# Is use of antiretroviral therapy among homosexual men associated with increased risk of transmission of HIV infection?

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ORIGINAL ARTICLE

# Is use of antiretroviral therapy among homosexual men associated with increased risk of transmission of HIV infection?

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**Background/objective:** There is concern that use of highly active antiretroviral therapy (HAART) may be linked to increased sexual risk behaviour among homosexual men. We investigated sexual risk behaviour in HIV positive homosexual men and the relation between use of HAART and risk of HIV transmission.

**Methods:** A cross sectional study of 420 HIV positive homosexual men attending a London outpatient clinic. Individual data were collected from computer assisted self interview, STI screening, and clinical and laboratory databases.

**Results:** Among all men, sexual behaviour associated with a high risk of HIV transmission was commonly reported. The most frequently reported type of partnership was casual partners only, and 22% reported unprotected anal intercourse with one or more new partners in the past month. Analysis of crude data showed that men on HAART had fewer sexual partners (median 9 versus 20, p=0.28), less unprotected anal intercourse (for example, 36% versus 27% had insertive unprotected anal intercourse with a new partner in the past year, p=0.03) and fewer acute sexually transmitted infections (33% versus 19%, p=0.004 in the past 12 months) than men not on HAART. Self assessed health status was similar between the two groups: 72% on HAART and 75% not on HAART rated their health as very or fairly good, (p=0.55). In multivariate analysis, differences in sexual risk behaviour between men on HAART and men not on HAART were attenuated by adjustment for age, time since HIV infection. CD4 count and self assessed health status.

**Conclusion:** HIV positive homosexual men attending a London outpatient clinic commonly reported sexual behaviour with a high risk of HIV transmission. However, behavioural and clinical risk factors for HIV transmission were consistently lower in men on HAART than men not on HAART. Although use of HAART by homosexual men with generally good health is not associated with higher risk behaviours, effective risk reduction interventions targeting known HIV positive homosexual men are still urgently needed.

In developed countries, highly active antiretroviral therapy (HAART) has had a major impact on morbidity and mortality from HIV infection.[1 2] Since data from untreated serodiscordant heterosexual partners have shown that viral load is strongly related to the risk of HIV transmission,[3] it is reasonable to hypothesise that HAART, which lowers plasma HIV RNA levels (viral load) in blood and genital secretions, will also reduce the risk of sexual transmission. On the other hand, use of HAART could lead to increased risk of transmission if an optimistic view prevails that HIV is readily treatable (treatment optimism), or if improved wellbeing among people on therapy gives rise to increased sexual activity, coupled with a belief that HAART induced suppression of viral load reduces a person's infectiousness to others.[4–6]

What is the net impact of these influences on the HIV transmission risk in different populations with HIV? This is a key question because the increased survival brought about by HAART will also increase the prevalence of HIV infection among treated populations, in which small changes in sexual risk behaviour could have a large impact on the course of the epidemic. We explored this question by studying the relation between use of HAART and risk factors for sexual transmission of HIV among HIV positive homosexual men attending an outpatient clinic in London.

## METHODS

SHARP (Sex, Health and Anti-Retrovirals Project) is a cross sectional study of sexual behaviour, risk of HIV transmission, and HAART in HIV positive homosexual men attending a large London HIV outpatient clinic. All known HIV positive homosexual men attending routine, but not emergency or on-call, clinics were eligible to take part in the study. Target recruitment was 420 men. Assuming two thirds would be on HAART, 413 men would be needed to detect (with 80% statistical power) a difference in the proportions reporting unprotected anal sex in the past year (35% for men not on therapy and 50% for those on therapy).[7]

Between July 1999 and August 2000, one researcher recruited 422 men (90% of those invited to take part and a third of all homosexual men registered at the clinic) who completed a computer assisted self interview (CASI) about their sexual behaviour, attitudes to HIV infection and transmission, their views and experiences of HAART, and their quality of life. Sexual contact was defined as mutual masturbation, oral sex, anal intercourse, or other physical contact involving the genital area. We asked separately about insertive and receptive anal sex, because unprotected insertive anal intercourse (that is, where the HIV positive partner is insertive), is considered to carry the highest risk for onward HIV transmission. Respondents were asked to rate their

**Table 1** Demographic, clinical, sexually transmitted infection, and sexual risk behaviour data for all men and by use of HAART

| | All respondents (n=413) | Not on HAART (n=113) | On HAART (n=292) | |
|---|---|---|---|---|
| | No (%) | No (%) | No (%) | p Value* |
| Demographic data: | | | | |
| Age (years) median (range) | 38 (21–64) | 34 (22–61) | 39 (23–64) | <0.000 |
| Ethnicity (white) | 373/413 (90) | 96/112 (86) | 270/292 (93) | 0.037 |
| Born in the UK | 293/413 (71) | 80/113 (71) | 209/292 (72) | 0.876 |
| Educated beyond secondary school | 317/413 (77) | 82/113 (73) | 228/292 (78) | 0.240 |
| Employment status | | | | |
| Working (part or full time) | 199/412 (48) | 63/113 (56) | 134/291 (46) | 0.149 |
| Unemployed | 77/412 (18) | 22/113 (20) | 53/291 (18) | |
| Medically retired | 93/412 (23) | 13/113 (12) | 76/291 (26) | |
| Other | 43/412 (10) | 15/113 (13) | 28/291 (10) | |
| Primary partner/boyfriend/lover | 203/413 (49) | 59/111 (53) | 139/292 (48) | 0.32 |
| Clinical data: | | | | |
| Self assessed health "very" or "fairly good" | 300/413 (73) | 85/113 (75) | 211/292 (72) | 0.547 |
| Time in years since first HIV positive diagnosis (range) | 5.5 (0.2–16.4) | 3.7 (0.2–15.3) | 6.6 (0.2–16.4) | <0.000 |
| Disease stage | | | | |
| Asymptomatic | 163/407 (40) | 90/113 (80) | 71/292 (24) | |
| Symptomatic non-AIDS | 134/407 (33) | 16/113 (14) | 118/292 (40) | <0.000 |
| AIDS | 110/407 (27) | 7/113 (6) | 103/292 (35) | |
| Viral load (copies/ml$^3$) (median (range)) | 400 (<50–500 000) | 23 600 (<50–500 000) | <50 (<50–500 000) | 0.001 |
| Viral load undetectable (Note: <50 copies/ml$^3$ = undetectable) | 170/331 (41) | 3/89 (3)) | 134/240 (56) | 0.006 |
| CD4 count (cells $\times 10^6$/l) (median (range)) | 360 (30–1130) | 415 (60–1130) | 340 (30–1020) | 0.002 |
| CD4 count >500 cells $\times 10^6$/l | 76/413 (18) | 28/113 (25) | 46/292 (16) | 0.08 |
| Sexually transmitted infections: | | | | |
| Any sexually transmitted infections diagnosed in the past year | 125/408 (31) | 45/112 (40) | 78/288 (27) | 0.011 |
| Bacterial sexually transmitted infection diagnosed in the past year | 94/408 (23) | 37/112 (33) | 56/288 (19) | 0.004 |
| Sexual risk behaviour data: | | | | |
| UAI with one or more new partners in the past month | 81/368 (22) | 26/101 (26) | 54/260 (21) | 0.307 |
| Insertive UAI with one or more new partners in the past month | 61/368 (17) | 18/101 (18) | 43/260 (17) | 0.770 |
| UAI with one or more new partners in the past year | 155/399 (39) | 51/107 (48) | 101/285 (35) | 0.058 |
| Insertive UAI with one or more new partners in the past year | 117/399 (29) | 39/107 (36) | 76/285 (27) | 0.027 |
| Median number of sexual partners in the past month (range) | 2 (0–55) | 3 (0–50) | 2 (0–55) | 0.028 |
| Median number of sexual partners in the past year (range) | 12 (0–750) | 20 (0–520) | 9 (0–750) | 0.057 |

*Comparing men on HAART with those not on HAART.

current health status as very good, fairly good, about average, or rather poor.

The questionnaire data were analysable for 413 men. For 405 men (96% of 422), we were able to combine the questionnaire results with data from clinic and laboratory databases about HIV disease stage, current treatment, CD4 count, viral load, and other sexually transmitted infections (STI). Other STI were defined as gonorrhoea, *Chlamydia trachomatis*, syphilis, and first clinical episode herpes or genital warts. We also analysed data on bacterial infections (gonorrhoea, chlamydia, and syphilis) separately because they are considered to be a better proxy for recent unprotected anal intercourse.[8]

Data were analysed using SPSS (version 10.0 for Windows) and STATA (version 6) software. For unadjusted comparisons between men on therapy and men not on therapy we used the $\chi^2$ test for binary data and *t* tests or Mann-Whitney U tests for continuous data. For binary outcomes, we adjusted for possible confounding factors (that is, age, self assessed wellbeing, disease stage (CD4 count), and time since HIV diagnosis) using logistic regression.

## RESULTS

Ninety per cent (372/413) of all participants reported sexual contact with another man in the past 6 months, of whom 14% (51/372) had sexual contact with a primary partner only, 46% (173/372) with casual partners only, 30% (110/372) with both primary and casual partners, and 10% (38/372) did not describe the nature of their sexual partnerships. Unprotected anal intercourse was reported frequently (table 1). Men gave detailed reports of 398 recent sexual episodes with casual partners; disclosure of HIV status was associated with only 127 (32%) of those episodes. Overall, 13% of men reported unprotected anal intercourse with a primary partner who was HIV negative or untested.

Overall, 73% (300/413) of men rated their health as very or fairly good. These men were more likely than men who rated their health as less good to report unprotected anal intercourse with one or more new partners in the past month (21% (63/294) versus 17% (18/107)) and in the past year (42% (120/286) versus 30% (32/106)).

Seventy two per cent (292/405) of all men were on HAART. They were significantly older and less likely to be from an ethnic minority group than men not on therapy (table 1). They were much more likely to have had a previous AIDS diagnosis, reflecting indication for therapy. The difference in viral load of course reflects the effect of antiretroviral drugs. There was little difference between the two groups in subjective wellbeing, with 72% of men on therapy and 75% not on therapy assessing their current health as very or fairly good. Only 13% (37/292) and 8% (9/113) respectively rated their health as rather poor.

Men on therapy reported consistently fewer new partners and less frequent unprotected anal intercourse than men not on therapy. Based on clinic and self reported data, men on therapy were significantly less likely to have acquired another STI in the past year (table 1).

Adjustment for age, subjective wellbeing, CD4 count, and time since HIV diagnosis together reduced the magnitude of difference in risk behaviours between men on therapy and those not on therapy (table 2). Attitudes relating to risk of HIV transmission (table 2) showed little evidence for the concept of treatment optimism: 78% of men on HAART reported they were "just as likely to practise safer sex as they always were,"[4]

**Table 2** Clinical, behavioural, and attitudinal factors related to HIV transmission by use of HAART

| | | On HAART | |
|---|---|---|---|
| | Not on HAART | Crude odds ratio | Adjusted* odds ratios |
| Clinical factors: | | | |
| Detectable viral load | 1 | 0.040 (0.018 to 0.091) | 0.030 (0.014 to 0.078) |
| Any STI diagnosed in past year | 1 | 0.55 (0.35 to 0.88) | 0.70 (0.40 to 1.22) |
| Bacterial STI diagnosed by screening at the clinic in past year | 1 | 0.49 (0.30 to 0.78) | 0.70 (0.38 to 1.27) |
| Behavioural factors: | | | |
| UAI with one or more new partners in the past month | 1 | 0.76 (0.44 to 1.29) | 1.03 (0.53 to 2.00) |
| Insertive UAI with one or more new partners in the past month | 1 | 0.91 (0.50 to 1.67) | 1.33 (0.63 to 2.78) |
| UAI with one or more new partners in the past year | 1 | 0.60 (0.39 to 0.95) | 0.95 (0.54 to 1.67) |
| Insertive UAI with one or more new partners in the past year | 1 | 0.63 (0.40 to 1.10) | 1.02 (0.56 to 1.86) |
| Two or more new sexual partners in the past month | 1 | 0.74 (0.47 to 1.15) | 0.88 (0.51 to 1.54) |
| Attitudinal factors: | Numbers (%) agreeing with the following statements: | | p Value |
| Safer sex is as important as ever | 75/84 (89) | 257/282 (91) | 0.719 |
| I am just as likely to practise safer sex as I always was | 54/83 (65) | 219/282 (78) | 0.016 |
| Getting another strain of HIV would be a serious risk to my health | 95/112 (85) | 239/289 (83) | 0.220 |
| Getting another strain of HIV could reduce my treatment options in the future | 86/112 (77) | 240/288 (83) | 0.279 |
| As an HIV positive man, I should feel an extra responsibility not pass on HIV to another person | 96/112 (86) | 252/289 (87) | 0.459 |
| HIV positive gay men have more responsibility to practise safer sex than HIV negative men | 32/112 (29) | 102/289 (35) | 0.332 |
| If someone is HIV positive but taking new medications that reduce "viral loal," safer sex isn't important | 1/84 (1) | 10/282 (4) | 0.914 |
| Undetectable viral load means that HIV is unlikely to be passed on to a sexual partner | 9/112 (8) | 38/290 (13) | 0.077 |
| Undetectable viral load in my blood means that HIV is unlikely to be passed on to a sexual partner, even if we fuck without a condom | 4/112 (4) | 23/289 (8) | 0.267 |
| All gay men will eventually get HIV, so whether I practise safer sex is unimportant | 4/112 (4) | 16/288 (6) | 0.659 |

*Adjusted for subjective wellbeing, CD4 count, age, and time since diagnosis of HIV infection.

and only 4% agreed that being on new drugs that reduce viral load means safer sex is not important.

Demographic and clinical data from all participants in this study are similar to national data for homosexual men with HIV infection.[9] Among 10 252 homosexual men resident in England and attending statutory health services in 1999, median age was 37 years, 88% were white, 29% had ever had an AIDS diagnosis, and 70% were on HAART (personal communication: Neil MacDonald, coordinator of the Survey of Prevalent Diagnosed HIV Infections).[9]

## DISCUSSION

This study was designed to fill gaps in knowledge about the sexual behaviour of HIV positive homosexual men and to investigate hypotheses about risk of HIV transmission and HAART.[10] The most rigorous method for investigating the hypothesis that HAART leads to increased sexual risk behaviour would be through a randomised trial of HAART, but such a trial could not be justified on ethical or practical grounds. Observational studies like this one allow an assessment of whether men currently on HAART have higher sexual risk behaviour than men not on HAART. Our study clearly shows that this is not the case; measures of sexual risk behaviour tended to be lower in men on HAART, thus refuting the study hypothesis. Explanations for this observation are more open to interpretation and need to take account of reasons for being on HAART, as well as the impact of HAART (see below).

Regardless of HAART, we found high levels of sexual risk behaviour among homosexual men who know they have HIV infection. Twenty two per cent of respondents reported unprotected anal sex with a new partner in the past month, and the most common type of sexual partnership reported over the past 6 months was casual partners only. Of course, new cases of HIV infection will only arise if the sexual partner is HIV negative. But disclosure to casual partners happened in less than a third of recent sexual encounters, and 13% of men reported unprotected anal intercourse with a primary partner who was HIV negative or untested. Comparison with two studies of HIV negative homosexual men shows that sexual risk behaviour in this HIV population is particularly high. In a study of HIV negative homosexual men conducted in the same clinic[11] the risk of acquiring a bacterial STI in a 12 month period was 10% compared with 23% in this study, and a community survey of homosexual men in London has shown higher rates of STI and unprotected anal intercourse in HIV positive men compared with HIV negative men.[12]

Concerning the link between HAART and treatment optimism,[4–6] we found that, in a population of HIV positive homosexual men who mostly rate their health as good, men on HAART are no more likely to have unprotected anal intercourse than those not on HAART. Together with data showing fewer other STI in the past year, lower viral load and fewer new partners, a consistent picture emerges of lower risk of onward HIV transmission among men taking HAART. The lower risk of other STI in this group is important, not just as an indicator of less unprotected anal intercourse, but because other sexually transmitted infections facilitate HIV transmission.[13]

The difference in sexual risk behaviour between therapy groups in this study does not appear to be explained by a difference in wellbeing (since around three quarters of both groups felt well) or by any consistent differences in attitudes towards risk of HIV transmission or risk to oneself. The older age of men on HAART is another possible explanation, since adjustment for time since HIV infection and age attenuated the differences in sexual risk behaviour between men on

HAART and men not on HAART. However, in a large cross sectional survey of homosexual men in London,[14] there was no statistically significant association between serodiscordant unprotected anal intercourse and age among HIV positive men (personal communication: Julie Dodds).[14] Might the findings reflect a conservative attitude towards use of therapy in the clinic? This is unlikely because the clinic follows nationally accepted clinical guidelines, based on viral load, CD4 count and symptoms, about when to start HAART.[15] Because the data are cross sectional, we cannot be sure whether they reflect some other form of selection pressure (such as age) that favours men with lower risk behaviour being on therapy, or whether being on therapy tends to reduce former high risk behaviour. Either way, our data suggest it is unlikely that taking HAART itself leads HIV positive homosexual men to throw caution to the winds.

Most other studies of homosexual men's perceptions about infectiousness, the significance of viral load, risk of transmission, and reported sexual behaviour give grounds for concern about a potential rise in transmission associated with HAART.[4–6 16–19] However, few studies have focused on HIV positive people and none has measured viral load, other sexually transmitted infections, subjective wellbeing, reported sexual behaviour, and attitudinal data in the same population. Our study also has the advantage of being representative of known HIV positive homosexual men nationally, at least in terms of age, ethnicity, disease stage, and proportion on HAART. A large register based study in the United States found that, among people (mainly homosexual men) with AIDS, those on HAART were more likely to have another STI than those not on HAART,[17] but it is unclear whether the opportunity for STI diagnosis was similar in the two groups or not. In our study, there was some evidence of a relation between subjective wellbeing and high risk sex, but no appreciable relation between wellbeing and use of therapy. Populations with a stronger association between wellbeing and therapy might also be expected to show bigger differences in sexual risk behaviour by therapy.

In conclusion, in a study of HIV positive homosexual men attending a London outpatient clinic, we found that clinical and behavioural risk factors for HIV transmission were consistently lower in men on HAART than in men not on HAART. However, the high levels of unprotected anal intercourse and casual partnerships reported by both groups are a cause for concern and their potential effects on transmission need further investigation. More effort should be directed towards risk reduction interventions with known HIV positive homosexual men.

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