Changing patterns of sexual risk behaviour among London gay men: 1998-2008

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Summary: Changing patterns of sexual behaviour among gay men in London between 1998 and 2008 were dynamic and complex. HIV risk with a main partner should be given greater priority by health promotion programmes.

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Abstract

Objectives: To examine changes in the sexual behaviour of London gay men between 1998-2008.

Methods: Gay men using London gyms were surveyed annually between 1998-2005, and again in 2008 (n = 6064; range 482 to 834 per year). Information was collected on HIV status of the respondent, unprotected anal intercourse (UAI) in the previous 3 months, type (main or casual) and HIV status of partner for UAI. Nonconcordant UAI (ncUAI) was defined as UAI with a partner of unknown or discordant HIV status. Concordant UAI (cUAI) was defined as UAI with a partner of the same HIV status ("serosorting").

Results: Between 1998-2008 the percentage of men reporting UAI increased from 24.3% to 36.6% (p=0.07). This overall increase concealed important differences between non-concordant and concordant UAI. While the percentage of men engaging in cUAI increased steadily between 1998-2008 (9.8%, 20.8%, p=0.01), the percentage reporting ncUAI increased between 1998-2001 (14.5%, 23.7%, p<0.001), decreased between 2001 and 2005 (23.7%, 15.6%, p<0.001) and then levelled off between 2005 and 2008 (15.6%, 15.7%, p=0.2). However, the percentage of men reporting ncUAI with a main partner increased between 2005-2008 for HIV positive men (2.5%, 8.1%, p<0.05) and HIV negative men (2.1%, 5.5%, p=0.06). While the percentage of HIV negative men who reported cUAI with a main partner (i.e. serosorting) increased between 1998-2008 (12.4%, 21.1%, p<0.05), less than half established seroconcordance by testing together.

Conclusion: The patterns of sexual behaviour among London's gay men between 1998-2008 were dynamic and complex. Our data suggest that HIV risk with a main partner and HIV testing among couples should be given greater priority by health promotion programmes.

Abstract 267 words

Introduction

Since 1996 there has been a steady increase in the number of sexually transmitted infections (STIs), including HIV, diagnosed among men who have sex with men (MSM) in the UK as well as across Europe, Canada, USA and Australia [1,2]. Enhanced surveillance of syphilis, gonorrhoea and LGV in the UK has also shown an increase in the percentage of cases diagnosed among HIV positive MSM, suggesting ongoing high risk behaviour among MSM already aware of their HIV positive status [1,3,4].

Engaging in unprotected anal intercourse (UAI) with partners of the same HIV status (serosorting) is an HIV risk reduction strategy adopted by some gay men [5-9]. While serosorting can reduce the risk of HIV transmission (providing HIV status is reliably ascertained) there remains the risk of transmitting other sexually transmitted infections. Serosorting explains, at least in part, the increasing number of STIs diagnosed among HIV positive MSM in recent years [1,10,11]. STIs are an important health problem for MSM; they may increase an individual's susceptibility to acquiring HIV infection but also impact upon the infectiousness and disease progression of those who are already HIV positive. [12,13].

In the UK, health promotion campaigns aimed at reducing HIV transmission have traditionally focused on the risks associated with casual sex partners. However, a number of studies suggest that a significant proportion of new HIV infections may be attributable to sex with a main rather than a casual partner [14,15]. This raises the question as to whether HIV risk with a main partner should be given greater priority in the UK.

Behavioural surveillance among gay men allows us to monitor changing patterns of HIV and STI risk behaviours [16,17] . In this paper we examine trends in sexual behaviour among

London gay men between 1998 and 2008, paying particular attention to the type of partner(s) men had sex with and the HIV status of their sexual partner(s).

Methods

Data collection

Gay/bisexual men who use London gyms were surveyed annually between 1998 and 2005 and again in 2008 as part of a behavioural surveillance programme [18,19]. Each year men were asked to complete a confidential self-administered questionnaire providing information on social and demographic characteristics, HIV status, self-reported sexual behaviour, recreational drug use and HIV treatment optimism. From 1999, men were asked whether they had participated in previous gym surveys. No financial incentives were offered for taking part. The methods have been described in detail elsewhere [20]

Men were asked whether they had had unprotected anal intercourse (UAI) in the previous 3 months and, if so, the type (main or casual) and HIV status of their UAI partner(s). Data were collected about partners in aggregate rather than on a partner-by-partner basis (eg UAI in the last 3 months with any casual partner who was HIV positive).

UAI was classified as either concordant (only with a partner of the same HIV status) or non-concordant (with a partner of unknown or discordant HIV status). Men reporting both concordant and nonconcordant UAI were assigned to the group of greatest risk for HIV transmission, i.e. nonconcordant UAI. Men were only classified as having concordant UAI if they said they *knew* the HIV status of their sexual partner was the same as theirs. If they said they *assumed* their partner's HIV status was the same as theirs they were classified as having UAI with a partner of unknown status (ie nonconcordant UAI).

In this analysis, concordant (cUAI) and nonconcordant UAI (ncUAI) are mutually exclusive categories. ncUAI clearly presents a risk for HIV transmission. Concordant UAI ("serosorting")

may not present a risk for HIV, providing both men can accurately ascertain their HIV status, but does present a risk for the transmission of other STIs [10,11]. Men who reported UAI only with a main partner were analysed separately from those who reported UAI with casual partners. Men who reported both a main and casual partner were placed in the "casual partner" category.

From 2000 onwards, men were asked whether they had used the Internet to look for sexual partners in the last 12 months. In addition, in 2008 we asked men who said they *knew* their UAI partner's HIV status, "How did you know the HIV status of the man (men) with whom you had anal sex without a condom in the last 3 months?".

Statistical analysis

The data were analysed using the R statistical environment on a Linux platform. Descriptive statistics are presented for all respondents in Tables 1-3. To assess the effect of potential confounding factors, both unadjusted (OR) and adjusted odds ratios (aOR) for the period 1998-2005 were calculated using logistic regression, excluding men who had completed a questionnaire in previous years. Potential confounders included age, being in a relationship, steroid use, HIV treatment optimism, recreational drug use and seeking sex through the internet [21-23]. Marginal differences were seen between unadjusted and adjusted ORs, therefore only aOR are shown in Tables 2 and 3 (full data available from authors upon request). Trends between 2005 and 2008 were examined using a Chi Squared test for trend with 2006 and 2007 data imputed through the *Amelia* bootstrapped multiple imputation algorithm [24]. Results are presented for three time periods. Phase I, 1998 to 2001; Phase II, 2001 to 2005; Phase III 2005 to 2008.

Results

Complete information on HIV status, sexual risk behaviour and potential confounders was provided by 6064 men over the study period (Table 1): HIV positive 1001 (16.5%), HIV negative 3866 (63.8%), never-tested 1197 (19.7%) (range: 482-834 per year, estimated response rate: 50-60%) [20]. The percentage of men who reported ever having had an HIV test increased from 72.1% in 1998 to 90.1% in 2008 ($p<0.001$), with 50.8% (329/648) of gay men in 2008 reporting a HIV test within the previous 12 months. Between 1998 and 2008, median age increased from 35 to 41 years for HIV positive men ($p<0.001$) and from 33 to 37 years for HIV negative men ($p<0.001$); there was no such increase for never tested men ($p=0.31$). The percentage of men who said they used the Internet to look for sex increased from 27.2% in 2000 to 59.1% in 2008 ($p=0.01$). There was no significant trend over time in recreational drug use, steroid use, HIV treatment optimism or being in a relationship (Table 1).

After excluding 2780 men who had completed a previous questionnaire, 3287 respondents remained for the independent samples analysis. Detailed analysis of the sexual behaviour of those respondents included and excluded from the independent samples analysis showed no systematic differences between the two groups (data available from the authors on request).

Unprotected anal intercourse

The overall percentage of gay men who reported engaging in any UAI in the previous 3 months (i.e. nonconcordant or concordant) increased from 24.3% in 1998 to 36.6% in 2008 ($p=0.07$; Table 2, figure 1). However, this overall increase conceals some important differences in trends for nonconcordant and concordant UAI.

Overall, the percentage of men who engaged in ncUAI increased significantly between 1998 and 2001 ($p<0.001$), followed by a significant decrease between 2001 and 2005 ($p<0.001$) and a levelling off between 2005 and 2008 ($p=0.23$; Table 2; Figure 1). In contrast, the percentage of men engaging in concordant UAI (ie serosorting) showed a steady increase between 1998 and 2008 ($p=0.01$; Table 2, Figure 1). In 2005, the percentage of men reporting cUAI exceeded the percentage reporting ncUAI for the first time since data collection began in 1998, and has remained higher ever since.

Nonconcordant unprotected anal intercourse

Although the percentage of men who engaged in ncUAI increased significantly between 1998 and 2001, decreased between 2001 and 2005 and then levelled off (Table 2; Figure 1), this overall trend conceals some important differences according to the HIV status of the respondent and the type of partner (main or casual; Table 3).

Casual partner

The overall trend in ncUAI has been largely driven by changing patterns of ncUAI with casual partners. The percentage of men reporting ncUAI with a casual partner increased from 6.7% to 15.2% between 1998 and 2001 ($p<0.001$), then decreased to 11.6% in 2005 ($p<0.05$), falling further to 8.6% in 2008 ($p=0.05$, Table 3, Figure 2a).

The increase in ncUAI with a casual partner between 1998 and 2001 was reported among all men irrespective of HIV status (HIV positive, negative and never tested; Table 3; Fig. 2b). The decline in the percentage of men reporting ncUAI with a casual partner between 2001 and 2005 was especially notable among HIV positive men ($p<0.05$) and to a lesser extent among HIV negative men ($p=0.09$). Between 2005 and 2008, however, ncUAI with a casual partner

among HIV positive (p=0.9) and never tested men (p=0.6) remained stable while the percentage of HIV negative men reporting ncUAI with a casual partner continued to fall (from 10.3% to 5.5%, p<0.05), reaching the lowest level reported over the 10 year survey period.

Main partner

The percentage of men reporting ncUAI with a main partner alone decreased significantly from 7.8% in 1998 to 3.9% in 2005 (p<0.05) followed by a significant increase to 7.1% in 2008 (p<0.05; Table 3, Fig. 2a). Between 2005 and 2008, the percentage of men reporting ncUAI with a main partner increased from 2.5% to 8.1% (p<0.05) for HIV positive gay men and from 2.1% to 5.5% (p=0.06) for HIV negative men (Table 3; Figure 2c). This is the first time we have recorded an increase in ncUAI with a main partner since data collection began in 1998.

As a result of the decrease in ncUAI with a casual partner and an increase in ncUAI with a main partner, in 2008 there was little difference in the overall percentage of men reporting ncUAI with a main partner alone (7.1%) or with a casual partner (8.6%) (Table 3, Figure 2a).

Discordant vs. status unknown partner

The majority of men who reported ncUAI in **2008** said this had occurred with a man of unknown rather than discordant serostatus. In most cases where men did not know the HIV status of their partners, they had *assumed* it was the same as theirs. Among the 24 HIV negative men who reported ncUAI with a main partner; one said he knew his partner was HIV positive while the remaining 23 said they did not know their partner's status. On the other hand, among the 12 HIV positive men reporting ncUAI with a main partner, 6 reported knowing their partner was HIV negative.

Concerning casual partners, all 28 HIV positive men and 23 out of 24 HIV negative men reporting ncUAI with a casual partner said their partners were of unknown serostatus. Only one HIV negative men said he knew his casual ncUAI partner was discordant (i.e. HIV positive).

Concordant unprotected anal intercourse – "Serosorting"

Overall, the percentage of men engaging in cUAI increased significantly from 9.8% in 1998 to 20.8% in 2008 (p=0.01) (Table 2, Figure 1). However this increasing trend conceals key differences depending upon the HIV status of the respondent and the type of partner (main or casual; Table 3).

Casual partner

The percentage of HIV positive men reporting cUAI with a casual partner increased significantly between 1998 and 2005 (6.8%, 17.7%, p<0.01) and then ***decreased*** between 2005 and 2008 (17.7%, 14.2%, p=0.05). On the other hand, only a small number of HIV negative men reported cUAI (serosorting) with a casual partner throughout the study period with no significant trend between 1998 and 2008 (1.7%, 1.6%, p=0.9) (Table 3, Figure 3a)

Main partner

The percentage of HIV negative men reporting cUAI with a main partner alone increased significantly from 12.4% in 1998 to 21.1% in 2008 (p<0.05). HIV positive men were less likely to report cUAI with a main partner than HIV negative men, but nonetheless there was also an increasing trend among positive men over time (5.1%, 10.1% p<0.05) (Table 3, Figure 3b).

Establishing seroconcordance

In **2008**, of the 135 men who reported cUAI (i.e. serosorting), 127 reported how they knew the HIV status of their partner(s). Among the HIV negative men who reported cUAI, only 7 reported cUAI with a casual partner while 85 reported cUAI with a main partner Of these 85 men, 53 (62.1%) said they knew their main partner's HIV status through verbal disclosure, while 35 (41.2%) reported HIV testing together. Nearly all the 35 HIV positive men who serosorted said their partner had told them about their status, but over a quarter (n=10) also relied on a person's online profile or website.

Discussion

In this paper we have described trends in unprotected anal intercourse (UAI) between 1998 and 2008 among gay men in London. Overall, the percentage of gay men in our study who engaged in UAI steadily increased between 1998 and 2008, a finding reported in other behavioural surveys in London and elsewhere [25-29]. In 2008 over a third of all men reported UAI in the previous 3 months, compared to a quarter in 1998.

The overall trend in UAI masked a more complex picture which became evident when UAI was classified as concordant (cUAI) or nonconcordant (ncUAI). ncUAI increased rapidly from 1998 to 2001, after which it decreased. By 2008 ncUAI had almost fallen back to the level reported in 1998. By way of comparison, cUAI, or serosorting, has shown an increasing trend among London's gay men since 1998. As a consequence, by 2008 more London gay men in our survey reported cUAI (serosorting) than ncUAI.

We have also found that patterns of ncUAI varied considerably by partner type, with distinctly different trends for casual and main partners. With casual partners, there was an increase in ncUAI between 1998 and 2003, after which it steadily decreased. However,

ncUAI with a main partner has shown the opposite trend, initially decreasing up until 2005, and then increasing. This is the first time that we have seen an increase in the percentage of men reporting ncUAI with their main partner since data collection began in 1998. As a result, in 2008 there was little difference between the level of risk reported with main or casual partners.

Main partners have been implicated in HIV transmission among gay men in the Netherlands, Germany and the USA [14,15,30,31]. Our data suggest that main partners may have become an important source of HIV risk among London's gay men, highlighting a key, and as yet, under-served area of health promotion. In addition we have shown that the majority of men who engaged in ncUAI with their main partner reported not knowing the status of their partner, rather than knowing that they were discordant. This suggests that work may also need to be done around HIV testing within partnerships.

Recent trends in ncUAI varied according to the HIV status of the respondent. The increase in ncUAI with a main partner since 2005 was seen mostly among HIV positive men, and to a slightly lesser extent among HIV negative men. However, ncUAI with a casual partner remained stable among HIV positive and never tested gay men between 2005 and 2008, but decreased among HIV negative men. By 2008, ncUAI with a casual partner reached the lowest level reported among HIV negative men over the 10 year survey period. This is an encouraging trend and is likely to reflect consistent and sustained health promotion campaigns targeting gay men. Similar decreases in ncUAI have been reported among MSM in San Francisco [10] and Sydney [32]

Over the 10 years of the survey, the overall percentage of men reporting UAI with men of the same HIV status (serosorting) doubled, although this varied according to partner type and HIV status of respondent.

Among HIV negative men serosorting with a casual partner has remained consistently low over the survey period in contrast to trends reported among HIV negative gay men in Sydney [33,34]. This is a reassuring finding and reflects how difficult it is for HIV negative men to reliably establish seroconcordance with casual partners [6]. In marked contrast, the percentage of HIV positive men who reported serosorting with a casual partner increased between 1998 and 2005 but then decreased between 2005 and 2008. Nonetheless, the overall percentage of HIV positive men who serosort with casual partners remains high (one in seven in 2008). An increase in serosorting has also been reported among HIV positive MSM in Seattle [8]

Enhanced surveillance for sexually transmitted infections in the UK has revealed an increasing proportion of STIs among those already infected with HIV [1]. This mirrors the trends in serosorting among HIV positive men reported here. In 2008, one in seven HIV positive men in our study reported serosorting with casual partners. It remains to be seen whether the reduction since 2005 in the percentage of HIV positive men serosorting with casual partners in this study translates into a reduction in new STI diagnoses among this group, or whether STIs will continue to circulate among networks of HIV positive MSM as has been seen in other European countries [35]. It is therefore important that targeted and innovative campaigns continue to highlight the implications of additional STIs in those already infected with HIV.

Serosorting relies on men disclosing their HIV status, and reliably establishing the HIV status of their sexual partners. Men described a variety of mechanisms through which they established the HIV status of their cUAI partners. Most frequently this involved verbal disclosure, co-testing for HIV and to a lesser extent, the use of online profiles and websites.

Among HIV negative men we continued to see a steady increase in the percentage who reported UAI only with a main partner of the same HIV status. However, in 2008, almost two thirds of HIV negative men who reported concordant UAI with their main partner relied on ***verbal*** disclosure to establish seroconcordance and ***less than half*** reported testing with their partner for HIV. Verbal disclosure among HIV negative men is not entirely satisfactory, since it relies on an accurate knowledge of their own HIV status, and will depend on the time since their last test and their subsequent risk behaviour. Although an increasing percentage of HIV negative men reported concordant UAI with a main partner, the mechanism through which many of them establish concordance is unreliable. Rather than serosorting or even seroguessing, many of these men appear to be "sero-hoping" [8]. It is therefore crucial that future health promotion campaigns promote HIV testing among couples, both at the outset of the relationship to establish seroconcordance and at intervals during the relationship depending upon the context (monogamous or otherwise).

The majority of HIV positive men who serosorted relied on verbal disclosure with almost a third also using online profiles and websites, highlighting the importance of the internet as a medium through which HIV positive men can disclose their status [36]. In marked contrast to HIV negative men, however, HIV positive men can reliably establish concordance through mutual disclosure.

It is encouraging that there has been a steady increase in the percentage of men *ever* tested for HIV in our study, reaching 90% in 2008. This is likely to reflect the success of universally offering the HIV test in sexual health clinics in Britain. HPA data indicate that uptake of HIV testing among MSM in this setting increased substantially between 2003 to 2008 [37].

There are a number of limitations to the study. No information is available on trends in *receptive* and *insertive* UAI over time, nor did we ask about withdrawal prior to ejaculation. Furthermore, we did not collect information on the viral load of HIV positive men which men may use to inform their decisions around risk.

In conclusion, the patterns of sexual behaviour among London's gay men between 1998 and 2008 appear to be dynamic and complex. We have seen clear differences in trends in sexual behaviour according to the type of partner (casual or main), and the HIV status of the partner (concordant or nonconcordant). These findings throw into sharp focus the importance of differentiating between seroconcordant and nonconcordant partners when tracking trends in UAI, as well as understanding the context in which risk occurs [38]. Our study highlights the importance of conducting behavioural surveillance, based on repeat cross-sectional studies in sentinel populations, to monitor trends in risk behaviour and partnership patterns over time [16,17]

For the first time since we began to survey gay men attending central London gyms, we have seen an increase in HIV risk behaviour with a ***main partner***. In addition, although we have seen an encouraging increase over time in the percentage of HIV negative men who serosort with a ***main partner*** the mechanism by which they establish seroconcordance is often unreliable. These recent trends in sexual behaviour among gay men suggest that HIV risk

with a ***main partner*** and HIV testing among couples should now be given greater priority by health promotion programmes in London and elsewhere in the UK.

Figures

Figure 1. Percentage of gay men who reported engaging in unprotected anal intercourse (UAI) in the previous 3 months; any UAI, concordant UAI and nonconcordant UAI. Data points for observed values are shown as filled points, and imputed values unfilled.

Figure 2. Percentage of gay men who reported engaging in nonconcordant unprotected anal intercourse (ncUAI) in the previous 3 months (a) by partner type (b) with a casual partner by HIV status and (c) with a main partner by HIV status. Data points for observed values are shown as filled points, and imputed values unfilled.

Figure 3. Percentage of gay men who reported engaging in concordant unprotected anal intercourse (cUAI) in the previous 3 months (a) with a casual partner by HIV status and (b) with a main partner by HIV status. Data points for observed values are shown as filled points, and imputed values unfilled.

References

1. The UK collaborative Group on HIV and STI Surveillance. **Sexually transmitted infections and man who have sex with men in the UK: 2008 Report**. London: Health Protection Agency, Centre for Infections. Dec 2008

2. Elford J. **Changing patterns of sexual behaviour in the era of highly active antiretroviral therapy**. *Curr Opin Infect Dis*. 2006;**19**:26-32.

3. Dodds JP, Johnson AM, Parry JV, Mercey DE. **A tale of three cities: persisting high HIV prevalence, risk behaviour and undiagnosed infection in community samples of men who have sex with men**. *Sex Transm Infect.* 2007;**83**:392-6.

4. Cohen MS. **HIV and sexually transmitted diseases: lethal synergy**. *Top HIV Med*. 2004;*12*:104-7.

5. Rietmeijer CA, Lloyd LV, McLean C. **Discussing HIV serostatus with prospective sex partners: a potential HIV prevention strategy among high-risk men who have sex with men**. *Sex Transm Dis.* 2007;**34**:215-9.

6. Wilson DP, Regan DG, Heymer KJ, Jin F, Prestage GP, Grulich AE. **Serosorting may increase the risk of HIV acquisition among men who have sex with men.** *Sex Transm Dis.* 2010;**37**:13-7.

7. Cassels S, Menza TW, Goodreau SM, Golden MR. **HIV serosorting as a harm reduction strategy: evidence from Seattle, Washington.** *AIDS*. 2009;23:2497-506.

8. Golden MR, Stekler J, Hughes JP, Wood RW. **HIV serosorting in men who have sex with men: is it safe?** *J Acquir Immune Defic Syndr.* 2008;49:212-8. Erratum in: *J Acquir Immune Defic Syndr.* 2008;49:464.

9. Marks G, Millett GA, Bingham T, Lauby J, Murrill CS, Stueve A. **Prevalence and Protective Value of Serosorting and Strategic Positioning Among Black and Latino Men Who Have Sex With Men.** *Sex Transm Dis.* 2010 Jan 14. [Epub ahead of print]

10. Truong HM, Kellogg T, Klausner JD, Katz MH, Dilley J, Knapper K, Chen S, Prabhu R, Grant RM, Louie B, McFarland W. **Increases in sexually transmitted infections and sexual risk behaviour without a concurrent increase in HIV incidence among men who have sex with men in San Francisco: a suggestion of HIV serosorting?** *Sex Transm Infect.* 2006;82:461-6. Erratum in: *Sex Transm Infect.* 2007;83:76. Truong, H-H M [corrected to Truong, H M].

11. van der Bij AK, Stolte IG, Coutinho RA, Dukers NH. **Increase of sexually transmitted infections, but not HIV, among young homosexual men in Amsterdam: are STIs still reliable markers for HIV transmission?** *Sex Transm Infect.* 2005;81:34-7.

12. Nusbaum MR, Wallace RR, Slatt LM, Kondrad EC. **Sexually transmitted infections and increased risk of co-infection with human immunodeficiency virus.** *J Am Osteopath Assoc* 2004;**104**:527-35.

13. Rottingen JA, Cameron DW, Garnett GP. **A systematic review of the epidemiologic interactions between classic sexually transmitted diseases and HIV: how much really is known?** *Sex Transm Dis*. 2001 **28**:579-97.

14. Sullivan PS, Salazar L, Buchbinder S, Sanchez TH. **Estimating the percentage of HIV transmissions from main sex partners among men who have sex with men in five US cities.** *AIDS*. 2009;**23**:1153-62.

15. Xiridou M, Geskus R, De Wit J, Coutinho R, Kretzschmar M. **The contribution of steady and casual partnerships to the incidence of HIV infection among homosexual men in Amsterdam.** *AIDS*. 2003;**17**:1029-38.

16 Elford J, Jeannin A, Spencer B, Gervasoni JP, van de Laar MJ, Dubois-Arber F; HIV and STI Behavioural Surveillance Mapping Group**. HIV and STI behavioural surveillance among men who have sex with men in Europe.** *Euro Surveill.* 2009;**14**. pii: 19414.

17 McGarrigle CA, Fenton KA, Gill ON, Hughes G, Morgan D, Evans B. **Behavioural surveillance: the value of national coordination.** *Sex Transm Infect*. 2002;**78**:398-405.

18. Elford J, Bolding G, Sherr L, Hart G. **High-risk sexual behaviour among London gay men: no longer increasing.** *AIDS*. 2005;**19**:2171-4.

19. Elford J, Bolding G, Davis M, Sherr L, Hart G. **Trends in sexual behaviour among London homosexual men 1998-2003: implications for HIV prevention and sexual health promotion.** *Sex Transm Infect*. 2004;**80**:451-4.

20. Elford J, Bolding G, Davis M, Sherr L, Hart G. **The Internet and HIV study: design and methods.** *BMC Public Health* 2004, 4:39 (http://www.biomedcentral.com/1471-2458/4/39)

21. Elford J, Bolding G, Sherr L **High risk sexual behaviour increases among London gay men between 1998-2001: what is the role of HIV optimism?** *AIDS* 2002;**16**:1537-1544;

22. Bolding G, Davis M, Hart G, Sherr L, Elford J **Gay men who look for sex on the Internet: is there more HIV/STI risk with online partners?** *AIDS* 2005;**19**:961-968;

23. Bolding G, Hart G, Sherr L, Elford J **Use of crystal methamphetamine among London gay men.** *Addiction* 2006;**101**:1622-30.

24. Honaker J, King G, Blackwell M. Amelia: **A Program for Missing Data.** Cambridge, Harvard University. http://GKing.Harvard.edu (accessed December 2008).

25. Dodds JP, Mercey DE, Parry JV, Johnson AM. **Increasing risk behaviour and high levels of undiagnosed HIV infection in a community sample of homosexual men.** *Sex Transm Infect*. 2004;**80**:236-40.

26 Dodds JP, Nardone A, Mercey DE, Johnson AM**. Increase in high risk sexual behaviour among homosexual men, London 1996-8: cross sectional, questionnaire study**. *BMJ*. 2000;**320**:1510-1. Erratum in: *BMJ* 2000;**321**:675.

27 Van de Ven P, Prestage G, Crawford J, Grulich A, Kippax S. **Sexual risk behaviour increases and is associted with HIV optimism among HIV-negative and HIV-positive gay men in Sydney over the 4 year period to February 2000**. *AIDS*. 2000;**14**:2951-3.

28 Grulich A. **HIV risk behaviour in gay men: on the rise?** *BMJ*. 2000;**320**:1487-8.

29 Osmond DH, Pollack LM, Paul JP, Catania JA. **Changes in prevalence of HIV infection and sexual risk behavior in men who have sex with men in San Francisco: 1997 2002.** *Am J Public Health*. 2007;**97**:1677-83.

30. Davidovich U, de Wit J, Albrecht N, Geskus R, Stroebe W, Coutinho R. **Increase in the share of steady partners as a source of HIV infection: a 17-year study of seroconversion among gay men.** *AIDS.* 2001;**15**:1303-8

31. Bochow M. **Schwule Manner, AIDS und Safer Sex: neue Entwicklungen**. Deutche AIDS-Hilfe. e.V., Berlin, 2001.

32. Zablotska IB, Prestage G, Grulich AE, Imrie J. **Differing trends in sexual risk behaviours in three Australian states: New South Wales, Victoria and Queensland, 1998-2006.** *Sex Health.* 2008;**5**:125-30.

33. Elford J, Bolding G, Sherr L, Hart G. **No evidence of an increase in serosorting with casual partners among HIV negative gay men in London 1998-2005**. *AIDS* 2007; **21**: 243-245

34. Mao L, Crawford J, Hospers H, Prestage G, Grulich A, Kaldor J, et al. **"Serosorting" in casual anal sex of HIV negative gay men is noteworthy and is increasing in Sydney, Australia.** *AIDS* 2006;**20**:1204-1206.

35. Dougan S, Evans BG, Elford J. **Sexually transmitted infections in western Europe among HIV positive men who have sex with men.** *Sexually Transmitted Diseases* 2007;**34**:783-790

36. Davis M, Hart G, Bolding G, Sherr L, Elford J. **Sex and the Internet: gay men, risk reduction and serostatus.** *Cult Health Sex*. 2006; **8**:161-174.

37. Leong, G. **Testing offer and uptake among MSM**. *Health Protection Agency, Centre for Infections*. Personal communication; 24. September 2009

38. Xia Q, Molitor F, Osmond DH, Tholandi M, Pollack LM, Ruiz JD, Catania JA. **Knowledge of sexual partner's HIV serostatus and serosorting practices in a California population-based sample of men who have sex with men**. *AIDS* 2006;**20**:2081-2089

Table 1. Number (%) of men surveyed between 1998 and 2008 and potential confounding factors

	1998		1999		2000		2001		2002		2003		2004		2005		2008		1998-2008
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	P value[1]
Number of men surveyed																			
HIV positive	118	*14.1*	101	*16.0*	120	*16.2*	116	*15.8*	121	*14.6*	78	*15.7*	120	*17.9*	79	*16.4*	148	*22.8*	-
HIV negative	483	*57.9*	396	*62.9*	459	*62.1*	438	*59.6*	542	*65.5*	334	*67.1*	447	*66.7*	331	*68.7*	436	*67.3*	-
Never tested	233	*27.9*	133	*21.1*	160	*21.7*	181	*24.6*	165	*19.9*	86	*17.3*	103	*15.4*	72	*14.9*	64	*9.9*	-
All men	834	*100.0*	630	*100.0*	739	*100.0*	735	*100.0*	828	*100.0*	498	*100.0*	670	*100.0*	482	*100.0*	648	*100.0*	-
Potential confounding factors																			
In a relationship with a man	478	*57.3*	359	*57.0*	410	*55.5*	384	*52.2*	436	*52.7*	273	*54.8*	341	*50.9*	246	*51.0*	350	*54.0*	0.25
HIV treatment optimism[2]	-	-	-	-	133	*18.0*	128	*17.4*	159	*19.2*	108	*21.7*	137	*20.4*	92	*19.1*	152	*23.5*	0.06
Steriod use	131	*15.7*	131	*20.8*	110	*14.9*	87	*11.8*	109	*13.2*	70	*14.1*	92	*13.7*	71	*14.7*	103	*15.9*	0.11
Recreational drug use[2]	-	-	391	*62.1*	416	*56.3*	393	*53.5*	442	*53.4*	294	*59.0*	383	*57.2*	263	*54.6*	408	*63.0*	0.72
Seeking sex on the Internet[2]	-	-	-	-	201	*27.2*	261	*35.5*	368	*44.4*	263	*52.8*	341	*50.9*	264	*54.8*	383	*59.1*	0.01
Median age (range)	34	*17-74*	34	*20-67*	35	*20-77*	35	*17-72*	35	*17-74*	36	*18-65*	37	*20-69*	36	*21-67*	39	*20-87*	<0.001

1. P value for confounding variables calculated using a Chi-Squared test for trend, incorporating imputed data for missing years
2. Data on HIV treatment optimism available from 2000 onwards (percentage of men who agreed with the statement “I am less worried about HIV infection now that treatments have improved”); data on recreational drug use in last 12 months available from 1999, and seeking sex through the Internet from 2000.

Table 2. Number (%) of men reporting unprotected anal intercourse (UAI) between 1998 and 2008

HIV status of respondent	1998		1999		2000		2001		2002		2003		2004		2005		2008		1998 - 2001			2001 - 2005			2005 - 2008		1998 - 2008	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	aOR[1]	95% CI	p val	aOR[1]	95% CI	p val	Chi-Stat[2]	p val	Chi-Stat[2]	p val
All UAI	203	*24.3*	182	*28.9*	249	*33.7*	255	*34.7*	307	*37.1*	181	*36.3*	227	*33.9*	164	*34.0*	237	*36.6*	1.31	1.16, 1.48	<0.001	0.97	0.92, 1.03	0.41	0.18	0.67	3.26	0.07
HIV positive	37	*31.4*	30	*29.7*	49	*40.8*	69	*59.5*	69	*57.0*	44	*56.4*	62	*51.7*	40	*50.6*	76	*51.4*	1.77	1.41, 2.03	<0.001	0.95	0.87, 1.51	0.37	0.03	0.89	13.73	<0.001
HIV negative	130	*26.9*	132	*33.3*	163	*35.5*	149	*34.0*	205	*37.8*	125	*37.4*	150	*33.6*	108	*32.6*	147	*33.7*	1.06	0.92, 1.21	0.43	1.03	0.96, 1.09	0.42	0.03	0.84	0.65	0.79
Never tested	36	*15.5*	20	*15.0*	37	*23.1*	37	*20.4*	33	*20.0*	12	*14.0*	15	*14.6*	16	*22.2*	13	*20.3*	1.24	0.95, 1.63	0.11	0.84	0.73, 0.97	0.02	0.11	0.74	0.54	0.65
Non-concordant UAI	121	*14.5*	106	*16.8*	136	*18.4*	174	*23.7*	181	*21.9*	108	*21.7*	137	*20.4*	75	*15.6*	102	*15.7*	1.44	1.24, 1.65	<0.001	0.64	0.32, 0.75	<0.001	0.03	0.23	0.45	0.50
HIV positive	23	*19.5*	20	*19.8*	25	*20.8*	50	*43.1*	51	*42.6*	31	*48.7*	41	*34.2*	18	*22.8*	40	*27.0*	1.88	1.43, 2.5	<0.001	0.88	0.79, 0.98	0.04	0.56	0.45	0.20	0.65
HIV negative	62	*12.8*	66	*16.7*	74	*16.1*	87	*19.9*	97	*17.9*	65	*19.5*	81	*18.1*	41	*12.4*	48	*11.0*	1.21	1.02, 1.45	0.03	0.95	0.87, 1.03	0.23	0.10	0.75	2.24	0.13
Never tested	36	*15.5*	20	*15.0*	37	*23.1*	37	*20.4*	33	*20.0*	12	*14.0*	15	*15.6*	16	*22.2*	14	*21.9*	1.24	0.95, 1.63	0.12	0.84	0.73, 0.97	0.02	0.60	0.96	1.78	0.18
Concordant UAI	82	*9.8*	76	*12.1*	113	*15.3*	81	*11.0*	126	*15.2*	73	*14.7*	90	*13.4*	89	*18.5*	135	*20.8*	1.16	0.68, 2.02	0.59	1.16	1.01, 1.25	0.04	0.64	0.47	9.09	0.01
HIV positive	14	*11.9*	10	*9.9*	24	*5.0*	19	*16.4*	18	*14.9*	13	*16.7*	21	*17.5*	22	*17.8*	36	*24.3*	1.43	1.01, 2.04	0.04	1.13	0.97, 1.32	0.11	1.55	0.22	17.45	<0.001
HIV negative	68	*14.1*	66	*16.7*	89	*19.4*	62	*14.2*	108	*19.9*	60	*18.0*	69	*15.4*	67	*20.2*	99	*22.7*	0.89	0.74, 1.08	0.24	1.11	1.02, 1.20	0.02	0.20	0.65	3.33	0.05

aOR, Adjusted odds ratio; CI, confidence interval; Chi-Stat, Chi Squared test for trend statistic; UAI, unprotected anal intercourse.

[1] aOR derived from a multivariate model that excluded men who had completed a questionnaire in a previous year to ensure the independence of samples [10]. After excluding men who had completed a previous questionnaire, 3287 respondents remained for the independent samples analysis. The aOR measured the annual increase (or decrease) in the likelihood of reporting UAI after controlling for confounding factors. Confounding factors were age, being in a relationship, steroid use, HIV treatment optimism (2000 - 2008); recreational drug use (1999-2008), and seeking sex through the Internet (2000–2008).

[2] Test for a trend for periods including imputed data (2006 and 2007)

Table 3. Number (%) of men reporting unprotected anal intercourse (UAI) by type of partner between 1998 and 2008

HIV status of espondent	1998		1999		2000		2001		2002		2003		2004		2005		2008		1998 - 2001			2001 - 2005			2005 - 2008		1998 - 2008	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	aOR[1]	95% CI	p val	aOR[1]	95% CI	p val	Chi-Stat[2]	Pval	Chi-Stat[2]	p val
Non-concordant UAI																												
All non-concordant UAI	121	*14.5*	106	*16.8*	136	*18.4*	174	*23.7*	181	*21.9*	108	*21.7*	137	*20.4*	75	*15.6*	102	*15.7*	1.54	1.25, 1.76	<0.001	0.64	0.32, 0.75	<0.001	0.03	0.23	-	-
With a casual partner																											-	-
HIV positive men	18	*15.3*	15	*14.9*	23	*19.2*	45	*38.8*	50	*41.3*	29	*37.2*	36	*30.0*	16	*20.3*	28	*18.9*	1.64	1.26, 2.13	<0.001	0.87	0.74, 0.99	<0.05	0.02	0.88	-	-
HIV negative men	33	*6.8*	40	*10.1*	49	*10.7*	53	*12.1*	65	*12.0*	47	*14.1*	52	*11.6*	34	*10.3*	24	*5.5*	1.40	1.16, 1.68	<0.001	0.91	0.83, 1.01	0.09	1.48	0.04	-	-
Never tested men	5	*2.1*	6	*4.5*	14	*8.8*	14	*7.7*	13	*7.9*	4	*4.7*	7	*6.8*	6	*8.3*	4	*6.3*	1.61	1.17, 2.22	<0.001	0.90	0.65, 1.22	0.50	0.31	0.58	-	-
All men	56	*6.7*	61	*9.7*	86	*11.6*	112	*15.2*	128	*15.5*	80	*16.1*	95	*14.2*	56	*11.6*	56	*8.6*	1.48	1.30, 1.69	<0.001	0.88	0.74, 0.96	<0.05	0.52	0.05	-	-
With main partner alone																											-	-
HIV positive men	5	*4.2*	5	*5.0*	2	*1.7*	5	*4.3*	1	*0.8*	2	*2.6*	5	*4.2*	2	*2.5*	12	*8.1*	0.67	0.17, 2.22	0.53	1.50	1.01, 2.42	0.05	3.22	0.04	-	-
HIV negative men	29	*6.0*	26	*6.6*	25	*5.4*	34	*7.8*	32	*5.9*	18	*5.4*	29	*6.5*	7	*2.1*	24	*5.5*	1.10	0.71, 1.71	0.67	0.96	0.85, 1.12	0.08	1.60	0.06	-	-
Never tested men	31	*13.3*	14	*10.5*	23	*14.4*	23	*12.7*	20	*12.1*	8	*9.3*	8	*7.8*	10	*13.9*	10	*15.6*	1.31	0.74, 2.39	0.36	1.05	0.83, 1.31	0.70	0.07	0.98	-	-
All men	65	*7.8*	45	*7.1*	50	*6.8*	62	*8.4*	53	*6.4*	28	*5.6*	42	*6.3*	19	*3.9*	46	*7.1*	1.11	0.81, 1.55	0.54	0.75	0.71, 1.07	0.05	1.34	0.03	-	-
Concordant UAI																												
All Concordant UAI	82	*9.8*	76	*12.1*	113	*15.3*	81	*11.0*	126	*15.2*	73	*14.7*	90	*13.4*	89	*18.5*	135	*20.8*	1.16	0.68, 2.02	0.589	1.16	1.01, 1.25	0.04	0.64	0.47	2.29	0.01
With a casual partner																												
HIV positive men	8	*6.8*	4	*4.0*	17	*14.2*	13	*11.2*	11	*9.1*	8	*10.3*	15	*12.5*	14	*17.7*	21	*14.2*	1.59	1.07, 2.35	<0.05	1.11	0.67, 1.85	0.70	0.42	0.05	10.20	0.001
HIV negative men	8	*1.7*	5	*1.3*	9	*2.0*	4	*0.9*	15	*2.8*	7	*2.1*	11	*2.5*	4	*1.2*	7	*1.6*	0.98	0.42, 2.28	0.95	0.94	0.73, 1.19	0.58	0.54	0.82	0.02	0.90
With main partner alone																												
HIV positive men	6	*5.1*	6	*5.9*	7	*5.8*	6	*5.2*	7	*5.8*	5	*6.4*	6	*5.0*	8	*10.1*	15	*10.1*	1.00	0.36, 2.75	1.00	1.35	1.01, 1.83	0.04	<0.001	0.69	5.40	0.02
HIV negative men	60	*12.4*	61	*15.4*	80	*17.4*	58	*13.2*	93	*17.2*	53	*15.9*	58	*13.0*	63	*19.0*	92	*21.1*	1.04	0.77, 1.39	0.82	1.12	1.01, 1.19	0.05	0.54	0.05	4.08	0.04

aOR, Adjusted odds ratio; CI confidence interval; Chi-Stat Chi Squared test for trend statistic; UAI, unprotected anal intercourse.

[1] aOR derived from a multivariate model that excluded men who had completed a questionnaire in a previous year to ensure the independence of samples [10]. After excluding men who had completed a previous questionnaire, 3287 respondents remained for the independent samples analysis. The aOR measured the annual increase (or decrease) in the likelihood of reporting UAI after controlling for confounding factors. Confounding factors were age, being in a relationship, steroid use, HIV treatment optimism (2000 - 2008); recreational drug use (1999-2008), and seeking sex through the Internet (2000–2008)

[2] Test for a trend for periods including imputed data (2006 and 2007)