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Characterising HIV Transmission Risk among US HIV Patients in Care: A Cross-Sectional Study of Sexual Risk Behaviour among Individuals with Viral Load above 1500 Copies/ml

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Abstract

Objectives—Viral load and sexual risk behaviour contribute to HIV transmission risk. High HIV viral loads present greater transmission risk than transient viral “blips” above an undetectable level. This paper therefore characterises sexual risk behaviour among HIV patients in care with viral loads >1500 copies/ml and associated demographic characteristics.

Methods—This cross-sectional study was conducted at six HIV outpatient clinics in the United States. The study sample comprises 1315 HIV patients with a recent viral load >1500 copies/ml. This study sample was drawn from a larger sample of individuals with a recent viral load >1000

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Competing Interests

There are no conflicts of interest for any of the authors.

Disclaimer

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Contributions:

M.J.S. conceived the idea, contributed to conceptualisation of statistical analyses, and wrote the manuscript. G.M. contributed to idea, conducted statistical analyses, and helped write and edit the manuscript. C.O. consulted on statistical analysis and edited manuscript. E.R.C., M.S., M.J.M., S.D., A.D., and T.P.G. contributed to the idea, edited the manuscript, and served as site investigators for the parent study.

copies/ml who completed a computer-assisted self-interview (CASI) regarding sexual risk practices in the last two months. The study sample was 32% heterosexual men, 38% men who have sex with men (MSM), and 30% women.

Results—Ninety percent of the sample had their viral load assay within 60 days of the CASI. Thirty-seven percent reported being sexually active (vaginal or anal intercourse) in the last two months. Most of the sexually active participants reported always using condoms (56.9%) or limiting condomless sex to seroconcordant partners (serosorting; 29.2% overall and 42.9% among MSM). Among sexually active participants who reported condomless anal or vaginal sex with an at-risk partner (14%), most had viral loads >10,000 copies/ml (62%).

Conclusions—A relatively small number of HIV patients in care with viral loads above 1500 copies/ml reported concurrent sexual transmission risk behaviours. Most of the individuals in this small group had markedly elevated viral loads, increasing the probability of transmission. Directing interventions to patients in care with high viral loads and concurrent risk behaviour could strengthen HIV prevention and reduce HIV infections.

Keywords

HIV; HIV infections; viral load; risk-taking; risk; sexual behaviour; sexual partners; condoms; serosorting; treatment as prevention; antiretroviral therapy; highly active; heterosexuality; homosexuality; male

Durable viral suppression through antiretroviral therapy (ART) is critical for supporting patient health and advancing HIV “treatment as prevention” (TasP). The percentages of United States (US) patients in HIV primary care who were prescribed ART and who achieved viral suppression have increased in recent years, with ART use rising from 89% to 94% and viral suppression at last test growing from 72% to 80% between 2009 and 2013.[1] Sustaining viral suppression over the long term, however, can present challenges. Population-level data show that more than one-third (38%) of US patients in HIV care lack durable viral suppression when followed longitudinally over a two-year period.[2]

From a clinical and TasP perspective, sustained high viral loads present greater concern than transient viral “blips” above an undetectable level. HIV transmission risk correlates with level of viral load and has been observed to increase as viral load exceeds 1500 copies/ml among heterosexual HIV-serodiscordant couples.[3,4] A cohort study with 14,532 US patients in HIV care determined that 54% had least one viral load >1500 copies/ml over an observation period averaging three years [5]. The cohort collectively spent 23% of observation time with viral loads above 1500 copies/ml; person-time above the threshold was higher among patients who were not on ART (58% of time) and among patients new to the clinic (34% of time) who may not have started ART immediately.[5] In US surveillance data which determined that 38% (91,120 of 238 641) of US patients lacked durable viral suppression over two years, patients spent 43.2% of that time period with viral load above 1500 copies/ml.[2] In the United Kingdom, sentinel surveys estimate that 35% of all men who have sex with men (MSM) who are living with HIV have viral loads >1500 copies/ml, with most men in this group (62%) undiagnosed and not in care [6]. These studies indicate

that many individuals living with HIV infection, including patients in HIV care, spend notable time above viral load levels where HIV transmission may occur.

Characterising the HIV transmission risk that accompanies high viral load requires concurrent information on sexual behaviours, because sexual transmission risks may be reduced through condom use and serosorting (limiting condomless sex to seroconcordant partners).[7,8] Only 6% of a representative sample of US persons in HIV care had detectable viral load (>200 copies/ml) and reported condomless sex with a serodiscordant partner during the past 12 months.[9] In a sample of young MSM who had detectable viral load (>200 copies/ml) in the past six months, 34.9% reported condomless anal sex with serodiscordant partners in the past 90 days.[10] Within a trans-national sample of HIV patients from Brazil, Zambia, and Thailand, 29% indicated ‘amplified transmission risk’ on the basis of having a detectable viral load or STI diagnosis and reporting condomless sex with a serodiscordant partner in the last three months.[11] Comparison of these studies is challenging since each used different recall periods, eligibility criteria, and viral load cut-offs. Several limitations are evident: Each study includes individuals with low viral loads (i.e., above the detectable limit but below 1500 copies/ml) who may present less HIV transmission risk; the wide-ranging recall periods mean that the sexual risk behaviour may be distal to the date of the viral load assay (up to 12 months); and at least one study [9] employed face-to-face interviewing which may reduce reports of risk behaviour.

The study reported herein provides novel characterisation of HIV sexual risk behaviour among US individuals in HIV primary care with viral loads above 1500 copies/ml. We used data establishing close concurrency of measured viral load and sexual risk behaviour as assessed by computer interview. This includes condomless anal or vaginal intercourse with at-risk partners (i.e., partners perceived to be HIV-negative or of unknown serostatus) as well as condomless intercourse reported exclusively with HIV-positive partners (serosorting). We examine these outcomes stratified by viral load status above 1500 copies/ml and by patients’ demographic characteristics.

Methods

Cross-sectional data were collected as part of the APTcare Project, co-sponsored by the Centers for Disease Control and Prevention (CDC) and the National Institute of Mental Health (NIMH). The project was conducted at six academically affiliated HIV clinics located in geographically diverse US cities (Birmingham, Boston, Houston, Miami, San Diego, and Seattle). The AptCare Project aimed to improve patients’ viral loads and retention in care through a multi-component clinic-based intervention targeted to patients whose viral loads exceeded 1000 copies/ml. Eligible patients were approached during clinic visits and offered study participation. The intervention was delivered via computer during regular primary care appointments. One intervention component was a brief computer-assisted self-interview (CASI). The CASI contained questions about sexual behaviour in the prior two months, which are the focus of this analysis. Following these questions, the computer-based intervention subsequently provided tailored messages, strategies, and tips for lowering viral load, being engaged in care, and having safer sex. Data collected from January 2014 and through December 2015 are reported herein. Participants were identified

by unique study codes computer-generated at the clinics. Institutional review board approval was obtained at each site (Institutional Review Board for Baylor College of Medicine and Affiliated Hospitals, IRB approval H-32781; Boston University Medical Campus Institutional Review Board, IRB approval H-32301; University of Alabama at Birmingham Institutional Review Board, IRB approval X130715003; University of California, San Diego, Human Research Protection Program, IRB approval 130733; University of Miami Institutional Review Board, IRB approval 20120619; University of Washington Institutional Review Board, IRB approval 45249).

We restricted our analysis to a subset of AptCare participants whose viral loads exceeded 1500 copies/ml around the time of the self-reported sexual behaviour. We used >1500 copies/ml as an inclusion criterion to reflect research indicating that HIV transmission risk sharply increases above this threshold [3,4], to match other studies using this criterion regarding infectivity [4,5,6], and to clearly distinguish the study sample from individuals with low viral loads that might be characterised as a “viral blip.” Patients were selected based on their CASI completion date and the viral load closest to the CASI date. Candidates had to have a viral load result within 120 days of the CASI or up to 7 days afterward to capture viral load results that were contemporaneous with the 2-month sexual history reporting period in the CASI. Among the candidates who had a viral load result within this window, we selected patients whose closest viral load to the CASI was above 1500 copies/ml. Finally, we only included patients diagnosed with HIV infection at least three months prior to their CASI, to focus on sexual behaviour that occurred when patients knew they were HIV-positive. The viral load data and demographic stratification variables were obtained from each clinic’s electronic medical records (EMR). Data were linked using patients’ study codes, not EMR numbers, to protect privacy.

The CASI included two sexual behaviour questions in English or Spanish, and one question about ART use. The questions appeared on successive screens and were audibly administered by a pre-recorded female narrator. The first sexual behavioural question was “In the past two months, did you have vaginal or anal sex?” These activities were verbally defined as a man’s penis in woman’s vagina or a man’s penis in someone’s anus or butt. Patients who said “yes” were asked “In the past two months, did you have vaginal or anal sex without using a condom?” The three response options were: “no,” “yes, only with someone you knew was HIV-positive,” or “yes, with someone who was HIV-negative or whose HIV status you didn’t know.” In addition to the sexual risk data, the CASI also assessed current ART status through the question, “Are you currently taking antiretroviral medications to treat your HIV infection?” (yes/no). Patients were given the option “don’t want to answer” for each question. Patients were informed that no clinic staff had access to their answers and that their responses were electronically transmitted to CDC in real time through a web-based system.

We examined the percentage of patients who reported vaginal or anal sex in the past two months, and, among that subset, the percent who always used a condom, the percent who reported condomless sex only with other HIV-positive partners (serosorting), and the percent who reported condomless sex with at-risk partners. The outcomes were examined stratified by the following subgroups: age (18–35, 36–50, over 50), race/ethnicity (non-Hispanic

white, non-Hispanic black, Hispanic, other), gender/sexual orientation (heterosexual men, MSM, women), language of CASI (English, Spanish), recency of HIV diagnosis (3–12 months, over 12 months), injection drug use (IDU) as an exposure for acquiring HIV infection (yes, no), viral load categories (copies/ml) closest to date of CASI (>1500–10,000; 10,001–50,000; over 50,000), and current ART status (yes/no). We did not include clinic as a stratification variable because 66% of the data came from the clinic with the largest patient population; the other five clinics contributed between 1% and 12% of the data to this analysis. Three clinics contributed low numbers of patients per protocol, because they delayed onset of intervention activities (including the CASI component) for approximately 16 months and served as a concurrent control group during that time.

We tested for differences in the sexual behaviour outcomes among the sexually active patients using multinomial logistic regression (with generalised logit). Coding of the outcome categories yielded the odds of engaging in condomless serosorting versus always using a condom, and the odds of condomless sex with at-risk partners versus always using a condom. These outcomes were examined by demographic and viral load subgroups in univariate and multivariable models. We present unadjusted and adjusted odds ratios (OR) and 95% confidence intervals (CI). All analyses were conducted with SAS, version 9.3, SAS Institute, Cary, NC.

Results

A total of 2512 patients with viral loads greater than 1000 copies/ml were approached for inclusion in the APTcare parent study; 1691 (67%) joined and completed the CASI. The current analysis focused on patients who had a viral load greater than 1500 copies/ml on the assay closest to their CASI date. A total of 1315 (78% of enrolled patients) were analysed. Patients omitted from the parent study included those with a viral load result outside the –120/+7 day measurement window (n=194), those diagnosed with HIV within 3-months of CASI completion (n=152), and those who did not answer the sexual behaviour questions (n=30). Ninety percent of the analytic sample had their closest viral load within 60 days of doing the CASI, which corresponds to the time interval for the sexual behaviour assessment. We did not find any statistically significant or appreciable differences in sexual risk behaviour when comparing all CASI completers from the parent study to the subset of CASI completers selected for this analysis based on the timing and quantification of their viral load results (data not reported here).

The analytic sample was 32% heterosexual men, 38% MSM, and 30% women. The racial/ethnic breakdown was 62% non-Hispanic black, 18% non-Hispanic white, 18% Hispanic, and 2% other. Overall, 61% of the analytic sample reported currently taking ART. Table 1 provides other sample characteristics as well as viral load subgroups.

Sexual Transmission Risk Behaviour

In this sample of patients with viral loads exceeding 1500 copies/ml, 37.0% reported that they engaged in anal or vaginal intercourse in the last two months (see Table 1). Fifty-four percent of the younger patients (age 18–35) were sexually active. Among all sexually active respondents, 56.9% reported that they always used a condom during that recent activity, and

an additional 29.2% reported that they had condomless intercourse only with other HIV-positive persons (serosorters). Fewer sexually active patients reported condomless anal or vaginal intercourse with at-risk partners (14%). Across the total analytic sample of 1315 individuals with viral loads exceeding 1500 copies/ml (including those with or without recent anal or vaginal intercourse), 68 (5.2%, 95% CI = 4.0% to 6.5%) reported condomless sex with an at-risk partner. Forty-two of these 68 patients (62%, 95% CI = 49% to 73%) had viral loads greater than 10,000 copies/ml.

Demographic and Clinical Correlates of Sexual Risk Behaviour

Table 2 reports the results of the multinomial logistic regression analysis of sexually active patients with viral loads above 1500 copies/ml (N=487) which compared subgroups of patients in terms of condomless sex with an at-risk partner (vs. always used a condom) and exclusive serosorting (vs. always used a condom). MSM were significantly more likely than heterosexual men to report condomless sex with an at-risk partner (Adj OR = 3.03, 95% CI = 1.73 to 5.31) and to report exclusive serosorting (Adj OR = 3.36, 95% CI = 1.52 to 7.46) relative to always using a condom. Patients with IDU as an HIV exposure risk factor were more likely than patients without this risk factor to report condomless sex with an at-risk partner (Adj OR = 2.49, 95% CI = 1.09 to 5.67) relative to always using a condom. There were no significant differences in sexual risk practices by viral load stratification level.

Discussion

The study provides a nuanced understanding of HIV sexual transmission risk from people aware of their seropositive status and in care by combining data on viral load and sexual risk behaviour. The methods allowed for close temporal proximity of viral load measurement and sexual risk behaviour assessment, with 90% of the viral load results occurring within the two-month reporting interval for sexual risk behaviour. This represents a tighter correspondence than prior studies, [9,10,11] and it provides greater confidence that any risk behaviour directly overlapped with a period of viral load exceeding 1500 copies/ml. The study also contained a relatively even distribution of participants (roughly one-third heterosexual men, MSM, and women), and the vast majority were racial or ethnic minorities.

In this sample of patients with recent viral loads above 1500 copies/ml, nearly two-thirds reported no vaginal or anal intercourse in the last two months. Among those who did, over half always used a condom, and nearly 30% restricted their condomless intercourse to known seropositive partners. Only 14% of sexually active patients (68 of 487), or 5.2% of the total patient sample (68 of 1315), reported condomless vaginal or anal sex with at-risk partners. This represents 68 patients who had a viral load above 1500 copies/ml around the time of the sexual activity; most of whom (62%, 42 of 68) had viral loads exceeding 10,000 copies/ml, posing high transmission risk. The comparatively limited group of high-risk patients observed in this and other samples[9,10,11] remains a challenge to TasP and the aspirational goal of eliminating onward transmission of HIV through viral suppression and sexual risk reduction.

Two variables emerged as correlates of sexual practices in adjusted analyses. First, sexually active MSM were more likely than sexually active heterosexual men to exclusively engage

in serosorting. Among the MSM participants, over twice as many MSM engaged in serosorting (42.9%) as engaged in condomless intercourse with at-risk partners (17.5%). Serosorting has been regularly described among MSM and may be normative among HIV-diagnosed MSM.[7] Serosorting reduces HIV transmission risk relative to condomless sex between discordant partners, but it can facilitate other sexually transmitted infections [7,8]. Second, patients in our analysis who had IDU as a risk factor for acquiring HIV infection were more likely than their counterparts to have engaged in condomless intercourse with at-risk partners. Although this study lacked data on current IDU, the results indicate that individuals with prior IDU may contribute to HIV sexual transmission through high viral loads and condomless sex.

We observed that 61% of this sample of patients with viral loads >1500 copies/ml reported currently taking ART. It is curious that so many people on ART would have a high viral load. Poor medication adherence is the most likely explanation, along with development of drug resistance and overreporting of ART use. Interestingly, the ART variable had significant associations with sexual behaviour, but the differences fell just short of significance in the adjusted analysis. Compared to patients not on ART, those that were on ART were more likely to always use a condom and less likely to serosort or engage in condomless intercourse with an at-risk partner.

In contrast to prior research which found greater sexual transmission risk behaviour among individuals who were virally unsuppressed, [9,10] our analysis did not find an association between higher levels of viral load and greater practice of condomless sex with at-risk partners. The ability of the study to characterise the relationship between viral load and sexual risk behaviour is limited by the focus on patients with viral loads >1500 copies/ml. Had our analysis contained patients with viral loads less than 1500 copies/ml (including those with undetectable viral loads), we could have better characterised the full relationship between viral load and sexual risk behaviour. It is possible that increased attention to TasP is beginning to reverse the pattern previously observed, by facilitating condomless sex in the context of viral suppression.

Our analysis was performed among a subset of HIV patients who participated in a clinic-based intervention to increase adherence to ART. Although the CASI was completed before any intervention was delivered, caution is warranted in interpreting the results, because the patients with elevated viral loads in our analysis were not randomly sampled from the populations at the six participating HIV clinics. We selected participants whose viral load closest to the date of the CASI (within a -120/+7 day window) was above 1500 copies/ml, but we do not know the viral load level at the exact time of sexual activity. Participants also lacked direct knowledge of their current viral load at the time of sexual activity, so this study broadly estimates transmission risk rather than the influence of viral load on sexual risk behaviour. The CASI risk assessment did not ask about number of sex partners, the number of occasions in which a behaviour occurred, or sex partner use of HIV pre-exposure prophylaxis (PrEP). We are therefore not able to fully estimate the likelihood or extent of HIV sexual transmission risk. Although the CASI approach can improve reporting of sensitive behaviours, the self-report questions remain subject to social desirability concerns which may have reduced reporting of risk behaviour. Finally, it should be noted that the

recall period for the behaviour was the past two months. Although not a study limitation, per se, this recall period must be taken into account when comparing our findings to studies that used longer recall periods (e.g., past 12 months).

In conclusion, even with widespread use of ART, there remains a small percentage of HIV patients in care who have viral loads above 1500 copies/ml and engage in sexual transmission risk behaviours. Some of these patients have markedly elevated viral loads (>10,000 copies/ml), increasing the probability of transmission. Future research should combine data on viral load and behavioural risk practices, cross-sectionally and longitudinally, to further illuminate understanding of HIV transmission risk. In clinical practice, efforts to identify patients in care with high viral loads and concurrent risk behaviour could facilitate delivery of ART adherence and safer behavioural interventions to this group, thereby helping to achieve the potential of TasP.

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References

1. Bradley H, Mattson CL, Beer L, et al. Increased antiretroviral therapy prescription and HIV viral suppression among persons receiving clinical care for HIV infection. *AIDS*. 2016; 30:2117–24. [PubMed: 27465279]
2. Crepaz N, Tang T, Marks G, et al. Durable viral suppression and transmission risk potential among persons with diagnosed HIV infection: United States, 2012–2013. *Clin Infect Dis*. 2016; 63:976–83. [PubMed: 27358354]
3. Attia S, Egger M, Müller M, et al. Sexual transmission of HIV according to viral load and antiretroviral therapy: systematic review and meta-analysis. *AIDS*. 2009; 23:1397–404. [PubMed: 19381076]
4. Quinn TC, Wawer MJ, Sewankambo N, et al. Viral load and heterosexual transmission of human immunodeficiency virus type 1. Rakai Project Study Group. *New Engl J Med*. 2000; 342:921–9. [PubMed: 10738050]
5. Marks G, Gardner LI, Rose CE, et al. Time above 1500 copies: a viral load measure for assessing transmission risk of HIV-positive patients in care. *AIDS*. 2015; 29:947–54. [PubMed: 25768835]
6. Brown AE, Gill ON, Delpech VC. HIV treatment as prevention among men who have sex with men in the UK: is transmission controlled by universal access to HIV treatment and care? *HIV Med*. 2013; 14:563–70. [PubMed: 23890150]
7. Eaton LA, Kalichman SC, O'Connell DA, et al. A strategy for selecting sexual partners believed to pose little/no risks for HIV: serosorting and its implications for HIV transmission. *AIDS Care*. 2009; 21:1279–88. [PubMed: 20024704]
8. Purcell DW, Higa D, Mizuno Y, et al. Quantifying the harms and benefits from serosorting among HIV-negative gay and bisexual men: a systematic review and meta-analysis. *AIDS Behav*. 2017 Epub ahead of print.
9. Mattson CL, Freedman M, Fagan JL, et al. Sexual risk behaviour and viral suppression among HIV-infected adults receiving medical care in the United States. *AIDS*. 2014; 28:1203–11. [PubMed: 25000558]
10. Wilson PA, Kahana SY, Fernandez MI, et al. Sexual risk behavior among virologically detectable human immunodeficiency virus-infected young men who have sex with men. *JAMA Pediatr*. 2016; 170:125–31. [PubMed: 26641367]

11. Magidson JF, Li X, Mimiaga MJ, et al. Antiretroviral medication adherence and amplified HIV transmission risk among sexually active HIV-infected individuals in three diverse international settings. *AIDS Behav.* 2016; 20:699–709. [PubMed: 26246068]

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Key Messages

- A small percentage of HIV patients in care with viral loads above 1500 copies/ml reported concurrent sexual transmission risk behaviours.
- Most of the individuals in this small group had markedly elevated viral loads, increasing the probability of HIV transmission.
- Directing interventions to patients in care with high viral loads and concurrent sexual transmission risk behaviours could strengthen HIV prevention.

Table 1

Sexual behaviours in the past two months in patients with viral loads >1500 copies/ml during that time, by subgroups, 2014–2015 (N=1315; sexually active n=487)

	Sexually active (anal or vaginal intercourse), in total sample % (n/N)	Always used condom during anal or vaginal intercourse, among sexually active % (n/N)	Condomless anal or vaginal intercourse with HIV+ partners only (serosorting), among sexually active % (n/N)	Condomless anal or vaginal intercourse with at-risk partners ¹ , among sexually active % (n/N)
Overall	37.0 (487/1315)	56.9 (277/487)	29.2 (142/487)	14.0 (68/487)
Gender/sexual orientation ²				
Heterosexual men	33.2 (139/419)	69.8 (97/139)	22.3 (31/139)	7.9 (11/139)
MSM	38.1 (189/496)	39.7 (75/189)	42.9 (81/189)	17.5 (33/189)
Women	39.5 (156/395)	66.0 (103/156)	19.2 (30/156)	14.7 (23/156)
Age at time of study entry, yr				
18–35	54.3 (204/376)	51.0 (104/204)	31.9 (65/204)	17.2 (35/204)
36–50	35.1 (194/553)	56.7 (110/194)	30.9 (60/194)	12.4 (24/194)
Over 50	23.1 (89/386)	70.8 (63/89)	19.1 (17/89)	10.1 (9/89)
Race/ethnicity				
White, non-Hispanic	35.5 (86/242)	46.5 (40/86)	37.2 (32/86)	16.3 (14/86)
Black, non-Hispanic	36.9 (301/815)	61.1 (184/301)	26.3 (79/301)	12.6 (38/301)
Hispanic	37.1 (85/229)	52.9 (45/85)	30.6 (26/85)	16.5 (14/85)
Other	51.7 (15/29)	53.3 (8/15)	33.3 (5/15)	13.3 (2/15)
Injection drug use as HIV acquisition risk factor ³				
No	36.9 (434/1175)	58.1 (252/434)	29.0 (126/434)	12.9 (56/434)
Yes	37.9 (53/140)	47.2 (25/53)	30.2 (16/53)	22.6 (12/53)
Recency of testing HIV positive (from time of study entry)				
3–12 months	40.0 (34/85)	38.2 (13/34)	38.2 (13/34)	23.5 (8/34)
13+ months	36.8 (453/1230)	58.3 (264/453)	28.5 (129/453)	13.3 (60/453)

	Sexually active (anal or vaginal intercourse), in total sample % (n/N)	Always used condom during anal or vaginal intercourse, among sexually active % (n/N)	Condomless anal or vaginal intercourse with HIV+ partners only (serosorting), among sexually active % (n/N)	Condomless anal or vaginal intercourse with at-risk partners ¹ , among sexually active % (n/N)
Language of CASI				
English	37.4 (460/1229)	56.1 (258/460)	29.8 (137/460)	14.1 (65/460)
Spanish	31.4 (27/86)	70.4 (19/27)	18.5 (5/27)	11.1 (3/27)
Viral load (copies/ml) contemporaneous to sexual behaviour				
>1500–10,000	41.6 (173/416)	59.5 (103/173)	25.4 (44/173)	15.0 (26/173)
10,001–50,000	38.9 (160/411)	53.1 (85/160)	33.8 (54/160)	13.1 (21/160)
50,001 and higher	31.6 (154/488)	57.8 (89/154)	28.6 (44/154)	13.6 (21/154)
Currently taking ART ⁴				
No	38.0 (193/508)	47.2 (91/193)	35.2 (68/193)	17.6 (34/193)
Yes	36.5 (294/806)	63.3 (186/294)	25.2 (74/294)	11.6 (34/294)

MSM, men who have sex with other men; CASI, computer-assisted self-interview; ART, antiretroviral therapy.

¹ At-risk partners were those perceived by study participant to be HIV-negative or of unknown serostatus at the time of the sexual activity.

² There were 5 transgender participants. They were omitted as a separate subgroup of the gender/sexual orientation variable, but were retained in the other variables in this table.

³ This does not reflect whether the patient is a current injection drug user.

⁴ There was 1 case of missing data on this variable.

Results from multinomial logistic regression analysis of sexually active patients in the past two months whose viral loads were >1500 copies/ml during that time, 2014–2015 (N=487)

Table 2

	Odds of condomless anal/vaginal intercourse with HIV+ partners only (serosorting) vs. Always used a condom during anal/vaginal intercourse		Odds of condomless anal/vaginal intercourse with at-risk partners ¹ vs. Always used a condom during anal/vaginal intercourse	
	Unadjusted OR, (95% CI)	Adjusted ² OR, (95% CI)	Unadjusted OR, (95% CI)	Adjusted ² OR, (95% CI)
Gender/sexual orientation ³				
Heterosexual men	Ref	Ref	Ref	Ref
MSM	3.38 (2.03 to 5.64)**	3.03 (1.73 to 5.31)**	3.88 (1.84 to 8.18)**	3.36 (1.52 to 7.46)**
Women	0.91 (0.51 to 1.62)	0.87 (0.48 to 1.57)	1.97 (0.91 to 4.25)	1.90 (0.85 to 4.22)
Age at time of study entry, yr				
18–35	Ref	Ref	Ref	Ref
36–50	0.87 (0.56 to 1.36)	1.10 (0.68 to 1.80)	0.65 (0.36 to 1.16)	0.83 (0.44 to 1.56)
Over 50	0.43 (0.23 to 0.80)**	0.62 (0.31 to 1.22)	0.42 (0.19 to 0.94)*	0.56 (0.23 to 1.33)
Race/ethnicity				
White, non-Hispanic	Ref	Ref	Ref	Ref
Black, non-Hispanic	0.54 (0.31 to 0.92)*	0.74 (0.41 to 1.33)	0.59 (0.30 to 1.19)	0.73 (0.34 to 1.55)
Hispanic	0.72 (0.37 to 1.41)	0.86 (0.39 to 1.88)	0.89 (0.38 to 2.09)	0.99 (0.38 to 2.61)
Other	0.78 (0.23 to 2.62)	0.68 (0.19 to 2.50)	0.71 (0.14 to 3.77)	0.62 (0.11 to 3.44)
Injection drug use as HIV acquisition risk factor ⁴				
No	Ref	Ref	Ref	Ref
Yes	1.28 (0.66 to 2.48)	1.26 (0.60 to 2.63)	2.16 (1.02 to 4.56)*	2.49 (1.09 to 5.67)*
Recency of testing HIV positive (from time of study entry)				
3–12 months	Ref	Ref	Ref	Ref
13+ months	0.49 (0.22 to 1.08)	0.50 (0.22 to 1.17)	0.37 (0.15 to 0.93)*	0.45 (0.16 to 1.22)

	Odds of condomless anal/vaginal intercourse with HIV+ partners only (serosorting) vs. Always used a condom during anal/vaginal intercourse		Odds of condomless anal/vaginal intercourse with at-risk partners ¹ vs. Always used a condom during anal/vaginal intercourse	
	Unadjusted OR, (95% CI)	Adjusted ² OR, (95% CI)	Unadjusted OR, (95% CI)	Adjusted ² OR, (95% CI)
Language of CASI				
English	Ref	Ref	Ref	Ref
Spanish	0.50 (0.18 to 1.36)	0.34 (0.10 to 1.14)	0.63 (0.18 to 2.18)	0.50 (0.11 to 2.16)
Viral load (copies/ml) contemporaneous to sexual behaviour				
>1500–10,000	Ref	Ref	Ref	Ref
10,001–50,000	1.49 (0.91 to 2.43)	1.17 (0.69 to 1.99)	0.98 (0.52 to 1.86)	0.86 (0.43 to 1.69)
50,001 and higher	1.16 (0.70 to 1.92)	0.96 (0.56 to 1.66)	0.94 (0.49 to 1.78)	0.80 (0.40 to 1.57)
Currently taking ART				
No	Ref	Ref	Ref	Ref
Yes	0.53 (0.35 to 0.81) **	0.64 (0.41 to 1.01)	0.49 (0.29 to 0.84) **	0.62 (0.35 to 1.10)

MSM, men who have sex with other men; CASI, computer-assisted self-interview.

¹ At-risk partners were those perceived by study participant to be HIV-negative or of unknown serostatus at the time of the sexual activity.

² The multivariable model adjusts for all variables in the first column.

³ There were 5 transgender participants. They were omitted as a separate subgroup of the gender/sexual orientation variable, but were retained in the other variables for the unadjusted analyses.

⁴ This does not reflect whether the patient is a current injection drug user.

* P < 0.05;

** P < 0.01