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Seroadaptive Strategies of Vancouver Gay and Bisexual Men in a Treatment as Prevention Environment

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Abstract

British Columbia's Treatment as Prevention policy has provided free access to Highly Active Antiretroviral Therapy (HAART) to all HIV-positive provincial residents since 1996. One outcome

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is an increase in HIV-positive gay and bisexual men (GBM) with suppressed viral loads. Previous cross-sectional analyses indicated that some Vancouver GBM now recognize condomless anal sex with men on HAART who report a suppressed viral load as a sero-adaptive strategy. To test the hypothesis that this new strategy, termed viral load sorting (VLS), is recognized and used among by GBM in the Momentum Health Study, we analyzed longitudinal data for HIV-negative/unknown (n=556) and HIV-positive (n=218) sero-status participants. Analyses indicated that both groups reported VLS, and that sero-status and Treatment Optimism Scale scores were significant determinants in frequency and use. Results exemplify the medicalization of sex and Rogers Diffusion of Preventative Innovations, and have important implications for HIV research and GBM sexual decision-making.

Keywords

Treatment as Prevention; sero-adaptation; Treatment Optimism; Diffusion of Preventative Innovations

INTRODUCTION

Treatment as prevention refers to HIV prevention methods that use antiretroviral treatment to decrease the risk of HIV transmission, by lowering HIV viral load in the blood, semen, vaginal fluid and rectal fluid to very low levels, reducing the risk of onwards HIV transmission (World Health Organization, 2012). In Canada, British Columbia's Treatment as Prevention policy has provided free access to Highly Active Antiretroviral Therapy (HAART) to all HIV-positive provincial residents since 1996, resulting in significant reductions in community viral load levels, new HIV diagnoses, and HIV-related mortality (Lima, Hogg & Montaner, 2010, Lima et al., 2015; Montaner et al., 2010, 2014). This policy allowed HIV-positive men and women to extend sexual activity that otherwise would be curtailed by illness and/or death. Because of this, one concern frequently expressed in the past (Huebner, Rebchook & Kegeles, 2004; Brennan, Welles, Miner, Ross & Rosser, 2010) was that Treatment as Prevention would initiate high risk sexual behavior because of the emergence of HIV Treatment Optimism, or more specifically, *"*Transmission Optimism*"*, i.e. behaviour "focused on optimism toward sexual transmissibility of HIV due to effective treatment" (Chen, 2013:86). In contrast, more recent studies suggest that rather than increasing risk of acquiring HIV, gay and bisexual men (GBM) are adopting highly active anti-retroviral therapy (HAART) as a sero-adaptive strategy, recognizing that condomless anal sex with HIV-positive men on HAART who report suppressed viral loads (VL≤200 copies/mL) may reduce HIV transmission probabilities (Van Den Boom et al., 2013; Holt et al., 2015; Otis et al., 2016). Seroadaptive strategies are defined as potential harm reduction behaviors using HIV status to inform sexual decision-making (Snowden, Raymond, & McFarland, 2009, 2011). Seroadaptive strategies relevant to anal sex, the primary mode of HIV infection for GBM (Baggaley, White, & Boily, 2010), include condom use, sero-sorting, strategic positioning, withdrawal, avoiding anal sex (in favor of oral sex and/or masturbation), and HIV sero-status disclosure (Cassels & Katz, 2013). Seroadaptive practices have a long history in GBM populations (Vallabhaneni et al., 2012), are widely

practiced today (Snowden et al. 2011; McFarland et al., 2012) and may exemplify GBM resilience (Kurtz, Buttram, Surratt & Stall, 2012).

We found suggestions of changing sero-adaptive patterns in response to British Columbia's Treatment as Preventions policy in a recent study of GBM in the Momentum Health Study who reported attending group sex events (Rich et al., 2016). Multivariable analysis revealed that both HIV-negative/unknown and HIV-positive group sex event attendees considered condomless anal intercourse with an HIV-positive partner on HAART and reporting an undetectable viral load as a sero-adaptive strategy. This finding, which called viral load sorting, or VLS (Card et al., 2016), has important practical and theoretical implications for HIV research and personal sexual decision-making. For HIV research, HIV-negative/unknown sero-status men having condomless anal intercourse with HIV-positive men previously would be considered "high risk" sexual behaviour since it constitutes sero-discordant sexual partnerships; just the opposite of the historic strategy of sero-sorting. Now considering it now as a sero-adaptation can cause confusion in education and/or intervention programs evaluating high risk sexual behavior (Vosburgh, Mansergh, Sullivan & Purcell, 2012; Jin et al., 2015). Similarly, this change from high risk to sero-adaptation affects lay perceptions of what constitutes "safe" or "risky" sexual behaviour for GBM (Prestage, Brown, Down, Jin & Hurley, 2013). Theoretically, VLS is another example of the medicalization of sex (Giami & Perry, 2012), with GBM adopting pharmacological drugs into sexual behaviour, as previously recorded for erectile dysfunction drugs (Holt, 2009) and amyl nitrates or poppers (Rich et al., 2016). What is distinctive about VLS is that rather than enhancing sexual pleasure, the behavior parallels the Diffusion of Preventative Innovations Model, defined by Rogers (2002:991) as "new ideas that require action at one point in time in order to avoid unwanted consequences at some future time."

While we found evidence of VLS among Momentum Study group sex attendees, as multivariable logistic regression analyses revealed they were significantly different from other Momentum participants with regard to substance use and sexual behaviour patterns (Rich et al., 2016). Similarly, subsequent analysis of the same data (Card et al., 2016) indicated that both HIV-positive and HIV-negative/unknown sero-status GBM with $\geq$ 7 anal sex partners in the previous 6 months were significantly more likely to report VLS. In addition, both analyses were cross-sectional. Therefore in an attempt to understand the spread of VLS relative to other seroadaptive strategies among Momentum Health Study participants, we analyzed longitudinal Momentum data from February 2012 to August, 2015, and adopted Rogers' (2002) Diffusion of Preventative Innovations as our theoretical framework. Analysis focused on four specific research questions: 1) what is the overall frequency and rank of the VLS strategy over the study period relative to other sero-adaptive strategies, 2) what is the effect of sero-status on VLS, 3) are there trends in VLS prevalence by sero-status, and 4) what is the relationship between sero-status, Treatment Optimism and VLS?

METHODS AND MATERIALS

Protocol

Momentum uses respondent-driven sampling, or RDS, (Heckathorn, 1997), to recruit Vancouver GBM. RDS is designed for "hidden" populations, i.e. those lacking a probability based-sampling scheme, and has been successfully applied to populations including jazz musicians, commercial sex workers, People Who Use Injection Drugs, and sexual minorities (Johnston and Sabin, 2010). RDS procedures begin by identifying "seeds" who share key characteristics, e.g. sexual orientation, substance use, with a target population. Seeds subsequently recruit a fixed number of peers in a long-chain sampling approach. Successive recruitment waves permit population parameter estimation via Markov Chain procedures (Heckathorne, 2002). Seeds distributed a maximum of 6 paper and/or electronic vouchers to Vancouver GBM. Voucher recipients were screened for study eligibility criteria, which included being 16 years of age and older, identifying as male, having sex with other men in the past six months, living in the Greater Vancouver Area region, and competency in understanding a questionnaire written in English. Every six months eligible participants completed a computer-assisted self-interview (CASI) questionnaire and biological tests including point-of-care HIV testing, blood tests for hepatitis C and syphilis serology, and optional tests for gonorrhea and chlamydia. Study participants received a fifty dollar honorarium, and earned an additional ten dollars for each eligible recruit who completed the questionnaire and tests. All procedures received human ethics clearances from Simon Fraser University, the University of British Columbia, and the University of Victoria.

Analysis

RDS uses respondents' social network size to estimate sampling probabilities and generate population estimates. Accordingly, sample data were adjusted by the RDS program RDSAT Ver. 7.1 to generate point estimates and 95% confidence intervals. The main variables of interest were yes/no responses to sero-adaptive statements in the Momentum questionnaire, asking about these behaviours in the past 6 months. As shown in **Table 1** these included withdrawal, sero-sorting, sero-positing, anal sex avoidance, condom use, asking partner's sero-status, and VLS. For HIV-positive men the last was represented by the statement, "Have anal sex without condoms only if my viral load is low and I am on treatment". For HIV-negative/unknown status men the corresponding statement read, "Have anal sex without condoms only with HIV-positive guys with low viral loads or on treatment." As this example shows, some strategies are HIV-sero-status dependent. Thus, strategic positioning was represented by the statement, "Being the bottom" for HIV-positive respondents, but "Being the top" was the statement for HIV-negative/unknown sero-status study participants. Therefore analysis stratified the sample by self-reported HIV-serostatus, dichotomized as HIV-positive and HIV-negative/unknown status. We used this measure, rather than the one derived from the Point of Care HIV tests, because it represented respondents' estimation of their serostatus at the time of questionnaire completion and before biological testing.

Cochran-Mantel-Hanszel Tests evaluated VLS reported by HIV sero-status over the 7 six-month visits. Univariable and multivariable Generalized Estimating Equation (GEE) models (Allison, 2012) analyzed sero-adaptive strategies reporting, with sero-status as the dependent

categorical variable (HIV-positive versus HIV-negative/unknown status) using the SAS (Ver. 9.4) PROC GENMOD sub-routine. Final multivariable models were determined using a backward elimination procedure based on the Quasi-likelihood Information Criterion (QIC) and Type-III p-values (Lima et al., 2007).

In addition to anal sex strategies, demographic, substance use, psycho-social and sexual behavior measures were independent variables. Socio-demographic variables included age, ethnicity, annual income, education, residence in Vancouver, presence/absence of a regular partner, sexual orientation (gay, bisexual, other), and anal sex preference (top, bottom, versatile). Substance use questions asked if respondents had used erectile dysfunction drugs, crystal methamphetamine, poppers, Ecstasy/MDMA and/or GHB in the past six months. Questions pertaining to alcohol use in the same time period permitted calculation of the Alcohol Use Disorder Test (AUDIT, Saunders, Asaland, Babor, De la Fuente & Grant, 1993) scores. Psycho-social measures consisted of validated scales. These included a Treatment Optimism Scale, adapted from Van Den Ven, Crawford, Kippax, Knox, & Prestage, G. (2000), (study $\alpha = 0.82$), the Sexual Escape Scale (McKirnan, Vanable, Ostrow & Hope, 2001, study $\alpha = 0.90$), the Sexual Sensation Seeking Scale (Kalichman & Rompa, 1995, study $\alpha = 0.73$), and a Sexual Altruism Scale, (O'Dell, Rosser, Miner & Jacoby, 2008) which included both personal (study $\alpha = 0.82$) and community (study $\alpha = 0.88$) sub-scales. Additional scales included the Gay/Bisexual Self-Esteem (Herek & Glunt, 1995, study $\alpha = 0.88$), Social Support (Lubben et al., 2006, study $\alpha = 0.86$), Loneliness Scales (Gierveld & van Tilburg, 2006, study $\alpha = 0.77$), in addition to the Hospital Anxiety/Depression Scale (Snaith, 2003), divided into the Anxiety sub-scale, (study $\alpha = 0.79$) and, Depression sub-scale, (study $\alpha = 0.83$). Sexual behaviour questions pertained to the past six months and included the number of male sex and male anal sex partners, and asked if the respondent had engaged in condomless anal sex or high risk sex, with the latter defined as condomless anal sex with a sero-discordant or unknown sero-status partner. Moderation analysis (Jose, 2013) investigated the effects of HIV sero-status on Treatment Optimism Scale scores and VLS. Effects and effect sizes for both models were calculated along with their 95% confidence intervals using the SAS® Ver. 9.4 GENMOD sub-routine.

RESULTS

Sample Characteristics

Altogether, a total of 774 GBM, (HIV-positive = 218, HIV-negative/unknown = 556), including 134 seeds, were recruited from February, 2012 to August, 2015. After recruitment participants returned every six months to repeat the questionnaire and tests. In total, data used for this study consisted of 2,698 visits. **Table 2** shows the sample's descriptive statistics. The median number of visits was 4 ($Q_1 – Q_3 = 1–5$). The sample had a median age of 34 years (Q1 – Q3 26 – 47), was predominantly White, and the majority (85%) had more than a high school education. Raw values falling outside RDS-generated 95% confidence intervals included an overrepresentation of HIV-positive men, Caucasians, and men with more than a high school education. Men in the lowest income class (<$30,000 per annum) were underrepresented, while the next annual income class ($30,000-$60,000) was overrepresented. The unadjusted HIV prevalence level of 28.2 was higher than the RDS-

derived value of 21.0, but just outside the RDS-adjusted upper 95% limit of 27.9. Over one-quarter of men (26.1%) reported condomless anal intercourse in the past 6 months, while 38.5% reported high risk sex, defined in the Momentum Study as having condomless anal intercourse with a sero-discordant or unknown sero-status partner.

Sero-Adaptive Strategies and Trend Analysis

The distribution of reported seroadaptive strategies, showing both the number reported over the study period and their relative rank, both overall and by sero-status, is shown in **Table 3**. Results show both widespread recognition and reporting of all sero-adaptive strategies, as well as variation in rank order by serostatus. In particular, VLS was ranked third among HIV-positive, while it had the lowest, 7th, rank for HIV-negative/unknown sero-status men. Analysis of VLS by study visits omitting the final seventh visit due to small sample size, is shown in **Figure 1**. This indicated an increasing trend for VLS among HIV-negative/unknown status men (p=0.049) overall, particularly notable in the last two visits. For HIV-positive men, the percentage reporting VLS strategy was consistent, and no trend was detectable (p=.0.358).

Generalized Estimating Equation Regression and Moderation Analyses

Since Tables 2 and 3 indicated significant differences in VLS strategy by sero-status, we explored sero-status further in GEE models, with statistically significant results from the final selected multivariable model shown in **Table 4**. Results indicated that in addition to HIV-positive men having significantly higher odds of VLS, they also were significantly older, scored higher on the Treatment Optimism Scale and had significantly higher odds of using crystal methamphetamine in the past six months compared to the HIV-negative/unknown sero-status referent group. In contrast, HIV-positive men showed significantly lower adjusted odds ratios for using condoms, earning more than $30,000 annually, living in Vancouver's downtown core, using Ecstasy/MDMA in the past six months, scored lower on the AUDIT scale, listing "top" as their preferred anal sex position, and having high risk sex in the past 6 months.

The most important result from GEE analysis for VLS was that HIV-positive men were significantly more likely to report VLS and scored higher on the Treatment Optimism Scale. To assess the relationships between sero-status, VLS, and Treatment Optimism Scores we conducted two moderation analyses. Treatment Optimism Scores were the dependent variable in the first model and VLS in the second, with sero-status the moderating variable in both. We chose to construct both models because even with longitudinal data we could not determine causality (Huebner, Neilands, Rebchook & Kegeles, 2011), i.e. does VLS determine Treatment Optimism Scores, or do Treatment Optimism Scores determine VLS? **Table 5** shows that in both models sero-status was a significant moderator and had a larger effect for the HIV-negative/unknown status sample. This is illustrated in **Figure 2**, which graphs the effects of sero-status on VLS. As shown here, HIV-positive men had a higher average Treatment Optimism Score over the study period. Both HIV-positive and HIV-negative/unknown serostatus men had higher mean Treatment Optimism Scores if they used VLS, but the effect was larger for the latter group, whose average Treatment Optimism Score increased by 2.5 points, compared to the 1.0 mean increase for HIV-positive men.

SUMMARY AND DISCUSSION

We analyzed longitudinal data from February 2012 to July, 2015 to assess whether Vancouver Momentum Health Study participants reported a sero-adaptive strategy based on HAART-induced viral load suppression along with already established anal sex strategies. In doing so we adopted Rogers' (2002) Diffusion of Prevention Innovations Model and formed four specific research questions: 1) what is the overall frequency and rank of VLS over the study period relative to other sero-adaptive strategies, 2) what is the effect of sero-status on VLS, 3) are there trends in VLS prevalence by sero-status, and 4) what is the relationship between sero-status, Treatment Optimism and VLS? For the first two questions univariable analysis showed VLS reported by both HIV-positive and HIV-negative/unknown status men, although the former reported much higher levels. For the third question trend analysis revealed an increase over time, most apparent for the last two visits, for VLS in HIV-negative/unknown sero-status men, but not for their HIV-positive counterparts. For the fourth question multivariable GEE analysis showed that HIV-positive men had both higher adjusted odds ratios for both VLS and Treatment Optimism Scores. Subsequent moderation analyses revealed that HIV sero-status significantly modified both Treatment Optimism Scores and VLS, with the effects greater for the HIV-negative/unknown sero-status men in both cases.

Overall, these findings indicate that in Vancouver's Treatment as Prevention environment already established anal sex sero-adaptive strategies remain important, but that the historic consideration of sero-status has expanded to include treatment status and viral load consideration, represented by VLS. The result is a contemporary blending of sero-adaptive strategies employed by GBM since the onset of the HIV/AIDS pandemic (Cassels & Katz, 2013) with new behaviors arising from the medicalization of sex, exemplified by Rogers' (2002) Diffusion of Preventative Innovations. In particular, VLS conforms to Rogers' definition of Preventative Innovations (2002:991) as "new ideas that require action at one point in time in order to avoid unwanted consequences at some future time," with Momentum GBM adopting HAART into sexual behaviour to avoid HIV/AIDS.

This study's findings parallel other research reporting that GBM incorporate viral load information into sexual decision-making. Horvath, Smolenski, Iantaffi, Grey & Rosser (2012) reported from an on-line survey of 356 GBM that condomless anal intercourse occurred more commonly with casual sex partners when viral load was discussed than when it was not (75% vs. 56%), and that 93% of men in sero-discordant primary or regular partnerships discussed viral load, as did 53% of men engaging in recent, casual partnerships. However, these sero-adaptations vary by prevalence and patterning. Australian research conducted in 2012 (Bavinton et al., 2016) showed only 20% of a sample of 839 HIV-positive and HIV-negative GBM men in an on-line survey were willing to have condomless anal intercourse with a sexual partner who was HIV-positive and on HAART. Those willing to do so were significantly more likely to be HIV-positive, had higher belief in Treatment as Prevention effectiveness and reported condomless anal sex with a casual sex partner in the previous six months. These results were interpreted as indicating that GBM willing to rely on HAART as HIV transmission prevention were HIV-positive men already engaging in higher risk behavior. This interpretation does not entirely fit the present study's sample.

Similar to the Australian study, Vancouver HIV-positive GBM reported higher VLS frequencies, and significantly higher Treatment Optimism Scores. However, they were also significantly less likely to have condomless anal sex with a sero-discordant and/or unknown sero-status partner in the past six months, which is Momentum's definition of high risk sex. As such they could not be viewed as already engaged in high risk sexual behavior.

Such heterogeneous results indicate a need for additional research on GBM behavior in different Treatment as Prevention environments to understand more fully relationships between Treatment Optimism, suppressed viral loads and condomless anal sex. Even with longitudinal data, we could not discern if reporting VLS was preceded and influenced by Treatment Optimism beliefs or the reverse, with VLS resulting in higher Treatment Optimism scores. Future qualitative studies could help determine context-specific causality. In addition, future studies should address other possible changes in GBM norms and behaviors resulting from widespread HAART uptake and adherence. Quantitative measures, in the form of HIV-stigma scales (Courtney-Quirk, Wolitski, Parsons, & Gomez, 2006; Smit, 2012) and/or measures of time spent with HIV-positive GBM (Prestage et al., 2013) could address this issue. Qualitative studies could also determine if and why HIV-positive men use VLS in higher frequencies than HIV-negative/unknown status men as they did in this study. This may be to reduce risk of HIV superinfection (Redd, Quinn & Tobian, 2013), may reflect the higher Treatment Optimism Scale scores for HIV-positive men as recorded here, or both.

Readers should be cautious when reviewing our findings. We analyzed self-reported sero-adaptive strategies, but had no way to determine if study participants actually used the strategies they reported. Similarly, we could not attribute different strategies to different partnerships, e.g. regular versus causal partners. Further, while corrected by RDS to produce population parameters estimates, we make no claims that our resulting sample is representative. Recent research (McCreesh et al., 2013) indicates that RDS methodology cannot overcome all biases involved in sampling hidden populations. For this study these include differences between on-line and off-line recruited respondents (Lachowsky et al., 2015), yet sensitivity analyses and simulation indicate that RDS produces robust parameter estimations even when seed numbers vary greatly (Lachowsky et al., 2016). Finally, we recognize that our data come from Vancouver, the epicentre of British Columbia's Treatment as Prevention Policy, and as such may not be representative of other locales where HAART is not as well accepted by community groups and supported by medical facilities.

In conclusion, despite the caveats listed above, our results support the hypothesis that VLS is diffusing throughout both HIV-positive and HIV-negative/unknown sero-status status GBM in the Momentum Study, exemplifying Rogers' (2002) Diffusion of Preventative Innovations Model. Our results show that this diffusion is affected by sero-status and Treatment Optimism, with HIV-positive men having both higher Treatment Optimism Scale scores and higher prevalence of VLS. Diffusion of this new sero-adaptive strategy has important implications for HIV research and individual GBM sexual decision-making and certainly merits future study.

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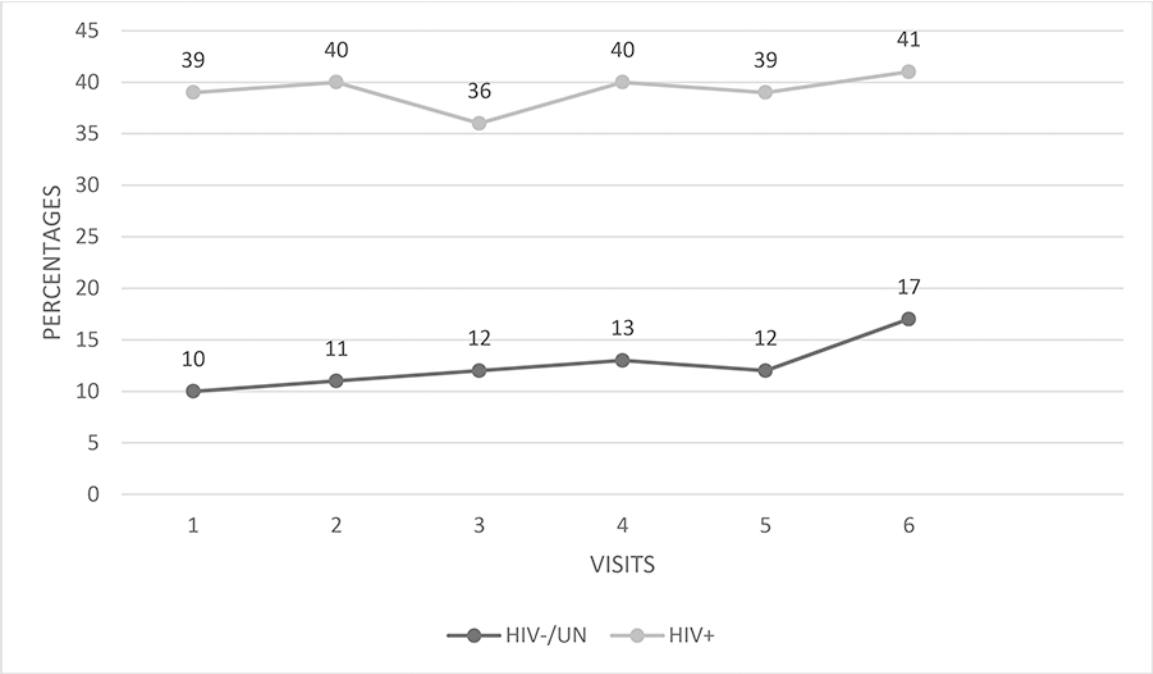

Figure 1.
VLS strategy by sero-status over the study interval.

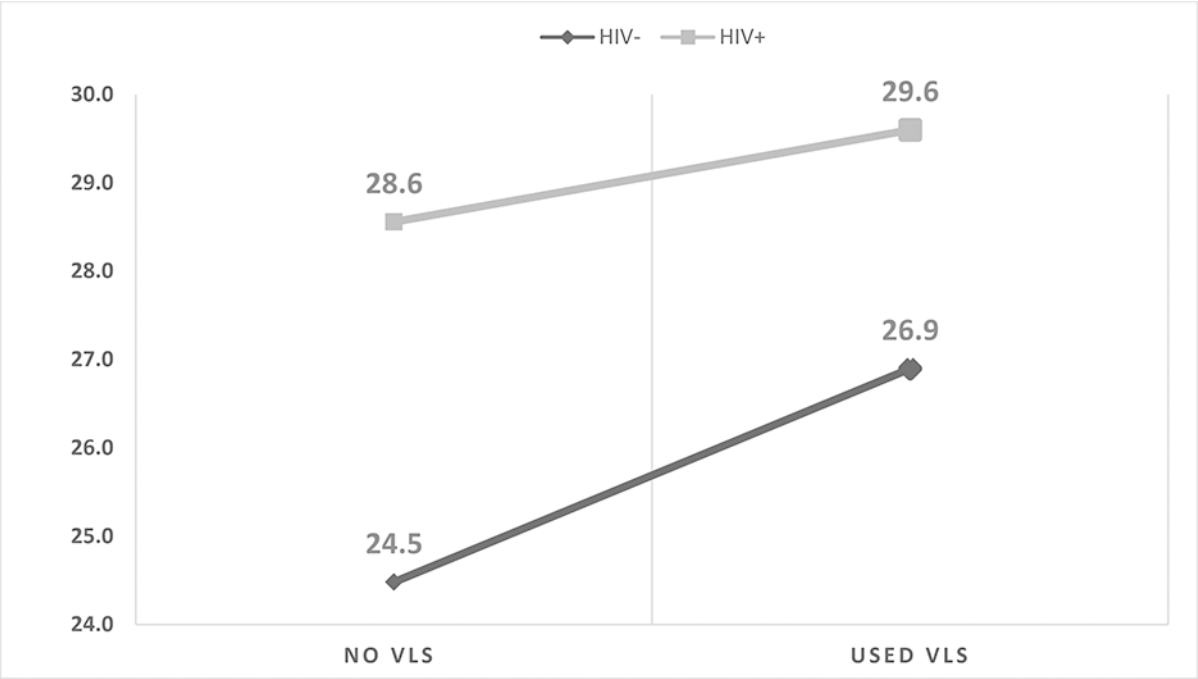

Figure 2.
Moderation effect of HIV sero-status and VLS on Treatment Optimism Scale scores.

Table 1.

Sero-adaptive strategies in Momentum questionnaire, listed by sero-status.

PREVENTION STRATEGIES BY SERO-STATUS	
HIV-POSITIVE	**HIV-NEGATIVE/UNKNOWN**
Always using condoms for anal sex	Always using condoms for anal sex
Being the bottom for anal sex	Being the top for anal sex
Having anal sex without condoms only with guys I know are HIV-positive	Having anal sex without condoms only with guys I know are HIV-negative
Having anal sex without condoms if my viral load is low and I am on treatment	Have anal sex without condoms with HIV-positive guys have low viral loads or are on treatment
Not cumming inside my partner	Not letting my partner cum inside me
Asking my sex partners about their HIV status before sex	Asking my sex partners about their HIV status before sex
Having sex which does not include anal sex	Having sex which does not include anal sex

Table 2.

Baseline sample crude and RDS adjusted descriptive statisticsd.

VARIABLE	N	%	RDS %	RDS 95% CI
Age (Median, Q1, Q3)	34 26, 47			
Sexual Partners (Median, Q1, Q3)	5 2, 14			
Anal Sex Partners (Median, Q1, Q3)	3 1, 8			
Participants by Visit				
1	770			
2	514			
3	458			
4	410			
5	318			
6	172			
7	56			
Total	2,698			
Ethnicity				
White	585	75.6	68.5	61.1, 74.5
Asian	74	9.6	9.2	5.9, 14.8
Aboriginal	50	6.5	9.7	5.1, 15.1
Other	65	8.4	12.7	8.1, 18.0
Sexual Identity				
Gay	655	84.6	79.9	75.3, 84.6
Bisexual/Other	119	15.4	20.1	15.4, 24.7
Education				
Less than high school	166	21.9	29.0	23.4, 36.2
More than high school	592	78.1	71.0	63.8, 76.6
Neighborhood				
Downtown	382	49.4	51.0	43.2, 58.2
Vancouver	240	31.0	30.8	24.8, 37.0
Outside Vancouver	152	19.6	18.2	13.5, 24.6
Annual Income				
< $30,000	485	62.7	72.9	67.6, 78.5
$30–60,000	200	25.8	18.6	14.4, 22.7
>= $60,000	89	11.5	8.6	5.3, 12.0
HIV Status – Self Report				
Negative/Unknown	556	71.8	79.0	72.1, 85.9
Positive	218	28.2	21.0	14.1, 27.9
P6M Unprotected Anal				

VARIABLE	N	%	RDS %	RDS 95% CI
Sex				
No	268	35.4	38.8	33.3, 46.2
Yes	197	26.1	24.9	19.8 29.8
High Risk Sex	291	38.5	36.3	29.7 42.0

Table 3.

Seroadaptive strategies by sero-status.

SERO-ADAPTIVE STRATEGY	TOTAL SAMPLE		HIV-NEGATIVE/ UNKNOWN		HIV-POSITIVE	
	N.	Rank	N.	Rank	N.	Rank
Disclose Sero-Status	1539	1	1141	2	398	1
Use Condoms	1392	2	1148	1	244	5
Avoid Anal Sex	1205	3	948	3	257	4
Sero-Sorting	1077	4	736	4	341	2
Sero-Positioning	778	5	544	5	234	6
Withdrawal	657	6	455	6	202	7
Viral Load Sorting	515	7	221	7	294	3

Table 4.

Statistically significant variables (in bold) from final Generalized Estimating Equations multivariable model with reported HIV sero-status (HIV-negative/unknown vs. HIV-positive) as the dependent variable, HIV-positive men as referent.

VARIABLE	UNIVARIABLE MODEL			MULTIVARIABLE MODEL		
		OR[1]	95% CI		AOR[2]	95% CI
Always using condoms						
No		1.00[3]			1.00	
Yes	**0.27**	**0.20**	**0.35**	**0.65**	**0.45**	**0.93**
Condomless Anal Sex with HIV(+) Men on HAART						
No		1.00			1.00	
Yes	**2.30**	**1.51**	**3.50**	**2.65**	**1.77**	**3.97**
Age	**1.10**	**1.08**	**1.12**	**1.10**	**1.08**	**1.12**
Treatment Optimism Scale	**1.12**	**1.08**	**1.17**	**1.13**	**1.08**	**1.18**
AUDIT Scores	**0.94**	**0.91**	**0.98**	**0.95**	**0.92**	**0.99**
Annual Income						
<$30,000		1.00			1.00	
$30–60,000	**0.48**	**0.33**	**0.71**	**0.38**	**0.23**	**0.62**
>$60,000	**0.30**	**0.16**	**0.54**	**0.16**	**0.08**	**0.35**
Anal Sex Preference						
Bottom		1.00			1.00	
Versatile	1.01	0.70	1.46	0.80	0.49	1.30
Top	0.71	0.48	1.06	**0.45**	**0.27**	**0.75**
None	0.88	0.44	1.76	0.46	0.19	1.13
Ecstasy/MDMA, Past 6 Months						
No		1.00			1.00	
Yes	**0.54**	**0.38**	**0.76**	**0.38**	**0.23**	**0.62**
Crystal Methamphetamine, Past 6 Months						
No		1.00			1.00	
Yes	**6.09**	**4.19**	**8.86**	**6.70**	**4.11**	**10.93**
Condomless Anal Sex, Past 6 Months						
No		1.00			1.00	
Yes	0.93	0.66	1.32	0.71	0.45	1.12
High Risk Sex	**1.57**	**1.13**	**2.17**	**0.61**	**0.38**	**0.97**

[1]Odds Ratio

[2]Adjusted Odds Ratio

[3]Referent

Table 5.

Moderation analysis results.

5A. VLS as the dependent variable, HIV sero-status as moderator and Treatment Optimism Scores (TOS) as the independent variable.		
VLS (yes vs. no)	**Odds Ratio**	**95% CI**
HIV X TOS	0.95	0.90 1.00
HIV-/UN:TOS	1.16	1.11 1.21
HIV+ : TOS	1.10	1.06 1.14

B. Moderation analysis with Treatment Optimism Scores (TOS) as dependent variable, HIV serostatus and VLS as independent variables. Effect estimate (EE), 95% confidence intervals and corresponding probabilities.		
TOS	**EE**	**95% CI**
HIV X VLS	−1.37	−2.44 −0.31
HIV-/UN :VLS	2.42	1.54 3.29
HIV+ : VLS	1.04	0.41 1.67