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Sexual Behaviors and Transmission Risks among People Living with HIV: Beliefs, Perceptions, and Challenges to Using Treatments as Prevention

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Abstract

Antiretroviral therapy (ART) improves the health of people living with HIV and can reduce infectiousness, preventing HIV transmission. The potential preventive benefits of ART are undermined by beliefs that it is safe to have condomless sex when viral load is below levels of detection (infectiousness beliefs and risk perceptions). In this study we hypothesized that infectiousness beliefs and HIV transmission risk perceptions would prospectively predict people living with HIV engaging in more condomless sex with HIV-negative and unknown HIV status sex partners. Sexually active HIV-positive men (n=538, 76%) and women (n= 166, 24%) completed computerized interviews of sexually transmitted infections (STI) symptoms and diagnoses, unannounced pill counts for medication adherence, medical chart abstracted HIV viral load, and 28 daily cell-phone delivered prospective sexual behavior assessments. Results showed that a total of 313 (44%) participants had engaged in condomless sex with HIV-negative/unknown status sex partners and these individuals demonstrated higher rates of STI symptoms and diagnoses. Two-thirds of participants who had condomless sex with HIV-negative/unknown status partners had not disclosed their HIV status. Multivariable logistic regression models showed that beliefs regarding viral load and HIV infectiousness and perceptions of lower risk for HIV transmission resulting from HIV viral suppression predicted condomless sex with potentially uninfected partners over and above sex behaviors with HIV-positive partners and STI symptoms/diagnoses. Interventions that address HIV status disclosure and aggressively treat STI in sexually active people living with HIV should routinely accompany the use of HIV treatments as prevention.

Keywords

HIV sexual risks; Sexual infectiousness; HIV treatments as prevention; HIV prevention

INTRODUCTION

Antiretroviral therapy restores immunity, improves health, and increases life expectancy for people living with HIV infection. HIV treatments effectively suppress virus replication and impede viral activity, with the potential to reduce HIV infectiousness (Cohen, McCauley, &

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Gamble, 2012). Observation studies and randomized controlled trials have shown that early antiretroviral therapy (ART) can reduce the risk of HIV transmission by as much as 90% (Cohen et al., 2011; Del Romero, Castilla, Hernando, Rodriguez, & Garcia, 2010). Studies of HIV serodiscordant couples where the HIV positive partner is treated with ART and is virally suppressed have shown no HIV transmission events (Rodger, 2014). Public health policy and clinical practice guidelines emphasize the potential HIV prevention benefits of ART (Amico, Zuniga, Wilson, Gross, & Young, 2013; Vernazza, 2008). Expanding ART with the aim of preventing new infections is therefore the cornerstone of current efforts to curtail HIV epidemics (Amico et al., 2013).

Antiretroviral therapy can prevent HIV transmission when individuals are adherent to their medication regimen and when HIV is suppressed in the genital tract. Optimal ART adherence, which is typically considered taking greater than 85% of medications as prescribed (Bangsberg, Kroetz, & Deeks, 2007), is necessary for suppressing HIV replication in blood plasma as well as the genital tract. Sexual health factors can also mitigate the viral suppressing effects of ART on sexual infectiousness. Local inflammatory processes, such as those caused by sexually transmitted infections (STI), however, increase HIV shedding in the genital tract and increase HIV infectiousness (Baeten & Overbaugh, 2003; Kalichman, 2013; Mayer & Venkatesh, 2011; Pilcher et al., 2004). Thus, HIV positive individuals with STI often have concentrations of HIV greater in their genital secretions than in their blood plasma (Cohen, Muessig, Smith, Powers, & Kashuba, 2012). There is indeed a dose-relationship between Leukocyte activity in the genital tract and HIV shedding (Anderson et al., 2008; Johnson & Lewis, 2008). Previous research has shown that local inflammation caused by urethritis is associated with an eightfold increase in genital tract HIV (Cohen et al., 1997).

Condoms not only protect against infected persons from transmitting HIV to sex partners, condoms also protect people already infected with HIV from contracting STI. Reductions in condom use therefore increase risks for STI exposure and increased HIV infectiousness (Kalichman, 2008). Theories of behavioral risk compensation predict that people who adjust their risk perceptions will compensate with increases in risk behaviors (Eaton & Kalichman, 2007). As efforts to use HIV treatments for prevention are brought to scale, individuals may adopt beliefs that they are less infectious when they have undetectable HIV in blood plasma (viral load), relaxing their concerns about HIV transmission and henceforth ceasing condom use, which increases their exposure to sexually transmitted pathogens (Kalichman et al., 2002).

The literature on risk compensation in response to HIV viral suppression includes studies of both beliefs regarding the effects of treatment on infectiousness and personal perceptions of HIV transmission risks (Crepaz, Hart, & Marks, 2004; Eaton & Kalichman, 2007). Although beliefs and personal risk perceptions are epistemologically related (Armstrong, 1968), they are distinct constructs with different implications for prevention (Fishbein & Ajzen, 1975; Fisher & Fisher, 2000; Janz & Becker, 1984). In the context of HIV transmission, infectiousness beliefs reflect an awareness and knowledge of HIV treatments used for prevention, including whether condoms are necessary when HIV replication is suppressed. In contrast, personal risk perceptions reflect the subjective judgment individuals make when

facing a potential hazard (Fischhoff, Bostrom, & Quadrel, 1993). Individuals can be sensitized to risk without necessarily changing beliefs. Thus, health beliefs and risk perceptions have potentially different roles in impacting behavior and are amenable to change through different processes.

The purpose of the current study was to investigate the effects of infectiousness beliefs and personal risk perceptions on HIV transmission risks among sexually active HIV-positive men and women. Sexual behavior was assessed over 28 days using electronic daily diaries to discern sexual behaviors with and without condoms with partners of known and unknown HIV status. We examined demographic, health, and behavioral characteristics including alcohol and drug use as potential covariates for sexual behaviors. We tested the hypothesis that (a) holding greater beliefs that sex is safer when a person is treated with ART (infectiousness beliefs) and (b) perceiving less HIV transmission risks when viral load is undetectable (transmission risk perceptions) would independently predict engaging in condomless sex with HIV-negative and unknown HIV status sex partners. In addition, we hypothesized that beliefs and perceptions would predict condomless sex over and above indicators of HIV infectiousness.

METHODS

Participants

A total of 760 men and 280 women were recruited from community services and infectious disease clinics during a 12-month period between 2013 and 2014. The site of the study was Atlanta, Georgia with an annual incidence of 30.3 per 100,000, exceeding the 19.6 per 100,000 population rate of HIV in major US cities. Eligible participants were age 18 or older and showed documentation of being HIV positive (e.g. antiretroviral medication prescription, HIV test result, viral load lab result, HIV clinic card) along with a photo ID.

Measures

Participants provided five sources of data: (a) audio-computer assisted self-interviews (ACASI) to assess demographic characteristics, infectiousness beliefs, and transmission risk perceptions; (b) HIV RNA (viral load) and CD4 cell counts from medical records; (c) urine specimens for substance use and genital tract inflammation screening; (d) unannounced pill counts to monitor medication adherence; and (e) daily sexual behavior electronic assessments. The specific measures are described below.

Audio-computerized Interviews—Computerized interviews asked participants their gender, age, years of education, income, ethnicity, employment status, and the year that they first tested HIV-positive. Participants indicated if they were currently taking ART and whether they knew the results of their most recent HIV viral load test. To assess global alcohol use the computerized interview administered the Alcohol Use Disorders Identification Test (AUDIT), a scale designed to measure alcohol consumption and problem drinking. The first three items of the AUDIT constitute the consumption subscale (AUDIT-C), a reliable and valid index of current alcohol use (Maisto, Conigliaro, McNeil, Kraemer, & Kelley, 2000; Saunders, Aasland, Babor, DeLaFuente, & Grant, 1993).

We assessed whether the participant had experienced any of three symptoms of an STI in the previous three months, including unexplained genital discharge, genital pain, or genital ulcer. Participants also reported whether they had been diagnosed with gonorrhea, chlamydia, syphilis, herpes simplex virus (HSV), or trichomoniasis in the previous three months. Both STI symptoms and diagnoses were dichotomously coded as present (1) or not present (0).

To assess infectiousness beliefs, participants responded to five items assessing beliefs about HIV treatments and routine viral load testing in relation to reducing HIV infectiousness (Kalichman et al., 2006). The items asked about whether HIV treatments make sex safer and whether an undetectable HIV viral load alleviates concerns about HIV transmission. Responses were made on a 5-point scale ; “Strongly agree”, “Agree”, “Uncertain”, “Disagree”, and “Strongly disagree”. To simplify interpretation of individual item endorsements, we dichotomized the responses to indicate agreement (“Strongly agree” and “Agree”) or disagreement (“Uncertain”, “Disagree”, and “Strongly Disagree”). Thus, we used dichotomized responses for descriptive purposes and we used the summed continuous measure based on the original response format is included in analyses. The summed composite score represented a unidimensional construct in factor analysis that was internally consistent, $\alpha = .70$.

Transmission risk perceptions were measured as a function of viral load status by asking participants to rate the relative risks of HIV transmission under three different scenarios. This measure has been used in previous research concerning HIV infectiousness-related transmission risk perceptions (Kalichman, Eaton, et al., 2007). Participants were first asked the following: “If you had anal or vaginal sex without a condom today with a partner who does not have HIV, what risk do you think there is that you would transmit the virus to that partner?” Responses were made on 11-point scales ranging from 0 = “very low risk” to 10 “very high risk”. After rating the perceived risk, the instructions were repeated, altering the scenario to present the respondent having an undetectable viral load. Participants were then again asked to rate the risk of this behavior a third time, but with the instruction set manipulated to have the respondent indicate risk if their viral load was detectable. The specific items are shown in the Results section. The order of presentation for the treatment status scenarios was not counterbalanced because of the successive and hierarchical logic of the scenarios.

We also calculated a difference score between perceived risks for HIV transmission with an undetectable viral load – perceived risks for HIV transmission with a detectable viral load. This variable indexes the perceived difference in HIV transmission risks when a person with HIV has an undetectable versus detectable HIV viral load. Scores with a positive value indicate perceiving greater risk when viral load is undetectable and scores with a negative value indicate perceived greater risk when viral load is detectable compared to undetectable.

Medical chart abstracted viral load and CD4 cell counts—We used a participant assisted method for collecting chart abstracted viral load and CD4 cell counts from their medical records. Participants were given a form that requested their doctor’s office to provide results and dates of their most recent, and not older than three months, viral load and

CD4 cell counts. These data were therefore obtained directly by the participant from their care provider. The form included a place for the provider's office stamp or signature to assure data authenticity. Providers used viral load testing with a range of sensitivities for detecting viral activity. HIV RNA below detection was defined as less than 100 copies/mL for uniformity across providers (Ruelle et al., 2012).

Urine tests for drug use and genital inflammation—To screen for drugs use we conducted a multi-panel urine dip-test to detect common illicit drug use. This test strip uses a lateral flow chromatographic immunoassay for qualitative detection of 12 drugs/metabolites, including THC, cocaine, and methamphetamine (Redwood Toxicology Labs - Reditest-12). These tests are FDA approved and are reliable and valid for initial drug screening. We also tested urine samples for leukocyte activity as a marker for genital tract inflammation (Anderson et al., 2008; Laisaar, Uuskula, Sharma, Dehovitz, & Amico, 2013). We used a chemstrip test for the presence of Leukocyte esterase, an enzyme that is indicative of urinary tract inflammation. Granulocytic Leukocytes contain esterases that catalyze the hydrolysis of an indoxylcarbonic acid ester to indoxyl, which reacts with a diazonium salt to produce a purple color on the test strip. Specimens taken with Roche Chemstrips 2 LN were processed using the Roche Urisys 1100 Urine Analyzer.

Antiretroviral adherence—Participants consented to three unannounced telephone-based pill counts that occurred over a six-week period. Unannounced pill counts are reliable and valid in assessing medication adherence when conducted in homes (Bangsberg, Hecht, Charlebois, Chesney, & Moss, 2001) and on cell-phones (Kalichman et al., 2008; Kalichman, Amaral, et al., 2007). In this study we conducted unannounced cell-phone based pill counts using study-provided free cell phones. Following an office-based interview that included a full accounting of all prescription medications and training in the pill counting procedure, participants were called at three unscheduled times over 12 to 16 day intervals. All antiretroviral medications were included in the pill counts and calculation of adherence. The first of the three pill counts is used to establish the initial number of pills in possession with the subsequent two pill counts allowing for calculation of adherence, defined as the ratio of pills counted relative to pills prescribed, taking into account the number of pills dispensed. We used 85% of antiretroviral medications taken to define a clinically relevant level of adherence and non-adherence (Bangsberg & Deeks, 2002).

Sexual behavior assessments—We used an interactive text-diary assessment to collect daily data on sexual behaviors. Participants were instructed in the use of text message functions of their study-provided cell phone. Brief daily assessments were designed and delivered using interactive short message system (SMS) response. Electronic diaries have provided reliable data collection of socially sensitive behaviors (Bernhardt et al., 2009; McAuliffe, DiFranceisco, & Reed, 2010). Participants received a text-prompt to initiate and answer questions about their sexual activity during the previous day. The questions specifically asked about whether participants had sex yesterday and if so, whether they engaged in vaginal/anal intercourse with or without condoms, whether their partner was aware of their HIV status, and their knowledge of their partner's HIV status. Thus, each behavior was dichotomous, indicating that it had occurred (coded 0) or not occurred (coded

1). Daily sex behavior data was recorded by entering numerical responses using the cell phone keypad. The data were stored on a central secured server. Sexual behavior assessments were administered for 28 consecutive days following the initial office assessment and sexual activity were aggregated across days.

Procedures

Men and women living with HIV were recruited through targeted community sampling with both venue and snowball sampling techniques. Venue recruitment relied on responses to brochures placed in waiting rooms of HIV service providers and infectious disease clinics throughout Atlanta, GA. At an initial office assessment, participants provided informed consent and completed a computer-assisted interview to collect demographic and health information. We used computerized interviews because they have been shown to increase responses to socially sensitive measures (Gribble et al., 2000; Morrison-Beedy, Carey, & Tu, 2006). Participants were trained to conduct phone-based unannounced pill counts and were trained in the daily cell-phone text message assessments. In addition, participants provided a urine sample for drug screening and leukocyte testing. We also asked participants to obtain their most recent HIV viral load and CD4 cell count results from their medical provider. Participants then completed three unannounced phone-based pill counts to determine ART adherence over the next six weeks and 28 daily text message assessments of sexual behavior. Participants were reimbursed \$145 for completing all measures and providing all data. The university Institutional Review Board approved all procedures.

Data Analyses

The analyses included the 704 participants who engaged in vaginal or anal intercourse during the 28 days of electronic daily diary assessments. Using daily diary data to determine participants' knowledge of their sex partners HIV status, we compared the 391 participants who did not engage in condomless sex with HIV-negative/unknown status partners to the 313 participants who did engage in sex without condoms with HIV-negative/unknown status partners. We conducted bivariate logistic regressions to test the associations between sexual behavior groups on participant demographic characteristics, health status, substance use, sexual behaviors, infectiousness beliefs, and transmission risk perceptions. We tested our main study hypothesis that infectiousness beliefs and perceptions would prospectively predict condomless sex with HIV-negative/unknown status partners. This hypothesis was tested in a multivariable logistic regression that entered all non-redundant variables found significant in bivariate analyses followed by the infectiousness beliefs and transmission risk perceptions. For all analyses, statistical significance was defined by $p < .05$.

RESULTS

Among the 1040 persons enrolled in the study, a total of 567 (54%) completed all (100%) 28 of the days of electronic sexual behavior surveys, with an additional 320 (31%) completing 23 to 28 days. For the entire sample we sent 30,716 days of daily sexual behavior surveys, of which 28,328 (93%) days were completed. Across participants, sexual activity was reported on 5,468 days, or 9.5% of all days surveyed. At the day level during which sexual activity occurred, 3,497 (63%) days of sexual activity involved a partner who had not disclosed

being HIV-positive to the study participant. For participants who's partner had not disclosed being HIV-positive, 789 (23%) days involved partners who had directly disclosed being HIV-negative, 791 (23%) were days in which participants assumed that their sex partner was HIV-positive but were not told so, 576 (16%) involved assuming that their partner was HIV-negative, and 1,341 (38%) involved neither knowing nor assuming the HIV status of their partner.

Sexual behavior surveys indicated that 704 (65%) participants reported any sexual activity on at least one of the 28 day period. All further analyses only included these 704 sexually active participants.

A total of 591 (84%) sexually active participants engaged in vaginal or anal intercourse without condoms. The mean number of days during which sex without condoms occurred was 3.11 (SD = 3.42). Thus, a total of 313 (44%) engaged in sex without condoms with a partner who had not disclosed being HIV-positive. These participants were subsequently defined as having condomless sex with HIV-negative/unknown status partners.

Among the other 391 participants who did not engage in condomless sex HIV-negative/unknown status partners, 114 (29%) reported sex without condoms with an HIV-positive partner, with the remaining 277 participants engaging only in condom-protected sex. These 391 participants were therefore classified as not having engaged in condomless sex with HIV-negative/unknown status partners.

Table 1 shows the demographic and health characteristics of participants who did not and those who did engage in condomless sex with HIV-negative/unknown status partners. The majority of participants were men (75%) and most were African-American (92%). Only 16% of the sample was employed and more than half indicated that they were disabled. Participants indicated living with HIV for an average of 13.6 years. More than 90% of participants were receiving ART with a mean of 85.2% (SD = 17.8) medications taken as prescribed over the subsequent six weeks. Results showed that there were no differences between participants who had and had not engaged in condomless sex with HIV-negative/unknown status partners on any of the demographic and health characteristics.

Sexual Behaviors

Prospective daily surveys showed that individuals who had engaged in condomless sex with HIV-negative/unknown status partners were significantly more likely to report both vaginal and anal intercourse without condoms as well as less use of condoms overall. (see Table 2) In addition, individuals with HIV-negative/unknown status condomless sex partners were more likely to engage in condomless sex with HIV concordant partners. Results showed that 65% of participants who engaged in condomless sex with HIV-negative/unknown status partners had not disclosed their HIV status to their sex partners, whereas only 2% of those who had not engaged in condomless sex had not disclosed to HIV-negative/unknown status partners.

Indicators of HIV Infectiousness

Nearly one-third of all participants had unsuppressed (detectable) HIV viral loads and 12% tested positive for urinary leukocyte esterase, neither of which differed between the two groups (see Table 3). However, individuals who engaged in condomless sex with HIV-negative/unknown status partners were significantly more likely to have recently been diagnosed with an STI and experienced STI symptoms. Overall, 61% of participants with HIV-negative/unknown status condomless sex partners had at least one marker for elevated sexual infectiousness, significantly more so than persons with no condomless HIV-negative/unknown status partners.

Sexual Infectiousness Beliefs

Overall, 40% of participants endorsed at least one infectiousness beliefs. (see Table 4) Participants who engaged in condomless sex with HIV-negative/unknown status partners endorsed significantly more beliefs that HIV treatments reduce HIV transmission. A similar pattern of results was observed for beliefs regarding having an undetectable HIV viral load makes sex safer, although differences for these items were not statistically significant.

HIV Transmission Risk Perceptions

Table 4 shows the risk perception ratings for HIV transmission without specifying information about viral load and again under two scenarios where viral load is specified as either undetectable or detectable. Results showed that participants who engaged in condomless sex with HIV-negative/unknown status partners perceived less risk for HIV transmission when viral load was not specified and when viral load was specified as undetectable. There was no difference between groups for perceived transmission risk when viral load was specified detectable. For both groups, the relative risk for HIV transmission was lower when viral load was undetectable and higher when viral load was detectable. Examining the difference between perceived risks for HIV transmission when viral load was undetectable versus detectable showed that individuals who engaged in condomless sex with HIV-negative/unknown status partners perceived a significantly greater reduction in risk when HIV viral load is undetectable.

Multivariable Model

To test our main study hypothesis that infectiousness beliefs and transmission risk perceptions would predict engaging in condomless sex with HIV-negative/unknown status partners over and above infectiousness factors, we constructed a multiple logistic regression model entering days of condomless sexual activity with HIV concordant partners as a control for sexual activity, chart abstracted HIV viral load, STI symptoms and diagnoses, followed by infectiousness beliefs and risk perception difference score as predictors of condomless sex with HIV-negative/unknown status partners. Results showed that infectiousness beliefs and transmission risk perceptions significantly predicted condomless sex over and above all of the other variables included in the model. (see Table 5)

DISCUSSION

People living with HIV who are treated and adherent to viral suppressive regimens of antiretroviral medications are at low risk for transmitting HIV when they are clear of genital tract inflammation (Cohen et al., 2011). The current study found that 44% of sexually active people living with HIV infection engaged in condomless sex with HIV negative/unknown status partners over 28 prospective daily behavioral assessments. Participants frequently did not know the HIV status of their sex partners. In addition, two out of three participants who had HIV-negative/unknown status sex partners had not disclosed their HIV status to these partners. Participants who had engaged in condomless sex with HIV-negative/unknown status partners were no more or less likely to have undetectable or detectable viral loads. Condomless sex with HIV-negative/unknown status partners was associated with also having condomless sex on more days with HIV-positive partners. These higher rates of condomless sexual activity increase risks for exposure to sexually transmitted pathogens, as seen in the differences in infectiousness markers. Thus, we observed that participants who engaged in condomless sex with HIV-negative/unknown status partners were also the most likely to be recently sexually infectious.

Consistent with previous studies show that people living with HIV often hold beliefs that HIV treatments reduce risks for HIV transmission, we found 40% of participants endorsing at least one belief regarding HIV treatments and safer sex. Engaging in condomless sex with HIV-negative/unknown status partners was associated with infectiousness beliefs and HIV transmission risk perceptions. Our analysis extends the results of previous cross-sectional and prospective studies by demonstrating that infectiousness beliefs and risk perceptions predict engaging in condomless sex with HIV-negative/unknown status partners over the subsequent 28 days after accounting for potential confounding of sexual behaviors and indicators of sexual infectiousness (Kalichman, Eaton, et al., 2007; Stolte, Kolader, Fennema, Coutinho, & Dukers, 2006).

We found that HIV transmission risk perceptions paralleled the pattern of results observed for infectiousness beliefs. Individuals who engaged in condomless sex with HIV-negative/unknown status partners perceived lower personal risk of HIV transmission and risk perceptions were even lower in the context of an undetectable viral load. Greater differences in risk perceptions when viral load is undetectable predicted engaging in condomless sex with HIV-negative/unknown status partners over the coming month. It should be noted that ratings of risk for condomless sex were at the high-end of the scale regardless of the viral load context, and that despite the high-level of perceived risk individuals still engaged in condomless sex with HIV-negative/unknown status partners. Our hypothesis was confirmed that infectiousness beliefs and risk perceptions would independently predict condomless sex with HIV-negative/unknown status partners. Although infectiousness beliefs and transmission risk perceptions are conceptually related, they emerged as non-redundant predictors.

These findings should be interpreted in light of the study limitations. We relied on a convenience sample that cannot be considered representative of men and women living with HIV infection. The sample also came from a wide-range of providers that likely varied in

sexual health services including STI screening and treatment. The study also relied on self-report instruments to assess sexual and HIV status disclosure behaviors. Although we collected sexual behaviors using state of the science daily diary assessments, these data may still be subject to reporting biases. The few number of questions that can be asked each day because of potential participant burden also limits daily text assessments. Future research should assess specific sex acts in the context of relationships and the use of pre-exposure prophylaxis by HIV negative partners. Socially sensitive behaviors may have been underreported, suggesting that rates of condomless sex, HIV status disclosure, STI symptoms, and diagnoses in this study should be considered lower-bound estimates. With these limitations in mind, we believe that our study findings have implications for implementing early HIV treatments as an HIV prevention strategy.

Our findings indicate that sexually active people living with HIV often hold beliefs that HIV treatments reduce the risk of HIV transmission and perceive lower risk for transmission when HIV viral load is suppressed. While these beliefs and perceptions are certainly consistent with the state of HIV prevention science and medicine, reductions in transmission risk will not be fully realized when individuals contract co-occurring STI and other sources of genital tract inflammation (Cohen, 1998). Implementing HIV treatments to prevent HIV transmission must therefore include aggressive approaches to screening and treating co-occurring STI in all sexually active persons with HIV. As providers inform patients that viral suppression will reduce the risks for HIV transmission, the discussions should include the critical importance of adhering to medications and routinely being tested and treated for STI. In addition, interventions should assist people with HIV in disclosing their own HIV status to sex partners, as well as directly asking partners about their HIV status (Holstad, DiIorio, Kelley, Resnicow, & Sharma, 2011; Kalichman et al., 2011; Kalichman, Rompa, Cage, DiFonzo, & 2001). However, HIV prevention is not solely the responsibility of people living with HIV. Individuals who are not infected with HIV share responsibility for condom use and discussing HIV status, as well as taking other measures to reduce their risks for HIV such as taking pre-exposure prophylaxis. Behavioral interventions have demonstrated promising results in achieving risk reduction goals with both infected and uninfected persons and should be integrated when implementing HIV treatments as prevention.

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Demographic and health characteristics of people living with HIV who did not and who did engage in condomless sex with HIV-negative/unknown status partners.

Table 1

Characteristic	Condomless sex with HIV-negative/unknown status partners							
	Total		Did not Engage (N = 391)		Did Engage (N= 313)		OR	95%CI
	N	%	N	%	N	%		
Gender							1.07	0.75–1.52
Men	538	76	301	77	237	76		
Women	166	23	90	33	76	24		
Transgender	48	1	28	7	20	6	0.67	0.48–1.59
Race							0.77	0.44–1.34
African American	654	93	367	94	287	91		
Caucasian	32	5	14	3	18	6		
Other race	19	2	10	3	9	3		
Income < \$10,000	441	62	246	63	195	62	1.03	0.76–1.40
Employment status							0.95	0.81–1.11
Unemployed	589	83	332	85	257	82		
Employed	115	17	59	15	56	18		
Alcohol use	443	62	238	61	205	65	1.22	0.89–1.66
Positive drug test	368	52	195	52	173	57	1.23	0.91–1.67
Currently on ART	638	90	356	91	282	90	0.86	0.52–1.43
Adherence < 85%	213	30	116	35	97	37	0.95	0.67–1.32
CD4 count < 200	123	17	60	17	63	20	0.75	0.50–1.10
Knows viral load	398	56	214	55	184	59	1.17	0.86–1.58
	M	SD	M	SD	M	SD		
Age	44.5	10.5	45.1	11.2	43.6	9.5	0.98	0.96–1.00
Education	12.7	1.8	12.8	1.7	12.7	1.9	0.96	0.88–1.04
Years testing HIV+	13.7	8.2	13.5	8.3	13.8	8.1	1.00	0.98–1.02
ART Adherence	85.2	17.5	85.5	18.1	84.6	16.6	0.76	0.30–1.90
CD4 cell count	485.2	297.9	499.1	309.7	468.5	282.6	1.00	0.99–1.01

28-Day prospective sexual behaviors among people living with HIV who did not and who did engage in condomless sex with HIV-negative/unknown status partners.

Table 2

	Condomless sex with HIV-negative/unknown status partners				
	Did Not Engage (N = 391)		Did Engage (N = 313)		95%CI
	N	%	N	%	
Vaginal sex without condoms	70	18	229	72	12.35 ^{***} 8.62–17.68
Vaginal sex with condoms	133	34	126	40	1.30 0.95–1.37
Anal sex without condoms	89	23	248	79	12.75 ^{***} 8.89–18.27
Anal sex with condoms	155	40	148	47	1.35 [*] 1.01–1.83
Undisclosed HIV status and sex w/o condoms	8	2	204	65	88.79 ^{***} 42.46–185.63
Days any sex w/o condoms					4.61 ^{***} 3.57–5.66
0	270	69	0		
1	60	15	95	30	
2–3	33	8	92	30	
4+	28	7	127	40	
Days concordant sex w/o condoms					1.21 [*] 1.04–1.42
0	277	70	188	60	
1	54	13	62	20	
2–3	32	8	32	10	
4+	28	7	31	10	
Days sex w/o condoms HIV-negative/unknown status partner					N/A
0	391	100	0		
1			132	42	
2–3			101	32	
4+			81	26	

Note:

* p < .05;

*** p < .01

Markers of HIV sexual infectiousness among people living with HIV who did not and who did engage in condomless sex with HIV-negative/unknown status partners.

Note:

* $p < .05$

** $p < .01$

Table 4

Infectiousness beliefs and sexual transmission risk perceptions among people living with HIV who did not and who did engage in condomless sex with HIV-negative/unknown status partners.

	Condomless sex with HIV-negative/unknown status partners					
	Did Not Engage (N = 391)			Did Engage (N = 313)		
	N	%		N	%	OR 95%CI
Reduced Infectiousness Beliefs¹						
People with HIV who take HIV medications are less likely to infect their sex partners.	89	22		104	33	1.68** 1.21–2.35
New HIV treatments make it easier to relax about unsafe sex.	53	13		62	20	1.58* 1.05–2.34
It is safe to have sex without a condom when my viral load is undetectable.	20	5		27	8	1.74+ 0.96–3.17
People with an undetectable viral load do not need to worry so much about infecting others with HIV.	31	8		38	12	1.60+ 0.97–2.64
HIV treatments take the worry out of sex.	44	11		43	14	1.25 0.79–1.96
Number of beliefs endorsed						
0	256	66		170	54	
1	78	20		73	23	
2	31	7		37	12	
3+	26	7		34	11	1.28** 1.10–1.50
Transmission Risk Perception²						
If you had anal or vaginal sex without a condom today with a partner who does not have HIV, what risk do you think there is that you would transmit the virus to that partner?						
	M	SD		M	SD	
If you had anal or vaginal sex without a condom today with a partner who does not have HIV, what risk do you think there is that you would transmit the virus to that partner?	8.0	3.1		7.4	3.3	0.94** 0.90–0.99
If you had anal or vaginal sex without a condom today with a partner who does not have HIV and your viral load was undetectable, what risk do you think there is that you would transmit the virus to that partner?	7.6	3.1		6.8	3.3	0.93** 0.88–0.97
If you had anal or vaginal sex without a condom today with a partner who does not have HIV and your viral load was detectable, what risk do you think there is that you would transmit the virus to that partner?	8.6	2.6		8.3	2.6	0.96 0.91–1.02
Perceived Risk if Viral Load is Undetectable – Risk if Viral Load is Detectable	–0.98	2.24		–1.51	2.7	1.09** 1.03–1.16

Note:

¹ Infectiousness beliefs responded to on 5-point scale, Strongly agree, “Agree”, “Uncertain”, “Disagree”, and “Strongly disagree” with endorsement defined by either Strongly agree or Agree responses;

² Transmission risk perception responded to on 11-point scales ranging from 0 = “very low risk” to 10 “very high risk”;

+ p < .10;

10' > d
**
'50' > d
*

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Table 5

Multivariable model predicting condomless sex with HIV-negative/unknown status partners.

Variable	Adjusted OR	95% CI
HIV Concordant sex without condoms	1.05	0.97–1.14
HIV viral load	1.15	0.81–1.62
STI symptoms	1.44	0.93–2.23
STI diagnosis	1.46	0.96–2.21
Infectiousness beliefs score	1.09 **	1.04–1.13
Perceived Risk if Viral Load is Undetectable – Perceived Risk if Viral Load is Detectable	1.07 *	1.01–1.15

Note:

*
p < .05;**
p < .01