men: Results From the National HIV Behavioural Surveillance Study—New York City. *Substance Use & Misuse*, 42(10), pp. 1613-1628.
- Kozlov, A. P., Shaboltas, A. V., Toussova, O. V., Verevchkin, S. V., Masse, B. R., Perdue, T., Beauchamp, G., Sheldon, W., Miller, W. C., Heimer, R., Ryder, R. W. and Hoffman, I. F. (2006) HIV incidence and factors associated with HIV acquisition among injection drug users in St Petersburg, Russia. *Aids*, 20(6), pp. 901-906.
- Kral, A. H., Lorvick, J., Ciccarone, D., Wenger, L., Gee, L., Martinez, A. and Edlin, B. R. (2005) HIV prevalence and risk behaviours among men who have sex with men and inject drugs in San Francisco. *Journal of Urban Health*, 82(SUPPL. 1), pp. i43-i50.
- Kral, A. H., Lorvick, J., Martinez, A., Lewis, M. A., Orr, W. A., Anderson, R., Flynn, N. and Bluthenthal, R. N. (2011) HIV prevalence and risk among heterosexual methamphetamine injectors in California. *Substance Use & Misuse*, 46(9), pp. 1081-1089.
- Lai, S. W., Chang, W. L., Peng, C. Y. and Liao, K. F. (2007) Viral hepatitis among male amphetamine-inhaling abusers. *Internal Medicine Journal*, 37(7), pp. 472-7.
- Liao, M., Jiang, Z., Zhang, X., Kang, D., Bi, Z., Liu, X., Fu, J., Zhang, N., Mao, W., Jiang, B. and Jia, Y. (2011) Syphilis and methamphetamine use among female sex workers in Shandong Province, China. *Sexually Transmitted Diseases*, 38(1), pp. 57-62.
- Liu, D., Wang, Z., Chu, T. and Chen, S. (2013) Gender difference in the characteristics of and high-risk behaviours among non-injecting heterosexual methamphetamine users in Qingdao, Shandong Province, China. *BMC Public Health*, 13, pp. 30.

- Lorvick, J., Bourgois, P., Wenger, L. D., Arreola, S. G., Lutnick, A., Wechsberg, W. M. and Kral, A. H. (2012) Sexual pleasure and sexual risk among women who use methamphetamine: A mixed methods study. *International Journal of Drug Policy*, 23(5), pp. 385-392.
- Lyons, A., Pitts, M. and Grierson, J. (2013) Methamphetamine use in a nationwide online sample of older Australian HIV-positive and HIV-negative gay men. *Drug and Alcohol Review*, 32(6), pp. 603-610.
- Macdonald, N., Elam, G., Hickson, F., Imrie, J., McGarrigle, C. A., Fenton, K. A., Baster, K., Ward, H., Gilbart, V. L., Power, R. M. and Evans, B. G. (2008) Factors associated with HIV seroconversion in gay men in England at the start of the 21st century. *Sexually Transmitted Infections*, 84(1), pp. 8-13.
- Marshall, B. D., Shoveller, J. A., Wood, E., Patterson, T. L. and Kerr, T. (2011a) Difficulty accessing syringes mediates the relationship between methamphetamine use and syringe sharing among young injection drug users. *AIDS and Behaviour*, 15(7), pp. 1546-1553.
- Marshall, B. D. and Werb, D. (2010) Health outcomes associated with methamphetamine use among young people: a systematic review. *Addiction*, 105(6), pp. 991-1002.
- Marshall, B. D., Wood, E., Shoveller, J. A., Patterson, T. L., Montaner, J. S. and Kerr, T. (2011b) Pathways to HIV risk and vulnerability among lesbian, gay, bisexual, and transgendered methamphetamine users: a multi-cohort gender-based analysis. *BMC Public Health*, 11, pp. 20.
- Martin, M., Vanichseni, S., Suntharasamai, P., Mock, P. A., van Griensven, F., Pitisuttithum, P., Tappero, J. W., Chiamwongpaet, S., Sangkum, U., Kitayaporn, D., Gurwith, M. and Choopanya, K. (2010) Drug use and the risk of HIV infection amongst injection drug users participating in an HIV vaccine trial in Bangkok, 1999–2003. *International Journal of Drug Policy*, 21(4), pp. 296-301.
- McKetin, R., Ross, J., Kelly, E., Baker, A., Lee, N., Lubman, D. I. and Mattick, R. (2008) Characteristics and harms associated with injecting versus smoking methamphetamine among methamphetamine treatment entrants. *Drug & Alcohol Review*, 27(3), pp. 277-85.
- Mehrjerdi, Z. A., Abarashi, Z., Noroozi, A., Arshad, L. and Zarghami, M. (2014) Correlates of shared methamphetamine injection among methamphetamine-injecting treatment seekers: The first report from Iran. *International Journal of STD and AIDS*, 25(6), pp. 420-427.
- Morineau, G., Nugrahini, N., Riono, P., Nurhayati, Girault, P., Mustikawati, D. and Magnani, R. (2011) Sexual Risk Taking, STI and HIV Prevalence Among Men Who Have Sex with Men in Six Indonesian Cities. *AIDS and Behaviour*, 15(5), pp. 1033-1044.
- Muñoz, F. A., Pollini, R. A., Zúñiga, M. L., Strathdee, S. A., Lozada, R., Martínez, G. A., Valles-Medina, A. M., Sirotin, N. and Patterson, T. L. (2010) Condom Access: Associations with Consistent Condom Use among Female Sex Workers in Two Northern Border Cities of Mexico. *AIDS Education and Prevention*, 22(5), pp. 455-465.

- Nakamura, N., Mausbach, B. T., Ulibarri, M. D., Semple, S. J. and Patterson, T. L. (2011) Methamphetamine use, attitudes about condoms, and sexual risk behaviour among HIV-positive men who have sex with men. *Archives of Sexual Behaviour*, 40(2), pp. 267-272.
- Pappas, M. K. and Halkitis, P. N. (2011) Sexual risk taking and club drug use across three age cohorts of HIV-positive gay and bisexual men in New York City. *AIDS Care*, 23(11), pp. 1410-6.
- Parry, C. D. H., Pluddemann, A., Myers, B., Wechsberg, W. M. and Flisher, A. J. (2011) Methamphetamine use and sexual risk behaviour in cape town, South Africa: A review of data from 8 studies conducted between 2004 and 2007. *African Journal of Psychiatry (South Africa)*, 14(5), pp. 372-376.
- Patterson, T. L., Semple, S. J., Zians, J. K. and Strathdee, S. A. (2005) Methamphetamine-using HIV-positive men who have sex with men: Correlates of polydrug use *Journal of Urban Health*, 82(SUPPL. 1), pp. i120-i126.
- Peck, J. A., Shoptaw, S., Rotheram-Fuller, E., Reback, C. J. and Bierman, B. (2005) HIV-associated medical, behavioural, and psychiatric characteristics of treatment-seeking, methamphetamine-dependent men who have sex with men. *Journal of Addictive Diseases*, 24(3), pp. 115-132.
- Plankey, M. W., Ostrow, D. G., Stall, R., Cox, C., Li, X., Peck, J. A. and Jacobson, L. P. (2007) The Relationship Between Methamphetamine and Popper Use and Risk of HIV Seroconversion in the Multicenter AIDS Cohort Study. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 45(1), pp. 85-92.
- Prestage, G., Jin, F., Kippax, S., Zablotska, I., Imrie, J. and Grulich, A. (2009) Use of Illicit Drugs and Erectile Dysfunction Medications and Subsequent HIV Infection among Gay Men in Sydney, Australia. *The Journal of Sexual Medicine*, 6(8), pp. 2311-2320.
- Rawstorne, P., Digiusto, E., Worth, H. and Zablotska, I. (2007) Associations between crystal methamphetamine use and potentially unsafe sexual activity among gay men in Australia. *Archives of Sexual Behaviour*, 36(5), pp. 646-654.
- Robertson, A. M., Syvertsen, J. L., Ulibarri, M. D., Rangel, M. G., Martinez, G. and Strathdee, S. A. (2014) Prevalence and correlates of HIV and sexually transmitted infections among female sex workers and their non-commercial male partners in two Mexico-USA border cities. *Journal of Urban Health*, 91(4), pp. 752-67.
- Robertson, M. J., Clark, R. A., Charlebois, E. D., Tulsy, J., Long, H. L., Bangsberg, D. R. and Moss, A. R. (2004) HIV Seroprevalence Among Homeless and Marginally Housed Adults in San Francisco. *American Journal of Public Health*, 94(7), pp. 1207-1217.
- Rudy, E. T., Shoptaw, S., Lazzar, M., Bolan, R. K., Tilekar, S. D. and Kerndt, P. R. (2009) Methamphetamine use and Other Club Drug use Differ in Relation to HIV Status and

- Risk Behaviour Among Gay and Bisexual Men. *Sexually Transmitted Diseases*, 36(11), pp. 693-695.
- Rusch, M., Lampinen, T. M., Schilder, A. and Hogg, R. S. (2004) Unprotected Anal Intercourse Associated With Recreational Drug Use Among Young Men Who Have Sex With Men Depends on Partner Type and Intercourse Role. *Sexually Transmitted Diseases*, 31(8), pp. 492-498.
- Schwarcz, S., Scheer, S., McFarland, W., Katz, M., Valleroy, L., Chen, S. and Catania, J. (2007) Prevalence of HIV Infection and Predictors of High-Transmission Sexual Risk Behaviours Among Men Who Have Sex With Men. *American Journal of Public Health*, 97(6), pp. 1067-1075.
- Semple, S. J., Amaro, H., Strathdee, S. A., Zians, J. and Patterson, T. L. (2009a) Ethnic differences in substance use, sexual risk behaviours, and psychosocial factors in a sample of heterosexual methamphetamine users. *Substance Use and Misuse*, 44(8), pp. 1101-1120.
- Semple, S. J., Grant, I. and Patterson, T. L. (2004a) Female methamphetamine users: Social characteristics and sexual risk behaviour. *Women and Health*, 40(3), pp. 35-50.
- Semple, S. J., Grant, I. and Patterson, T. L. (2005) Negative self-perceptions and sexual risk behaviour among heterosexual methamphetamine users. *Substance Use and Misuse*, 40(12), pp. 1797-1810.
- Semple, S. J., Patterson, T. L. and Grant, I. (2004b) The context of sexual risk behaviour among heterosexual methamphetamine users. *Addictive Behaviours*, 29(4), pp. 807-810.
- Semple, S. J., Patterson, T. L. and Grant, I. (2004c) Determinants of condom use stage of change among heterosexually-identified methamphetamine users. *AIDS and Behaviour*, 8(4), pp. 391-400.
- Semple, S. J., Strathdee, S. A., Zians, J. and Patterson, T. L. (2009b) Sexual risk behaviour associated with co-administration of methamphetamine and other drugs in a sample of HIV-positive men who have sex with men. *American Journal on Addictions*, 18(1), pp. 65-72.
- Semple, S. J., Strathdee, S. A., Zians, J. and Patterson, T. L. (2010a) Factors associated with sex in the context of methamphetamine use in different sexual venues among HIV-positive men who have sex with men. *BMC Public Health*, 10, pp. 178.
- Semple, S. J., Strathdee, S. A., Zians, J. and Patterson, T. L. (2010b) Social and behavioural characteristics of HIV-positive MSM who trade sex for methamphetamine. *American Journal of Drug and Alcohol Abuse*, 36(6), pp. 325-331.

- Semple, S. J., Zians, J., Grant, I. and Patterson, T. L. (2006a) Methamphetamine use, impulsivity, and sexual risk behaviour among HIV-positive men who have sex with men. *Journal of Addictive Diseases*, 25(4), pp. 105-114.
- Semple, S. J., Zians, J., Grant, I. and Patterson, T. L. (2006b) Sexual compulsivity in a sample of HIV-positive methamphetamine-using gay and bisexual men. *AIDS and Behaviour*, 10(5), pp. 587-598.
- Semple, S. J., Zians, J., Grant, I. and Patterson, T. L. (2006c) Sexual risk behaviour of HIV-positive methamphetamine-using men who have sex with men: The role of partner serostatus and partner type. *Archives of Sexual Behaviour*, 35(4), pp. 461-471.
- Semple, S. J., Zians, J., Strathdee, S. A. and Patterson, T. L. (2009c) Sexual marathons and methamphetamine use among HIV-positive men who have sex with men. *Archives of Sexual Behaviour*, 38(4), pp. 583-590.
- Shannon, K., Strathdee, S., Shoveller, J., Zhang, R., Montaner, J. and Tyndall, M. (2011) Crystal methamphetamine use among female street-based sex workers: Moving beyond individual-focused interventions. *Drug & Alcohol Dependence*, 113(1), pp. 76-81.
- Sherman, S. G., Sutcliffe, C. G., German, D., Sirirojn, B., Aramrattana, A. and Celentano, D. D. (2009) Patterns of Risky Behaviours Associated with Methamphetamine Use Among Young Thai Adults: A Latent Class Analysis. *Journal of Adolescent Health*, 44(2), pp. 169-175.
- Srirak, N., Kawichai, S., Vongchak, T., Razak, M. H., Jittiwuttikarn, J., Tovanabutra, S., Rungruengthanakit, K., Keawvichit, R., Beyrer, C., Wiboonatakul, K., Sripaipan, T., Suriyanon, V. and Celentano, D. D. (2005) HIV infection among female drug users in Northern Thailand. *Drug and Alcohol Dependence*, 78(2), pp. 141-145.
- Steinberg, J. K., Grella, C. E., Boudov, M. R., Kerndt, P. R. and Kadrnka, C. M. (2011) Methamphetamine use and high-risk sexual behaviours among incarcerated female adolescents with a diagnosed STD. *Journal of Urban Health*, 88(2), pp. 352-64.
- Sutcliffe, C. G., Aramrattana, A., Sherman, S. G., Sirirojn, B., German, D., Wongworapat, K., Quan, V. M., Keawvichit, R. and Celentano, D. D. (2009) Incidence of HIV and sexually transmitted infections and risk factors for acquisition among young methamphetamine users in northern Thailand. *Sexually Transmitted Diseases*, 36(5), pp. 284-9.
- Talu, A., Rajaleid, K., Abel-Ollo, K., Rüütel, K., Rahu, M., Rhodes, T., Platt, L., Bobrova, N. and Uusküla, A. (2010) HIV infection and risk behaviour of primary fentanyl and amphetamine injectors in Tallinn, Estonia: Implications for intervention. *International Journal of Drug Policy*, 21(1), pp. 56-63.
- Tavitian-Exley, I., Vickerman, P., Bastos, F. I. and Boily, M. C. (2015) Influence of different drugs on HIV risk in people who inject: systematic review and meta-analysis. *Addiction*, 110(4), pp. 572-84.

- Thiede, H., Jenkins, R. A., Carey, J. W., Hutcheson, R., Thomas, K. K., Stall, R. D., White, E., Allen, I., Mejia, R. and Golden, M. R. (2009) Determinants of Recent HIV Infection Among Seattle-Area Men Who Have Sex with Men. *American Journal of Public Health*, 99(Suppl 1), pp. S157-S164.
- Truong, H.-H. M., Kellogg, T. A., McFarland, W., Louie, B., Klausner, J. D., Philip, S. S. and Grant, R. M. (2011) Sentinel Surveillance of HIV-1 Transmitted Drug Resistance, Acute Infection and Recent Infection. *PLoS ONE*, 6(10), pp. e25281.
- Uhlmann, S., DeBeck, K., Simo, A., Kerr, T., Montaner, J. S. and Wood, E. (2014) Health and social harms associated with crystal methamphetamine use among street-involved youth in a Canadian setting. *Am J Addict*, 23(4), pp. 393-8.
- Urada, L. A., Strathdee, S. A., Morisky, D. E., Schilling, R. F., Simbulan, N. P., Estacio, L. R., Jr. and Raj, A. (2014) Sex work and its associations with alcohol and methamphetamine use among female bar and spa workers in the Philippines. *Asia Pac J Public Health*, 26(2), pp. 138-46.
- Van Den Berg, C., Smit, C., Van Brussel, G., Coutinho, R. and Prins, M. (2007) Full participation in harm reduction programmes is associated with decreased risk for human immunodeficiency virus and hepatitis C virus: evidence from the Amsterdam Cohort Studies among drug users. *Addiction (Abingdon, England)*, 102(9), pp. 1454-1462.
- Vaudrey, J., Raymond, H. F., Chen, S., Hecht, J., Ahrens, K. and McFarland, W. (2007) Indicators of use of methamphetamine and other substances among men who have sex with men, San Francisco, 2003–2006. *Drug & Alcohol Dependence*, 90(1), pp. 97-100.
- Vogt, T. M., Perz, J. F., Van Houten, C. K., Jr., Harrington, R., Hansuld, T., Bialek, S. R., Johnston, R., Bratlie, R. and Williams, I. T. (2006) An outbreak of hepatitis B virus infection among methamphetamine injectors: the role of sharing injection drug equipment. *Addiction*, 101(5), pp. 726-30.
- Vu, N. T. T., Maher, L. and Zablotska, I. (2015) Amphetamine-type stimulants and HIV infection among men who have sex with men: Implications on HIV research and prevention from a systematic review and meta-analysis. *Journal of the International AIDS Society*, 18(1).
- Wechsberg, W. M., Doherty, I. A., Myers, B., Morgan-Lopez, A. A., Emanuel, A., Carney, T., Kline, T. L. and Zule, W. A. (2014) Contextualizing gender differences and methamphetamine use with HIV prevalence within a South African community. *International Journal of Drug Policy*, 25(3), pp. 583-590.
- Wechsberg, W. M., Jones, H. E., Zule, W. A., Myers, B. J., Browne, F. A., Kaufman, M. R., Luseno, W., Flisher, A. J. and Parry, C. D. H. (2010) Methamphetamine ("tik") use and its association with condom use among out-of-school females in Cape Town, South Africa. *American Journal of Drug and Alcohol Abuse*, 36(4), pp. 208-213.

- Wohl, A., Frye, D. and Johnson, D. (2008) Demographic Characteristics and Sexual Behaviours Associated with Methamphetamine Use among MSM and Non-MSM diagnosed with AIDS in Los Angeles County. *AIDS and Behaviour*, 12(5), pp. 705-712.
- Zapata, L. B., Hillis, S. D., Marchbanks, P. A., Curtis, K. M. and Lowry, R. (2008) Methamphetamine Use Is Independently Associated With Recent Risky Sexual Behaviours and Adolescent Pregnancy. *Journal of School Health*, 78(12), pp. 641-648.
- Zule, W. A., Costenbader, E. C., Meyer, W. J. J. and Wechsberg, W. M. (2007) Methamphetamine Use and Risky Sexual Behaviours During Heterosexual Encounters. *Sexually Transmitted Diseases*, 34(9), pp. 689-694.

## Appendix: Data Extraction: ATS Review

### 1. Non-Injecting Drug Users

Authors, Year	Country	Design	Quality Score	Population, Sample Size	Age, Gender	Drug, Route	HIV Prevalence	Relevant findings
1. Colfax, 2010	Global	SR	n/a	Qualitative analyse only on the association of HIV and MA.	n/a	n/a	n/a	<b>Amphetamine-group substances and HIV</b> “Many, but not all, studies show an association between amphetamine-group substance use and risk of HIV infection. Much use of amphetamine-group substances is non-injection and is associated with increased HIV risk, particularly in men who have sex with men. The structural, social, interpersonal, and personal factors that link to amphetamine- group substance use and HIV risk are poorly understood. The contribution of amphetamine-group substances to the global HIV epidemic cannot be quantified, and the contribution of non-injection use of amphetamine-group substances to the HIV epidemic has been understudied. Improved efforts are needed to quantify and monitor the extent to which amphetamine-group substances are used, and the role of amphetamine-group substances in the HIV/AIDS epidemic, especially in developing countries. Most research has focused on men who have sex with men in developed countries, and little is known about how these factors interact to contribute to sexual risk taking in other populations. The prevalence of other drug use among users of amphetamine-group substances needs quantification, and the contribution of specific patterns and combinations of amphetamine-group substance use with other drugs to risk of HIV infection needs to be established.”
2 . Marshall, 2010	Global	SR	n/a	Young MA users	n/a	MA, IV & NIV	n/a	<b>Health outcomes associated with methamphetamine use among young people: a systematic review</b> - Four studies reported HIV prevalence: two reported null results. The authors concluded that evidence to suggest an increased risk of infectious diseases among young MA injectors is equivocal.
3. Wechsberg, 2010	South Africa	CS	5/9	out-of-school women between 13 and 20 years of age.	16.8 years (SD = 1.9), female only	MA use past 30 days	n/a	<b>Methamphetamine ("tik") use and its association with condom use among out-of-school females in Cape Town, South Africa</b>

				MA users (n = 261) and non-users (n = 188).				- Higher methamphetamine rates were found among young Coloured (mixed-race ancestry) females (87%) than among young Black females (11%). Coloured female methamphetamine users were over six times more likely than other participants to report not using a condom the last time they had sex (OR = 6.21; 95% CI = 1.21, 31.94).
4. Parry, 2011	South Africa	SR	n/a	Diverse populations: heterosexual drug users and students from Cape Town	n/a	MA, mostly NIV	n/a	<b>Methamphetamine use and sexual risk behaviour in cape town, South Africa: A review of data from 8 studies conducted between 2004 and 2007</b> - Observed increase in MA ('tick', usually smoked) use after 2006. - 8 studies identified (2 qualitative) - MA use was consistently associated with early vaginal sex (3 studies), condom use during sex (4), and having casual sex (2). - Mixed findings were noted for the association between MA use and anal sex, STI symptoms, having multiple partners and forced sex.
5. Wechsberg, 2014	South Africa	CS	9/9	580 study participants recruited from 30 neighbourhoods between 2010 and 2012.	25 years old; 51% male	9.3% of the sample used MA (N=54)	18.5% of MA users were HIV+ (N=10). No significant differences found.	<b>Contextualizing gender differences and methamphetamine use with HIV prevalence within a South African community</b> Women were twice as likely as men to be HIV infected, yet they reported fewer sex partners. Neighbourhood prevalence of HIV was correlated with greater likelihood of HIV infection among women, but not men. Neighbourhood methamphetamine use was marginally associated with HIV among women but not among men. At the individual level, heavy alcohol use was marginally associated with HIV infection among men but not among women. Having an HIV positive partner was the strongest correlate of being HIV positive among both men and women. there was no clear visual or statistical correlation (r = 0.000, p = 0.999) between neighbourhood HIV prevalence and neighbourhood methamphetamine use. Methamphetamine use was not associated with HIV infection among men or women at the individual level or at the neighbourhood level
6. Bao, 2012	China	CS	7/9		33.4 years 66.3% were male	During the past month, 82.1%, 24.8%, and 3.4% used	4.5%	<b>Prevalence and correlates of HIV and HCV infection among amphetamine-type stimulant users in 6 provinces in China</b> - Exposure to HCV 43.5

						MA, magu pills, and MDMA, respectively. 1.5% had a history of injection use of ATS		<ul style="list-style-type: none"> <li>- HIV infection was independently associated with living in Yunnan province, polydrug use, increased frequency of sexual behaviour, history of sex with sexually transmitted infection-positive persons, and HCV infection</li> <li>- HCV was associated with study site, marital status, unemployment, a longer duration of ATS use, and history of injection use of ATS.</li> <li>- he injection use of ATS was associated with HCV but not HIV</li> <li>- 30% had a history of heroin use (IV). However, injection drug use was not measured or controlled in the data analysis.</li> </ul>
7. Ding, 2013	China	CS	6/9	276 club drug users in Shanghai, China	72.8% were male, mean age was 28.6 years (SD=7.4)	methamphetamine, MDMA/ecstasy, and/or ketamine use at least once in the past three months and three times or more in the past 12 months (51.8%)	four (0.3%) self-reported being HIV-positive	<p><b>Sexual risk behaviours among club drug users in Shanghai, China: Prevalence and correlates</b></p> <ul style="list-style-type: none"> <li>- 43.8% reported <math>\geq 2</math> sex partners in the past 30 days, and 48.9% reported having sex with non-regular partners, 67.4% of whom had unprotected sex.</li> <li>- More than half (58.0%) reported ever having sex under the influence of club drugs in the past three months.</li> </ul>
8. Jia, 2010	China	CS	n/a	The drug use data from the National Institute on Drug Dependence (NIDD), Peking University, from January 2003 to December 2007 HIV/AIDS data from China Centres for Disease Control (AIDSCDC)	n/a	Drug use divided: heroin use (HU), ATS, and other use (OU). Drug transmission: (DT), sexual transmission (ST), and other transmission (OT).	n/a	<p><b>Exploratory analysis of the association between new-type drug use and sexual transmission of HIV in China</b></p> <ul style="list-style-type: none"> <li>- Type of drug use is directly associated with the mode of HIV/AIDS transmission: "HIV infection by drug use mode mainly results from heroin users (<math>R = .5</math>). ATS (<math>R = -.9</math>) and other drug users (<math>R = -.4</math>) have a negative relationship with HIV infection by drug use mode. However, for HIV infection by sexual transmission mode, ATS (<math>R = 5.5</math>) and other drug users (<math>R = .6</math>) show a positive association. ATS, especially, presents a strongly association with the sexual transmission of HIV."</li> </ul>
9. Jia, 2013	China	CS	4/9	438 ATS users and 524 heroin users were recruited in 10 detoxification treatment centres in Beijing, Shenzhen, Guangzhou, Xi'an, and Taiyuan.	ATS users 64.7% men, mean age 31.4 (7.7). Heroin users	ATS (dependence DSM-IVR) only 1.1 of ATS users injected	n/a	<p><b>Sexual behaviour differences between amphetamine-type stimulants users and heroin users</b></p> <ul style="list-style-type: none"> <li>- Sexual behaviours were significantly different between ATS users and heroin users: sexual behaviours among ATS users include sexual intercourse often or each time after taking drug (30.1%), multiple sexual intercourse (16.5%), casual sex partners (34.0%), homosexual partners (2.5%),</li> </ul>

					75.3% men, mean age was 38.0 (7.4) .			and never or occasionally using condom with a steady sex partner (79.3%) or with casual sex partners (39.1%). The rate of ever-infecting sexually transmitted disease (STD) was high in both the groups (ATS, 20.5%; heroin, 30.9%).
10. Liu, 2013	China	CS	4/9	398 non-injecting heterosexual MA users from in Chengyang District, Qingdao, Shandong Province, China.	Age 32.3 (9.6), 72% male and	NIV MA as a major addictive drug and used at least once in the last month	n/a	<b>Gender difference in the characteristics of and high-risk behaviours among non-injecting heterosexual methamphetamine users in Qingdao, Shandong Province, China</b> Gender differences in the characteristics of and high-risk behaviours among non-injecting hetero-sexual MA users were observed: males who had had sex with multiple partners and exchanged sex partners during MA use was significantly higher than those in females (96.9% vs. 77.3%, $X^2=39.147$ , $p<0.05$ 72.9% vs. 46.4%, $X^2=24.862$ , $p<0.05$ ). 96.2% of males had had sex with CSWs during MA use, and the number of CSWs as sex partners per MA use was 1.9 persons. Among males who had had sex with CSWs, 72.2% had never used condoms. Among 77 males who had had sex with multiple CSW partners and reported always or usually using condoms, 87.0% had never changed condoms when changing CSW partners. About 96.4% of the females reported having had sex with partners for MA or money.
11. Lai, 2007	Taiwan	CS	4/9	285 amphetamine-inhaling male subjects atone prison in Taiwan and 285 age-matched healthy men without history of using illicit drugs or tattooing were enrolled	mean age 34.1 ± 8.6 years	ATS	n/a	<b>Viral hepatitis among male amphetamine-inhaling abusers</b> - 13.3% were positive for HBsAg, 20.0% positive for anti-HCV and 2.5% positive for combined HBsAg and anti-HCV. - tattoo (OR) 2.97, 95% CI 1.37–6.43) and elevated alanine aminotransferase (ALT) (OR 3.15, 95% CI 1.49–6.66) were independently related to persons being anti-HCV positive. Elevated ALT was related to persons being HBsAg positive (OR 2.60, 95% CI 1.15–5.89). - prevalence of HBsAg-positive persons was significantly lower in the study subjects than in the control subjects (15.8 vs 22.8%, $P = 0.034$ ). The overall prevalence of anti-HCV-positive persons was significantly higher in the study subjects than in the control subjects (22.5 vs 2.1%, $P < 0.001$ ).
12. German, 2008	Thailand	CS	8/9	Young 305 females MA users (18-25 years) in Chiang Mai	most respondents under 20 years old.	MA use at least three times in the past three months and sex at least three	Risk Behaviour	<b>Young Thai women who use methamphetamine: Intersection of sexual partnerships, drug use, and social networks</b> We compared women with only one male partner in the past year (39%) to those with multiple male partners (37%) and those with only female partners (24%). The multiple partner

						times in the past three months		group reported an average of five male partners in the past year; 12% reported consistent condom use in the past 30 days. Compared to both groups, women with multiple male partners used MA more frequently, had larger non-sex networks with more MA users, were more likely to have an MA-using sex partner, and received less emotional support from their partners.
13. Celentano, 2008  (data also reported in Thomson, 2009)	Thailand	CS	6/9	658 young adults 18-25years, only 568 tested voluntarily for HIV	median age of 19 years (IQR 18–20 years); 73% male	MA use: at least 3x in the past 3 months (4.8 ever injected)	1.1%	<b>Sexually transmitted infections and sexual and substance use correlates among young adults in Chiang Mai, Thailand</b> - 38% had a STI - Chlamydia were significantly more common among women - Hepatitis B virus was significantly more common among men. - HCV 2.5% and HBV 8.5% - 62.6% did not use condom at last sexual intercourse - Substance abuse, either frequency of MA use or drunkenness, was not independently associated with prevalent STI in this study.
14. Beyrer, 2004	Thailand	CS	7/9	750 methamphetamine (MA) users presenting for drug treatment in northern Thailand (40.2% of the total sample)	MA users younger (50% younger than 20yrs)	MA seeking detoxification treatment.	3.2% of MA users were HIV infected (compared to 15.1% of opioid users).	<b>Methamphetamine Users in Northern Thailand: Changing Demographics and Risks for HIV and STD among Treatment-Seeking Substance Abusers</b> MA users had significantly different sexual risks and sexually transmitted disease rates, including lower syphilis seropositivity and higher chlamydial prevalence, than persons admitted for opiate or mixed drug treatment. For those who reported MA use only, use by injection was rare and HIV infections significantly less common than among all other drug users. MA users had higher rates of chlamydia infection than opiate users, reflecting their young age, and HIV rates in this population were lower than injecting drug users, but still elevated.
15. Srirak, 2005	Thailand	CS	7/9	200 women admitted for 21-day inpatient drug detoxification in Chiang Mai, Thailand	Mean age 34 years (IQR=21, 43)	30% heroin, 70% opium or methamphetamine dependent	4.1%	<b>HIV infection among female drug users in Northern Thailand</b> Overall, 14 (7%) were HIV positive: 25% among 28 heroin injectors and 4.1% among 172 opium or methamphetamine smokers (p<0.001).
16. Sutcliffe, 2009	Thailand	Long (secondary analyse of an RCT)	7/11	519 methamphetamine users aged 18 to 25 years in a 12-month randomized behavioural intervention trial in Chiang Mai, Thailand in 2005	median age of 19 (IQR: 18-20),	used MA least 3 times in the past 3 months,	0.6% over 12 months period	<b>Incidence of HIV and Sexually Transmitted Infections and Risk Factors for Acquisition among Young Methamphetamine Users in Northern Thailand</b> A 12-month study of young methamphetamine users in northern Thailand found 13% acquired STIs, and risk factors

								included incarceration, having a prevalent infection at baseline and more sexual partners. Overall, 12.7% of 519 participants acquired at least one STI. Chlamydia was the most common (10.6%), followed by HSV-2 (4.0%), gonorrhoea (2.9%), and HIV (0.6%). Risk factors for both men and women included self-reported incarceration and having a casual sex partner during follow-up, and having a prevalent STI at baseline. Additionally, among women, having 2 or more heterosexual partners, and among men, having a greater frequency of drunkenness were risk factors for STI acquisition.
17. Sherman, 2009	Thailand	CS	6/9	1,189 18–25 year old street-recruited methamphetamine smoker{German, 2008 #256}	75% male median age of 19 years	MA at least three times in the past three months. Half of the sample reported smoking MA $\geq$ 2 days/week.	n/a	<b>Patterns of Risky Behaviours Associated with Methamphetamine Use Among Young Thai Adults: A Latent Class Analysis</b> Over half of males and females reported engaging in sex in the context of MA use. Three classes of activities emerged for male participants (n=863): “work” (job related); “high-risk behaviours” (motor cycle riding, fighting, sex); and “combined” (all activities). Two classes emerged for the women (n=299): “work” (housework) and “high-risk behaviours.”
18. Truong, 2011	USA	CS	8/9	9,868 voluntary counselling and testing at the San Francisco municipal STI clinic from January 2004 to December 2006	84.4% male, 14.1% female, and 1.3% transgender Age: 18.1% were under 25 years old, 41.1% were 25–34, 27.6% were 35–44, and 13.0% were 45 and older	11.7% used amphetamines	Recent HIV Infection among MA users: OR 3.90 (2.60, 5.8); AOR 2.67 (1.77, 4.04)	<b>Sentinel Surveillance of HIV-1 Transmitted Drug Resistance, Acute Infection and Recent Infection</b> Among MSM, recent infection was associated with amphetamine use (AOR=2.67; p,0.001). Amphetamine use was reported by 27.8% of long-term infections, 41.4% of recent infections, 27.6% of acute infections, and 25.5% of ARV drug-resistant cases.
19. Cartier, 2008	USA	Long	8/11	<b>Prisoners</b> 765 prisoners: 263 of them MA users	32.3 [7.7] MA users at baseline, 73% of them were male	MA (self-reported use in the 30 days prior to interview date or incarceration), route NS	n/a	<b>The Persistence of HIV Risk Behaviours Among Methamphetamine-Using Offenders</b> - Methamphetamine users were more likely to engage in unprotected sex, have unprotected sex with casual partners, and have unprotected sex while they, their partner, or both, were high on drugs or alcohol at both baseline and follow-up. - indicate that the association of methamphetamine use and HIV risk, especially sexual risk behaviours, persists even after a period of incarceration and substance abuse treatment.

20. Gonzales, 2006	USA	CS	4/9	723 MA-dependent individuals who sought outpatient treatment from 1999 through 2005	Mean age 34.5 years; 56% were males	MA dependent individuals in outpatient treatment. About 20% injected (n = 146)	n/a	<b>Hepatitis C virus infection among methamphetamine-dependent individuals in outpatient treatment</b> - 15% of the total sample and 44% of the injectors were found to be infected with HCV. - HCV infection was more associated with injection use, older age, and female sex.
21. Centres for Disease, Control & Prevention 2006	USA	CS	8/9	968 participants heterosexual men	18--35 years	15.6% reported Meth use: 9.6% reported historical use and 6.0% reported recent use	n/a	<b>Methamphetamine use and HIV risk behaviours among heterosexual men--preliminary results from five northern California counties, December 2001-November 2003</b> A greater percentage of meth users reported having anal sex with a female during this period than never users and historical users. Statistically significant differences with respect to other high-risk sexual behaviours were observed between recent meth users and never users. These differences included having a casual or anonymous female sex partner (recent users [64.8%] versus never users [44.4%]; p<0.01), having multiple partners (56.9% versus 26.3%; p<0.001), having a partner who injected drugs (11.1% versus 1.7%; p<0.01) during the preceding 6 months, and ever having received drugs or money for sex with a male or female partner (15.5% versus 3.5%; p<0.001). Recent meth users were no more likely to have been tested for HIV or chlamydial infection than were men who had never used. After adjustment for demographic characteristics, recent and historical meth use was associated with recent use of one or more other illicit drugs use of club drugs.
22. Semple, 2009	USA	CS	5/9	402 heterosexual methamphetamine users from San Diego, California.	67% male Latinos in the sample were significantly younger than the Caucasian and African American participants	using methamphetamine at least twice during the past two months	n/a	<b>Ethnic differences in substance use, sexual risk behaviours, and psychosocial factors in a sample of heterosexual methamphetamine users</b> A larger percentage of African Americans reported anonymous sex partners in the past two months
23. Semple, 2005	USA	CS	5/9	156 heterosexual methamphetamine users from San Diego, California	76% male, mean age of 39.1 years.	MA used at least twice in the past two months	n/a	<b>Negative Self-Perceptions and Sexual Risk Behaviour Among Heterosexual Methamphetamine Users</b> Participants with high levels of negative self-perceptions evidenced the greatest degree of sexual risk behaviour, including significantly more unprotected vaginal sex and a larger number of sexual partners as compared to individuals with low levels of negative self-perceptions. In cross-

								sectional analyses, negative self-perceptions predicted intensity of methamphetamine use and depressive symptoms. However, neither of these variables were found to mediate the relationship between negative self-perceptions and sexual risk behaviour.
24. Semple, 2004a	USA	CS	4/9	139 HIV-negative, heterosexual meth-using men and women	average age of 38.6 years	MA used at least twice in the past two months	n/a	<b>The context of sexual risk behaviour among heterosexual methamphetamine users</b> The average number of unprotected vaginal, anal, and oral sex acts over a 2-month period were 21.5, 6.3, and 41.7, respectively. Participants reported an average of 9.4 sex partners over 2 months.
25. Semple, 2004b	USA	CS	6/9	181 HIV-negative, heterosexually identified meth users	mean age of 38.3 years (SD = 9.4). 74% males	MA used at least twice in the past two months	n/a	<b>Determinants of Condom Use Stage of Change Among Heterosexually-Identified Methamphetamine Users</b> Sexual risk behaviour was highest among those in the contemplation stage of change. When compared with those in the preparation stage of change. Rates of unprotected vaginal, anal, and oral sex over a 2-month period were also high (M=29.6, 13.1, 52.1, respectively). On the basis of these findings, we may conclude that meth-using heterosexual men and women engage in a variety of sexual activities that place them at risk for contracting HIV infection and other sexually transmitted diseases.
26. Zapata, 2008  Also reported in Springer, 2007	USA	CS	9/9	15,214 students in grades 9-12	51.4% Male	Lifetime methamphetamine use was reported by 7.6% of students	n/a	<b>Methamphetamine Use Is Independently Associated With Recent Risky Sexual Behaviours and Adolescent Pregnancy</b> After adjustment for demographic covariates and lifetime use of cigarettes, alcohol, marijuana, and other illicit drugs, lifetime methamphetamine use was associated with recent sexual intercourse (AOR = 1.8, 95% confidence interval [CI] = 1.5-2.3), having 2 or more recent sex partners (AOR = 3.0, 95% CI = 2.2-4.2), and ever being pregnant or getting someone pregnant (AOR = 2.9, 95% CI = 2.1-3.9).
27. Steinberg, 2011	USA	CS	6/9	Incarcerated Female Adolescents with a Diagnosed STD from California juvenile detention facility (2006-2007)  539 incarcerated female adolescents between ages 12-18 years with an STD diagnosis:	Mean age of MA users was 16, Female only	Regular MA use, route not specified- 16% used MA	n/a	<b>Methamphetamine use and high-risk sexual behaviours among incarcerated female adolescents with a diagnosed STD</b> - Those who reported inconsistent condom use had over twice the odds of MA use (OR=2.7) compared with consistent condom users - Methamphetamine use was significantly associated with regular use of any drug - Methamphetamine use was also strongly differentiated by ethnicity, as African Americans were less likely to use

				MA users= 86 Non-MA users= 453				compared with whites.
28. Semple, 2004	USA	CS	5/9	98 HIV-negative, heterosexually-identified, meth-using females residing in San Diego, California.	Mean age= 35.1 (SD 10.4)	MA used at least twice in the past two months	n/a	<b>Female Methamphetamine Users: Social Characteristics and Sexual Risk Behaviour</b> {Semple, 2004 #284}
29. Deiss, 2011	Mexico	CS	7/9	503 non injecting drug users	median age 34 years; 55% were male	87% reporting any MA use within the last six months and 84% reporting MA as their most commonly used drug	3.7%	<b>HIV prevalence and sexual risk behaviour among non-injection drug users in Tijuana, Mexico</b> “HIV prevalence among NIDUs was similar to that of IDUs suggests that HIV transmission has occurred outside of traditional core groups in Tijuana. During the prior six months, 52% of NIDUs reported having 1 casual partner; 35% reported always using condoms with a casual partner; and 13% and 15%, respectively, reported giving or receiving something in exchange for sex. Women were significantly more likely than men to have unprotected sex with an IDU (p 0.01).”
30. Uhlmann, 2014	Canada	Long	7/11	1,019 street-involved youth	median age was 22 (inter-quartile range [IQR]: 20 – 24), 68.6% male	31.4% female and 44.6% had previously used crystal methamphetamine at baseline.	HCV+ factors associated with MA use: OR 1.17 (95%CI 0.91–1.50),ns  HIV+ OR 0.99 (95%CI 0.35–2.78)	<b>Health and Social Harms Associated with Crystal Methamphetamine Use Among Street-Involved Youth In A Canadian Setting</b> In adjusted GEE analyses, active crystal methamphetamine use was independently associated with Caucasian ethnicity (Adjusted Odds Ratio [AOR] = 1.37; 95% Confidence Interval [CI]: 1.04 – 1.81), homelessness (AOR = 1.34; 95% CI: 1.15 – 1.56), injection drug use (AOR = 3.40; 95% CI: 2.76 – 4.19), non-fatal overdose (AOR = 1.46; 95% CI: 1.07 – 2.00), being a victim of violence (AOR = 1.19; 95% CI: 1.02 – 1.38), involvement in sex work (AOR = 1.39; 95% CI: 1.03 – 1.86) and drug dealing (AOR = 1.60; 95% CI: 1.35 – 1.90). HIV positivity and unsafe sex, being a victim of violence and incarceration were not associated with prior crystal methamphetamine use.

## 2. Injecting Drug Users Only

Author, Year	Country	Design	Quality Score	Population, Sample Size	Age, Gender	Drug , Route	HIV Prevalence	Relevant findings
1. Degenhardt, 2010  Degenhardt, 2007	Global	SR	n/a	MA users - focus on IV	n/a	IV	n/a	<b>Meth/amphetamine use and associated HIV: Implications for global policy and public health</b> - M/A injectors may be more likely than those injecting other drugs to engage in risky injecting practices (Degenhardt et al., 2007). - There are conflicting findings related to the association of MA injection and HIV infection, because of concurrent sexual HIV risks (Degenhardt et al., 2007).
2. Tavitian-Exley, 2015	Global	SR	n/a	n/a	n/a	n/a	n/a	<b>Influence of different drugs on HIV risk in people who inject: systematic review and meta-analysis</b> Of 5779 studies screened, 15 were included. HIV incidence was reported for people injecting cocaine (eight: North America, Europe), amphetamine-type stimulants (ATS) (four: Western and Eastern Europe, Asia), heroin (11: all settings), opiate-stimulants (four: North America, Western and Eastern Europe) and opiates-sedatives (five: Europe, Asia). HI risk in cocaine injectors was 3.6 times 95%confidence interval (CI)=2.8–4.7, I2=0%; n=4) that of non-injectors and 3.0 for ATS injectors (95%CI=2.2–4.1, I2=0%; n=2). Higher sexual risk was reported in cohorts injecting stimulants. Compared to not-injecting, HIV IRR was 2.8 (95%CI=1.7–4.7, I2=77%; n=6) for all heroin injectors and 3.5 (95%CI=2.3–5.2, I2=40%; n=5) for heroin injectors in Asia and Europe.
3. McKetin, 2008	Australia	CS	8/9	400 MA treatment entrants in Sydney and Brisbane, Australia	Mean age 30.6 years (SD 7.2); 75% were male	IV only= 195, Smokers only= 73, Both = 90, MA in the past month	n/a	<b>Characteristics and harms associated with injecting versus smoking methamphetamine among methamphetamine treatment entrants</b> In comparison with injectors, smokers had similarly high levels of sexual risk behaviour. Injectors who smoked had comparable levels of needle sharing, but they used methamphetamine more often. Smokers were younger and had less severe methamphetamine dependence than injecting, but they had more intense use patterns and similar levels of other harms.
4. Martin, 2010	Thailand	Longitudinal analysis of the	10/*11	2546 HIV-uninfected IDUs	93.4% Male with a median age of 26 years (range, 20–59 years)	16.2% injected amphetamine in the past 6 months at baseline and	7.1 (95% CI, 5.4–9.2) per 100 person years	<b>Drug use and the risk of HIV infection amongst injection drug users participating in an HIV vaccine trial in Bangkok, 1999–2003</b> The proportions injecting methamphetamine (16.2–19.6%) and midazolam (9.9–31.9%) increased. HIV incidence was

		HIV vaccine trial)				20.4% at 36 months follow-up		highest amongst participants injecting methamphetamine, 7.1 (95% CI, 5.4–9.2) per 100 person years. Injecting heroin and injecting methamphetamine were independently associated with incident HIV infection. The proportion of participants who shared needles was higher amongst methamphetamine injectors (33.0%) than heroin injectors (21.0%) or midazolam injectors (28.1%). Controlling for heroin use and other risk factors, participants injecting methamphetamine were 1.7 times more likely to become HIV-infected during the trial than participants not injecting methamphetamine
5. Hayashi, 2011	Thailand	CS	7/9	311 IDU from the Mitsampan Community Research Project in Bangkok.	70.7% men	114 (36.7%) participants reported having injected MA twice or more per week in the past six months.	n/a	<b>Methamphetamine injection and syringe sharing among a community-recruited sample of injection drug users in Bangkok, Thailand</b> “Over one-third of a community-recruited sample of Thai IDU reported more than weekly injection of methamphetamine, and methamphetamine injection was independently associated with syringe sharing. In multivariate analyses, after adjustment for potential social, demographic and behavioural confounders, syringe sharing remained independently associated with injecting methamphetamine more than once per week (adjusted odds ratio=2.86, 95% confidence interval: 1.59–5.15).”
6. Mehrjerdi, 2014	Iran	CS	6/9	209 MA injecting treatment seekers in the south of Tehran	90.9% were male	reported MA injection as one of their main drugs of injection in the past 12 months		<b>{Mehrjerdi, 2014 #213}: The first report from Iran</b> - HCV (self-reported) 26.7% (n=56)= 20 (18.2%) never shared and 36 (29.3%)shared p=0.001 - HBV (self-reported) 9.6% (n=20), difference ns between groups - 52.6% reported current MA injection without any shared injection behaviour and 47.4% reported current shared methamphetamine injection. - Shared methamphetamine injection was found to be primarily associated with living with sex partners (AOR 1.25, 95% CI 1.13–1.98), reporting 3 years of dependence on methamphetamine injection (AOR 1.61, 95% CI 1.27–2.12), injection with pre-filled syringes in the past 12 months (AOR 1.96, 95% CI 1.47–2.42), homosexual sex without condom use in the past 12 months (AOR 1.85, 95% CI 1.21–2.25), and positive hepatitis C status (AOR 1.98, 95% CI 1.67–2.83).
7. Kozlov, 2006	Russia	Long	10/11	520 IDUs	Median age was 24.3 years (range, 17.2–	191 (36.7%) injected psychostimulants (ephedrine-	Incidence/100 person-years )95% CI) among	<b>HIV incidence and factors associated with HIV acquisition among injection drug users in St Petersburg, Russia</b>

					42.0%); 70.2% were Male	based and/or amphetamines), but only 9 (1.7%) used psychostimulants alone.	stimulant injectors: 7.7 (4.1-13.1) compared to 2.6 (1-5.3) among non-stimulant injectors p=0.020 Hazard ratio 3.61 (1.08-11.17)	13 new HIV cases of 191 stimulants injectors; compared to 7 new HIV cases among the non-stimulant injectors (329) during a 12 month period. Those injecting stimulants more than 3 times a week had an incidence/100 person-years of 20.0 (6.5-46.7) compared to 5.5 (2.4-10.9) among those injecting stimulants 2 or less times a week p=0.032. Hazard Ratio 3.61 (1.08-11.17). In univariate analysis, psychostimulant use, especially frequent use, three or more sex partners in the past 6 months, and females selling sex were associated with HIV seroconversion. In the multivariate analysis, psychostimulant use three or more times per week was the only factor still associated with HIV seroconversion.
8. Talu, 2010	Estonia	CS	7/9	350 current IDUs	83% Male and mean age of amphetamine IDUs 23.45 (5.87)	23% (75/331) amphetamine as their main drug of injection	27% (95 CI 18.45–35.51)	<b>HIV infection and risk behaviour of primary fentanyl and amphetamine injectors in Tallinn, Estonia: Implications for intervention</b> The overall HIV prevalence in the study population was 54%. HIV prevalence among fentanyl injectors was 62% (95% CI: 56.97–67.03), which is significantly higher (at p<0.001 level) than the HIV prevalence among amphetamine users (27%, 95% CI: 18.45–35.51). Fentanyl injectors were more likely than amphetamine injectors to report previous HIV testing (89% vs. 79%, p=0.006) and having had a positive self-reported HIV test result (44% vs. 9%, p<0.0001).
9. Gyarmathy, 2009	Hungary	CS	7/9	186 IDUs	62.9% 30 and under; 75.8% were male	19.9% IV amphetamine only in the past 30 days 26.9% IV amphetamine + heroin in the past 30 days. 8.9% injected amphetamine daily.	64.9% of amphetamine-only injectors had one type of hepatitis and 13.5% had one type of STI	<b>Vulnerability to drug-related infections and co-infections among injecting drug users in Budapest, Hungary</b> 0% HIV, 37% HCV, 24% HAV, and 14% past HBV infection. Infections with Herpes 1 or 2, tuberculosis, Chlamydia, syphilis, and gonorrhoea were 79%, 12%, 7%, 4%, and 0%, respectively. Co-infection with HAV/HCV was 12%, HBV/HCV 9%, HAV/HBV 7%, and HAV/HBV/HCV 4%. Amphetamine injectors were more likely to have a higher number of drug-related infections
10. Van Den Berg, 2009	Netherlands	Long	10/11	714 ever-injecting drug users from the Amsterdam Cohort Studies (ACS).	Median age at entry: 30.0 (27.0–36.0) 61.4% were Male		IRR (ATS-HIV) = 4.92 (1.54–15.7) Incidence	<b>Full participation in harm reduction programmes is associated with decreased risk for human immunodeficiency virus and hepatitis C virus: evidence from the Amsterdam Cohort Studies among drug users</b>

							(/100 PY) 1.87  IRR (ATS- HCV) IRR 7.45 (1.63– 34.0)	
11. Fairbairn, 2007	Canada	CS	9/11	1587 IDU were enrolled into the VIDUS cohort between May 1996 and December 2004 in Vancouver.	Median age was 33 years	injecting crystal methamphetamine in the previous six months increased, from 2.5% in 1997 to 6.7% in 2004	n/a	<b>Increasing use and associated harms of crystal methamphetamine injection in a Canadian setting</b> “There was a significant trend towards increasing crystal methamphetamine injection in this setting and elevated HIV risk behaviour and younger age were independently associated with crystal methamphetamine injection. In multivariate GEE analyses, crystal methamphetamine injection was independently associated with younger age, Caucasian ethnicity, syringe borrowing, and syringe lending.”
12. Marshall, 2011	Canada	Long	9/11	Young IDU from Vancouver (<30 years),  384 (187 IV MA users)	Median 24 (IQR: 22–27), 55.7% Male	MA, IV	HIV prevalence: MA IV users: 20 of 187 (10.8%) vs DUs Non-MA users: 29 of 197 (15.1%) NS.	<b>Difficulty accessing syringes mediates the relationship between methamphetamine use and syringe sharing among young injection drug users</b> - Injecting MA was independently associated with syringe sharing - Mediation analyses revealed that difficulty accessing sterile syringes partially mediated the association between injecting MA and syringe sharing. - MA injectors were significantly more likely to report syringe sharing (AOR = 2.60, P<0.001) and difficulty accessing sterile syringes (AOR = 2.19, P<0.001) over the study period.
13. Braine, 2005	USA	CS	7/9	amphetamine injectors attending syringe exchange programs in the United States  Amphetamine Injectors N = 854; Other SEP Participants N = 1615	ATS injectors: Mean age: 34; 62% Male; 14% were MSM/WSW	ATS, IV	- Self-reported HIV: 3.6% ATS IV and 2.4% other SEP users	<b>HIV risk behaviour among amphetamine injectors at U.S. syringe exchange programs</b> - Amphetamine injection is an independent risk factor for injection risk behaviour among SEP participants. - Rates of injection risk behaviour (receptive and distributive) are higher among amphetamine injectors than other SEP participants, but rates of condom use are similar. - Similar sexual risk behaviour between the groups (note unsafe sex is very high in both groups).
14. Kral, 2011	USA	CS	7/9	Heterosexual methamphetamine and non-methamphetamine injectors California,	Majority over 30, heterosexual	MA IV in the past 30 days	3%	<b>HIV prevalence and risk among heterosexual methamphetamine injectors in California</b> - HIV was not highly prevalent among MA injectors (3%).

				USA, during 2001–2003 n = 1,306 Heterosexual IDUS MA (n = 428) and non-MA (n = 878) injectors				- But sexual and injection risk behaviours were highly prevalent (ranging from 21% to 72%). - MA injectors had higher odds than non-MA injectors of unprotected vaginal intercourse and sex with five or more sexual partners in the past 6 months and of distributive and receptive syringe sharing in the past 30 days.
15. Vogt, 2006	USA	CC	7/9	MA injectors from Natrona County, Wyoming during an outbreak of hepatitis B reported between January–June, 2003  18 case-patients (symptomatic or confirmed HBV ) and 49 controls (susceptible to HBV infection)	60% of cases male, the median age was 38 years (range: 19–60)	MA IV	n/a	<b>An outbreak of hepatitis B virus infection among methamphetamine injectors: the role of sharing injection drug equipment</b> - sharing water used to prepare injections and/or rinse syringes was associated with HBV infection (94% of case-participants versus 44% of controls; OR = 21.9, 95% CI: 2.7, 177.8), as was sharing cotton filters (89% of case-participants versus 52% of controls; OR = 7.4, 95% CI: 1.5, 35.6); sharing syringes was not statistically associated.
16. Lorvick, 2012	USA	CS	7/9	477 female, street-recruited IDUs in San Francisco, CA, from 2003–2005.	MA injectors were significantly more likely to be under 30 years old, more likely to be White and more likely to identify as lesbian or bisexual than non-MA injectors.	158 injected MA in the past six months	9% MA injectors and 11% in other IDUs	<b>Sexual and Injection Risk among Women Who Inject Methamphetamine in San Francisco</b> “Women who inject MA in San Francisco engage in a range of sexual and injection behaviours. Female MA injectors were significantly more likely than non-MA injectors to report unprotected anal intercourse, multiple sexual partners, receptive syringe sharing and sharing of syringes with more than one person in the past six months. In multivariate analysis, MA use among female injectors was significantly associated with anal sex, more than five sexual partners, receptive syringe sharing, and more than one syringe-sharing partner in the past six months. It also indicates that injection risk is higher among female MA injectors than non-MA injectors. HCV self-reported 75% MA injectors and 74% In other IDUS.”
17. Zule, 2007	USA	CS	6/9	1213 heterosexual encounters from 703 injecting drug users in North Carolina	73% male,	Methamphetamine was used in 7% of encounters.	3 out of 77 who used MA in the last 30 days were HIV + (3.9%)	<b>Methamphetamine Use and Risky Sexual Behaviours During Heterosexual Encounters</b> Methamphetamine use by either or both partners was associated with an increased likelihood of anal intercourse (odds ratio [OR] 2.41, 95% confidence interval [CI] □ 1.29–4.53), vaginal and anal intercourse (OR □ 2.41, 95% CI □ 1.22–4.77), and sex with a new partner (OR 1.98, 95% CI □ 1.09–3.61). In addition to these behaviours, methamphetamine use by both partners was also

								significantly associated with unprotected intercourse with a new partner (OR □ 5.20, 95% CI 2.09–12.93) and unprotected anal intercourse (OR □ 4.63, 95% CI 1.69–12.70).
18. Cheng, 2010  Cheng 2009	USA	CS	7/9	452 HIV-negative heterosexual MA users: 133 (29.4%) were IDU and 319 (70.6%) were NIDU	mean age 36.6 years; 68% male	used MA at least twice in the past two months	n/a	<b>Increased Drug Use and STI Risk with Injection Drug Use Among HIV-Seronegative Heterosexual Methamphetamine Users</b> “Compared to non-IDU, IDU were more likely to report a recent STI. No significant differences were observed between IDU and NIDU on other sexual risk behaviour. The majority of participants also reported having had both steady (55.4%) and casual or anonymous (95.8%) sex partners whose HIV status was positive or unknown; no difference was noted by injection status for either of these variables.”
19. Cheng, 2009	USA	CS	6/9	452 HIV-negative MA users	68% men 36.6 years (SD=9.9);	MA in the previous two months	n/a	<b>Differences in sexual risk behaviours among male and female HIV-seronegative heterosexual methamphetamine users</b> Females in the sample were younger and more likely to be married, to have been diagnosed with an STI in the last two months, and to report having been introduced to MA by a sexual partner. Women were also more likely to experience depressive symptoms and to report using MA “to lose weight.” Men were more likely to engage in sex marathons while high on MA and to use MA “to enhance sexual pleasure.”
20. Robertson 2004	USA	CS	9/9	2508 adults from shelters, meal programs, and low-cost hotels received interviews, blood tests, and tuberculosis screening.	65% <30 years old; 75% male	27.7% ever injected ATS	15.9% of those who ever injected ATS were HIV + OR 2.1( 95%CI 1.6-2.7)	<b>HIV Seroprevalence Among Homeless and Marginally Housed Adults in San Francisco</b>  All MSM: 46.4% ever injected ATS, 34.6% were HIV+, OR 1.6(1.1-2.4) IDUS (non-MSM IDUS): 55.4% ever injected ATS, 7.2% HIV+, OR0.85(0.51-1.4)  At the bivariate level, HIV infection among MSM was higher among stimulant and heroin injectors, but not among syringe sharers.
21. Semple, 2004	USA	CS	6/9	194 HIV+ MSM who actively used MA from San Diego	mean of 35.9 (SD= 7.0)	MA used at least twice in the past two months	n/a	<b>A comparison of injection and non-injection methamphetamine-using HIV positive men who have sex with men</b>

								<p>Injectors reported more years of meth use, greater frequency and amount of meth use, more social and health problems, including higher prevalence of STDs and Hepatitis C, and more sexual risk behaviours.</p> <p>No significant differences in CD4+ cell count were found between injectors and non-injectors. 45% of injection meth users reported sharing needles with other users during the past 2 months. Eighteen percent indicated that they had shared needles without cleaning them. Thirty-seven percent injected with a borrowed needle and 28% loaned their needle to a fellow user. Only 14% of the sample reported using a borrowed needle in a shooting gallery. Twenty-three percent of those who injected meth also reported injecting a drug other than meth in the past 2 months (heroin and cocaine). In terms of sexual risk behaviour IV and NIV differed only in terms of their partner types and number of partners. Men in the injection group had significantly more HIV+ partners over the previous 2-month period as compared to men who did not inject. Twice as many men in the injection group reported having sexual partners with whom they exchanged sex for drugs or money as compared to men who did not inject</p>
22. Kral, 2005	USA	CS	7/9	357 MSM-IDU in San Francisco between 1998 and 2002	78% were above 30 years old, 27% were gay, 27 heterosexual and 46 were bisexual	IDUS: 66% injected ATS in the past 6 months	28%	<p><b>HIV prevalence and risk behaviours among men who have sex with men and inject drugs in San Francisco</b></p> <ul style="list-style-type: none"> <li>- high prevalence of HIV infection among MSM-IDU, as well as a high prevalence of risky sexual and injection behaviours</li> <li>- The only drug-related variable significantly associated with HIV status in bivariate analyses was amphetamine injection (76% HIV – and 86% HIV+, p=.044)</li> <li>- HIV status varied greatly by self-identified sexual orientation: 46% among gay, 24% among bisexual, and 14% among heterosexual MSM-IDU.</li> <li>- There was little difference in risk behaviours between HIV-negative and HIV-positive MSM-IDU.</li> <li>- 30% of HIV-positive MSM-IDU reported distributive syringe sharing, compared to 40% of HIV negatives.</li> <li>- 70% of positives and 66% of HIV negatives reported unprotected anal intercourse.</li> </ul>

### 3. Men who have Sex with Men (MSM) Only

Authors, Year	Country	Design	Quality Score	Population, Sample Size	Age, Gender	Drug, Route	HIV Prevalence	Relevant findings
1. Vu, 2015	Global	SR	n/a	MSM in general: it is not clear the % of MA/ Ecstasy users in the included studies.	n/a	MA and ecstasy, IV & NIV	n/a	<p><b>Amphetamine-type stimulants and HIV infection among men who have sex with men: Implications on HIV research and prevention from a systematic review and meta-analysis- 35 studies selected</b></p> <ul style="list-style-type: none"> <li>- MA use was significantly associated with HIV infection among MSM in high-income countries in all study designs, evidence of the role of ecstasy in HIV infection was lacking in cross-sectional studies.</li> <li>- 25 cross-sectional studies (out of 29) reported high HIV prevalence (9-34%) among MSM. In cross-sectional studies, MSM who reported ever using ATS were 1.70 times more likely to be infected with HIV than non-users</li> <li>- Longitudinal studies found an HIV incidence between 1.90 and 2.55 per 100 person years among MSM.</li> </ul>
2. Drumright , 2006	Global	SR	n/a	Nine studies examining methamphetamine and five examining amphetamine as independent risk factors for HIV/STI acquisition that provided a multiply controlled risk ratio measure were reviewed. Of these 14 studies, 4 were longitudinal, 1 was a case-control, and 9 were cross-sectional.	n/a	n/a	n/a	<p><b>Club Drugs as Causal Risk Factors for HIV Acquisition Among Men Who Have Sex with Men: A Review</b></p> <p>In three of the longitudinal studies (Burcham et al., 1989; Chesney et al., 1998; Page-Shafer et al., 1997), amphetamine use over the follow-up period was associated with at least a twofold increased risk of HIV seroconversion. The remaining longitudinal analysis (Rusch et al., 2004) demonstrated associations between methamphetamine use and UAI at a particular sexual encounter. This study also provides evidence for temporality, as drug use occurred before UAI. All but two (Harawa et al., 2004; Mattison et al., 2001) of the nine cross-sectional studies demonstrated that either methamphetamine or amphetamine were consistently associated with the majority of risk behaviours or disease outcomes measured. Of the seven studies demonstrating positive associations, most had risk ratios above 1.5 with confidence intervals that excluded one. A study of 337 MSM in San Francisco (Chesney et al., 1998) demonstrated some evidence of dose-response relationships. In this longitudinal study, long-term amphetamine use was associated with HIV seroconversion (RR = 2.89, 95% CI, 1.36–6.16); however, a similar association was not observed for recent adoption of amphetamine use, suggesting that the longer one uses the drug, the more likely they are to seroconvert. A number of studies demonstrate that cessation of methamphetamine use</p>

								results in a reduction in risky sexual behaviours (Shoptaw et al., 1998, 2004). Although more studies are needed to establish irrefutable evidence that methamphetamine is a causative risk factor for HIV, current evidence suggests that a causative relationship is likely to exist. However, the pathways in which methamphetamine or amphetamine may lead to HIV/STI acquisition remain unclear and warrants further investigation.
3. Halkitis, 2005	USA	Long	9/11	gay and bisexual men in New York City with six instances of club-drug use in the year before assessment. N= 293 recent MA users out of a total sample of 450 participant	Mean 33 (SD=7.99), M, gay and bisexual	MA, NIV	- HIV prevalence among 293 MA users was 38% (N=111) and 35% (N=33) among non-MA users	<b>Longitudinal investigation of methamphetamine use among gay and bisexual men in New York City: Findings from project BUMPS</b> - MA use at baseline was unrelated to HIV status - At both baseline and the 12-month follow-up, HIV status was associated with the context of methamphetamine use at sex clubs and sex parties. - Many participants indicated using methamphetamine in combination with alcohol, MDMA, ketamine, marijuana, and Viagra.
4. Fisher, 2011	USA	CS	8/9	heterosexual from Long Beach, California area  1,794 men: Methamphetamine alone, Viagra alone, Both drugs combined.	M = 40.66 years, SD = 11.27; 52.5% heterosexual	Methamphetamine and Viagra	n/a	<b>Methamphetamine and Viagra use: relationship to sexual risk behaviours</b> -Men who used both MA and Viagra showed a significantly higher prevalence of hepatitis B, syphilis, and HIV compared to those who used only one or neither drug. - The MA-only group was also more likely to report being positive for HIV than the reference group. - The proportion of those using MA immediately before or during sex in the MA-only group was lower (24%) than in the group using both MA and Viagra (33%). Indicating that the use of MA was more closely associated with sexual activity for those who used both methamphetamine and Viagra. - Gay men who take both Viagra and MA engaged in higher levels of risky sex, and as a consequence, had a significantly higher prevalence of hepatitis B, untreated syphilis, and HIV. - Viagra is associated with insertive, and methamphetamine is associated with receptive, anal intercourse. - a very strong association between the use of GHB and the use of both MA and Viagra was found. Cocaine use was the second strongest predictor in all three models.

5. Bousman, 2009	USA	CS	5/9	Sexually active non-monogamous men who have sex with men (MSM) from San Diego area TOTAL= 175: METH+/HIV+; n=71; METH+/HIV-; n=20; METH-/HIV+; n=64; HIV-/METH-; n = 20	Mean age between 37 and 40; M; MSM	MA, route NS	n/a	<b>Negative mood and sexual behaviour among non-monogamous men who have sex with men in the context of methamphetamine and HIV</b> - METH+/HIV+ group reported significantly greater negative mood and sexual risk behaviour when compared to controls. This group presented greater likelihood of unprotected sex and more than twice the number of partners in the previous year than the other groups. - METH-/HIV+ group reported significantly greater use of condoms. Among those in HIV+ groups, METH use is a critical in the frequency of condom use: among METH+ individuals, frequency of condom use is 6–25% and among METH- individuals it is at 51–75%.
6. Fernandez , 2007	USA	CS	7/9	Hispanic men who have sex with men from South Florida  Non-users n=325; Non-crystal drug users n=184; Crystal users n=57	MA users: 30.86 (S.D.=5.9)MSM	MA, route not specified	n/a	<b>Crystal methamphetamine: A source of added sexual risk for Hispanic men who have sex with men?</b> - Crystal users were not significantly different from non-crystal drug users in number of sex partners; however, differences in unprotected receptive anal sex approached significance. - Findings suggests that crystal may be contributing to additional risk of URAS. - Poly-drug use was present among the vast majority of crystal users. So it could be that poly-drug use, rather than crystal use per se, is driving the association between crystal use and sexual risk.
7. Freeman, 2011	USA	CS	5/9	adolescent boys and young men who have sex with men, aged 12 to 24 years from Eight US cities.  595 young MSM: 64 MA use; 87 hard drugs other than MA	Most MA users were between 18-24 years; YMSM	MA use (past 90 days)	check	<b>Methamphetamine use and risk for HIV among young men who have sex with men in 8 US cities</b> - Recent methamphetamine use was associated with a history of sexually transmitted diseases (51.6%), 2 or more sex partners in the past 90 days (85.7%), sex with an injection drug user (51.6%), and sex with someone who has human immunodeficiency virus (32.8%) compared with individuals reporting no recent hard drug use. - Adolescent boys and young MSM and use methamphetamine seem to be at high risk for human immunodeficiency virus.
8. Patterson, 2005	USA	CS	5/9	HIV-positive MA using MSM  261 HIV-positive classified into: (1) MAe only; (2) MA,	MSM	MA (at least twice in the past 2 months)	n/a	<b>Methamphetamine-using HIV-positive men who have sex with men: Correlates of polydrug use.</b> - Heavy polydrug users reported more sex partners who were HIV negative or of

				light polydrug users; and (3) MA and heavy polydrug users.				unknown serostatus (11.1 vs. 9.5, $t=2.0$ , $P=.04$ ) and more unprotected sex with these partners (37.3 vs. 29.4, $t=2.1$ , $P=.03$ ). - Just 5% of the participants used methamphetamine only - Heavy polydrug users were more likely to use one or more drugs in addition to MA before or during sex compared with light polydrug users (78.9% vs. 55.3%, $\chi^2=16.7$ , $P=.001$ ).
9. Nakamura, 2011	USA	CS	6/9	297 HIV+ MSM from San Diego, California	Age 36.89 (7.27) All MSM	MA use at least twice in the past two months	n/a	<b>Methamphetamine use, attitudes about condoms, and sexual risk behaviour among HIV-positive men who have sex with men</b> Negative condom attitudes moderate the relationship between methamphetamine use and unprotected sex. The relation between methamphetamine frequency and unprotected sex was significant for individuals who had more negative attitudes toward condoms, while among participants with less negative attitudes toward condoms, no significant association was found.
10. Pappas, 2011	USA	CS	6/9	ethnically and racially diverse sample of 166 New York City-based seropositive, club drug-using, gay and bisexual men	18.7% were in their 20s, 50.6% in their 30s, and 30.7% were 40+.	club drug use six times in the previous year. Club drugs: GHB, ketamine, ecstasy, MA, and cocaine. 67.5% used methamphetamine in the four months prior.	n/a	<b>Sexual risk taking and club drug use across three age cohorts of HIV-positive gay and bisexual men in New York City</b> UAI and club drug use is common among seropositive gay and bisexual men regardless of age category, but that differential patterns of risk emerge in relation to the number of years one has been living with HIV and age. The likelihood of engaging in UAI with seronegative casual partners was greater among those in their 20s than those in their 30s or 40+. Participants were equally likely to engage in unprotected receptive anal intercourse and unprotected insertive anal intercourse with each casual partner serostatus type. With regard to number of years living with HIV, those living longer with the disease were more likely to report UAI with casual partners with a seropositive status than with a negative or unknown serostatus.
11. Halkitis, 2008	USA	CS	5/9	293 gay and bisexual men MA users from New York City (32 were Black)	Black MA users 32 years old (SD = 7.60)	49% had used MA in the 4 months prior to assessment	40.6% (Black MA users)	<b>A Comparative Analysis of Methamphetamine Use: Black Gay and Bisexual Men in Relation to Men of Other Races</b> Black methamphetamine users tended not to reside in neighbourhoods considered traditionally gay, were more likely to be HIV-positive, have lower educational attainment, and have lower levels of income than other methamphetamine users. In terms of frequency and reasons for use, Black methamphetamine users did not differ in any

								substantive way compared to other races and ethnicities. In addition, they did not differ along any key demographic lines from Black non-methamphetamine users. Poly-drug use was common among all Black men in the sample, with almost all methamphetamine users also reporting use of cocaine, but cocaine users not necessarily reporting methamphetamine use.
12. Halkitis, 2005	USA	CS	7/9	49 gay and bisexual men MA users from New York City	mean age of 35.63 (SD=6.81)	Self-reported use of MA use in the past 3 month	Self- reported 57.1%	<b>Sexual Behaviour Patterns of Methamphetamine-Using Gay and Bisexual Men</b> MA attracts a hypersexual risk-taking group of men who engage in unprotected sexual behaviours regardless of their methamphetamine use. Participants reported equivalent rates of unprotected anal insertive and receptive behaviours when comparing their sexual acts while high on methamphetamine, high on other drugs, and sober. In addition, equivalent rates of “extreme” sex acts were found for 10 of the 12 behaviours examined while high on methamphetamine and while sober. More frequent risky sexual behaviours among HIV positive men when compared with HIV negative men was found.
13. Peck, 2005	USA	CS	6/9	263 MA-dependent, treatment-seeking men who have sex with men (MSM)in Los Angeles.	36.6 (SD = 6.4)	263 MA- dependence	Self- reported 61%	<b>HIV-associated medical, behavioural, and psychiatric characteristics of treatment-seeking, methamphetamine-dependent men who have sex with men</b> Findings demonstrate the powerful connection between methamphetamine dependence and HIV infection. HIV infection status strongly associated with prior treatment for methamphetamine dependence; unprotected receptive anal intercourse; history of sexually transmitted infections; and health insurance status. HIV-infected participants were more than twice as likely (48.0% vs. 21.9%) as their HIV-uninfected peers to report unprotected receptive anal intercourse (URAI) in the 30 days prior to intake ( $\chi^2(1) = 11.22, p = .001$ ). reports of HIV infection corresponded closely with severity of drug dependence as nearly 2.5 times more HIV-infected participants (51.1%) reported prior methamphetamine treatment episodes as HIV-uninfected participants (18.3%; $\chi^2(1) = 16.04, p < .001$ ). There was a trend that approached significance with HIV-infected participants (37.8%) more likely to report injection use of methamphetamine than HIV non-infected participants (23.4%; $\chi^2(1) = 3.64, p = .056$ ). While injection users reported histories of more sexually transmitted infections

								than non-injection users they were equally likely to engage in sexual risk behaviours in the past 30 days.
14. Semple, 2009	USA	CS	5/9	341 HIV-positive MSM	37.3 years (SD = 7.5)	MA used at least twice in the past two months	n/a	<p><b>Sexual risk behaviour associated with co-administration of methamphetamine and other drugs in a sample of HIV-positive men who have sex with men</b></p> <p>Those who reported methamphetamine co-administration in the past two months (65%) reported significantly more unprotected anal and oral sex and a greater number of casual, anonymous, and paid sex partners in this timeframe compared to men who used methamphetamine alone. Two primary patterns of co-administration were identified: 1) drug combinations motivated by sexual performance and enhancement (e.g., methamphetamine, poppers, sildenafil) and 2) "party drug" combinations (e.g., methamphetamine, GHB, ketamine). 1</p>
15. Semple, 2009	USA	CS	6/9	341 HIV-positive MA-using MSM in San Diego, CA	37.4 (SD 7.4)	MA used at least twice in the past two months	n/a	<p><b>Sexual marathons and methamphetamine use among HIV-positive men who have sex with men</b></p> <p>Sexual marathons were prevalent in our sample and that risk behaviours, including unprotected anal and oral sex, were common among sexual marathon participants. Eighty-four percent of the sample reported engaging in marathon sex while high on methamphetamine. Men who engaged in marathon sex used significantly more illicit drugs, were more likely to use sildenafil (Viagra®) and amyl nitrates, and scored higher on a sexual compulsivity scale compared to men who did not engage in marathon sex. In multivariate analyses, use of sildenafil in the past two months was significantly correlated with participation in sexual marathons.</p>
16. Semple, 2006	USA	CS	7/9	261 HIV + meth-using MSM.	Age 37.0 (7.3)	MA used at least twice in the past two months	n/a	<p><b>Methamphetamine use, impulsivity, and sexual risk behaviour among HIV-positive men who have sex with men</b></p> <p>Intensity of meth use and sexual risk behaviour were significantly correlated. In a multiple regression analysis, more education, greater intensity of meth use and higher levels of impulsivity predicted more unprotected sex. A plot of the interaction revealed that the relationship between intensity of meth use and total unprotected sex was strongest among participants who had higher levels of impulsivity. This suggests that targeting impulsivity in interventions may help reduce sexual risk behaviours in high intensity meth-using HIV-positive MSM.</p>

17. Semple, 2006	USA	CS	6/7	132 HIV-positive meth-using MSM who reported having both serodiscordant and seroconcordant partners.	36.2 years (SD=7.2)	MA used at least twice in the past two months	n/a	<b>Sexual risk behaviour of HIV-positive methamphetamine-using men who have sex with men: The role of partner serostatus and partner type</b> HIV-positive meth-using MSM engaged in significantly fewer acts of anal sex with serodiscordant partners as compared to seroconcordant partners. However, mean levels of unprotected anal and oral sex were high, and mean levels of protected sex were low for both seroconcordant and serodiscordant partners. Oral sex was practiced twice as often as anal sex; however, both types of sex were primarily unprotected. This pattern of risky sexual behaviour was reported for steady, casual, and anonymous partners, regardless of partner serostatus. Despite high rates of unprotected sex, rates of HIV serostatus disclosure were consistently high for HIV-positive and HIV-negative steady, casual, and anonymous partners. However, rates of disclosure to unknown serostatus partners were low, particularly in relation to anonymous partners.
18. Semple, 2006	USA	CS	6/9	217 HIV-positive MSM	Age 37.9 (SD 7.3)	MA used at least twice in the past two months	n/a	<b>Sexual compulsivity in a sample of HIV-positive methamphetamine-using gay and bisexual men</b> Participants reported a mean score of 2.4 on the Sexual Compulsivity Scale (SCS) (SD=.76, range 1–4). Sexual compulsivity was positively associated with high-risk sexual behaviours (e.g., number of unprotected sex acts with anonymous partners, total number of HIV-negative or unknown serostatus partners). In multivariate analyses, higher scores on sexual compulsivity were associated with older age, meth use before or during sex, visits to sex clubs and street corners to find sex partners, lower self-efficacy for condom use, lower levels of self-esteem, higher scores on a measure of disinhibition, and a greater number of HIV-negative or unknown serostatus partners.
19. Semple, 2009	USA	CS	5/7	321 MA-using HIV-positive MSM in San Diego, C	37.1 years (range: 20 to 61)	MA used at least twice in the past two months	n/a	<b>Factors associated with sex in the context of methamphetamine use in different sexual venues among HIV-positive men who have sex with men</b> Respondents were classified according to their preference of sexual venue: private (e.g., home), commercial (e.g., bathhouse), or public (e.g., public park or restroom). The commercial venue group was younger, better educated, more likely to identify as gay, and significantly more likely to have used “club drugs” as compared to the other two groups. Men in the commercial-and public-venue groups reported more high-risk sex compared to the private-venue group. The

								public-venue group reported heavier drug and alcohol use, had significantly higher Beck depression scores, reported more experiences of stigma, and scored higher on a measure of sexual compulsivity than did the other two groups.
20. Drumright , 2009	USA	CC	8/9	Eighty-six recently (previous 12 months) HIV-infected MSM (cases) and 59 MSM who recently tested HIV-negative (controls)	The median age 32	57.9% used MA in the past 12 months (use of other substances also reported)	n/a	<b>Associations Between Substance Use, Erectile Dysfunction Medication and Recent HIV Infection Among Men Who have Sex with Men</b> - Cases were more likely than controls to report methamphetamine or nitrite use, in the previous 12 months and with their last three sexual partners. Use of nitrites and amphetamine may increase HIV risk among MSM.
21. Plankey, 2007	USA	Long	8/11	Seronegative (n = 4003) men	Median of 33.4 years at enrolment.	Use of methamphetamine at the current or last visit.	1.46 (95%CI: 1.12 to 1.92) increased relative hazard of HIV seroconversion associated with methamphetamine use.	<b>The Relationship Between Methamphetamine and Popper Use and Risk of HIV Seroconversion in the Multicenter AIDS Cohort Study</b> A significant association between methamphetamine use and HIV seroconversion was found after adjusting for other important risk factors. “There was a 1.46 (95%CI: 1.12 to 1.92) increased relative hazard of HIV seroconversion associated with methamphetamine use. The relative hazard associated with popper use was 2.10 (95% CI: 1.63 to 2.70). The relative hazard of HIV seroconversion increased with the number of unprotected receptive anal sexual partners, ranging from 1.87 (95% CI: 1.40 to 2.51) for 1 partner to 9.32 (95% CI: 6.21 to 13.98) for 5+ partners. The joint relative hazard for methamphetamine and popper use was 3.05 (95% CI: 2.12 to 4.37). There was a significant joint relative hazard for methamphetamine use and number of unprotected receptive anal sexual partners of 2.71 (95% CI: 1.81 to 4.04) for men with 1 unprotected receptive anal sexual partner, which increased in a dose-dependent manner for 1 partners.” Seroconverters more likely to have ever used MA.
22. Buchacz, 2005	USA	Long	7/11	2991 MSM who tested anonymously for HIV in San Francisco	median age 34 years;	MA use in the past year	Incidence rate: 6.3% per year	<b>Amphetamine use is associated with increased HIV incidence among men who have sex with men in San Francisco</b> “HIV incidence among 290 amphetamine users was 6.3% per year (95% CI 1.9–10.6%), compared with 2.1% per year (95% CI 1.3–2.9%) among 2701 non-users (RR 3.0, 95% CI 1.4–6.5), the incidence was 7.7% per year (95% CI 2.4–13.0) among those who had sex while using amphetamine. After adjusting for age, race or ethnicity, and the use of other non-injectable drugs in the past year

									(barbituates, cocaine, ecstasy, heroin, LSD, PCP, poppers and tranquilizers), amphetamine use was still associated, but less strongly, with HIV seroconversion [odds ratio (OR) 2.4, 95% CI 0.9–6.3]. When we further controlled for the use of marijuana and alcohol in the past year, reported by 33 and 74% of MSM, respectively, amphetamine use remained associated with HIV seroconversion (OR 2.5, 95% CI 0.9–6.9). Compared with non-users, amphetamine users were more likely to report either unprotected anal sex in the past year [odds ratio (OR) 2.3, 95% confidence interval (CI) 1.8, 3.0] or 10 or more sex partners in the past year (OR 2.5, 95% CI 2.0, 3.3). In addition, amphetamine users were more likely to be under 35 years of age ( $P < 0.05$ ), but were no more likely to belong to any racial or ethnic group.”
23. Drumright , 2006	USA	CS	7/9	194 MSM who were recently infected with HIV	mean age of 35 years	31.4% used MA with any of the last 3 partners	n/a	<b>Unprotected Anal Intercourse and Substance Use Among Men Who Have Sex with Men With Recent HIV Infection</b> In multivariate CLR models and GLMMs, UAI was associated with the use of methamphetamine (odds ratio [OR] = 4.9 and OR = 3.5, respectively)	
24. Halkitis, 2008	USA	CS	5/9	311MSM attending gyms in NYC	mean age 39 years (SD=9.79)	23.8% used methamphetamine in the 6 months. Only 6.8% of these used MA IV.	Self - reported: 32.4% HIV + reported MA use in the past 6 months.	<b>Methamphetamine and Poly-Substance Use Among Gym-Attending Men Who Have Sex with Men in New York City</b> Seropositive men were more likely to report methamphetamine use than seronegative men [32.4 vs 20.9%; $\chi^2(2) = 8.29$ , $p=0.02$ ]. Study participants also indicated a variety of other substances used.	
25. Koblin, 2006	USA	Long	8/11	4295 HIV-negative MSM	Mean age 34 years old	Use of MA in the past 6 months (12.3% of the total sample)	67 of 527 amphetamine users seroconverted during the study . The HIV hazard rate of amphetamine users was 3.98 (CI 3.06-5.16) in the univariate	<b>Risk factors for HIV infection among men who have sex with men</b> This study also found that the use of alcohol or drugs before sex and overall use of amphetamines and heavy alcohol were independent predictors of seroconversion. In multivariate analysis, men reporting amphetamine or heavy alcohol use and alcohol or drug use before sex were at increased risk of HIV infection. The overall HIV incidence was 2.1 per 100 person-years [95% CI, 1.9–2.4].	

							analysis and 1.96 in the multivariate analysis. The HIV attribute risk of amphetamine use was 16.3%	
26. Koblin, 2007	USA	CS	7/9	503 MSM attend public venues in New York City	51.1% of the men were under the age of 30 years,	13.8% used amphetamine in the past year	29.8% of men reporting amphetamine use were HIV positive compared to 16.6% HIV positive among men who did not use amphetamines (p = 0.029)	<b>Amphetamine Use and Sexual Risk Among Men Who Have Sex with Men: Results From the National HIV Behavioural Surveillance Study—New York City</b> Men who used amphetamines were significantly more likely to be HIV infected. Of those, 71.0% used amphetamines with sex. Amphetamine use was associated with unprotected receptive anal intercourse with non-main partners, after controlling for covariates. In event-specific analysis, amphetamine use was higher with unprotected encounters compared with protected encounters. This study confirms the association between amphetamine use and sexual risk. men using amphetamines also used other drugs, with most of the men using marijuana and amyl nitrites. In summary: amphetamine-using men were also more likely to be polydrug users, to be HIV infected and to engage in unprotected receptive anal intercourse with non-main partners.
27. Rudy, 2009	USA	CS	5/9	6435 MSM sexually transmitted disease (STD) clinic in Los Angeles	52% were under 34 years old.	Use of MA in the past year: 13%. Of those 37% only reported methamphetamine use. 63% reported at least one other drug in addition to MA.		<b>Methamphetamine use and Other Club Drug Use Differ in Relation to HIV Status and Risk Behaviour Among Gay and Bisexual Men.</b> Of 6435 participants, newly recognized HIV status (OR: 3.02 95% CI: 2.30, 3.99) was associated with methamphetamine use compared with nondrug users, an association not found among other club drug users. After adjusting for demographic and risk factors and using the nondrug use category for comparison, known HIV-positive status, newly recognized HIV status, laboratory-confirmed positive rectal and urethral gonorrhoea infection as well as sex for drugs or money in the past year and sex with an injection drug user in the past year were associated with methamphetamine use. These associations were not significant in the other club drug use analysis. Blacks had lower odds associated with methamphetamine use.

28. Vaudrey, 2007	USA	TS	n/a	4602 MSM	n/a	Use in the past 6 months and just before or during sex	n/a	<b>Indicators of use of methamphetamine and other substances among men who have sex with men, San Francisco, 2003–2006</b> Overall, use of diverse substances tended to decrease from 2003 to 2006, many significantly so. Reported use of methamphetamine significantly decreased among HIV-negative MSM. However, methamphetamine and alcohol use during sex was associated with unprotected potentially HIV serodiscordant sex.
29. Wohl, 2008	USA	CS	7/9	455 men who have sex with men (MSM) and 228 non-MSM diagnosed with AIDS in Los Angeles County	Mean age 39 years	Lifetime methamphetamine use was 35% for MSM, 14% for non-MSM, 50% for white MSM, and 35% for black MSM. Methamphetamine use in the previous 12 months among MSM (11%) and non-MSM (0.4%) was less than lifetime use.	n/a	<b>Demographic Characteristics and Sexual Behaviours Associated with Methamphetamine Use among MSM and Non-MSM diagnosed with AIDS in Los Angeles County</b> Compared to MSM with no history of methamphetamine use in a multivariate analysis, MSM methamphetamine users were more likely reported more than 10 sexual partners in the previous 12 months (OR = 3.1, 95% CI: 1.7, 5.6).
30. Carey, 2009	USA	CC	6/9	111 cases with recent HIV infection, and 333 HIV-negative controls from Chicago and Los Angeles	47.5 % were younger than 30 years old.	15.8% used MA at least once in the past 6 months	Cases (HIV+) 28.8% used MA in the past 6 months Controls (HIV-) 11.4% OR3.13 (1.78–5.52)	<b>Drug Use, High-Risk Sex Behaviours, and Increased Risk for Recent HIV Infection among Men who Have Sex with Men in Chicago and Los Angeles</b> MA use in the past 6 months associated with recent HIV seroconversion among MSM OR 3.13 (1.78–5.52). Cases more frequently used Viagra, poppers, and methamphetamine during UAI compared with controls. In multivariate analysis, income, UAI with HIV-positive partners, Viagra, and poppers remained associated with recent HIV seroconversion. Strong crude associations between HIV seroconversion and drug use during high-risk UAI, particularly for methamphetamine, Viagra, and poppers. the initial strong crude association between methamphetamine and HIV seroconversion disappeared in all our multivariate models. This likely is because methamphetamine users tended to engage in more

								unprotected anal sex with HIV-seropositive partners. In essence, methamphetamine use was a proxy marker for persons engaged in the highest risk sexual activities, which in turn put them at direct risk for HIV infection.
31. Ackers, 2012	USA	Long	8/11	4684 high-risk MSM	Median age was 35 years	MA use in the past 6 months: 9% (417)	IRR 5.0/100 py; 95% CI 3.8, 6.4) HR 2.9 (2.2–3.9)	<b>High and Persistent HIV Seroincidence in Men Who Have Sex with Men across 47 U.S. Cities</b> Overall, HIV incidence was 2.7/100 py and was relatively uniform across study sites and study years. HIV incidence was highest among young men and men reporting unprotected sex, recreational drug use, and a history of a sexually transmitted infection. Independent predictors of HIV seroconversion included: age 18–30 years (aHR=2.4; 95% CI 1.4,4.0), having .10 partners (aHR=2.4; 95% CI 1.7,3.3), having a known HIV-positive male sex partner (aHR=1.6; 95% CI 1.2, 2.0), unprotected anal intercourse with HIV positive/unknown male partners (aHR=1.7; 95% CI 1.3, 2.3), and amphetamine (aHR=1.6; 95% CI 1.1, 2.1) and popper (aHR=1.7; 95% CI 1.3, 2.2) use. Elevated HIV seroconversion rates among men who reported baseline drug use: amphetamines: (5.0/100 py; 95% CI 3.8, 6.4) and crack (5.2/100 py; 95% CI 2.7, 8.8). Risk factors for HIV infection among MSM in univariate and multivariate analyses: HR 2.9 (95%CI 2.2–3.9) ,. AHR 1.6 (1.1–2.1). Amphetamine and popper use were significantly linked to higher risks of seroconversion.
32. Buchbinder, 2005	USA	Long	7/11	3257 MSM in 6 US cities from 1995 to 1997	Age 65.4% older than 35	8.8% used MA in the past 6 months	Annual seroconversion 4.4  OR 3.3 (95%CI 1.9-5.7)	<b>Sexual Risk, Nitrite Inhalant Use, and Lack of Circumcision Associated with HIV Seroconversion in Men Who Have Sex With Men in the United States</b>  Several drugs were also associated with HIV seroconversion, including nitrite inhalants (“poppers”), amphetamines, cocaine, hallucinogens, and injection drugs. MA use not significant in the multivariable analysis. The risk factors appearing to contribute to the greatest number of infections in this cohort included a larger number of HIV-negative sex partners, inhaled nitrite use, and younger age.
33. Harawa, 2004	USA	CS	8/9	3316 US black, multi-ethnic black, Latino, and white MSM	Median age was 19 years for multi-ethnic blacks and 20	NR	HIV prevalence and amphetamin	<b>Associations of Race/Ethnicity with HIV Prevalence and HIV-Related Behaviours Among Young Men Who Have Sex with Men in 7 Urban Centers in the United States</b>

					years for each other group.		e use during sex past 6 months: AOR= 0.83 (0.46, 1.5)	HIV prevalences were 16% for both black and multi-ethnic black participants, 6.9% for Latinos, and 3.3% for whites. Paradoxically, potentially risky sex and drug-using behaviours were generally reported most frequently by whites and least frequently by blacks. In a multiple logistic regression analysis, positive associations with HIV included older age, being out of school or work, sex while on crack cocaine, and anal sex with another male regardless of reported condom use level. Differences in these factors did not explain the racial/ethnic disparities in HIV prevalence, with both groups of blacks experiencing more than 9 times and Latinos experiencing approximately twice the fully adjusted odds of infection compared with whites.
34. Colfax, 2004	USA	CS	7/9	4,295 HIV- negative MSM	61% were 35 years old or younger	11% used amphetamines less than once a week and 2% used more than once a week	n/a	<p><b>Substance Use and Sexual Risk: A Participant- and Episode-level Analysis among a Cohort of Men Who Have Sex with Men</b></p> <p>UAI with sero-discordant partner last sex and:  - used methamphetamine just before last sex: OR = 1.5 (1.1-2.0)  - partner used drugs before sex OR = 1.5 (1.2-2.0)  - used methamphetamine in last 6 months &lt; 1/week: OR = 1.4 (1.2-1.7)  - used methamphetamine in last 6 months 1/week +:OR = 2.0 (1.3-3.1)</p>
35. Schwarcz, 2007	USA	CS	6/9	Telephone survey of 1976 adult MSM in San Francisco.	Median age of 42 years	Used 3 or less days per month: 13.5% Used weekly or daily 3.3%	MA used by 26% of HIV+ men compared with 13.6% of HIV- men,	<p><b>Prevalence of HIV Infection and Predictors of High-Transmission Sexual Risk Behaviours Among Men Who Have Sex with Men</b></p> <p>7% of the HIV infected men reported daily or weekly crystal methamphetamine use compared with 2% of the uninfected men.  Crystal methamphetamine use was high overall and was independently and strongly predictive of high-transmission sexual risk behaviour among the non-HIV-infected men. Although crystal methamphetamine use was significantly associated with unprotected insertive anal intercourse among HIV-infected men with their uninfected or unknown serostatus partners in the bivariate analysis (OR 0.89 (95%CI 0.4, 1.9)), it was not retained in the final multivariate model.  An additional logistic regression analysis in which we excluded all drugs except crystal methamphetamine from</p>

								the model, and we found that use of methamphetamine was independently predictive of high-transmission-risk sexual intercourse among the men who were HIV infected (odds ratio=1.9; 95% CI=1.1, 3.3.)
36. Hirshfield, 2004	USA	CC	5/9	2,943 gay and bisexual men who were recruited online	46% were under 30 years old	6% used MA	n/a	<b>Substance use and high-risk sex among men who have sex with men: a national online study in the USA</b> Men with an incident STD were more likely than men without an STD to report drug use (crystal methamphetamine odds ratio 3.8; 95% confidence interval 2.1-6.7). In the multivariate analysis, significant independent predictors associated with an incident STD were crystal methamphetamine use (adjusted OR 2.0; 95% CI 1.1-3.8){Hirshfield, 2004 #519}
37. Thiede, 2009	USA	CC	6/9	32 HIV-positive MSM (58 partners) and 110HIV-negative MSM (213 partners).	<30 case: 31.3% Control 40%	Prevalence MA use during UAI	Prevalence MA use during UAI Case/control : Meth: 34.4%/12.7 %	<b>Determinants of Recent HIV Infection Among Seattle-Area Men Who Have Sex with Men</b>  In multivariate analysis, recent HIV infection was associated with meeting partners at bathhouses or sex clubs, bars or dance clubs, or online; methamphetamine use during unprotected anal intercourse; and unprotected anal intercourse, except with HIV-negative primary partners. Drug use (particularly use of methamphetamine and poppers [amyl nitrites]) during unprotected anal intercourse was significantly more prevalent among case participants compared with control participants.
38. Marshall, 2011	Canada	Long	9/11	drug users and self-identified sexual minority participants (N=248) from Vancouver,  n = 248	58% were female, mean age 32	MA use in the past 6 months, IV & NIV.  Over half (62.1%) reported recently using MA	- Cristal MA use was not associated with HIV status at baseline: 40.4% of the males and 28.5% of the females were HIV+.	<b>Pathways to HIV risk and vulnerability among lesbian, gay, bisexual, and transgendered methamphetamine users: a multi-cohort gender-based analysis</b> - MA use associated with different sets of HIV risks and vulnerabilities. - MA use among sexual minority males was associated with unprotected intercourse (AOR = 1.62, p = 0.048) - Among females, MA use was associated with injection drug use (AOR = 2.49, p = 0.002), and unprotected intercourse with sex trade clients (AOR = 2.62, p = 0.027), FMA users more likely to have multiple regular or casual sex partners (OR = 1.55, p = 0.029).
39. Nakamura , 2011	Canada	CS	7/9	MA users and HIV-positive men who have sex with	mean age 37 year, Male, MSM and MSMW	MA use (twice in the	n/a	<b>HIV risk profiles among HIV-positive, methamphetamine-using men who have sex with both men and women</b>

				both men and women (200-2004)  MSMW(n=50) compared to men who have sex with men only (MSM) (n=150)		past 2months and at least once in the last 30days)		<ul style="list-style-type: none"> <li>- HIV-positive MA users MSMW differ significantly from MSM in their HIV risk behaviours:</li> <li>- Factors independently associated with MSMW were acquiring HIV through injection drug use, being an injection drug user, using hallucinogens, using crack, being less likely to have sex at bath house, being less likely to be the receptive partner when high on methamphetamine, having greater intentions to use condoms for oral sex, and having more negative attitudes about HIV disclosure</li> <li>- MSMW were also more likely to use meth for frequently in the past 30days, inject methamphetamine use, and use cocaine and crack in the past 2months (moderate effect size).</li> <li>- MSMW and MSM did not differ significantly in their number of reported unprotected anal or oral sex acts.</li> </ul>
40. Rusch, 2004	Canada	Long	7/11	261 MSM	Age median 27 (24–30)	MA use: sex situations 4%; global use 11%	n/a	<p><b>Unprotected Anal Intercourse Associated with Recreational Drug Use Among Young Men Who Have Sex With Men Depends on Partner Type and Intercourse Role</b></p> <p>UAI was significantly associated with sexual situation-specific use of marijuana (OR, 1.43), crystal methamphetamine (OR, 1.75), ecstasy (OR, 1.88), and ketamine (OR, 2.17); global use associations were similar. Methamphetamine was associated with RUAI with casual partners.</p> <ul style="list-style-type: none"> <li>- CrystalMA use during sex and UAI: OR = 1.75 (1.0, 3.05)</li> <li>- CrystalMA use anytime and UAI: OR = 1.57 (1.12,2.19)</li> <li>- CrystalMA use during sex and IUAI: OR = 1.74 (1.05, 2.91)</li> </ul>
41. Chariyalertsak, 2011	Thailand	CS	4/9	551 MSM	Mean age was 23.9 years	Ever 11.1%	OR 1.78 (0.81-3.65) Among MA use (ever)	<p><b>HIV Incidence, Risk Factors, and Motivation for Biomedical Intervention among Gay, Bisexual Men, and Transgender Persons in Northern Thailand</b></p> <p>alcohol use, but use of methamphetamine and heroin, rare overall, were much more common among HIV positive men, with methamphetamine reaching borderline significance.</p>
42. Morineau, 2011	Indonesia	CS	8/9	1,450 MSM, among whom 749 were tested for HIV and syphilis and 738 for gonorrhoea and Chlamydia	Mean age 28 years.	15% of MSM used MA before having sex, in the 3 months prior to the survey.	OR = 2.69; 95% CI = 1.33–5.43	<p><b>Sexual Risk Taking, STI and HIV Prevalence Among Men Who Have Sex with Men in Six Indonesian Cities</b></p> <p>Multivariate analyses revealed recent methamphetamine (OR = 2.69; 95% CI = 1.33–5.43)</p>

43. Macdonald, 2008	UK	CC	6/9	75 cases (recent HIV positive test following a negative test within the past 2 years) and 157 controls (recent HIV negative test following a previous negative test within the past 2 years)	Mean age: Cases 35.2; controls 35.1	MA use: Cases 21.3%; Controls 8.28%	OR 1.30 (0.60, 2.83)	<b>Factors associated with HIV seroconversion in gay men in England at the start of the 21<sup>st</sup> century</b> MA use and association with HIV seroconversion: Univariate analysis OR 1.30 (0.60, 2.83). Contrary to findings from the USA, we found no evidence of methamphetamine's association with seroconversion despite being reported by over 10% of participants. Rather, the drug that stands out from our study is nitrite inhalants.
44. Lyons, 2013	Australia	CS	5/9	1135 HIV-positive and HIV-negative gay-identified men aged 40 years and older.	median age of 48 years	13% reported using methamphetamine in the past 12 months.	Self-reported 17% of total sample	<b>Methamphetamine use in a nationwide online sample of older Australian HIV-positive and HIV-negative gay men</b> The adjusted odds of HIV-positive men reporting methamphetamine use were 2.5 times those of HIV-negative men. Reported methamphetamine use was considerably more prevalent among HIV-positive (24%) than HIV-negative men (11%). In a multivariable logistic regression, reported use was significantly greater among men in their 40s compared with those in their 50s and older (P = 0.002), who were single as opposed to being in an ongoing relationship (P = 0.03), who were HIV-positive (P = 0.003), and who reported using other drugs for non-medical purposes in the past 12 months (P < 0.001).
45. Rawstorne, 2007	Australia	Long	7/11	Men who identified themselves as gay or homosexual from NSW N= 448	Median age 36 years, M	Crystal MA in the past 6 months, route not specified	n/a	Associations between crystal methamphetamine use and potentially unsafe sexual activity among gay men in Australia - Compared to non-users, crystal users reported having more sex partners, looking for sex in more types of venues, and being more likely to engage in unprotected anal intercourse with casual partners (UAIC) and in esoteric sex. - Crystal users were also more likely to be using other recreational drugs and Viagra than non-users. - Crystal use does not necessarily drive unsafe sexual behaviour: The prevalence of crystal use among Australian men who have sex with men (MSM) increased between 2002 and 2005. However, the prevalence of UAIC remained stable or decreased over time in various study subgroups, as did the prevalence of other sex-related behaviours.
46. Prestage, 2009	Australia	Long	10/11	1,427 HIV-negative homosexually active men	The median age of the sample was 37 years	28.4% used ATS less than monthly; 23.1% used at least monthly; 7.2%	MA once a month: HIV Incidence per 100PY 2.71; HR	<b>Use of Illicit Drugs and Erectile Dysfunction Medications and Subsequent HIV Infection among Gay Men in Sydney, Australia</b> In multivariate analysis, use of methamphetamine (HR = 1.34, CI = 1.01–1.78, P = 0.041) and amyl nitrite (HR =

						used at least weekly	5.21 (1.85–14.65)  MA use more than once a month: HIV Incidence per 100PY 1.75; HR 3.50 (0.87–13.99)	1.30, CI = 1.02– 1.67, P = 0.037) were both independently associated with HIV seroconversion. The risk of infection was substantially increased when both OEM and methamphetamine were used. When adjusted for each other, a significant effect remained for methamphetamine, amyl nitrite, and OEM. When further adjusted for detailed measures of HIV risk behaviour, the increased risk remained significant only for two drugs typically used during sexual contact, OEM, and amyl nitrite. Stratified analysis showed that those who reported using methamphetamine and amyl nitrite were only at increased risk if they also reported use of OEM. The risk of infection was substantially increased when both OEM and methamphetamine were used. Our finding that men who use both OEM and methamphetamine are at substantially increased risk of infection supports this case.
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#### 4. Sex Workers

Authors, Year	Country	Design	Quality Score	Population, Sample Size	Age, Gender	Drug, Route	HIV Prevalence	Relevant findings
1. Couture, 2012	Cambodia	Long	9/11	young women engaged in sex work in Phnom Penh N= 160	Median 25 years, F, NS	ATS (meth pill ‘yama’ and crystal), NIV  ATS lifetime use 63.7% and past 3 mths 38.6%	- HIV prevalence (tested at baseline only) among 42 SW who reported recent ATS use was 28% (N=12); in non-ATS users HIV prevalence was 21% (N=25 out of 118).	<b>Correlates of amphetamine-type stimulant use and associations with HIV-related risks among young women engaged in sex work in Phnom Penh, Cambodia</b> - ATS users (use in the past 3 months) had more sex partners, high level of alcohol use, and were at increased risk of STI than non-users. - ATS use was not associated with inconsistent condom use at last sexual encounter.
2. Couture, 2011	Cambodia	Long	9/11	160 SW	median age was 25 years	Any ATS use reported by 43.8%, specifically yama by 40.6% and “crystal,” 23.1%.	HIV PR 30% in those who used Yama in the last 3 months  HIV PR19% in those who used crystal in the last 3 months	<b>Young women engaged in sex work in Phnom Penh, Cambodia, have high incidence of HIV and sexually transmitted infections, and amphetamine-type stimulant use: new challenges to HIV prevention and risk</b> ATS use was associated with incident STI.  Prevalence rate (for the whole sample): 23% (95% CI, 20.0%–26.7%); HIV estimated incidence (for the whole sample) of 3.6 per 100 PY (95% CI, 1.2%–11.1%)
3. Urada, 2014	Philippines	CS	8/9	498 Female bar/spa workers 35% engaged in sex work	median age was 23 years	9% used methamphetamines (shabu)	n/a	<b>Sex work and its associations with alcohol and methamphetamine use among female bar and spa workers in the Philippines</b> Sex work was independently associated with methamphetamine use (19% vs 4%; adjusted odds ratio [AOR] =2.9, 95% confidence interval [CI] = 1.3–6.2),
4. Kang, 2011	China	CS	7/9	1187 FSWs	Median age 21	30.2% MA use in last 6 months, 1.6% ever injected.	n/a	<b>Commercial sex venues, syphilis and methamphetamine use among female sex workers</b> MA users who frequent commercial sex venues are engaging in high-risk behaviours and are at risk for syphilis/other sexually transmitted diseases. Among the syphilis-infected participants, 50% ever used MA in the last six months. Among all participants, MA users were more likely to be younger (AOR □2.5; 95% CI: 1.1 □4.1 vs. ]25 years of age), single (AOR □2.5, 95% CI: 1.1 □5.3), younger at first lifetime sex act (AOR □1.8, 95% CI: 1.4 □2.5), have ever had unprotected sex with clients (AOR □1.7, 95% CI: 1.1 □2.3), and have syphilis

								(AOR $\square$ 2.6, 95% CI: 1.4 $\square$ 5.2). MA use was much higher among FSWs recruited from night clubs, bars, saunas, and hotels than among any other venue-based subgroups, a finding that is not consistent with other reports (Yang et al., 2005). In addition, we found that the practice of unprotected sex was more prevalent among street-based FSWs than among other venue-based subgroups (Yang et al., 2005).
5. Liao, 2011	China	CS	7/9	1,211 FSWs	41.9% were 20-24 yrs old	30.2% used MA in the past 6 months. 1.6% injected MA in the last 6 months.	n/a	<b>Syphilis and methamphetamine use among female sex workers in Shandong Province, China</b> In the multivariate analysis, the participants with syphilis were more likely to have ever used methamphetamine (AOR 2.2, 95% CI: 1.1–4.5). Methamphetamine users were more likely to be younger (AOR 2.1; 95% CI: 1.2–3.9, 20 vs.25 years of age), single (AOR 2.4, 95% CI: 1.1–5.3), $\square$ 18 years of age at first lifetime sex (AOR 1.7, 95% CI: 1.3–2.3), not have used a condom in the last sex with clients (AOR 1.5, 95% CI: 1.0 –2.1), have inconsistent condom use with clients in last month (AOR 1.6, 95% CI: 1.2–2.1), and have syphilis (AOR 2.3, 95% CI: 1.1–4.8). Methamphetamine use was independently associated with unprotected sex and syphilis.
6. Shannon, 2011	Canada	Long	7/11	255 street-based FSWs,	Median age 36 years (IQR: 25–41)	32% reported lifetime crystal MA use and 24% used crystal MA during the two-year follow-up period. CM use in the past 6 months. For 85% Injection was the primary mode of administration.	HIV prevalence among FSWs was 23%, with no statistically significant difference in likelihood of CM use by HIV status (p=0.83).	<b>Crystal methamphetamine use among female street-based sex workers: Moving beyond individual-focused interventions</b> No significant associations between methamphetamine use and sexual risk patterns were found. In a final multivariate GEE model, FSWs who used crystal methamphetamine had a higher proportional odds of dual heroin injection (adjOR=2.98, 95%CI: 1.35–5.22), having a primary male sex partner who procures drugs for them (adjOR=1.79, 95%CI: 1.02–3.14), and working (adjOR=1.62, 95%CI: 1.04–2.65) and living (adjOR=1.41, 95%CI: 1.07–1.99) in marginalized public spaces. The findings highlight the crucial need to move beyond the individual to gender-focused safer environment interventions that mediate the physical and social risk environment of crystal methamphetamine use among FSWs.
7. Deering, 2013	Canada	CS	8/9	510 SWs	Median age of 35 years (IQR: 28–42 years)	MA use daily 2.5% offered money and 1.5% not offered money	Not reported for MA use only	<b>Client demands for unsafe sex: the socio-economic risk environment for HIV among street and off-street sex workers</b> More frequent drug use (e.g., use of speedballs, non-injection crystal methamphetamine) was strongly

						<p>MA use less than daily 12.4% Offered money, 11.1% not offered</p> <p>MA use daily 4.2% accepted money and 2.1% not accepted money MA use less than daily 29.6% accepted money, 7.4% not accepted</p>		associated with being offered or accepting more money for sex without a condom.
8. Semple, 2010	USA	CS	6/9	155 HIV-positive MSM	39.4 years SD = 8.2,	MA used at least twice in the past two months	n/a	<p><b>Social and behavioural characteristics of HIV-positive MSM who trade sex for methamphetamine</b></p> <p>Forty-three percent of the sample reported trading sex for methamphetamine in the past 2 months. Trading sex for methamphetamine was associated with being a binge user, homelessness, having an income of less than \$20,000 per year, being less assertive at turning down drugs, engaging in more anal sex without a condom, and seeking out risky sex partners when high on methamphetamine.</p>
9. Semple, 2011	USA	CS	7/9	342 HIV-negative heterosexual	37.4 years (SD = 9.8) female 51.5%	MA used at least twice in the past two months	n/a	<p><b>Correlates of trading sex for methamphetamine in a sample of HIV-negative heterosexual methamphetamine users</b></p> <p>26% overall (21% of males and 31% of females) reported trading sex for methamphetamine in the past two months. Multiple logistic regression analysis revealed that recently trading sex for methamphetamine was independently associated with being female, homeless, bingeing on methamphetamine, sexual victimization in the past two months, engaging in anal sex 24 or more times in the past two months, and higher sexual compulsivity scores.</p>
10. Muñoz, 2010	Mexico	CS	5/9	924 FSWs	Median age was 32 years	21% used MA	n/a	<p><b>Condom Access: Associations with Consistent Condom Use among Female Sex Workers in Two Northern Border Cities of Mexico</b></p> <p>Factors inversely associated with consistent condom use included poor financial status (AdjOR = 0.65; 95% CI: 0.47–0.90), methamphetamine use (AdjOR = 0.58; 95% CI: 0.40–0.83), alcohol use (AdjOR = 0.68; 95% CI: 0.49–0.96), and recent injection drug use (AdjOR = 0.62; 95% CI: 0.39–0.97).</p>

11. Robertson, 2014	Mexico	CS	6/9	Among 212 couples (n=424)	median age 37 (men) vs. 33 years (women)	MA use in the past 6 months 31% Women 33%; Men 29%	Among MA users: 40% HIV+ and 30% HIV- Overall 31%	<b>Prevalence and Correlates of HIV and Sexually Transmitted Infections among Female Sex Workers and Their Non-commercial Male Partners in Two Mexico-USA Border Cities</b> Men who recently used methamphetamine or reported perpetrating any conflict within steady relationships were more likely to test positive for HIV/STIs. among men, those who recently used methamphetamine were ~6% more likely to have HIV/STIs (p<0.05)
12. Goldenberg, 2013	Mexico	CS	6/9	214 FSWs	Median 33 (IQR 26–39)	Ma use in the past 6 months 33.8%	Not reported for MA use only	<b>Individual, interpersonal, and social-structural correlates of involuntary sex exchange among female sex workers in two Mexico-U.S. border cities</b> Involuntary sex exchange: MA users 48.3% No involuntary sex exchange: MA users 31.5% Difference not significant