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Trends in Sexual Behavior among Men who have Sex with Men (MSM) in High-Income Countries, 1990–2013: A Systematic Review

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Abstract

HIV diagnoses among men who have sex with men (MSM) have been increasing in several high-income countries. A better understanding of the sexual behavior trends among MSM can be useful for informing HIV prevention. We conducted a systematic review of studies that examined behavioral trends (1990–2013) in any condomless anal sex, condomless anal sex with an HIV-discordant partner, and number of partners. Studies included come from the United States, Europe, and Australia. We found increasing trends in condomless anal sex and condomless anal sex with an HIV-discordant partner, and a decreasing trend in number of partners. The increase in condomless anal sex may help to explain the increase in HIV infections. More explanatory research is needed to provide insight into factors that contribute to these behavior trends. Continuous monitoring of HIV, risk behaviors, and use of prevention and treatment is needed to evaluate prevention efforts and monitor HIV transmission risk.

Keywords

HIV; risk behaviors; men who have sex with men; condom use

Introduction

Gay, bisexual, and other men who have sex with men (collectively referred to as MSM) remain a core population affected by HIV in many parts of the world (1). In several high-income countries, including France, the Netherlands, the United Kingdom, and the United States, overall trends in HIV diagnoses are in decline except among MSM, where they have been increasing since early 2000 (2, 3). Although HIV diagnoses do not necessarily reflect

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recent HIV infection, the increase in HIV diagnoses in several high-income countries occurred during the same time period as a rise in primary and secondary syphilis among MSM, and the increase was apparently not correlated with changes in HIV testing (2), suggesting a true increase in HIV infections among MSM.

Several factors contribute to the high transmission rates among MSM, including high background prevalence of HIV, type and frequency of sex acts, number of sex partners, HIV status of partners, treatment and viral load status (if partners are HIV-positive), and whether pre-exposure prophylaxis (PrEP) is being used. HIV transmission among MSM is higher than among other populations in part because of the higher transmission probabilities during anal sex. The estimated per-act probability of acquiring HIV is 138 per 10,000 exposures for condomless receptive anal sex compared to 8 per 10,000 exposures for condomless receptive vaginal sex (4). Evidence also shows that the number of sex partners affects the risk of HIV transmission (5, 6). The more partners a person has, the more likely to have a partner with HIV whose viral load is not suppressed or to have a sex partner with a sexually transmitted infection (STI) - both factors can increase the risk of HIV transmission. However, antiretroviral therapy (ART) lowers the viral load of HIV-positive partners who adhere to the medication which, in turn, reduces HIV transmission to HIV-negative partners (7). In studies from both Europe (8) and Australia (9) there have been no HIV transmissions among MSM couples where the HIV-positive partner was on ART. Taking antiretroviral drugs as PrEP has also shown protective effects of HIV infection among HIV-negative MSM (10); while showing no evidence of risk compensation (11–13). Daily PrEP is recommended as one effective option for MSM at substantial risk of HIV acquisition (14).

While the scale-up of early detection and treatment may make the end of the HIV epidemic possible (15), there is evidence that reductions in condom use may jeopardize the population-level benefits of ART (16–18). Mathematical modeling suggests that the increases in HIV incidence in the United Kingdom, over a period in which ART coverage and viral suppression were also increasing, was likely due to the counter-effect of concomitant increases in condomless sex among MSM who were not virally suppressed (16). Increases in STIs, which facilitate HIV transmission, could also play a role in the increasing HIV incidence. However, increases in STIs are also likely to be the result of increases in condomless sex. Modeling work from the Netherlands reached similar conclusions and suggested that the reductions in HIV incidence due to ART and earlier HIV diagnosis had been offset by increases in risk behaviors among MSM in the Netherlands (17). These findings show that modest increases in condomless sex are enough to overcome the beneficial effects of ART at a population level (16, 17).

A better understanding of the sexual behavior trends among MSM would be useful for informing changes in the risk of HIV acquisition or transmission, for identifying sub-groups that would benefit the most from HIV prevention interventions, and resource allocation within the United States and other high-income countries. In this report, we evaluate changes in sexual risk behaviors among MSM in high-income countries. We conducted a systematic review of studies that examined sexual behaviors among MSM over time (1990–2013) to determine the trends for three behaviors that are predictors of HIV transmission: condomless

anal sex (with any, casual or main partners), condomless anal sex with a partner of unknown or discordant HIV status, and number of sex partners.

Methods

Systematic Search

A systematic literature search was conducted to locate citations that assessed changes over time in sexual risk behaviors and prevalence of STIs among MSM. A Centers for Disease Control and Prevention (CDC) librarian conducted a search of multiple electronic databases (Medline, Embase, Global Health, PsychInfo, CAB Abstracts, CINHAL, Sociological Abstracts, Web of Science, Cochrane Library, and LILACS). Indexing and keyword terms were cross-referenced using Boolean logic in three areas: [1] sexual risk behavior/STI descriptors (sexual behavior, safe sex, protected sex, unsafe sex, unprotected sex, anal intercourse, condom use, high-risk sex, barebacking, sex partner, sex risk, sexually transmitted disease, STD, sexually transmitted infection, STI, syphilis, gonorrhea, Chlamydia, Lymphogranuloma venereum, LGV), [2] MSM descriptors (homosexuality, men who have sex with men, MSM, men having sex with men, gay men, bisexual men, homosexual), and [3] descriptors related to change over time (trend, pattern, change, increase, decrease, unchanged, over time, epidemiology, survey, surveillance). No language restriction was applied to the automated search. The systematic searches were conducted in May 2014 and updated in May 2015. The full searches are available from the corresponding author.

Inclusion/Exclusion Criteria

This paper focuses on sexual risk behaviors among MSM (a separate paper focuses on syphilis trends (19)). Studies were included in this systematic review if they [1] were conducted in a high-income country (based on the World Bank definition (20)), [2] were published between January 2004 and May 2015, [3] reported data on MSM for at least two time points, and [4] reported on relevant sexual behaviors. Relevant sexual risk behaviors included: condomless anal sex (with any, casual or main partners), condomless anal sex with a partner of unknown/discordant HIV status, and number of sex partners. It usually took many years for the studies that examined behavioral trends to collect and analyze data before the findings were published. We chose a publication cut-off of 2004 because it covered ten years from the original search date and allowed the focus to be on more recent behavior trends. Several studies that we reviewed reported data points back to 1990. These data points were included in this systematic review if the studies met the inclusion criteria. Studies were excluded at the abstract level if they were (a) modeling, review or intervention papers, (b) published in languages other than English (most were conducted in low or middle income countries or the abstracts did not provide sufficient information), or (c) conference abstracts, posters, or dissertations. Studies were excluded at the full-report level if they (d) covered only specific sub-populations (e.g., sex workers), and (e) had duplicated data sources (see *data abstraction and analysis* for more information).

Data abstraction and analysis

A trained coder screened the titles and abstracts of 7,113 citations for eligibility (Figure 1). After review of the abstracts, 6,830 were determined to not meet the inclusion criteria, and the remaining 283 were retained for retrieval of the full-length article. Upon reviewing the full-length article, 51 were determined to meet the inclusion criteria and were coded for the following: study date, location, sampling method, sample size, HIV status of participants, sexual behavior outcomes, assessment time frame, and study results. The full-report data abstraction was reviewed by an additional person to verify accuracy. Discrepancies were reconciled between the coders. To avoid potential bias in the trend analyses, we excluded an additional 14 papers for the following reasons at the full-report level: specific sub-populations (i.e., sex workers; n=2) and duplicated data source (n=12).

We applied the following rules for guiding data abstraction for analyses. For studies that reported multiple sexual behavior outcomes, separate analyses were conducted for condomless anal sex, condomless anal sex with casual partners, condomless anal sex with main partners, condomless anal sex with a partner of unknown/discordant HIV status, and number of partners. This approach allowed us to examine the trends with all available data in the literature. For the studies that reported condomless anal sex, we selected the data for all study participants regardless of their HIV status, unless the study only reported data on HIV-positive or HIV-negative participants without reporting data on all study participants, then we treated HIV-positive and HIV-negative participants as separate samples in the analyses. For studies that reported on condomless sex with a partner of unknown/discordant HIV status, the results stratified by HIV status were used as separate samples in the analyses. If stratified results were not reported, the overall results were used. The analysis for number of partners was stratified into two groups of studies – studies that measured multiple partners with a high cut point (10+ to 21+ partners) and those with a lower cut point (2+ to 6+ partners).

For each study sample, we abstracted the percentage of persons who engaged in a specific sexual behavior at each assessment time (i.e., year of data collection). Multi-level models were used to examine the overall trends, with the study treated as the random-effect and year as the fixed effect. The beta, which represents the slope of the line on the log scale, was reported. A positive beta represents an upward trend, a negative number represents a downward trend. The larger the beta, the steeper the slope. Additionally, we conducted "knot" analyses to determine whether the direction of the trend changed at a particular year. While all the included studies were published between 2004 and 2015, the data collected were between 1990 and 2013. A knot was set at year 2002 because it is about the mid-point of the data collected across studies and ART had improved and become more widely available around this time. For the knot analyses, the slope of the line was allowed to change at 2002 generating two estimates for the slope: one for 1992 to 2002 and one for 2003 to the latest data collection date (usually 2012 or 2013). The results from multi-level models without and with a knot were both reported. If a change in significance or direction of the slope occurred with the addition of the knot, the summary line presented in the figure was based on the knot analysis result. If no significant change in slope occurred based on the knot analyses, the summary line presented in the figure was based on the overall result.

Sensitivity analyses were also conducted by stratifying the studies by HIV status and study design.

Results

Figure 1 summarizes the study selection process. Among the 37 included studies that provided behavioral trend data between 1990 to 2013, 13 were conducted in the United States (21–33), nine in continental Europe (34–42), seven in Australia (43–49), five in the United Kingdom (50–54), two in New Zealand (55, 56), and one in Canada (57). Twenty-nine studies examined condomless anal sex (Table I), 16 examined condomless anal sex with a discordant or unknown HIV-status partner (Table II), and 16 examined number of partners (Table III). The majority were repeated cross-sectional studies (n=26) while six were longitudinal cohorts (27, 34, 35, 42, 44, 57) and five were retrospective medical record analyses from STD clinics or emergency rooms (23, 36, 38, 47, 49). Most sampled MSM specifically, but two analyses were based on general population surveys (21, 50). Recall periods differed across studies and variables, but most common were past year, past six months, past three months, and last sex. There was not substantial change in age composition across study samples over time.

Condomless anal sex with any, casual or main sex partners

Among the 29 studies that examined condomless anal sex from 1990 to 2013 (21–28, 34–41, 43–47, 50–57), 19 findings were included in the analysis of condomless anal sex (Figure 2), 19 findings were included in the analysis of condomless anal sex with casual partners (Figure 3A), and 12 findings were included in the analysis of condomless anal sex with main partners (Figure 3B). Figure 2 showed an upward trend in condomless anal sex with any partners from 1990 to 2012 among most of the study samples. The results of the multi-level models indicated a significant positive slope for the summary line (overall analysis without knot for the time period 1990–2012: beta = 0.05, $p < 0.001$; with a knot: 1990–2002, beta = 0.07, $p < 0.001$; 2003–2012, beta = 0.04, $p < 0.001$). Sensitivity analyses showed similar results when only cross-sectional studies were included. There were not enough cohort studies to run a separate sensitivity analysis. Sensitivity analysis among HIV-positive samples and HIV-negative samples also did not differ substantially. Figure 3 also showed upward trends in condomless anal sex by partner type. As seen in Figure 3A, the summary line indicated a significant increase in the percentage of MSM who engaged in condomless anal sex with casual partners over time (overall analysis without knot for the time period 1992–2013: beta = 0.05, $p<0.001$; with a knot: 1992–2002, beta = 0.10, $p < 0.001$; 2003–2013, beta = 0.03, $p < 0.001$). Similarly, Figure 3B showed a significant increase in the percentage of MSM who engaged in condomless anal sex with main partners over time (overall analysis without knot for the time period 1992–2013: beta = 0.03, $p < 0.001$; with a knot: 1992–2002, beta = 0.07, $p < 0.001$; 2003–2013, beta = 0.01, $p = 0.004$). Sensitivity analyses showed for CAS with a casual partner, results were similar when only cross-sectional studies were included. There were not enough cohort studies or studies with stratified results by HIV status to run separate sensitivity analyses. None of the CAS with a main partner studies were cohort designs and none presented data stratified by HIV status.

Condomless anal sex with a partner of unknown/discordant HIV status

From the 16 studies that examined condomless anal sex with a partner of unknown/discordant HIV status from 1994 to 2011 (22, 23, 25–29, 35, 37, 39, 42, 44, 51–53, 57), 25 findings were included in the analysis (Figure 4). The results of the multi-level models indicated a significant increase in the behavior over time (overall analysis without knot for the time period 1994–2011: beta = 0.03, $p < 0.001$; with a knot: 1994–2002, beta = 0.05, $p < 0.001$; 2003–2011, beta = 0.02, $p < 0.001$). Results were not substantially different for sensitivity analyses that stratified by study design or HIV status. However, although the slopes were similar to the overall analysis, sensitivity analyses for HIV-positive samples and HIV-negative samples did not result in significant betas for the 2003–2011 time period.

Number of sex partners

Sixteen studies examined trends in numbers of partners between 1992 and 2013 (30–33, 36, 39, 41, 45–49, 51, 53, 55, 56). Since the included studies had a wide range of cut-points from 2 or more partners to greater than 20 partners, we divided the studies into two groups: 2+ to 6+ partners (9 findings, Figure 5A) and 10+ to 21+ partners (10 findings, Figure 5B). The multi-level models without a knot did not produce stable results for either group. However, the models with a knot at 2002 generated an estimate for the summary line parameters. The knot analysis of the studies with a cut-point at 2 to 6 partners showed that the percentages of MSM who reported 2+ to 6+ partners did not change between 1992 and 2002 (beta = 0.004, $p = 0.75$, Figure 5A). There was an increase from 2003 to 2013 (beta = 0.08, $p < 0.001$, Figure 5A) primarily due to one large study that had a significant increasing trend. When this study was removed from the analysis, the slope from 2003 to 2013 was negative (beta = −0.02, $p = 0.05$). The knot analysis of the studies with a cut-point at 10 to 21 partners showed that the percentages of MSM who reported having 10+ to 21+ partners did not change between 1992 and 2002, and there was a significant downward trend from 2003 to 2011 (1992–2002, beta = 0.005, $p = 0.55$; 2003–2011, beta = −0.04, $p < 0.001$). None of the studies for the number of sex partners outcome were cohorts, and too few reported results stratified by HIV status to conduct a stratified analysis.

Discussion

This systematic review of studies conducted in high-income countries indicated increasing sexual risk behaviors over time among MSM. The upward trends were seen not only in condomless anal sex, condomless anal sex with casual partners and main partners, but also in condomless anal sex with partners of unknown or discordant HIV status, the highest-risk behavior for HIV transmission and acquisition. For these behaviors there was a steady increase from the 1990s through 2013, but the knot analysis suggested the rate of increase may have been slightly lower in 2003 and later compared to the earlier years. This could possibly be explained by a more rapid change in condom norms after the introduction of ART with a slowing of change overtime. Although there may be a decreasing trend in the number of sex partners since 2002, the increasing condomless anal sex, especially with partners of unknown or discordant HIV status, may partially explain the increase in HIV infections among MSM in high-income countries despite increasing treatment coverage during the same time frame, as seen in other studies (58).

There are several plausible explanations for why condomless anal sex is increasing. Condom fatigue, complacency about HIV, availability of other prevention options, optimism about HIV treatments, and the adoption of seroadaptive strategies may have eroded consistent condom use (18, 59). For example, MSM could be engaging in more serosorting or they, or their partners, could be on ART and virally suppressed or on PrEP to lower risk of HIV transmission. A recent study in the United States using the National HIV Behavioral Surveillance data found that the increases in condomless sex among MSM from 2005 to 2014 were not associated with serosorting or ART (60). Although the study found evidence of serosorting among HIV-positive MSM there was no indication that HIV-negative MSM were serosorting beyond what would be expected by chance (61). Based on our review, there appears to be a downward trend in the number of partners since 2002. The reason for this trend is unclear. However, researchers in Australia have noted a shift away from open relationships among MSM, which could help explain the reduction in number of partners (48). The extent to which the downward trend is actually occurring and why it might be occurring requires further examination. Other potential correlates of condomless sex that have been examined in the literature include methamphetamine use, alcohol use (62, 63), depression (64), and increased access to internet and mobile-app for seeking sexual partners (65, 66). The evidence on what contributes to these trends among MSM is still limited. Our study echoes the call for comprehensive HIV prevention for MSM (2, 3, 67) as well as more explanatory research to help understand the contributors of these trends.

The HIV prevention paradigm has expanded in recent years to include a focus on biomedical interventions such as ART and PrEP and helping people identify the best prevention option or options for them and their partners (68). PrEP was not widely available during the time period of the studies included in this review. This new prevention tool could help to offset the increased risk due to increases in condomless anal sex (16). As PrEP becomes more widely used, studies can evaluate its impact on HIV transmission rates and sexual behaviors. To better understand the influence and impact of ART and PrEP use, behavioral surveillance systems need to include more nuanced measures of biomedical prevention (69, 70). However, awareness of HIV status is not universal and increasing efforts are needed to reach optimal uptake of biomedical interventions. In addition, condom use continues to be a critical component of a comprehensive approach to HIV prevention among MSM (71) and condoms protect against many STIs which have been increasing among MSM worldwide. The United States CDC as well UNAIDS recommend condom distribution programs as part of an effective combination prevention program (72, 73). Furthermore, condom promotion interventions have success in increasing condom use among MSM, as evidenced by an intervention in New Zealand (74).

The results of this systematic review should be considered in light of the following limitations. The sexual risk behavior data were self-reported and these sensitive behaviors may have been under-reported. This may have been a bigger issue in some studies than others due to variations in data collection method (face-to-face interview versus self-interview). The outcome definitions also varied from study to study, in particular the recall period time frame. The samples in the included studies may not be representative of all MSM as many were convenience samples or venue-based recruitment samples. In some countries, the trends may differ across communities of MSM and thus the overall trend on

the country level masks these differences. Only studies written in English were included in the review. Therefore, some studies from non-English speaking countries could have been excluded. The exclusion of studies published before 2004 could have resulted in missing some trend studies that covered the earlier time period. Because the samples presented the age composition results in different manners (median, mean, categorical), it was impossible to control for age in the analyses to better understand the impact of different generations of MSM on HIV risk. Study limitations also pointed to further research needs. Collecting and reporting sex behavior data stratified by HIV-status of participants and partners, standardizing the collection of key indicators for comparison purposes, and collecting additional measures on the use of biomedical prevention strategies (e.g., participants and partner use of ART and PrEP) will facilitate data synthesis and increase our understanding of why these behavioral trends are occurring.

The landscape of HIV prevention has changed substantially in the past decade, both because of biomedical advances such as ART and PrEP and because of the evolution of the risk environment for MSM. The increases in condomless anal sex among MSM, especially with partners of unknown or discordant HIV status, found in our review may help explain the increase in HIV infections among MSM documented in some high-income countries. Continuous monitoring of HIV, risk behaviors, and use of prevention and treatment is needed to evaluate prevention efforts and monitor HIV transmission risk.

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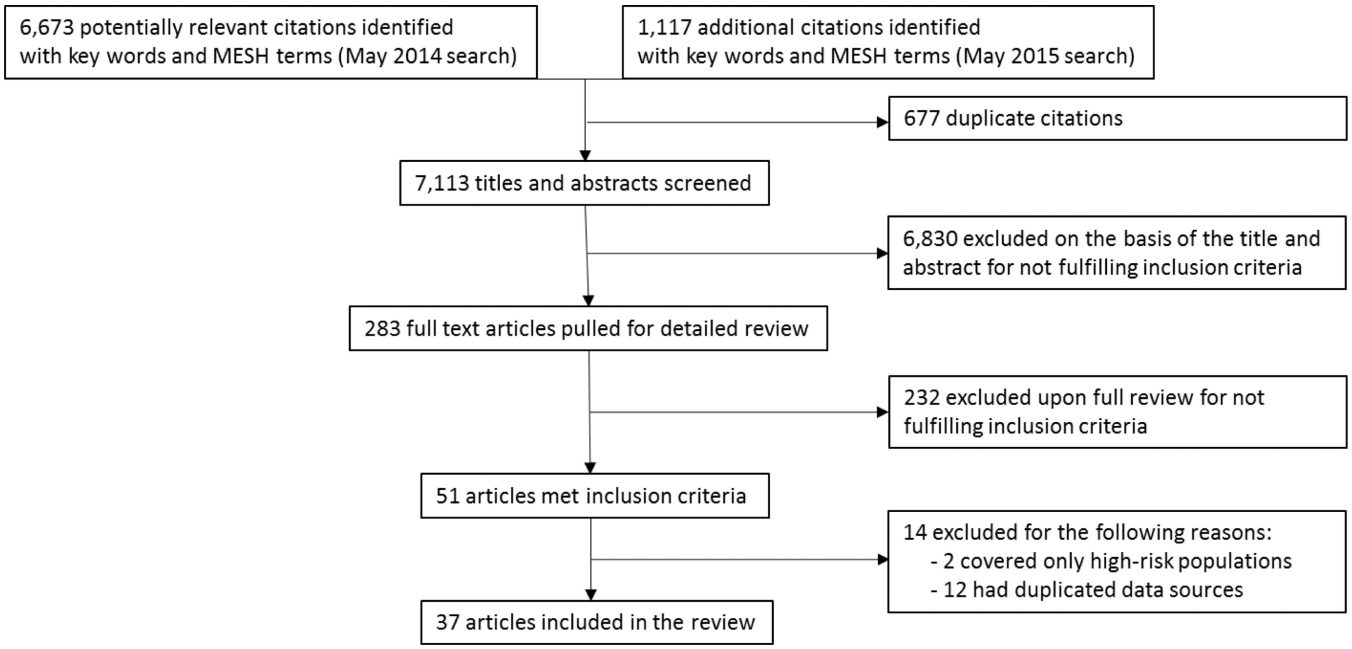

Figure 1.

Selection process for study inclusion in the systematic review on trends in sexual behavior among MSM in high-income countries

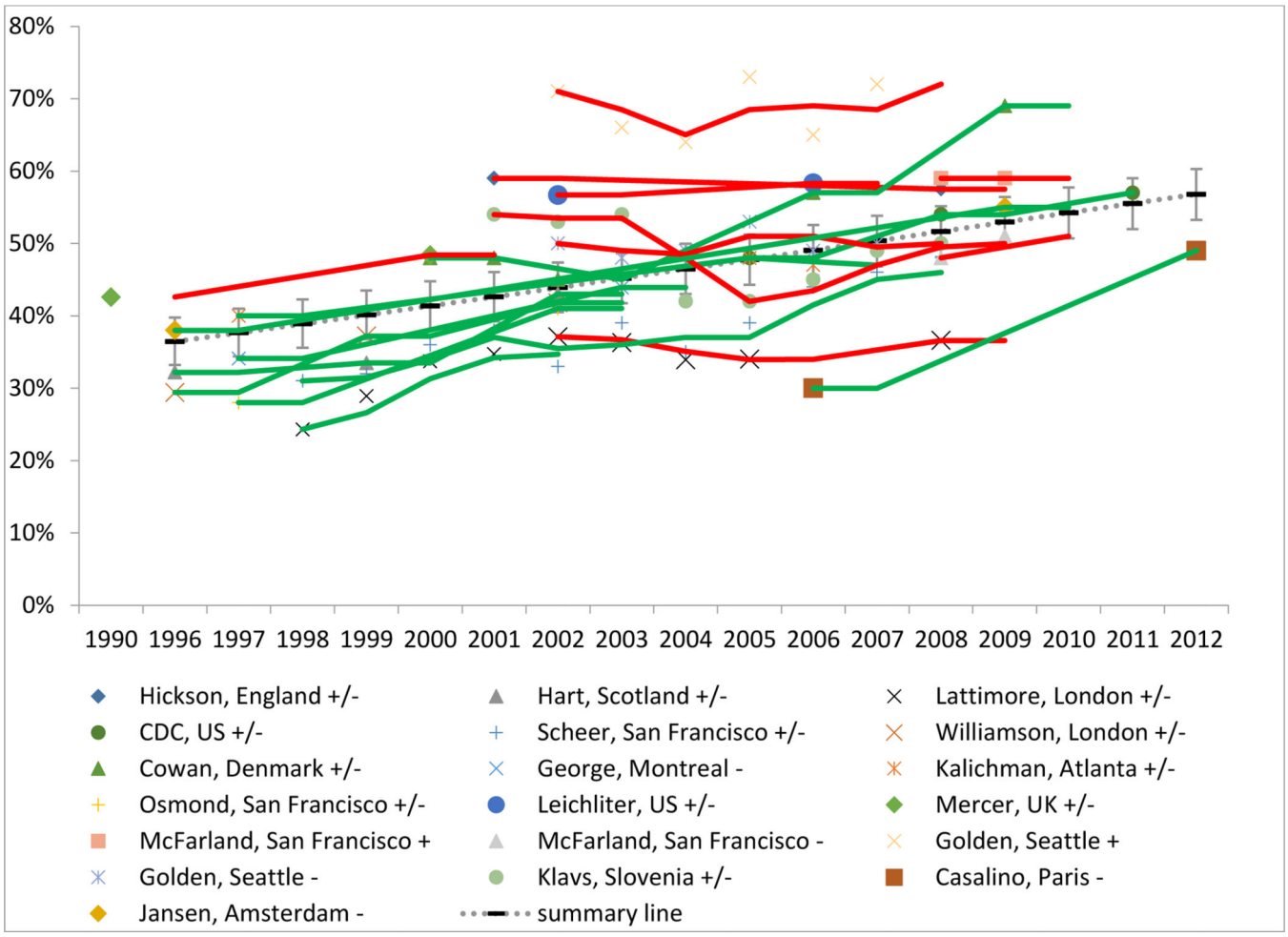

Figure 2.

Trends in condomless anal sex among MSM, high-income countries, 1990–2012

Note. red trend line = no significant change; green trend line = significant increase; blue trend line = significant decrease. Studies are labeled with the first author's last name, location, HIV-status of men (+/−). Summary line: beta = 0.05, $p < 0.001$, suggests an increase in condomless anal sex 1990–2012.

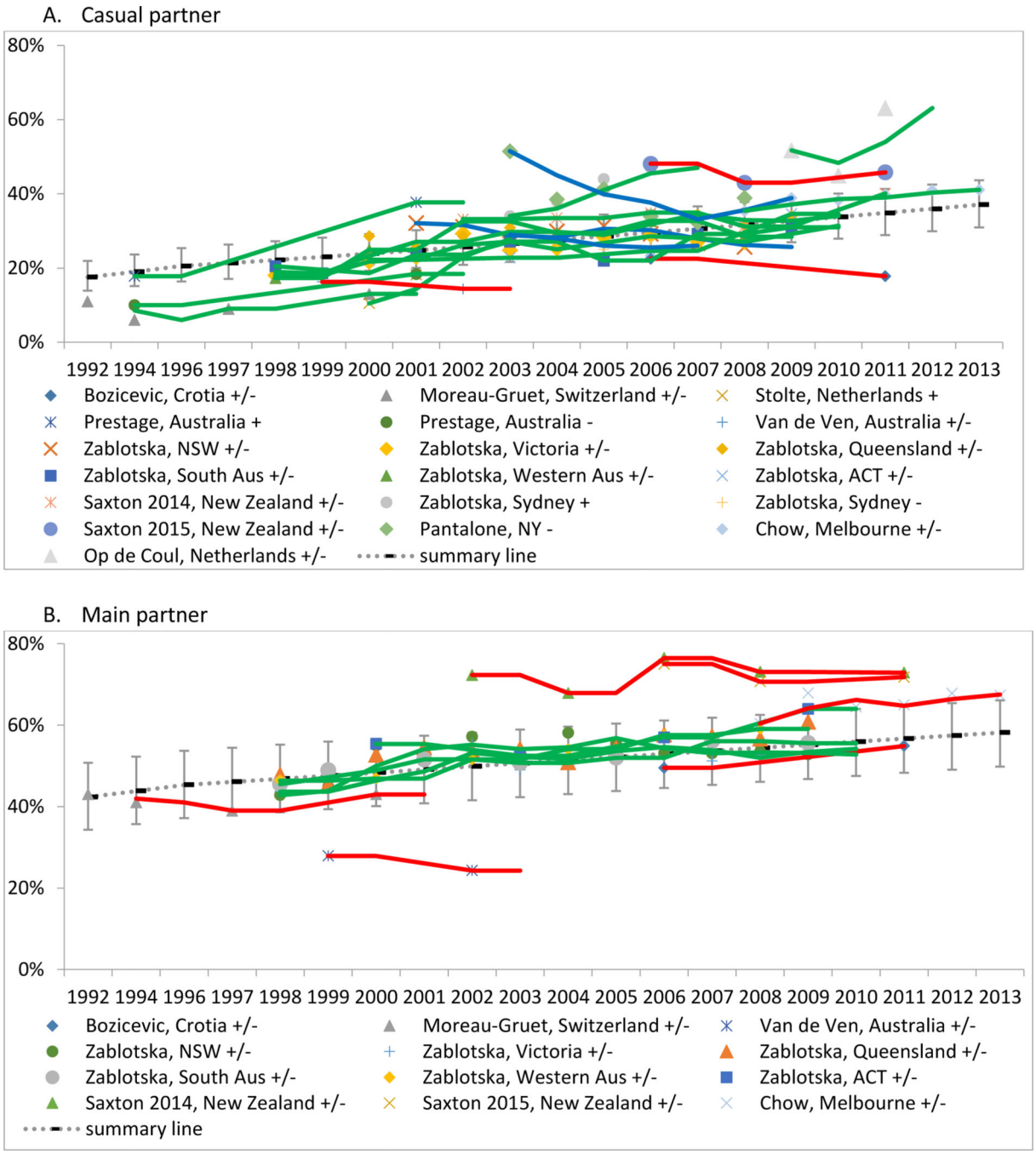

Figure 3.

Trends in condomless anal sex among MSM by partner type, high-income countries, 1992–2013

Note. red trend line = no significant change; green trend line = significant increase; blue trend line = significant decrease. Studies are labeled with the first author's last name, location, HIV-status of men (+/−). Summary line for 3A: Beta = 0.05, p < 0.001– suggests an increase in condomless anal sex with casual partners 1992–2013. Summary line for 3B:

beta = 0.03, $p < 0.001$, suggests an increase in condomless anal sex with main partners 1992–2013.

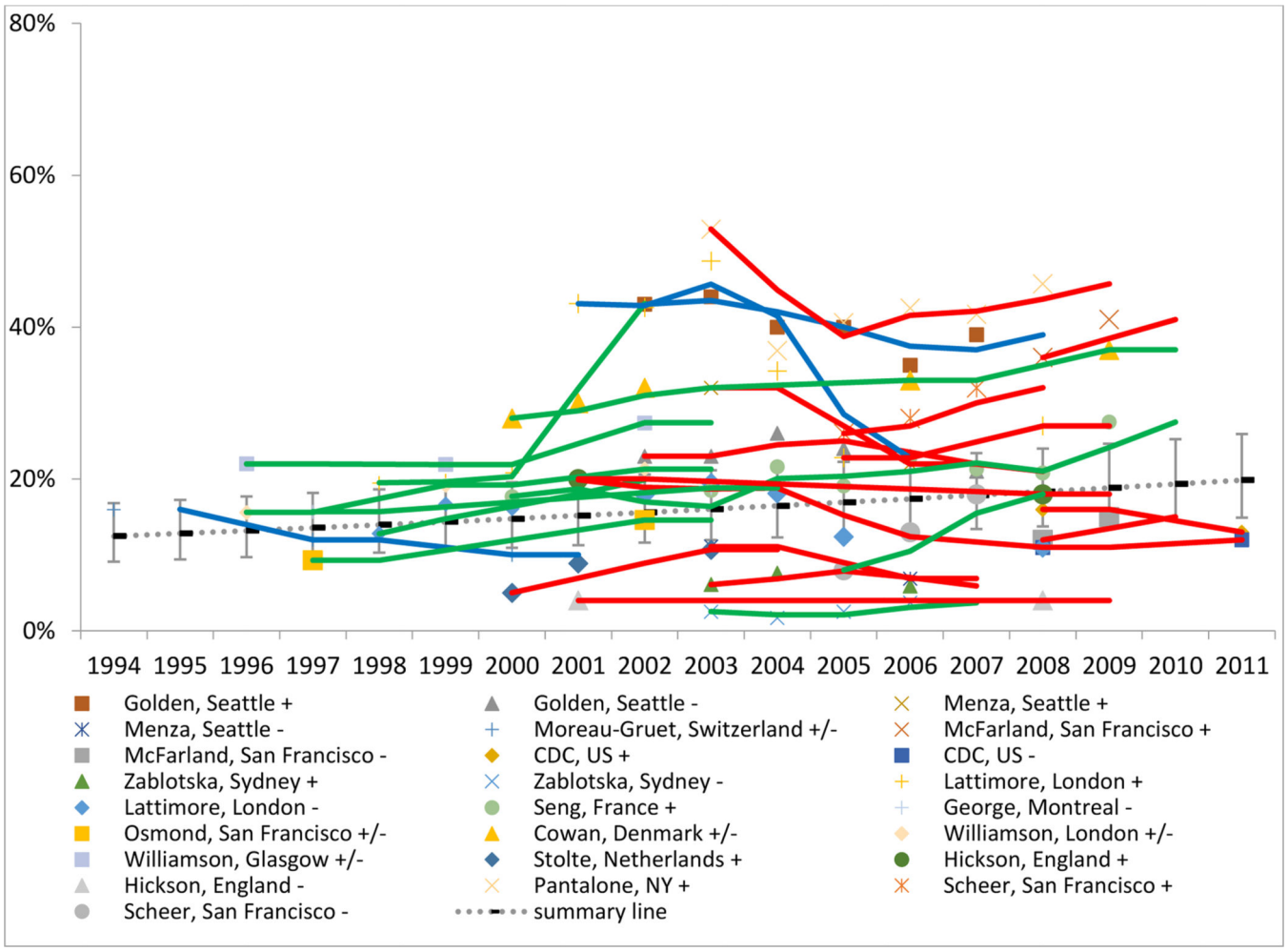

Figure 4.

Trends in condomless anal sex with a partner of unknown/discordant HIV status among MSM, high-income countries, 1994–2011

Note. red trend line = no significant change; green trend line = significant increase; blue trend line = significant decrease. Studies are labeled with the first author's last name, location, HIV-status of men (+/−). Summary line: beta = 0.03, $p < 0.001$, suggests an increase 1994–2011.

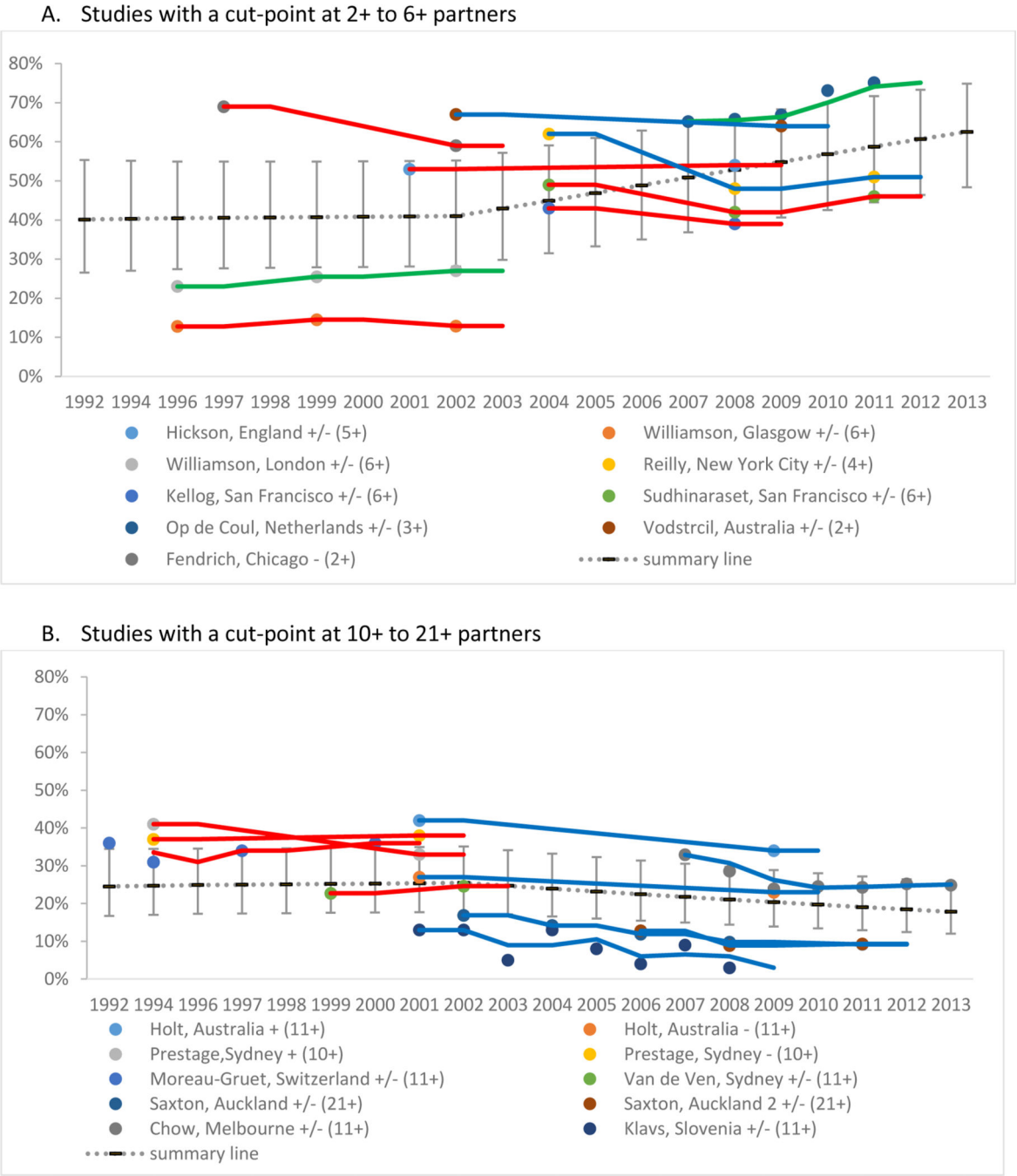

Figure 5.

Trends in number of partners among MSM, high-income countries, 1992–2013

Note. red trend line = no significant change; green trend line = significant increase; blue trend line = significant decrease. Studies are labeled with the first author's last name, location, HIV-status of men (+/−), and cut-point for number of partners. Summary line for 5A.: 1992–2002, beta = 0.004, p = 0.75; 2003–2013, beta = 0.08, p < 0.001 – suggests no change 1992–2002 and an increase in 2 to 6 partners 2003–2013. Summary line for 5B.:

1992–2002, beta = 0.005, p = 0.55; 2003–2013, beta = −0.04, p < 0.001 – suggests no change 1992–2002 and a decrease in 10+ to +21 partners 2003–2013.

Table I

Summary of 29 studies on temporal trends in anal intercourse without a condom among MSM in high income countries, 1990–2013

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame	Results reported by authors
Leichliter et al. (2013)	USA	2002, 2006–2010	National Survey of Family Growth - multistage national probability sample of 15–44 year olds living in US households	2002: N=197; age distribution: 15–24 N=57, 25–34 N=64, 35–44 N=76 2006–2010: N=272; age distribution: 15–24 N=77, 25–34 N=97, 35–44 N=98 (HIV prevalence not reported)	At last sex	**Any type of partner:** No change
CDC (2013)	USA	2005, 2008, 2011	Venue-based sampling of MSM in 20 cities	2005: N=11,457 (13% HIV+); age distribution: 18–24 N=2,235, 25–29 N=1,911, 30–39 N=3,879, ≥40 N=3,432 2008: N=9,253 (12% HIV+); age distribution: 18–24 N=2,071, 25–29 N=1,711, 30–39 N=2,562, ≥40 N=2,909 2011: N=9,253 (13% HIV+); age distribution: 18–24 N=2,352, 25–29 N=1,750, 30–39 N=2,190, ≥40 N=2,961	1 year	**Any type of partner:** Increase
Golden et al. (2008)	Seattle, Washington	2002–2007	All MSM attending STD clinics	2002: HIV− N=1,282; HIV+ N=166 2003: HIV− N=1,214; HIV+ N=160 2004: HIV− N=1,236; HIV+ N=261 2005: HIV− N=1,373; HIV+ N=182 2006: HIV− N=2,134; HIV+ N=260 2007: HIV− N=1,718; HIV+ N=232 Age distribution overall (not presented by year): <24 N=2,170, 25–29 N=2,303, 30–34 N=2,071, 35–39 N=2,117, ≥40 N=3,788	1 year	**Any type of partner: HIV+:** No change **HIV−:** No change
Kalichman et al. (2007)	Atlanta, Georgia	1997, 2005, 2006	Venue intercept procedures at Gay Pride events	1997: N=511 (14% HIV+); age distribution: mean 33.6, SD 8.4 2005: N=473 (14% HIV+); age distribution: mean 34.3, SD 10.4 2006: N=449 (17% HIV+); age distribution: mean 34.8, SD 10.1	6 months	**Any type of partner:** Increase
Osmond et al. (2007)	San Francisco, California	1997, 2002	Random-digit-dial telephone survey of MSM households	1997: N=915 (20% HIV+); age distribution: 18–29 15.9%, 30–39 38.0%, 40–49 28.4%, ≥50 17.7% 2002: N=879 (27% HIV+); age distribution: 18–29 8.5%, 30–	1 year	**Any type of partner:** Increase

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame	Results reported by authors
				39 31.8%, 40–49 30.6%, ≥50 29.1%		
Scheer et al. (2008)	San Francisco, California	1998–2007	Street-based intercept interview at gay-oriented events, outside gay clubs/bars, and in gay neighborhoods	N > 1,200 per year (HIV prevalence and age distribution not reported)	Not reported	**Any type of partner:** Increase
McFarland et al. (2012)	San Francisco, California	2008–2009	Venue-based sampling of MSM	N=732 (21% HIV+); Age distribution (baseline): 18–24 14%, 25–34 34%, 35–44 27%, 45–54 15%, ≥55 10% (1-year cohort)	6 months	**Any type of partner: HIV+:** No change **HIV−:** No change
Pantalone et al. (2015)	New York City	2003–2008	Intercept sampling at 2 large lesbian, gay, bisexual community events	2003: N=610; age distribution: 18–40 N=416, >40 N=194 2004: N=418; age distribution: 18–40 N=282, >40 N=136 2005: N=421; age distribution: 18–40 N=268, >40 N=153 2006: N=384; age distribution: 18–40 N=261, >40 N=123 2007: N=254; age distribution: 18–40 N=170, >40 N=84 2008: N=423; age distribution: 18–40 N=267, >40 N=156 (100% HIV−)	3 months	**Casual partner: HIV−:** decrease
George et al. (2006)	Montreal, Canada	1997–2003	Convenience sampling: Recruitment by posters, internet, gay print media, & information cards at gay pride week	N=1,587 (100% HIV−); age distribution: <30 N=753, ≥30 N=843 (cohort)	6 months	**Any type of partner: HIV−:** Increase
Mercer et al. (2004)	Britain	1990, 2000	Stratified probability samples of the general population	1990: N=100; age distribution not reported 2000: N=175; age distribution: mean 31.5 (HIV prevalence not reported)	4 weeks	**Any type of partner:** No change
Hickson et al. (2013)	England	2001, 2008	Convenience sampling: Recruitment via internet banner ads on gay dating sites, news sites, and community health promotion organization sites	2001: N=3,517 (3% HIV+); age distribution: <20 N=409, 20–29 N=1,407, 30–39 N=1,036, 40–49 N=480, ≥50 N=185 2008: N=1,382 (9% HIV+); age distribution: <20 N=56, 20–29 N=396, 30–39 N=387, 40–49 N=348, ≥50 N=195	1 year	**Any type of partner:** No change
Lattimore et al. (2011)	London, England	1998–2005, 2008	Venue-based recruitment of gay men at gyms	1998: N=834 (14% HIV+); age distribution: median 34 range 17–74 1999: N=630 (16% HIV+); age distribution: median 34 range 20–67 2000: N=739 (16% HIV+); age distribution: median 35 range 20–77 2001: N=735 (16%	3 months	**Any type of partner:** 1998–2001 increase, 2001–2005 & 2005–2008 no change

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame	Results reported by authors
				HIV+); age distribution: median 35 range 17–72 2002: N=828 (15% HIV+); age distribution: median 35 range 17–74 2003: N=498 (16% HIV+); age distribution: median 36 range 18–65 2004: N=670 (18% HIV+); age distribution: median 37 range 20–69 2005: N=482 (16% HIV+); age distribution: median 36 range 21–67 2008: N=648 (23% HIV+); age distribution: median 39 range 20–87		
Williamson et al. (2006)	London, England	1996, 1999, 2002	Venue-based recruitment at commercial gay venues	1996: N=1,895 (HIV prevalence not reported); age distribution: median 30 1999: N=1,368 (13% HIV+); age distribution: median 32 2002: N=1,325 (11% HIV+); age distribution: median 33	1 year	**Any type of partner:** Increase
Hart et al. (2005)	Glasgow and Edinburgh, Scotland	1996, 1999, 2002	Venue-based recruitment at gay bars	1996: N=2,276; age distribution: 15–25 N=620, >25 N=1,630 1999: N=2,498; age distribution: 15–25 N=614, >25 N=1,788 2002: N=1,734; age distribution: 15–25 N=528, >25 N=1,114 (HIV prevalence not reported)	1 year	**Any type of partner:** Increase
Jansen et al. (2011)	Amsterdam, Netherlands	1995–2009	Amsterdam Cohort Studies - Convenience sampling from STI clinics and MSM meeting places and chain referral	N=1,642 (100% HIV−); age distribution (baseline): median 28.8 IQR 24.8–35.9 (cohort)	6 months	**Any type of partner: HIV−:** increase
Stolte et al. (2004)	Amsterdam, Netherlands	2000–2003	HIV+ men from the Amsterdam Cohort Studies - Convenience sampling from STI clinics and MSM meeting places and chain referral	N=57 (100% HIV+); age distribution (baseline): median 43 IQR 37.8–53.6 (cohort)	6 months	**Casual partner: HIV+:** Increase
Op de Coul et al. (2013)	Netherlands	2009–2011	All STD clinic attendees	2009: N=16,304 2010: N=19,535 2011: N=21,719 (overall 15% HIV+); Age distribution overall (not presented by year): 15–24 N=11,837, 25–34 N=22,448, 35–44 N=23,979, 45–55 N=16,385, >55 N=7,689	6 months	**Casual partner:** increase

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame	Results reported by authors
Cowan et al. (2012)	Denmark	2000, 2001, 2002, 2006, 2009	Convenience sampling: Recruitment through gay and HIV-related websites and venues attended by MSM	2000: N=1,745 (11% HIV+) 2001: N=1,574 (9% HIV+) 2002: N=1,538 (11% HIV+) 2006: N=3,141 (8% HIV+) 2009: N=1,310 (9% HIV+); Age distribution not reported	1 year	**Any type of partner:** Increase
Casalino et al. (2014)	Paris, France	2006–2012	All MSM who visited an emergency department after a sexual exposure to HIV	2006: N=71 2007: N=101 2008: N=95 2009: N=78 2010: N=142 2011: N=147 2012: N=154 (100% HIV−); age distribution not reported	At last sex	**Any type of partner: HIV−:** Increase
Moreau-Gruet et al. (2006)	Switzerland	1992, 1994, 1997, 2000	Convenience sampling: Surveys were inserted into gay magazines and distributed in homosexual associations, bars, and saunas	1992: N=934 (11% HIV+); age distribution: <20 <1%, 20–29 31%, 30–39 32%, 40–49 24%, ≥50 13% 1994: N=1,195 (10% HIV+); age distribution: <20 1%, 20–29 33%, 30–39 38%, 40–49 17%, ≥50 11% 1997: N=1,097 (11% HIV+); age distribution: <20 1%, 20–29 24%, 30–39 42%, 40–49 18%, ≥50 14% 2000: N=918 (11% HIV+); age distribution: <20 1%, 20–29 16%, 30–39 43%, 40–49 21%, ≥50 18%	1 year	**Casual partner:** Increase **Main partner:** No change
Bozicevic et al. (2012)	Zagreb, Croatia	2006, 2011	Recruitment by respondent driven sampling of MSM	2006: n=350 (4.5%HIV+); age distribution: median 27 2011: n=387 (2.8% HIV+); age distribution: median 28	At last sex	**Casual partner:** No change **Main partner:** No change
Klavs et al. (2009)	Ljubljana, Slovenia	2001–2008	Venue-based convenience sample of MSM	Range N=68–124 (average N=89) per year (HIV prevalence and age distribution not reported)	1 year	**Any type of partner:** No change
Saxton et al. (2014)	Auckland, New Zealand	2002, 2004, 2006, 2008, 2011	Convenience sampling in community locations (fair day, gay bars, sex-on-site venues)	2002: n=812 (5% HIV+); age distribution: <30 31.1%, 30–44 48.5%, ≥45 20.4% 2004: n=1,220 (4.8% HIV+); age distribution: <30 33.4%, 30–44 42.2%, ≥45 24.4% 2006: n=1,228 (3.5% HIV+); age distribution: <30 33.4%, 30–44 44.0%, ≥45 22.7% 2008: n=1,527 (4.3% HIV+); age distribution: <30 31.8%, 30–44 38.9%, ≥45 29.3% 2011: n=1,304 (5.9% HIV+); age	6 months	**Casual partner:** increase 2002–2011, 2006–2011 no change 2002–2006 **Main partner:** no change 2002–2011, 2002–2006, 2006–2011

AIDS Behav. Author manuscript; available in PMC 2018 October 01.

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame	Results reported by authors
				distribution: <30 35.8%, 30–44 35.5%, ≥45 28.7%		
Saxton et al. (2015)	Auckland, New Zealand	2006, 2008, 2011	Convenience sample: Web-based	2006: N=647 (1.4% HIV+); age distribution: mean 34.1 2008: N=443 (2.1% HIV+); age distribution: mean 33.3 2011: N=523 (3.3% HIV+); age distribution: mean 35.1	6 months	**Casual partner:** no change **Main partner:** no change
Zablotska et al. (2011)	Australia	1998–2009	Gay Community Periodic Surveys (GCPS) - Venue-based recruitment	Average annual sample size (range) New South Wales: N=2,642 (2,222–3,732); age distribution: mean 35.6 SD 9.5 Victoria: N=1,907 (1,578–2,064); age distribution: mean 34.8 SD 10.1 Queensland: N=1,428 (1,225–1,787); age distribution: mean 33.0 SD 11.0 South Australia: N=595 (463–864); age distribution not reported Western Australia: N=894 (750–1,035); age distribution not reported Australian Capital Territory: N=296 (255–350); age distribution not reported (HIV prevalence not reported)	6 months	**New South Wales:** Casual partners: Decrease Main partners: Increase **Victoria:** Casual partners: Increase Main partners: Increase **Queensland:** Casual partners: Increase Main partners: Increase **South Australia:** Casual partners: Increase Main partners: Increase **Western Australia:** Casual partners: Increase Main partners: Increase **Australian Capital Territory:** Casual partners: Increase Main partners: Increase
Prestage et al. (2005)	Sydney, Australia	1993–1995, 2001–2003	Convenience sampling at gay community events, venues, and other sources: 1993–1995 Sydney Men and Sexual Health; 2001–2002 Positive Health (HIV+); 2001–2003 Health in Men (HIV−)	1993–1995 HIV+: N=191; age distribution: <25 9.7%, ≥50 4.6% 2001–2002 HIV+: N=154; age distribution: <25 0.0%, ≥50 19.4% 1993–1995 HV−: N=737; age distribution: <25 29.3%, ≥50 6.4% 2001–2003 HIV−: N=920; age distribution: <25 10.5%, ≥50 9.6%	6 months	**Casual partner: HIV+:** increase **HIV−:** increase
Van de Ven et al. (2004)	Sydney, Australia	1999, 2002	Venue community-based recruitment at gay bars, sex on-premises venues, and social events/meetings	1999: N=319 (3.2% HIV+); age distribution: median 29 range 19–65 2002: N=457 (3.6% HIV+); age distribution: median 30 range 19–65	6 months	**Casual partner:** No change **Main partner:** No change
Zablotska et al. (2009)	Sydney, Australia	2003–2006	Convenience sampling at gay community events, venues, and other sources: 2 cohorts – Positive Health (pH) and Health in Men (HIM)	pH: N=760 (HIV+); age distribution (in 2006): median 46 range 26–72 HIM: N=1,427 (HIV−); age distribution (in 2006): median 36 range 18–73 (cohorts)	6 months	**Casual partner: HIV+:** Increase **HIV−:** Decrease

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame	Results reported by authors
Chow et al. (2015)	Melbourne, Australia	2008–2013	All MSM attending a sexual health clinic	2008: casual N=724; main N=396 2009: casual N=1,780; main N=887 2010: casual N=1,320; main N=668 2011: casual N=2,470; main N=1,227 2012: casual N=3,030; main N=1,493 2013: casual N=3,637; main N=1,698 (HIV prevalence not reported); Age distribution overall (not presented by year): median 30 range 14–85	1 year	**Casual partner:** increase **Main partner:** no change

AIDS Behav. Author manuscript; available in PMC 2018 October 01.

Table II

Summary of 16 Studies on temporal trends in anal intercourse without a condom with a partner of unknown/discordant HIV status among MSM, 1994–2011

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame	Results reported by authors
CDC (2013)	USA	2008, 2011	Venue-based sampling of MSM in 20 cities	2008: N=9,253 (12% HIV+); age distribution: 18–24 N=2,071, 25–29 N=1,711, 30–39 N=2,562, ≥40 N=2,909 2011: N=9,253 (13% HIV+); age distribution: 18–24 N=2,352, 25–29 N=1,750, 30–39 N=2,190, ≥40 N=2,961	At last sex	**Overall:** No change **HIV+:** No change **HIV−:** No change
Golden et al. (2008)	Seattle, Washington	2002–2007	All MSM attending STD clinics	2002: HIV− N=1,282; HIV+ N=166 2003: HIV− N=1,214; HIV+ N=160 2004: HIV− N=1,236; HIV+ N=261 2005: HIV− N=1,373; HIV+ N=182 2006: HIV− N=2,134; HIV+ N=260 2007: HIV− N=1,718; HIV+ N=232 Age distribution overall (not presented by year): <24 N=2,170, 25–29 N=2,303, 30–34 N=2,071, 35–39 N=2,117, ≥40 N=3,788	1 year	**HIV+:** Decrease **HIV−:** No change
Menza et al. (2011)	Seattle, Washington	2003, 2006	Random-digit dial household telephone survey	2003: N=400 (13% HIV+); age distribution: median 38 range 19–90 2006: N=400 (13% HIV+); age distribution: median 44 range 20–83	1 year	**Overall:** No change **HIV+:** No change **HIV−:** No change
McFarland et al. (2012)	San Francisco, California	2008–2009	venue-based sampling of MSM (1-year cohort)	N=732 (21% HIV+) Age distribution (baseline): 18–24 14%, 25–34 34%, 35–44 27%, 45–54 15%, ≥55 10% (1-year cohort)	6 months	**HIV+:** No change **HIV−:** No change
Scheer et al. (2008)	San Francisco, California	2005–2007	Street-based intercept interview at gay-oriented events, outside gay clubs/ bars, and in gay neighborhoods	N > 1200 per year (HIV prevalence and age distribution not reported)	Not reported	**HIV+:** No change **HIV−:** Increase
Osmond et al. (2007)	San Francisco, California, USA	1997, 2002	Random-digit-dial telephone survey of MSM households	1997: N=915 (20% HIV+); age distribution: 18–29 15.9%, 30–39 38.0%, 40–49 28.4%, ≥50 17.7% 2002: N=879 (27% HIV+); age distribution: 18–29 8.5%, 30–39 31.8%, 40–49 30.6%, ≥50 29.1%	1 year	**Overall:** Increase
Pantalone et al. (2015)	New York City	2003–2008	Intercept sampling at 2 large lesbian, gay, bisexual community events	2003: N=104; age distribution: 18–40 N=59, >40 N=45 2004: N=84; age distribution: 18–40 N=45, >40 N=39 2005: N=69; age distribution: 18–40 N=36, >40 N=33 2006: N=87; age distribution: 18–40 N=37, >40 N=50 2007: N=36; age distribution: 18–40 N=19, >40 N=17 2008: N=86; age	3 months	**Casual partner: HIV+:** no change

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame	Results reported by authors
				distribution: 18–40 N=41, >40 N=45 (100% HIV+)		
George et al. (2006)	Montreal, Canada	1997–2003	Convenience sampling: recruitment by posters, internet, gay print media, & information cards at gay pride week	N=1,587 (100% HIV−); age distribution (baseline): <30 N=753, ≥30 N=843 (cohort)	6 months	**HIV−:** Increase
Hickson et al. (2013)	England	2001, 2008	Convenience sampling: Recruitment via internet banner ads on gay dating sites, news sites, and community health promotion organization sites	2001: N=3,517 (3% HIV+); age distribution: <20 N=409, 20–29 N=1,407, 30–39 N=1,036, 40–49 N=480, ≥50 N=185 2008: N=1,382 (9% HIV+); age distribution: <20 N=56, 20–29 N=396, 30–39 N=387, 40–49 N=348, ≥50 N=195	1 year	**Known discordant: HIV+:** No change **HIV−:** No change
Lattimore et al. (2011)	London, England	1998–2005, 2008	Venue-based recruitment of gay men at gyms	1998: N=834 (14% HIV+); age distribution: median 34 range 17–74 1999: N=630 (16% HIV+); age distribution: median 34 range 20–67 2000: N=739 (16% HIV+); age distribution: median 35 range 20–77 2001: N=735 (16% HIV+); age distribution: median 35 range 17–72 2002: N=828 (15% HIV+); age distribution: median 35 range 17–74 2003: N=498 (16% HIV+); age distribution: median 36 range 18–65 2004: N=670 (18% HIV+); age distribution: median 37 range 20–69 2005: N=482 (16% HIV+); age distribution: median 36 range 21–67 2008: N=648 (23% HIV+); age distribution: median 39 range 20–87	3 months	**Overall:** 1998–2001 increase, 2001–2005 decrease, 2005–2008 no change **HIV+:** 1998–2001 increase, 2001–2005 decrease, 2005–2008 no change **HIV−:** 1998–2001 increase, 2001–2005 & 2005–2008 No change
Williamson et al. (2006)	London, England & Glasgow, Scotland	1996, 1999, 2002	Venue-based recruitment at commercial gay venues	London: 1996: N=1,895 (HIV prevalence not reported); age distribution: median 30 1999: N=1,368 (13% HIV+); age distribution: median 32 2002: N=1,325 (11% HIV+); age distribution: median 33 Glasgow: 1996: N=1,245 (HIV prevalence not reported); age distribution: median 30 1999: N=1,442 (HIV prevalence not reported); age distribution: median 31 2002: N=972 (7% HIV+); age distribution: median 30	1 year	**London:** Increase **Glasgow:** Increase
Moreau-Gruet et al. (2006)	Switzerland	1994, 1997, 2000	Convenience sampling: surveys were inserted into gay magazines and distributed in homosexual associations, bars, and saunas.	1994: N=1195 (10% HIV+); age distribution: <20 1%, 20–29 33%, 30–39 38%, 40–49 17%, ≥50 11% 1997: N=1097 (11% HIV+); age distribution: <20 1%, 20–29 24%, 30–39 42%, 40–49 18%, ≥50 14% 2000: N=918 (11% HIV+); age distribution: <20 1%, 20–29 16%, 30–39 43%, 40–49 21%, ≥50 18%	1 year	**Main partner: Overall** Decrease

AIDS Behav. Author manuscript; available in PMC 2018 October 01.

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame	Results reported by authors
Seng et al. (2011)	France	2000–2009	Patients with primary HIV-1 infection attending any of 85 hospitals	N=670 (100% HIV+); age distribution (baseline): median 34 IQR 29–40 (cohort)	6 months	**Casual partner: HIV+:** Increase
Cowan et al. (2012)	Denmark	2000, 2001, 2002, 2006, 2009	Convenience sampling: recruitment through gay and HIV-related websites and venues attended by MSM	2000: N=1,745 (11% HIV+) 2001: N=1,574 (9% HIV+) 2002: N=1,538 (11% HIV+) 2006: N=3,141 (8% HIV+) 2009: N=1,310 (9% HIV+); Age distribution not reported	1 year	**Overall:** Increase
Stolte et al. (2004)	Amsterdam, Netherlands	2000–2003	HIV+ men included in the Amsterdam Cohort Studies - Convenience sampling from STI clinics and MSM meeting places and chain referral	N=57 (100% HIV+); age distribution (baseline): median 43 IQR 37.8–53.6 (cohort)	6 months	**Main partner: HIV+:** No change
Zablotska et al. (2009)	Sydney, Australia	2003–2006	Convenience sampling at gay community events, venues, and other sources: 2 cohorts – Positive Health (PH) and Health in Men (HIM)	PH: N=760 (HIV+); age distribution (in 2006): median 46 range 26–72 HIM: N=1,427 (HIV−); age distribution (in 2006): median 36 range 18–73 (cohorts)	12 months	**Known discordant casual partners: HIV+:** No change **HIV−:** Increase

AIDS Behav. Author manuscript; available in PMC 2018 October 01.

Table III

Summary of 16 Studies on temporal trends in number of sex partners among MSM, 1992–2013

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame – cut point	Results reported by authors
Kellogg et al. (2013)	San Francisco, California	2004, 2008	Street intercept sampling of MSM	2004: N=1,079 (13% HIV+); age distribution: median 34 IQR 28–42 2008: N=545 (17% HIV+); age distribution: median 36 IQR 28–45	6 months – 6+ partners	**Overall:** No change
Sudhinaraset et al. (2013)	San Francisco, California	2005, 2008, 2011	Venue-based time-location recruitment in gay venues/areas	2005: N=332 (25% HIV+); age distribution: <30 N=99, ≥30 N=233 2008: N=444 (23% HIV +); age distribution: <30 N=126, ≥30 N=318 2011: N=431 (23% HIV+); age distribution: <30 N=123, ≥30 N=308	6 months – 6+ partners	**Overall:** No change
Reilly et al. (2014)	New York City	2005, 2008, 2011	Venue-based time-location recruitment in gay venues/areas	2005: N=457 (19% HIV+); age distribution: 18–30 N=247, >30 N=210 2008: N=550 (29% HIV +); age distribution: 18–30 N=244, >30 N=306 2011: N=510 (19% HIV+); age distribution: 18–30 N=278, >30 N=232	1 year – 4+ partners	**Overall:** Decrease
Fendrich et al. (2010)	Chicago, Illinois	1997, 2002	Random-digit-dial telephone survey of MSM households (1997); household sampling from two zip codes with high MSM residential density (2002)	1997 n=288 (100% HIV−); age distribution: 18–29 26%, 30–39 44%, 40–49 20%, ≥50 10% 2002 n=151 (100% HIV−); age distribution: 18–29 20%, 30–39 40%, 40–49 28%, ≥50 12%	1997: 1 year; 2002: 6 months – 2+ partners	**HIV−:** No change
Hickson et al. (2013)	England	2001, 2008	Convenience sampling: Recruitment via internet banner ads on gay dating sites, news sites, and community health promotion organization sites	2001: N=3,517 (3% HIV+); age distribution: <20 N=409, 20–29 N=1,407, 30–39 N=1,036, 40–49 N=480, ≥50 N=185 2008: N=1,382 (9% HIV+); age distribution: <20 N=56, 20–29 N=396, 30–39 N=387, 40–49 N=348, ≥50 N=195	1 year – 5+ partners	**Overall:** No change **HIV+:** No change **HIV−:** Decrease
Williamson et al. (2006)	London, England & Glasgow, Scotland	1996, 1999, 2002	Venue-based recruitment at commercial gay venues	London: 1996: N=1,895 (HIV prevalence not reported); age distribution: median 30 1999: N=1,368 (13% HIV+); age distribution: median 32 2002: N=1,325 (11% HIV+); age distribution: median 33 Glasgow: 1996: N=1,245 (HIV prevalence not reported) ; age distribution: median 30 1999: N=1,442 (HIV	1 year – 6+ partners	**London:** Increase **Glasgow:** No change

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame – cut point	Results reported by authors
				prevalence not reported); age distribution: median 31 2002: N=972 (7% HIV+); age distribution: median 30		
Op de Coul et al. (2013)	Netherlands	2007–2011	All STD clinic attendees	2007: N=11,026 2008: N=13,754 2009: N=16,304 2010: N=19,535 2011: N=21,719 (overall 15% HIV+) Age distribution overall (not presented by year): 15–24 N=11,837, 25–34 N=22,448, 35–44 N=23,979, 45–55 N=16,385, >55 N=7,689	6 months – 3+ partners	**Overall:** Increase
Moreau-Gruet et al. (2006)	Switzerland	1992, 1994, 1997, 2000	Convenience sampling: Surveys were inserted into gay magazines. Surveys were also distributed in homosexual associations, bars, and saunas	1992: N=934 (11% HIV+); age distribution: <20 <1%, 20–29 31%, 30–39 32%, 40–49 24%, ≥50 13% 1994: N=1,195 (10% HIV+); age distribution: <20 1%, 20–29 33%, 30–39 38%, 40–49 17%, ≥50 11% 1997: N=1,097 (11% HIV+); age distribution: <20 1%, 20–29 24%, 30–39 42%, 40–49 18%, ≥50 14% 2000: N=918 (11% HIV+); age distribution: <20 1%, 20–29 16%, 30–39 43%, 40–49 21%, ≥50 18%	1 year – 11+ partners	**Overall:** No change
Klavs et al. (2009)	Ljubljana, Slovenia	2001–2008	Venue-based convenience sample of MSM	Range N=68–124 (average N=89) per year (HIV prevalence and age distribution not reported)	12 months – 11+ partners	**Overall:** Decrease
Saxton et al. (2014)	Auckland, New Zealand	2002, 2004, 2006, 2008, 2011	Convenience sampling in community locations (fair day, gay bars, sex-on-site venues)	2002: N=812 (5.0% HIV+); age distribution: <30 31.1%, 30–44 48.5%, ≥45 20.4% 2004: N=1,220 (4.8% HIV+); age distribution: <30 33.4%, 30–44 42.2%, ≥45 24.4% 2006: N=1,228 (3.5% HIV+); age distribution: <30 33.4%, 30–44 44.0%, ≥45 22.7% 2008: N=1,527 (4.3% HIV+); age distribution: <30 31.8%, 30–44 38.9%, ≥45 29.3% 2011: N=1,304 (5.9% HIV+); age distribution: <30 35.8%, 30–44 35.5%, ≥45 28.7%	6 months – 21+ partners	**Overall:** Decrease
Saxton et al. (2015)	Auckland, New Zealand	2006, 2008, 2011	Convenience sampling: Web-based	2006: N=647 (1.4% HIV+); age distribution: mean 34.1 2008: N=443 (2.1% HIV+); age distribution: mean 33.3 2011:	6 months – 21+ partners	**Overall:** Decrease

Author (year)	Location	Years of Data Collection	Sampling Method	Sample	Outcome time frame – cut point	Results reported by authors
				N=523 (3.3% HIV+); age distribution: mean 35.1		
Holt et al. (2013)	Australia	2000/2001, 2008/2009	Venue-based recruitment - Gay Community Periodic Surveys (GCPS)	2000–2001: N=10,537 (11% HIV +); age distribution: HIV+ mean 39.2, HIV− mean 34.9 2008–2009: N=11,083 (10% HIV+); age distribution: HIV+ mean 42.1, HIV− mean 35.7	6 months – 11+ partners	**HIV+:** Decrease **HIV −:** Decrease
Prestage et al. (2005)	Sydney, Australia	1993–1995, 2001–2003	Convenience sampling at gay community events, venues, and other sources: 1993–1995 Sydney Men and Sexual Health; 2001–2002 Positive Health; 2001–2003 Health in Men	1993–1995 HIV+: N=191; age distribution: <25 9.7%, ≥50 4.6% 2001–2002 HIV+: N=154; age distribution: <25 0.0%, ≥50 19.4% 1993–1995 HV−: N=737; age distribution: <25 29.3%, ≥50 6.4% 2001–2003 HIV−: N=920; age distribution: <25 10.5%, ≥50 9.6%	6 months – 10+ partners	**HIV+:** No change **HIV−:** No change
Van de Ven et al. (2004)	Sydney, Australia	1999, 2002	Venue community-based recruitment at gay bars, sex on-premises venues, and social events/meetings	1999: N=319 (3.2% HIV+); age distribution: median 29 range 19–65 2002: N=457 (3.6% HIV+); age distribution: median 30 range 19–65	6 months – 11+ partners	**Overall:** No change
Vodstrcil et al. (2011)	Melbourne, Australia	2002–2009	all MSM attending a sexual health clinic with a positive STD result	N=7133 – total; age distribution: median 31 range 15–84 (HIV prevalence not reported)	3 months – 2+ partners	**Overall:** Decrease
Chow et al. (2015)	Melbourne, Australia	2007–2013	All MSM attending a sexual health clinic	2007: N=2,607 2008: N=3,191 2009: N=3,566 2010: N=4,082 2011: N=4,614 2012: N=5,422 2013: N=6,188 (HIV prevalence not reported) Age distribution overall (not presented by year): median 30 range 14–85	12 months – 11+ partners	**Overall:** Decrease