

**Polydrug use, chemsex drug use, and associations with sexual risk behaviour in HIV negative men who have sex with men attending sexual health clinics.**

**Authors and Affiliations**

Janey Sewell<sup>1</sup>, Ada Miltz<sup>1</sup>, Fiona C Lampe<sup>1</sup>, Valentina Cambiano<sup>1</sup>, Andrew Speakman<sup>1</sup>, Andrew N Phillips<sup>1</sup>, David Stuart<sup>2</sup>, Richard Gilson<sup>1</sup>, David Asboe<sup>2</sup>, Nneka Nwokolo<sup>2</sup>, Amanda Clarke<sup>3</sup>, Simon Collins<sup>4</sup>, Graham Hart<sup>1</sup>, Jonathan Elford<sup>5</sup>, Alison J Rodger<sup>1</sup>, for the Attitudes to and Understanding of Risk of Acquisition of HIV (AURAH) study group.

1 Research Department of Infection & Population Health, UCL, London, United Kingdom

2 Chelsea and Westminster Hospital NHS Foundation Trust, London, United Kingdom

3 Brighton and Sussex University Hospitals NHS Trust, Brighton, United Kingdom

4 HIV i-Base, London, United Kingdom

5 City University London, London, United Kingdom

**Corresponding author**

Alison Rodger, UCL Department of Infection and Population Health, Royal Free Campus, London, NW3 2PF. Email: Alison.rodger@ucl.ac.uk

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## **Abstract**

**Background:** Recreational drug use and associated harms continue to be of significant concern in men who have sex with men (MSM particularly in the context of HIV and STI transmission).

**Methods:** Data from 1484 HIV-negative MSM included in the AURAH study, a cross-sectional, self-completed questionnaire study of 2630 individuals from 20 sexual health clinics in the United Kingdom in 2013-2014, was analysed. Two measures of recreational drug use in the previous three months were defined; (i) polydrug use (use of 3 or more recreational drugs) and (ii) chemsex drug use (use of mephedrone, crystal methamphetamine or GHB/GBL). Associations of socio-demographic, health and lifestyle factors with drug use, and associations of drug use with sexual behaviour, were investigated.

**Results:** Of the 1484 MSM, 350 (23.6%) reported polydrug use and 324 (21.8%) reported chemsex drug use in the past three months. Overall 852 (57.5%) men reported condomless sex in the past three months; 430 (29.0%) had CLS with  $\geq 2$  partners, 474 (31.9%) had CLS with unknown/HIV+ partner(s); 187 (12.6%) had receptive CLS with an unknown status partner. For polydrug use, prevalence ratios (95% confidence interval) for association with CLS measures, adjusted for socio-demographic factors were: 1.38 (1.26, 1.51) for any CLS; 2.11 (1.80, 2.47) for CLS with  $\geq 2$  partners; 1.89 (1.63, 2.19) for CLS with unknown/HIV+ partner(s); 1.36 (1.00, 1.83) for receptive CLS with an unknown status partner. Corresponding adjusted prevalence ratios for chemsex drug use were: 1.38 (1.26, 1.52); 2.07 (1.76, 2.43); 1.88 (1.62, 2.19); 1.49 (1.10, 2.02). Polydrug and chemsex drug use were also strongly associated with previous STI, PEP use, group sex and high number of new sexual partners. Associations remained with little attenuation after further adjustment for depressive symptoms and alcohol intake.

**Conclusion:** There was a high prevalence of polydrug use and chemsex drug use among HIV negative MSM attending UK sexual health clinics. Drug use was strongly associated with sexual behaviours linked to risk of acquisition of STIs and HIV.

## Introduction

Gay, bisexual, and other men who have sex with men (MSM) continue to be one of the highest risk groups for HIV in the UK and globally (Beyrer, 2012; Sullivan, 2012; Beyrer, 2012), and experience a significant burden of ill health and harm through the use of alcohol, recreational drugs and tobacco (PHE, 2015). Recreational drug use in MSM and the associations with sexual-risk behaviour has been documented on an international level (Heiligenberg, 2012; Prestage, 2009, Pappas, 2011, Santos, 2013; Colfax, 2006; De Ryck, 2013; Drumright, 2007; McCarty-Caplan, 2014) and is an important public health consideration in Western Europe (EMIS, 2010), particularly the UK (Kirby, 2013; Hickson, 2010; Hunter, 2014; Daskalopoulou, 2014; Bolding, 2006; Home Office, 2013/14), where transmission of HIV and other sexually transmitted infections (STIs), remain high (Public Health England, 2014a). A 2014 report described the use of psychoactive drugs in sexual settings among MSM in London (Bourne, 2014). This has been termed 'chemsex' which relates to the use of certain sexually-disinhibiting recreational drugs used before or during sex with the specific purpose of facilitating or enhancing sex; namely any combination of crystal methamphetamine, mephedrone and gammahydroxybutyrate / gammabutyrolactone (GHB/GBL) (Bourne, 2014; McCall, 2015; Bourne (a), 2015, Melendez-Torres GJ (a), 2016). By definition, chemsex differs from generic illicit/recreational drug use (Bourne, 2014); it is thought to be associated with higher-risk sexual activity, and linked to an increase in transmission of STIs (Stuart, 2015, Melendez-Torres GJ (b), 2016).

Changing trends in the popularity of certain recreational drugs and combinations of poly drug use in MSM have been reported (Daskalopoulou, 2014, Stuart, 2013, Melendez-Torres GJ (a), 2016) and there is evidence that specific drugs, are associated with facilitation of HIV (Macdonald, 2007; Plankey, 2007; Buchacz, 2005) and STI (Hirshfield, 2004) transmission, increased sexual risk behaviour (Hoenigl, 2016; Mansergh, 2006), or serious overdose and death (Caldicott, 2004; Liechti, 2004, ). However, there is less information relating specifically to HIV negative or undiagnosed MSM and recreational drug use in the UK,

particularly around chemsex drug use (Public Health England, 2014a) and the associations with sexual behaviours which are linked to risk of acquiring HIV or other STIs. Information on prevalence of recreational drug use and potential associations with sexual risk behaviour is essential if targeted sexual health and HIV prevention policies are to be developed and delivered effectively to those that may benefit from them most.

The aim of this study was to use data from a cross-sectional multi-centre study among HIV negative MSM attending UK GUM clinics, to assess prevalence and factors associated with polydrug use and chemsex drug use, and to explore the associations of drug use with sexual behaviour, in particular condomless sex.

## **Methods**

AURAH (Attitudes to and Understanding of Risk of Acquisition of HIV) is a cross-sectional, clinic-based study that recruited HIV negative or undiagnosed participants from 20 GUM clinics across England between June 2013 and November 2014. Methodological details have been published elsewhere (Sewell, 2016). Participants completed a self-administered paper questionnaire that included items on demographics (gender, sexual orientation, age, ethnicity, UK birth, relationship status), socio-economic factors (education, employment, housing, money for basic needs), health and lifestyle factors (alcohol use, ascertained by a modified version of the WHO (AUDIT) questionnaire (Babor et al 2001), symptoms of depression ascertained using the Patient Health Questionnaire (PHQ-9) (Kroenke et al 2001), symptoms of anxiety ascertained using the GAD-7 (Spitzer et al 2006), ), as well as recent sexual behaviour, and recent recreational drug use).

Men were classified as MSM if they met at least one of the following criteria: (i) reported being gay, bisexual or reported an identity that is not explicitly based on attraction to one sex/gender (Galupo, 2016) (ii) reported anal sex with a man in the past three months, or (iii)

reported having disclosed to their family, friends or workmates as being gay, bisexual and/or attracted to men.

#### *Ascertainment of recreational drug use*

All participants were asked to report whether they had used recreational drugs in the past three months and, if so, to select which drug or drugs from the following list of 18 options: acid, lysergic acid diethylamide (LSD), or magic mushrooms (all grouped as psychedelics); anabolic steroids; cannabis (marijuana, grass); cocaine (coke); crack; codeine; crystal meth (methamphetamine); ecstasy (MDMA or E); GHB (GBL or liquid ecstasy); heroin, ketamine (k); khat (chat); mephedrone; morphine; opium; poppers (amyl nitrites); speed (amphetamine); erectile dysfunction drugs (Viagra); and other (whereby participants were asked to specify the drug). Other drugs specified were coded to the above categories where appropriate (in most cases, participants specified one of the drug options under a different or street name). Participants were also asked whether they had injected recreational drugs in the past three months.

#### *Recreational drug use definition*

Two measures of recreational drug-use were defined: (i) poly drug use: use of three or more recreational drugs (from the above list of 18) in the past three months and (ii) chemsex drug use: use of one or more of mephedrone, methamphetamine or GHB/GBL in the past three months. It should be noted that the questionnaire did not ask about drug use during sex specifically.

#### *Sexual behaviour questions*

Eight self-reported sexual behaviour measures were derived from the questionnaire. Sex was defined throughout as anal sex with men, or vaginal or anal sex with women. Four measures of condomless (anal or vaginal) sex (CLS) in the past three months were defined: (i) any CLS (ii) CLS with two or more partners, (iii) CLS with partners of an unknown or HIV

positive status (men who reported only one CLS partner who was HIV positive and with whom they 'thought the risks were low because their partner was taking ART', were not counted as fulfilling this criterion), and (iv) receptive CLS with an unknown status partner. The following additional measures were also investigated: (v) self-reported diagnosis with a bacterial STI in the past year (Gonorrhoea, Chlamydia, Syphilis, and/or Lymphogranuloma venereum, LGV) and (vi) post-exposure prophylaxis (PEP) use in the past year. Finally, two measures of partner numbers were investigated: (vii) report of eleven or more new sexual partners in the past year and (viii) group sex in the past three months. It is reported in Genitourinary Medicine Clinic Activity Dataset (GUMCAD) data that having a bacterial STI and use of PEP in the previous year are associated with increased risk of HIV acquisition in MSM (GUMCAD 2012).

### *Statistical Analysis*

To examine the associations of specific socio-demographic factors, health and lifestyle factors, with (i) poly drug use and (ii) chemsex drug use, we conducted univariable analyses using Pearson  $\chi^2$  tests and  $\chi^2$  tests for trend and multivariable analysis using modified Poisson regression with robust error variances to produce adjusted prevalence ratios (PRs) (Zou, 2004) . In adjusted models, each factor was considered in a separate model and adjusted for age (as a continuous variables), ethnicity (white or non-white), education (university degree level education or not), sexual identity (gay or bisexual/other) relationship status (ongoing relationship or not) and study clinic region (London, South, or Midlands/Yorkshire and the Humber). The associations between the two measures of drug use and the eight sexual behaviour measures were assessed (i) unadjusted (ii) adjusted for age, ethnicity, education, sexual identity, relationship status and study region, and (iii) adjusted for the previous factors and depressive symptoms (reporting a score of 10 or greater on PHQ-9) and higher risk alcohol use (score of  $\geq 6$  on the first two questions of the WHO AUDIT-C questionnaire). Chi-squared tests were used to assess univariable

associations and modified Poisson regression analysis was used to produce unadjusted and adjusted prevalence ratios.

An additional analysis of the association of drug use measures with sexual behaviour was conducted among a restricted sample of MSM who reported anal and/or vaginal sex in the past three months, in order to specifically compare those having condom protected sex to those having CLS, when investigating recent measures of recreational drug use.

## **Results**

### *Sample characteristics*

In total, 2630 individuals participated in the AURAH Study; the response rate was 60%. Of the 1954 male participants, 1484 were defined as MSM. Table 1 shows participants characteristics. The majority of MSM were of white ethnicity (n= 1196, 81.6%), 1313 (88.8%) self-identified as gay, 141 (9.5%) as bisexual and 25 (1.7%) as other . The median age was 31.5 years. Overall, 1112 (74.9%) participants attended a clinic in London, 276 (18.6%) attended a clinic in the South and 96 (6.5%) attended a clinic in the Midlands/the North of England. The majority of men reported having enough money to cover basic needs (n=1062 (71.8%)), two thirds were educated to university degree level (n=990, 66.7%) and there was a high rate of employment (1182 (79.6%)) (Table 2).

### *Prevalence of recreational drug use*

Of the 1484 included MSM, 812 (55.7%) reported use of one or more recreational drug(s) in the past three months. Overall, 300 (20.2%) men reported use of one drug, 162 (10.9%) reported use of two drugs, 93 (6.3%) reported use of three drugs, 64 (4.3%) reported use of four drugs and 193 (13.0%) reported use of five or more drugs in the past three months.



Overall, 350 (23.6%) men reported poly drug use and 324 (21.8%) men reported use of at least one chemsex drug. Only 34 (2%) men reported injecting recreational drugs in the past three months.

Overall, the most commonly reported drug used was nitrites (32.9%) (Figure 1). This was followed by cannabis (21.0%), cocaine (19.4%), mephedrone (19.1%), erectile dysfunction drugs (17.1%), MDMA (13.0%), GHB/GBL (12.0%), ketamine (8.4%) and methamphetamine (6.4%). The other drugs had a prevalence of use of <5%.

### *Correlates of recreational drug use*

Table 1 shows the association of socio-demographic, health and lifestyle factors with the two measures of recreational drug use, in the past three months.

In univariable analysis, younger age, non-university education, non-home ownership, not being in an ongoing relationship, attending a clinic in London or the South, higher risk drinking, and depressive symptoms were associated with poly drug use in the past three months. The prevalence of poly drug use also appeared to be higher among men of white ethnicity, although the association was of borderline statistical significance. After adjusting for socio-demographic factors (age, ethnicity, sexual identity, education, relationship status and study clinic region), with the exception of non-home ownership, these associations with polydrug use remained. There was also evidence of an association between financial hardship and poly drug use after adjustment for socio-demographic factors.

A similar pattern was observed for chemsex drug use, whereby, younger age, non-university education, not being in an ongoing relationship, attending a clinic in London or the South, financial hardship, higher risk drinking and depressive symptoms were found to be associated with use of chemsex drugs, including after adjustment for socio-demographic factors. Additionally, men who identified as gay were more likely to report chemsex drug use in unadjusted and adjusted analysis compared to those who identified as bisexual or other.

### *Prevalence of sexual behaviour measures*

Of the 1484 MSM, over half reported having CLS within the past three months (n=853; 57.5%), of these men, 91.7% had CLS with men only, 3.9% had CLS with both men and women, and 4.5% had CLS with women only (Table 1). Of the 33 men who reported CLS with both men and women, 18.2% (n=6) reported anal CLS with a woman at least once, and of the 38 men who reported CLS with women only, 31.6% (n=12) reported anal CLS at least once. Furthermore, 29.0% (n=430) of men reported CLS with  $\geq 2$  partners in the past three months, 31.9% (n=474) of men reported CLS with unknown/HIV positive status partners (excluding men who reported one HIV positive long-term CLS partner with whom they thought the risks were low because their partner was taking ART), 12.6% (n=187) of men reported receptive CLS with an unknown status partner, 34.1% (n=506) of men reported eleven or more new sexual partners in the past year and 35.5% (n=527) reported group sex in the past three months. Overall 441 MSM (29.7%) self-reported a bacterial STI diagnosis in the past year. The most common bacterial STI reported was gonorrhoea (21.8%, n=323) followed by chlamydia (14.0%, n=208). Fourteen percent (n=212) of all MSM had reported using post-exposure prophylaxis (PEP) within the previous year. Participants were also asked whether they had ever taken PrEP and 4.5% reported that they had.

### *Relationship between recreational drug use and sexual behaviour*

Comparing men who reported poly drug use in the past three months with men who did not, there was a significantly higher prevalence in the past three months of; any CLS (71.4% vs. 53.2%), CLS with two or more partners (47.4% vs. 23.3%), CLS with unknown/HIV positive status partner(s) (49.7% vs. 26.5%), receptive CLS with an unknown status partner (16.0% vs. 11.6%), bacterial STI diagnosis (47.4% vs. 24.3%), PEP use (24.0% vs. 11.3%), report of eleven or more new sexual partners (56.3% vs. 27.3%) and group sex (66.0% vs.

26.1%); all  $\chi^2$  p values <0.001 (with the exception of receptive CLS with an unknown status partner;  $\chi^2$  p=0.028).

The results were similar for chemsex use. Compared to men who did not use chemsex drugs, those who did had a higher prevalence of; any CLS (80.0% vs. 53.7%), CLS with two or more partners (47.5% vs. 23.8%), CLS with unknown/HIV positive status partner(s) (50.0% vs. 26.9%), receptive CLS with an unknown status partner (17.0% vs. 11.4%), bacterial STI diagnosis (53.4% vs. 23.1%), PEP use (29.0% vs. 10.2%), report of eleven or more new sexual partners (57.7% vs. 27.5%) and group sex (69.8% vs. 26.0%); all p values <0.001 (with the exception of receptive CLS with an unknown status partner; p=0.007).

Figures 2A, and 2B show the strong associations found between poly drug and chemsex drug use respectively, with the sexual behaviour outcomes. The prevalence ratios are shown as (i) unadjusted, (ii) adjusted for socio-demographic factors (age, ethnicity, education, sexual identity, relationship status, and study region) and (iii) adjusted for socio-demographic factors plus higher risk drinking and depressive symptoms. Poly drug use remained strongly associated with the sexual behaviour measures after adjustment for socio-demographic factors (any CLS [Prevalence Ratio 1.38 95% CI: 1.26, 1.51], CLS with  $\geq 2$  partners [PR 2.11 95% CI: 1.80, 2.47] CLS with unknown/HIV+ partner(s) [PR 1.89 95% CI: 1.63, 2.19], receptive CLS with an unknown status partner [PR 1.36 95% CI: 1.00, 1.83], STI diagnosis [PR 1.85 95% CI: 1.58, 2.16], PEP use [PR 2.06 95% CI: 1.59, 2.67],  $\geq 11$  new sex partners [PR 1.99 95% CI: 1.74, 2.28], and group sex [PR 2.59 95% CI: 2.29, 2.94]). After adjusting additionally for higher risk drinking and depressive symptoms, most associations were slightly attenuated but remained significant.

Similarly, chemsex drug use remained strongly associated with the sexual behaviour measures after adjustment for socio-demographic factors (any CLS [Prevalence Ratio 1.38 95% CI: 1.26, 1.52], CLS with  $\geq 2$  partners [PR 2.07 95% CI: 1.76, 2.43] CLS with unknown/HIV+ partner(s) [PR 1.88 95% CI: 1.62, 2.19], receptive CLS with an unknown

status partner [PR 1.49 95% CI: 1.10, 2.02], STI diagnosis [PR 2.22 95% CI: 1.91, 2.58], PEP use [PR 2.78 95% CI: 2.16, 3.58],  $\geq 11$  new sex partners [PR 1.94 95% CI: 1.69, 2.22], and group sex [PR 2.73 95% CI: 2.41, 3.09]). Again, adjusting additionally for higher risk drinking and depressive symptoms, most associations were slightly attenuated but remained significant.

The associations of polydrug use and chemsex drug use with the sexual behaviour measures remained strong for most of the sexual behaviour measures in the subgroup of 1340 MSM who had anal or vaginal sex in the past three months, as shown in Table 3,

## **Discussion**

Our results demonstrate that over half (55.7%) of the HIV negative MSM attending sexual health services during the study period (2013-14) had reported use of one or more recreational drugs in the past three months. Nearly a quarter (23.6%) of these men reported use of three or more drugs, and over a fifth (21.8%) reported use of at least one chemsex drug (though use of chemsex drugs does not necessarily equate to engaging in chemsex). There was a striking association between the two measures of recreational drug use and measures of CLS, these associations were only slightly attenuated when adjusted for socio-demographic factors (age, ethnicity, education, sexual identity, relationship status, study region), and most remained after additional adjustment for alcohol use and symptoms of depression.

The prevalence of recreational drug use in our clinic-based study is higher than that found by the third National Survey of Sexual Attitudes and Lifestyles (NATSAL-3) which included a small sample of MSM recruited from a general population study (n=190) (Mercer et al 2016), and demonstrated that 36% of all MSM had reported any recreational drug use in the past year. Our estimated prevalence of recreational drug use is also higher than that reported by the Crime Survey for England and Wales (CSEW) 2013/2014 (Home Office, 2013/14) which

demonstrated that gay or bisexual men were the group most likely to have taken any illicit drug in the past year (33.0%). Differences in sampling frame (recruited through STI clinics) and the younger average age of the AURAH participants may account for the higher prevalence of recreational drug use in the AURAH study.

In AURAH, the most commonly used recreational drug was nitrites (since made illegal by the Psychoactive Substance Act 2016 (Santos, 2014)), which have been shown to be associated with increased risk of HIV transmission (Romanelli et al 2004). Overall 32.9% of MSM reported use of nitrites within the past three months. This is similar to the UK prevalence of nitrite use in the past month (29%) found in the European MSM Internet Sex Survey (EMIS), a European-wide (38 countries) volunteer online sample of MSM in 2010, in which the UK had the second highest prevalence of nitrite use (the overall prevalence was 19% and 28.3% in the Western Europe sub-region) (EMIS, 2010). EMIS also presented the prevalence of other drug composites in the past month, in the Western Europe sub-region (Belgium, France, Netherlands, United Kingdom, and Republic of Ireland) these included; cannabis or LSD at 13.8%, heroin or crack at 0.4% and 'party drugs' (MDMA, amphetamines, methamphetamine, mephedrone, GHB/GBL, ketamine or cocaine) at 10.6% (17% in the UK) (EMIS, 2010). For the equivalent composite measures in AURAH, the prevalence was the same at 0.4% for heroin or crack use in the past three months and higher at 33.1% for 'party drug' use in the past three months. The higher prevalence for the latter measure may not be surprising given the differences in recall periods of drug use between the studies. In the AURAH study, men were asked about LSD use as part of a group of other psychedelic drugs, prohibiting comparison with the cannabis/LSD measure investigated in EMIS.

The Gay Men's Sex Survey (GMSS) is an annual community-based survey for MSM that (since 2003) collects data from volunteer convenience samples of men using gay community and commercial websites (as well as snowball sampling). The most recent survey was carried out from July-October 2014 in England (N=15360). HIV diagnosed individuals were

included in the sample (9%). Data was collected on recreational drug use; in the past six months, 34.6% of all men reported using nitrites, 19.0% erectile dysfunction drugs, 19.9% cannabis, 11.5% MDMA, 3.8% amphetamine, 3.8% methamphetamine, 0.3% heroin, 4.6% ketamine, 1.1% psychedelics, 12.7% cocaine, 0.7% crack cocaine, 8.5% mephedrone, and 5.2% GHB/GBL. Although the recall period for drug use in AURAH (past three months) was half that of the GMSS 2014, the prevalence of reported use of methamphetamine (6.4%), ketamine (8.4%), cocaine (19.4%), mephedrone (19.1%), and GHB/GBL (12.0%) was higher. For all other drugs, the prevalence was similar or slightly lower in the AURAH study. Again, this may be affected by age differences between the two studies (although the median ages were similar and the GMSS 2014 included men aged 16 years or older instead of 18 years or older in AURAH), the inclusion of men with diagnosed HIV (although a small proportion of the sample were positive), or more likely the fact that AURAH was a sample of GUM clinic service users, who may report different patterns of behaviour to men recruited online (Hickson et al 2016).

In the current study, younger age, markers of lower socio-economic status (non-university degree education and financial insecurity), not being in an ongoing relationship, attending a study clinic in London, higher risk drinking and report of depressive symptoms, were found to be associated with poly drug use and chemsex drug use. There is little information from quantitative studies on factors associated with recreational drug use among HIV negative MSM in the UK. In GMSS 2014, living in London and having diagnosed HIV were found to be associated with chemsex drug use (methamphetamine, mephedrone and/or GHB/GBL - men were not asked whether drug use occurred before or during sex). Europe-wide data from EMIS found that younger age was associated with use of 'party drugs' in the past month (adjusted for factors including recruitment online site, education, settlement size, HIV status, outness, European sub-region, gay community/commercial venue attendance and CLS with a man) (EMIS, 2010). In AURAH, men who identified as gay were more likely to report chemsex drug use than men who did not, and this is in line with the findings described

in UK qualitative work on chemsex drug use (Bourne et al 2014; Bourne et al 2015a; Bourne et al 2015b).

In general, it has been suggested that MSM's use of recreational drugs is potentially part of coping with minority and other stressors (Meyer 1995; Meyer et al 2013). Worry, stigma and victimization associated with a sexual minority status (as described in minority stress theory) may lead to high levels of psychological distress (including depression, anxiety and PTSD). The 'gay scene' (including clubs, bars, pubs, saunas etc.) can represent a culturally endorsed 'time-out' from stresses common to the gay community (and other sexual minority men). Drug use often plays a key role in escaping self-awareness of social and sexual norms. For many men, the 'scene' is an important social nexus (Caudill & Marlatt 1975; Crowe & George 1989; McKirnan et al 1996; Meyer et al 2013) where gay sexuality is sanctioned and celebrated (Caudill & Marlatt 1975; Crowe and George 1989).

The transmission of STIs and HIV are facilitated by, or in the case of HIV largely due to CLS. A modelling study suggested that for HIV, the majority of transmissions are due to CLS with a casual, rather than long-term, partner (Phillips, 2015). One UK study, the SALLEE study in 2009 (online sample of 616 MSM), has presented an adjusted OR (controlling for socio-demographic factors; age, education, nationality, language of questionnaire, time spent in UK, living in London and recruitment site, health and lifestyle factors; HIV status and injection drug use, and sexual behaviour measures; having been paid for sex in the UK) for the association between any recreational drug use in the past year and sexual risk behaviour. Men who reported drug use were found to be more likely to report CLS with a casual partner in the past year (AOR 2.07 95% CI: 1.40, 3.06;  $p < 0.001$ ), than men who did not. This study was restricted to MSM who self-identified as migrants from one of the ten Central and Eastern European Countries (Evans et al 2011).

Of note, chemsex is a newly emerging and fast developing phenomenon in the UK. Qualitative work (2013-2014) among a volunteer sample of MSM (promotion via a gay social

networking app, and a London gay 'scene' publication, and referral from gay/bisexual charities) suggests that serosorting practices are common among HIV positive men who engage in chemsex (i.e. seeking CLS with partners of the same, HIV positive status, to themselves). At the same time, it suggests that a number of men whose last HIV test was negative had unintentional CLS as a direct result of 'chem' use (Bonell et al 2010; Bourne et al 2015; Bourne et al 2015).

There is also evidence to suggest that the HIV transmission risk associated with CLS may be enhanced by substance use (Hirshfield, 2015; Purcell, 2005; Colfax, 2004; Melendez-Torres (b) 2016,) that is considered syndemic among MSM (Melendez-Torres (a), 2016; Santos, 2014). There is evidence that some specific drugs may facilitate the biological mechanism of HIV transmission, these may include nitrites (Hirshfield, 2005), amphetamines (Hoenigl, 2016) and certain combinations of drugs (Drumright, 2006; Ostrow, 2009).

Recreational drug use may also impact on other aspects of physical and psychological health and wellbeing. The use of chemsex drugs such as GHB/GBL alone and in combination with other drugs such as mephedrone pose a risk of serious overdose (Galicia, 2011) and death (Aromatario, 2012), and studies have increasingly reported on the harmful effects of psychoactive substances in highly sexual circumstances (Bourne (b) 2015, Melendez-Torres GJ (b) 2016) However, in discussing the risk associated with recreational drug use, it is important to emphasise that some individuals may perceive positive benefits from drug (and alcohol) use, whether or not they experience any negative consequences. We did not ask in this study about individuals' perceptions or experiences of drug use, whether positive or negative, though this has been explored in other studies (Weatherburn P, 2016; Bourne A (a) 2015). It is important that sexual health services recognise the motivations for gay men engaging in chemsex, often described as facilitating sexual self-confidence or self-esteem, as well as discussing the potential harms of drug use.

Recent advances in HIV prevention, including results from the PROUD (McCormack, 2016) and IPERGAY (Molina, 2015) studies, which both demonstrated the highly protective effect



(86%) of pre-exposure prophylaxis (PrEP) for HIV negative MSM, are highly relevant to MSM who report recreational drug use. As previous research has demonstrated that drug use among MSM is generally episodic rather than continuous (McCarty-Caplan, 2014) and, given the strong association between measures of recreational drug use and increased sexual risk behaviour among HIV negative MSM demonstrated in the AURAH study, identification of MSM using particular drugs associated with chemsex could help to identify those that are most likely to benefit from access to PrEP.

### *Strengths and limitations*

AURAH is the largest published study of recreational drug use among HIV negative or undiagnosed MSM attending sexual health clinics in the UK. A limitation of the study is that the reporting of use of chemsex drugs does not necessarily equate to engagement in chemsex; for example mephedrone use may be associated with clubbing or other social activity. In addition, AURAH did not collect information on personality traits associated with sensation seeking and compulsivity, factors that have been found to be associated with recreational drug use (Singer & Clair 2003; Singer et al 2006; Jie et al 2012; Parsons et al 2012). Furthermore, although potential causal mechanisms between certain drugs and associations with HIV/STIs have been identified (Drumright, 2006), causality cannot be determined in this cross-sectional study and it is recognised that both recreational drug use and sexual risk behaviour may be part of pre-disposition to risk (Drumright, 2006). Whatever the direction of association, exposure to HIV and STIs remains a serious risk among HIV negative MSM who use recreational drugs, and there is a need for further longitudinal and qualitative studies to allow us to develop better understandings of the motivations for recreational drug use among HIV negative MSM, and the link with sexual behaviour.

### *Conclusions*

The high prevalence of poly drug, and chemsex drug use reported by HIV negative MSM in the AURAH study points to a clear need for cross-agency collaboration to provide non-judgemental, tailored services that are accessible to HIV negative MSM through sexual health services. Active identification of MSM at increased risk of HIV acquisition who would benefit from potential HIV prevention interventions is vital, and consideration should be given to all MSM that report recreational drug use, and particularly those that report use of multiple or chemsex drugs. Among MSM, particularly in London, engagement with sexual health services is generally high (Bourne, 2014), which places these services in an opportune position to offer education, screening and interventions for different types of drug use. In addition, identification of recreational drug use within the sexual health setting may also highlight the need for opportune assessment by psychology or mental health teams that may be of benefit to individuals. Greater consideration should be given to the impact of recreational drug use on HIV and STI prevention strategies and allocation of funding and research to allow existing services to integrate harm reduction strategies into patient care.

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### **Ethics approval and participant consent**

The study received ethics approval from: NRES committee London-Hampstead, ref: 13/LO/0246 in April 2014. Based on these documents, the study subsequently received permission for clinical research at all participating National Health Service sites. All participants provided written, informed consent before taking part.

### **Author contributions**

Design and data collection: JS, AS, AP, FL, RG, DA, NN, AC, SC, GH, JE, AR.

Analysis and interpretation: JS, AM, FL, VC, DS, AS, AP, AR.

Drafting the manuscript: JS, AM, FL, VC, AS, AP, DS, RG, DA, NN, AC, SC, GH, JE, AR.

### **Declaration of competing interests**

All authors have completed the Unified Competing Interest form and declare that they have no relationships with companies that might have an interest in the submitted work in the previous 3 years; their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and have no non-financial interests that may be relevant to the submitted work.

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### **Data access**

All authors had full access to all of the data (including statistical reports and tables) in the study and are responsible for the integrity of the data and the accuracy of the data analysis.

### **AURAH teams**

The AURAH study group: Janey Sewell, Ada R Miltz, Alison J Rodger, Andrew Speakman, Andrew N Phillips, Lorraine Sherr, Richard J Gilson, David Asboe, Nneka C Nwokolo, Amanda Clarke, Mark M Gompels, Sris Allan, Simon Collins, Fiona C Lampe, Christopher Scott, Sara Day, Martin Fisher, Jane Anderson, Rebecca O'Connell, Monica Lascar, Vanessa Apea, Paymaneh Farazmand, Susan Mann, Jyoti Dhar, Daniel R Ivens, Tariq Sadiq, Graham J Hart, Anne M Johnson, Alec Miners, and Jonathan Elford.

**AURAH clinic teams:** Sharmin Obeyesekera (Barking), John Saunders (Barts), Gerry Gilleran, Cathy Stretton (Birmingham), Nicky Perry, Elaney Youssef, Celia Richardson, Louise Kerr, Mark Roche, David Stacey, Sarah Kirk (Brighton), Louise Jennings, Caroline Holder, Katie-Anne Baker (Bristol), Matthew Robinson, Emma Street (Calderdale & H'field), Abayomi Shomoye (Coventry), Ali Ogilvy (Dean Street), Sfiso Mguni, Rebecca Clark, Cynthia Sajani, Veronica Espa (Homerton), Ali Ogilvy, Sarah Ladd (John Hunter), Jonathan Syred, Lisa Hamza, Lucy Campbell, Emily Wandolo, Janagan Alagarajah (Kings), Linda Mashonganyika, Sally Batham (Leicester), Rita Trombin, Ana Milinkovic, Clare Oakland (Mortimer Market), Nyasha Makoka (Newham), Ruth Wilson, Elizabeth Green, Sheila O'Connor, Sarah Kempster, Katie Keating-Fedders (Reading), Nicola Tyrrell, Jemima Rogers, Silvia Belmondo, Manjit Sohal (Royal Free), Wendy Majewska, Anne Patterson, Olanike Okolo, David Cox, Mariam Tarik, Charlotte Jackson, Jeanette Honigsbaum, Clare Boggon, Simone Ghosh, Bernard Kelly, Renee Aroney (St George's), James Hand, Nyasha

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**AURAH advisory board:** Sir Nick Partridge, Kay Orton, Anthony Nardone, Ann Sullivan, Lorraine Sherr, Graham Hart, Simon Collins, Anne Johnson, Alec Miners and Jonathan Elford.

**AURAH (core) Study Group:** Alison Rodger, Fiona Lampe, Andrew Phillips and Andrew Speakman

**AURAH data managers:** Andrew Speakman and Ada Miltz

**AURAH Study Nurse Coordinator:** Janey Sewell

**Table 1: Unadjusted and adjusted associations of socio-demographic and lifestyle factors with measures of recreational drug use (past 3 months)**

N=1484 MSM			Poly drug use (use of 3 or more recreational drugs)		Use of least one 'chemsex' associated drug (crystal meth/meph or GHB/GBL)	
		N (%)	% <i>p value</i> †	Adjusted PR** [95% CI] <i>Overall p value</i>	% <i>p value</i> †	Adjusted PR** [95% CI] <i>Overall p value</i>
Age in years	<25 25-29 30-34 35-39 40-44 45+	254 (17.4%) 372 (25.4%) 277 (18.9%) 193 (13.2%) 143 (9.8%) 225 (15.4%)	25.6% 20.7% 29.6% 27.5% 21.0% 17.3% <i>0.011</i> <i>0.126*</i>	1 1.49 [1.04, 2.13] 1.21 [0.85, 1.72] 1.77 [1.26, 2.49] 1.71 [1.18, 2.47] 1.32 [0.86, 2.01] 1 <i>0.005</i> <i>0.166*</i>	20.9% 18.8% 28.9% 25.9% 21.7% 16.0% <i>0.005</i> <i>0.550*</i>	1 1.29 [0.88, 1.90] 1.15 [0.80, 1.66] 1.80 [1.27, 2.55] 1.67 [1.14, 2.45] 1.44 [0.94, 2.19] 1 <i>0.003</i> <i>0.753</i>
Born in the UK and white ethnicity	Yes, white Yes, non-white No, white No, non-white	759 (51.8%) 97 (6.6%) 437 (29.8%) 172 (11.7%)	24.9% 16.5% 24.9% 17.4% <i>0.058</i>	1 0.60 [0.37, 0.97] 0.96 [0.78, 1.17] 0.70 [0.49, 1.00] <i>0.062</i>	22.0% 14.4% 23.8% 19.2% <i>0.185</i>	1 0.67 [0.40, 1.14] 1.01 [0.82, 1.26] 0.91 [0.65, 1.27] <i>0.464</i>
Sexual identity	Gay Bisexual*** Other****	1313 (88.8%) 141 (9.5%) 25 (1.7%)	24.1% 19.9% 12.0% <i>0.204</i>	1 0.90 [0.64, 1.27] 0.59 [0.20, 1.73] <i>0.540</i>	23.2% 12.1% 4.0% <i>0.001</i>	1 0.56 [0.35, 0.88] 0.20 [0.03, 1.48] <i>0.013</i>
Money to cover basic needs	All the time Most of the time Sometimes/never	1062 (71.8%) 311 (21.0%) 107 (7.2%)	23.5% 22.2% 29.9% <i>0.258</i> <i>0.376*</i>	1 0.92 [0.72, 1.16] 1.38 [1.02, 1.87] <i>0.057</i> <i>0.287*</i>	21.6% 19.9% 30.8% <i>0.056</i> <i>0.179*</i>	1 0.95 [0.74, 1.22] 1.71 [1.27, 2.30] <i>0.001</i> <i>0.027*</i>
University education	Yes No	990 (66.7%) 494 (33.3%)	21.5% 27.7% <i>0.008</i>	1 1.39 [1.15, 1.67] <i>0.001</i>	20.5% 24.5% <i>0.080</i>	1 1.34 [1.10, 1.63] <i>0.004</i>
Employment (full or part time)	Yes No	1182 (79.6%) 302 (20.4%)	23.4% 24.5% <i>0.674</i>	1 1.07 [0.85, 1.34] <i>0.590</i>	21.8% 21.9% <i>0.992</i>	1 1.04 [0.82, 1.33] <i>0.742</i>

**Table 1: Unadjusted and adjusted associations of socio-demographic and lifestyle factors with measures of recreational drug use (past 3 months) (continued)**

Housing situation ‡	Home owner	421 (28.8%)	19.0%	1	18.3%	1
	Renting	832 (56.9%)	25.6%	1.16 [0.90, 1.50]	23.4%	1.16 [0.89, 1.50]
	Unstable/	210 (14.4%)	24.3%	1.15 [0.81, 1.62]	22.4%	1.20 [0.84, 1.72]
	Other		0.033	0.517	0.111	0.502
			0.047*	0.390*	0.114*	0.284*
Ongoing relationship with a partner	Yes	640 (43.1%)	18.6%	1	15.9%	1
	No	844 (56.9%)	27.4%	1.35 [1.11, 1.65]	26.3%	1.53 [1.24, 1.89]
			<0.001	0.003	<0.001	<0.001
Study region	London	1112 (74.9%)	24.6%	1	23.4%	1
	South	276 (18.6%)	23.9%	0.90 [0.71, 1.14]	21.0%	0.83 [0.64, 1.08]
	Midlands & the North	96 (6.5%)	11.5%	0.42 [0.24, 0.73]	6.3%	0.25 [0.12, 0.55]
			0.015	0.008	<0.001	0.001
Higher risk drinking <sup>¶</sup>	Yes	288 (19.4%)	36.1%	1.65 [1.37, 2.00]	31.9%	1.58 [1.29, 1.93]
	No	1196 (80.6%)	20.6%	1	19.4%	1
			<0.001	<0.001	<0.001	<0.001
Current symptoms of depression (PHQ-9≥10)	Yes	185 (12.5%)	33.0%	1.46 [1.15, 1.85]	29.2%	1.45 [1.13, 1.87]
	No	1299 (87.5%)	22.3%	1	20.8%	1
			0.001	0.002	0.010	0.004
Current symptoms of anxiety (GAD-7≥10)	Yes	158 (10.7%)	26.6%	1.14 [0.86, 1.52]	22.0%	0.99 [0.71, 1.38]
	No	1326 (89.4%)	23.2%	1	20.9%	1
			0.348	0.357	0.761	0.960

‡ $\chi^2$  test

\*Test for trend.

\*\*Each factor considered in a separate model adjusted for age (as a continuous variable), ethnicity (white or non-white), sexual identity (gay or bisexual/other), education, ongoing relationship status and study region.

\*\*\*Includes men who identified as queer, pansexual, omnisexual, open, bi-curious, and transgendered.

\*\*\*\*Includes men who identified as straight/heterosexual, three of whom specified a 'straight identity but have/had sex with a man'.

‡Renting includes from a private landlord and council or housing association. Unstable includes temporary accommodation (hostel, shelter, bed and breakfast, squat), staying with partner/friend(s)/family and homeless.

¶ Higher-risk drinking is based on the first two questions of the WHO AUDIT-C questionnaire. Higher risk drinking is indicated by a score of  $\geq 6$  and lower risk drinking/no alcohol consumption by a score of  $< 6$  (Babor, 2001).

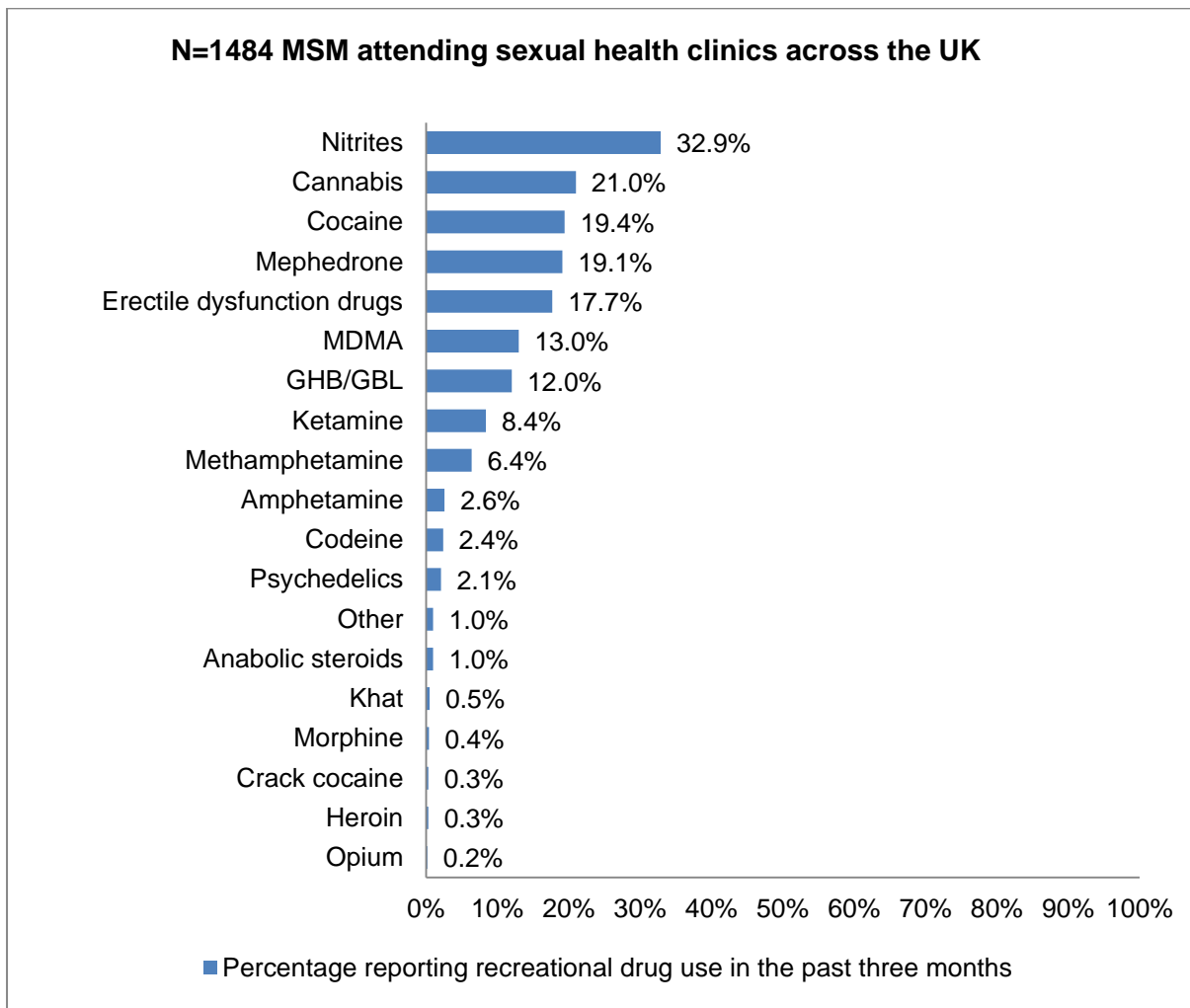
**Table 2: Prevalence of sexual behaviours among 1484 MSM**

	All MSM [N=1484]
	n (%) (95% CI)
Any CLS (past 3 months)	853 (57.5%) (54.9%, 60.0%)
CLS with two or more partners (past 3 months)	430 (29.0%) (26.7%, 31.3%)
CLS with unknown/HIV positive status partner(s)* (past 3 months)	474 (31.9%) (29.6%, 34.4%)
Receptive CLS with an unknown status partner(s) (past 3 months)	187 (12.6%) (11.0%, 14.4%)
Self-reported bacterial STI diagnosis (past year)	441 (29.7%) (27.4%, 32.1%)
PEP use (past year)	212 (14.3%) (12.6%, 16.2%)
Eleven or more new sexual partners (past year)	506 (34.1%) (31.7%, 36.6%)
Group sex (past 3 months)	527 (35.5%) (33.1%, 38.0%)

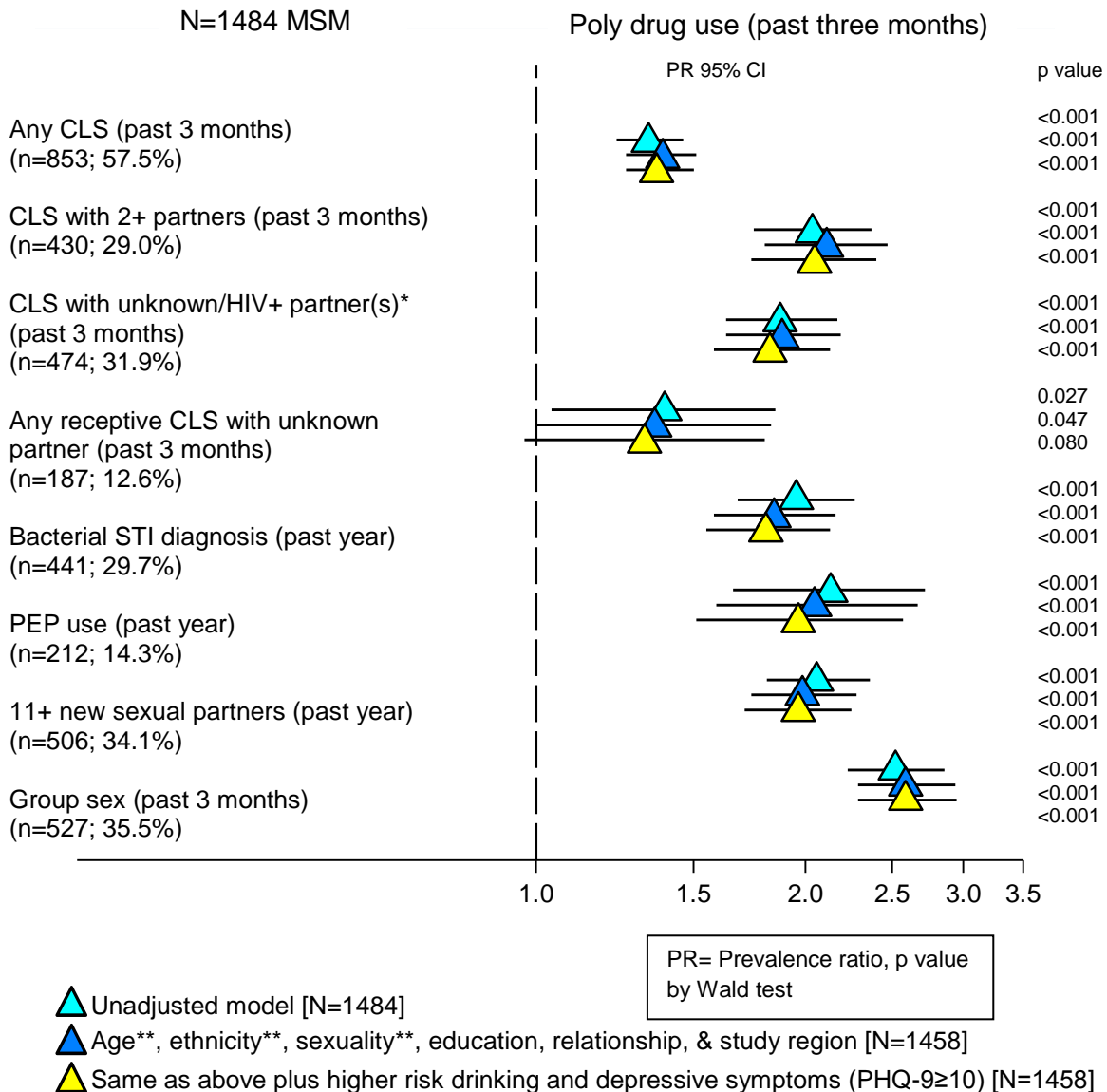
\*\*Excludes men who reported one HIV positive long-term CLS partner with whom they thought the risks were low because their partner was taking ART.



**Figure 1: Prevalence of individual recreational drug use in the past three months among 1484 MSM**



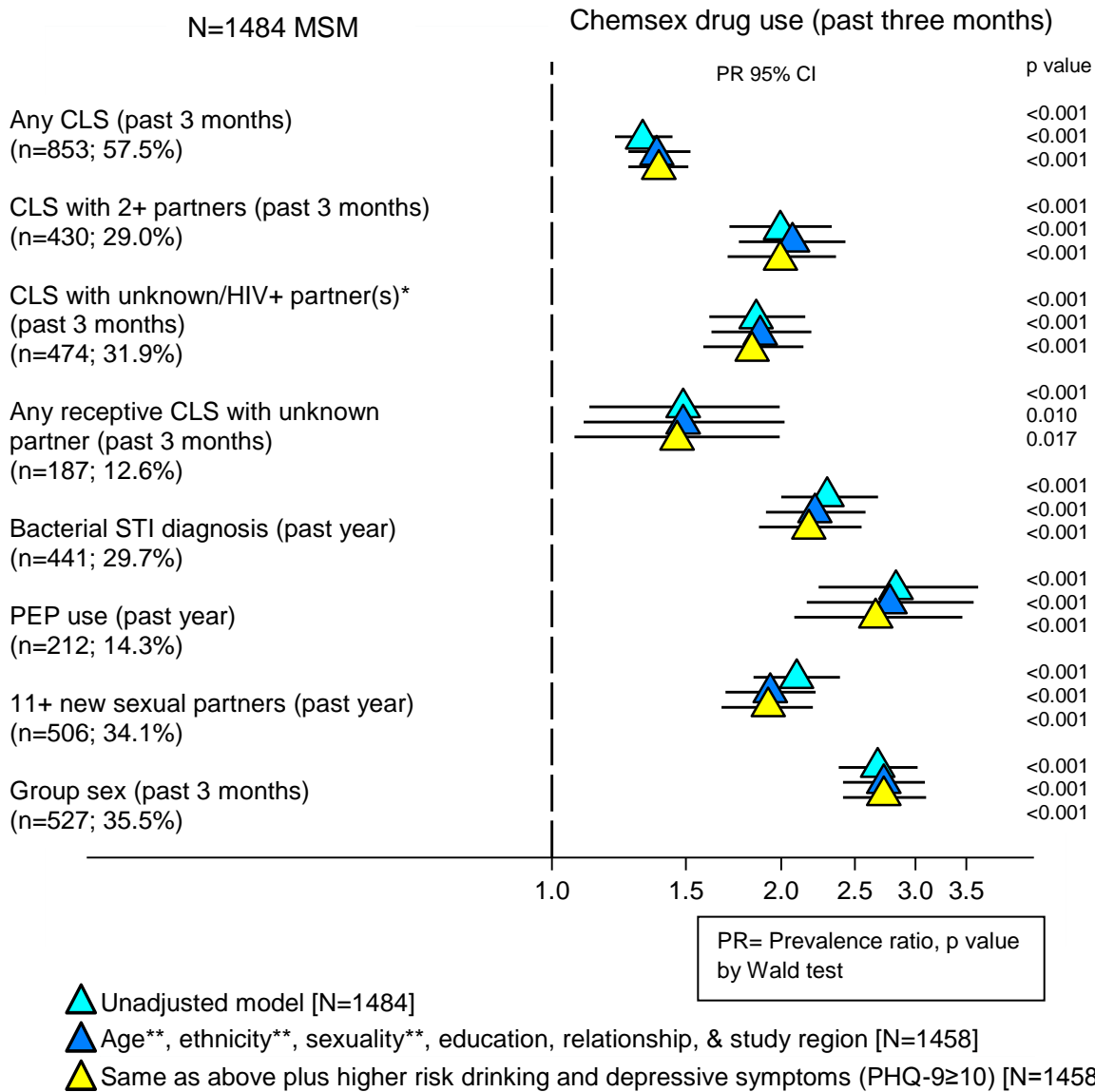
**Figure 2A: Association poly drug use in the past three months with sexual behaviour measures among 1484 MSM**



\*Excludes men who reported one HIV positive long-term CLS partner with whom they thought the risks were low because their partner was taking ART.

\*\*The model was fitted to include continuous age and dichotomous ethnicity (white or non-white) and self-reported sexual identity (gay or bisexual/other).

**Figure 2B: Association of chemsex drug use in the past three months with sexual behaviour measures among 1484 MSM**



\*Excludes men who reported one HIV positive long-term CLS partner with whom they thought the risks were low because their partner was taking ART.

\*\*The model was fitted to include continuous age and dichotomous ethnicity (white or non-white) and self-reported sexual identity (gay or bisexual/other).

**Table 3: Unadjusted and adjusted associations of poly drug use and chemsex drug use with measures of sexual risk behaviour among 1340 MSM who reported having anal or vaginal sex in the past three months**

N=1340 MSM reporting anal/vaginal sex in the past three months	Poly drug use (past three months)			Chemsex drug use (past three months)		
	Unadjusted PR[95% CI] <i>p</i> value <sup>II</sup>	Adjusted model (i) PR[95% CI] <i>p</i> value <sup>II</sup>	Adjusted model (ii) PR[95% CI] <i>p</i> value <sup>II</sup>	Unadjusted PR[95% CI] <i>p</i> value <sup>II</sup>	Adjusted model (i) PR[95% CI] <i>p</i> value <sup>II</sup>	Adjusted model (ii) PR[95% CI] <i>p</i> value <sup>II</sup>
Any CLS (past three months)	1.21 [1.12, 1.32] <0.001	1.26 [1.16, 1.36] <0.001	1.25 [1.15, 1.35] <0.001	1.21 [1.12, 1.32] <0.001	1.28 [1.17, 1.39] <0.001	1.27 [1.16, 1.38] <0.001
CLS with two or more partners (past three months)	1.84 [1.58, 2.14] <0.001	1.90 [1.63, 2.22] <0.001	1.84 [1.57, 2.15] <0.001	1.83 [1.57, 2.13] <0.001	1.89 [1.61, 2.21] <0.001	1.82 [1.55, 2.14] <0.001
CLS with unknown/HIV positive status partner* (past three months)	1.70 [1.48, 1.96] <0.001	1.70 [1.47, 1.97] <0.001	1.65 [1.42, 1.91] <0.001	1.70 [1.48, 1.96] <0.001	1.72 [1.48, 1.99] <0.001	1.67 [1.44, 1.94] <0.001
Receptive CLS with unknown status partner (past three months)	1.25 [0.94, 1.67] 0.126	1.22 [0.91, 1.65] 0.184	1.19 [0.87, 1.61] 0.275	1.37 [1.02, 1.82] 0.033	1.36 [1.01, 1.84] 0.045	1.33 [0.98, 1.81] 0.070
Bacterial STI diagnosis (past year)	1.87 [1.61, 2.18] <0.001	1.79 [1.53, 2.09] <0.001	1.75 [1.49, 2.05] <0.001	2.25 [1.94, 2.60] <0.001	2.18 [1.87, 2.54] <0.001	2.14 [1.83, 2.50] <0.001
PEP use (past year)	2.00 [1.56, 2.57] <0.001	1.93 [1.48, 2.50] <0.001	1.83 [1.41, 2.39] <0.001	2.73 [2.14, 3.48] <0.001	2.64 [2.04, 3.40] <0.001	2.53 [1.95, 3.27] <0.001
Eleven or more new sexual partners (past year)	1.98 [1.73, 2.27] <0.001	1.91 [1.66, 2.18] <0.001	1.87 [1.63, 2.15] <0.001	2.02 [1.77, 2.31] <0.001	1.86 [1.62, 2.14] <0.001	1.83 [1.59, 2.10] <0.001
Group sex (past three months)	2.45 [2.16, 2.78] <0.001	2.50 [2.20, 2.84] <0.001	2.50 [2.19, 2.84] <0.001	2.62 [2.31, 2.96] <0.001	2.65 [2.33, 3.01] <0.001	2.64 [2.32, 3.01] <0.001

II P value by Wald test.

Adjusted model (i): Age (as a continuous variable), ethnicity (white or non-white), sexual identity (gay or bisexual/other), university education, ongoing relationship status and study region.

Adjusted model (ii): Age (as a continuous variables), ethnicity (white or non-white), sexual identity (gay or bisexual/other), university education, ongoing relationship status, study region, higher risk drinking, and depressive symptoms (PHQ-9≥10).

\*Excludes men who reported one HIV positive long-term CLS partner with whom they thought the risks were low because their partner was taking ART.

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