HHS Public Access

Author manuscript

Arch Sex Behav. Author manuscript; available in PMC 2018 May 24.

Published in final edited form as:

Arch Sex Behav. 2017 May ; 46(4): 895–902. doi:10.1007/s10508-016-0934-9.

Diminishing Perceived Threat of AIDS and Increasing Sexual Risks for HIV among Men Who Have Sex with Men, 1997 to 2015

Seth C Kalichman, **Devon Price**, **Lisa A Eaton**, **Kaylee Burnham**, **Mathew Sullivan**, **Stephanie Finneran**, **Talea Cornelius**, and **Aerielle Allen**

University of Connecticut

Abstract

Community-wide awareness that ART provides protection against HIV has the potential to increase perceived safety and thereby increase condomless anal sex among men who have sex with men (MSM). Furthermore, reductions in condom use can increase exposure to sexually transmitted infections, which in turn can reduce the protective effects of ART on HIV transmission. The current study extends previous community-based behavioral surveillance research on beliefs regarding use of ART for HIV prevention and sexual practices among MSM. Anonymous cross-sectional community surveys were collected from 1831 men at the same Gay pride event in Atlanta, GA four times over nearly two decades; 1997, 2005–2006 (the 2006 survey over-sampled African Americans to diversify the study), and 2015. Results indicate clear and consistent trends of increasing beliefs that HIV treatments reduce HIV transmission risks, reflecting the dissemination of HIV prevention research findings. Changes in treatment beliefs coincide with increased rates of condomless anal intercourse. Increased beliefs that treatments prevent HIV and increased condomless anal sex were observed for both HIV positive men and men who had not tested HIV positive. Results illustrate the emergence of an era where ART is the focus of HIV prevention and community-held beliefs and behaviors regarding definitions of risk create a new and potentially problematic environment for HIV transmission.

Keywords

HIV Prevention; HIV Treatment; Risk Behavior; Sexual Behavior

Correspondence should be addressed to Seth C. Kalichman, Department of Psychology, 406 Babbidge Road, University of Connecticut, Storrs, CT 06269, USA Phone (860) 208-3706 seth.k@uconn.edu.

Conflict of Interest: Seth Kalichman has received research grants from the National Institutes of Health and a training grant from the National Institute of Mental Health. Devon Price declares that she has no conflict of interest. Lisa A. Eaton has received research grants from the National Institutes of Health and a training grant from the National Institute of Mental Health. Kaylee Burnham, Mathew Sullivan, Stephanie Finneran, Talea Cornelius and Aerielle Allen declare that she/he has no conflict of interest.

Compliance with Ethical Standards

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all participants included in this study.

Introduction

Antiretroviral therapies (ART) have revolutionized the treatment of HIV infection and ART is now used as a means of primary HIV prevention. For example, daily dosing of the co-formulated antiretroviral medication tenofovir disoproxil fumarate and emtricitabine (TDF/FTC, Truvada®) is approved for use as HIV pre-exposure prophylaxis (PrEP) in HIV negative persons and is being integrated into HIV prevention services (Amico et al., 2012). Also of critical importance to preventing the forward transmission of HIV is the potential for ART to reduce HIV infectiousness when treating HIV infection (Cohen, McCauley, & Gamble, 2012;Pilcher, Eaton, Kalichman, Bisol, & de Souza, 2006). Following the results of a randomized controlled trial showing that early treatment prevents HIV transmission (Cohen et al., 2011), the focus of HIV prevention has shifted away from condom use toward detecting and treating those already infected (Forsyth & Valdiserri, 2012;Schwartlander et al., 2011). The impact of ART on HIV transmission at the community-level has also been observed in South Africa's generalized HIV epidemic during the early stages of scaling up ART (Tanser, Barnighausen, Grapsa, Zaidi, & Newell, 2013). However, early observations have not translated to community-level reductions in HIV infections (Oldenburg et al., 2016). The outcomes of one large community-level trial of administering early ART as prevention in South Africa demonstrated high-levels of uptake and viral suppression, but failed to show significant impacts on new HIV infections (Iwuji et al., 2016). In addition, HIV infections remain stable or are rising among men who have sex with men (MSM) in countries that have scaled-up HIV testing programs and provide wide-scale access to ART. Thus, the well-established potential for ART to change the course of HIV epidemics has not yet demonstrated significant reductions in HIV incidence at the community-level in major cities where ART is widely accessible (Matthews et al., 2016;Newman et al., 2015;Wilson, 2012). Multiple factors may account for the limited impact of ART on new infections including large numbers of undetected HIV positive individuals, poor retention in care, and incomplete ART adherence (Fellows et al., 2015;Risher, Mayer, & Beyrer, 2015).

There are likely several factors that undermine the HIV preventive impact of ART. First, as ART transforms HIV infection into a chronic and manageable disease, the perceived threat of AIDS is diminishing. Second, as MSM become increasingly aware of the effects of ART on HIV transmission, individuals may reduce their motivation to use condoms to prevent the spread of HIV. For example, one in five men who participated in an online survey in Australia reported that they would be willing to engage in condomless anal sex with an HIV positive partner as long as that partner was taking HIV treatments (Bavinton et al., 2016). Finally, as condom use declines, individuals will more likely be exposed to other sexually transmitted infections (STI) which could increase risks for HIV transmission (Alaei, Paynter, Juan, & Alaei, 2016).

Shifts in HIV treatment-related beliefs over the course of HIV epidemics are associated with reductions in condom use and increased risks for other STI. For example,Holt et al. (2016) report that HIV positive MSM in Australia are increasingly more likely to believe that ART can prevent HIV transmission and that men who endorsed beliefs that HIV treatments prevent HIV are significantly more likely to engage in condomless anal sex. Similar changes are observed in MSM who are HIV uninfected, with beliefs that ART prevents HIV coincide

with increases in condomless anal sex over time (Holt et al., 2014; Holt et al., 2016). Increased beliefs related to the potential for ART to prevent HIV transmission are associated with reductions in condom use in several countries (Laga & Piot, 2012), including Brazil (Hanif et al., 2014) and the United States (Kalichman, Eaton, & Cherry, 2010).

Research conducted years before there was evidence for the potential of ART to prevent HIV transmission had already demonstrated that MSM who held such beliefs reported less condom use (Chen, 2013). Studies between 1997, when highly active combinations of ART first became available, and 2006 showed significant increases in condomless anal sex among MSM (Kalichman, Eaton, et al., 2007b;Kalichman, Eaton, White, et al., 2007). These shifts in behavior occurred in a context of advances in ART used to prevent HIV transmission, including PrEP, and increasing beliefs that HIV treatments reduce HIV infectiousness. Similar patterns of association between HIV treatment beliefs and condomless anal sex are observed in both HIV positive and HIV uninfected MSM (Kalichman, Eaton, et al., 2007a). Thus, a pattern is emerging where increased awareness of the preventive effects of ART coincide with sexual behaviors that increase exposure to sexually transmitted pathogens that in turn increase risks for HIV transmission (Kalichman, 2008).

Previous studies of HIV treatment beliefs and condom use among MSM in the US were conducted prior to what is now definitive evidence that HIV viral suppression resulting from ART can directly translate to protection against HIV transmission (Crepaz, Hart, & Marks, 2004). Specifically, in 2011 the results of a widely publicized randomized trial demonstrated that early treatment with ART reduces HIV transmission risks to nearly zero, ushering in an era defined by ‘HIV treatment as prevention” (Cohen et al., 2011) and the media coverage that has subsequently declared an end to AIDS (Park, 2014). The current study extends research conducted prior to definitive evidence for using HIV treatment as prevention (TasP). We examined community held beliefs about TasP and sexual behaviors among MSM attending the same Gay Pride festival in the southeastern US with cross-sectional surveys collected four times over 18 years. TasP beliefs and sexual behaviors were assessed using the same instrument at the same community event in 1997, 2005, 2006, and 2015. Here we present those four waves of behavioral surveillance data to examine community trends in treatment-related beliefs and sexual behaviors among MSM.

Methods

Participants, Settings and Procedures

Cross-sectional surveys were collected using venue intercept procedures that have been reported in previous studies (Kalichman, Eaton, White, et al., 2007). The same survey instrument and procedures were used to collect data at four time points; June 1997, June 2005, September 2006, and October 2015. Potential participants were asked to complete anonymous surveys concerning health behaviors as they walked through the exhibit areas of a gay pride festival in Atlanta. For each year, we rented two booths in the exhibit area of the festival. Participants were told that the survey contained personal questions about their health and behavior, was anonymous, and would take 15-minutes to complete. In each year, greater than 80% of men approached agreed to complete the survey. Participant names were not obtained at any time. Survey respondents in 1997, 2005, and 2006 were offered $4 for

completing the survey and $5 in 2015. In each year participants were given the option of donating their incentive payment to a local AIDS service organization.

Participants were 511 men surveyed at the Atlanta Gay Pride festival in 1997 (Kalichman, Nachimson, Cherry, & Williams, 1998), 473 men surveyed at this same event in 2005 (Kalichman, Eaton, et al., 2007b), 449 men surveyed in 2006 (Kalichman, Eaton, White, et al., 2007), and 398 men surveyed in October 2015. As reported previously (Kalichman, Eaton, White, et al., 2007), the 2006 survey was intended to diversify the sample by including events targeted to African American MSM. It was therefore planned that the 2006 survey year would be substantially different from the others in racial composition.

Measures

Participants completed self-administered anonymous surveys measuring demographic characteristics, substance use, sexual behaviors, HIV treatment beliefs, and treatment-related perceptions of sexual risk in relation to HIV treatment status.

Demographic characteristics—Participants were asked their age, years of education, income, ethnicity, whether they identified as gay, bisexual, or heterosexual, whether they had been tested for HIV antibodies, and if so the number of times they were tested and the results of their most recent HIV test. We also asked if they were exclusively partnered, defined as being in a relationship with only one man for at least six months.

Substance use—Participants reported use of alcohol, marijuana, nitrite inhalants (poppers), powder or crack cocaine, or methamphetamine in the past six months. Responses were coded dichotomously, Yes/No.

Sexual behaviors—Participants reported the number of times they had engaged in anal intercourse as the insertive and receptive partner, with and without condoms in the past six months. We also collected the number of sexual partners with whom participants had engaged in each behavior. Open response formats were used to reduce response bias and to minimize measurement error (Catania, Gibson, Chitwood, & Coates, 1990). Proportion of condom use during anal intercourse was calculated with the formula *frequency of condom protected acts / total frequency of acts*. Measures similar to these have been found reliable in self-reported sexual behavior assessments (Schroder, Carey, & Vanable, 2003).

TasP beliefs—Participants responded to nine items assessing beliefs about HIV treatments, including beliefs about their effectiveness in treating HIV infection and reducing risks for HIV transmission. Items are the same for all years (Kalichman, Eaton, et al., 2007b;Kalichman, Eaton, White, et al., 2007;Kalichman et al., 1998). Responses to each item were made on 4-point scales ranging from 1 = Strongly Disagree to 4 = Strongly Agree. For data reduction purposes, we replicated the varimax rotated principle components factor analysis reported by Kalichman et al. (Kalichman, Eaton, et al., 2007b). The same three-factor structure that was previously extracted emerged again the 2015 survey data. With all data across all surveys combined, we again replicated the same factor structure. The first component accounted for 32% of the variance in the analysis and included three items with rotated factor loading greater than .30; “HIV positive persons who take HIV

medications are less likely to infect their sex partners during unsafe sex" (.735), "New AIDS treatments make it easier to relax about unsafe sex" (.776), and "It is safe to have anal sex without a condom with an HIV positive man who has an undetectable viral load" (.774). This factor was labeled HIV TasP beliefs and the linear composite (factor score) was used in analyses comparing survey years, partitioned by HIV status and engaging in condomless anal sex. Factor scores are interpreted as *z*-scores, with means of 0 and standard deviations of 1, representing orthogonal linear composites of weighted items. Factor scores are therefore by definition internally consistent.

Treatment-related risk perceptions—This measure directly examined risk perceptions as a function of HIV treatment status by asking men to rate their perceived risk of serodiscordant receptive condomless anal sex, specifically risk during receptive condomless anal sex for an HIV negative male partner when their HIV positive partner has an undetectable viral load.

Participants were asked to respond to the following scenario: "Imagine that an HIV negative man has sex with an HIV positive man who is being treated for his HIV infection and has an undetectable viral load. Please rate how risky you believe anal sex without a condom is when the HIV negative partner is bottom (receptive)". Responses were made for this single item on a 5-point scale ranging from 1 = Very Low Risk to 5 = Very High Risk.

Data quality assurances and statistical analyses

Surveys from each year were examined for inconsistencies and invalid responses which were treated as missing values (less than 5%), resulting in slightly different cell sizes for analyses. Comparisons of survey years were first conducted on demographic characteristics using contingency table chi-square tests for categorical variables and analyses of variance for continuous variables.

As a general framework, comparisons were made across survey years accounting for HIV status (HIV negative/unknown and HIV positive) and whether men had or had not practiced condomless anal intercourse in the previous six months. We first examined differences across survey years for demographic and HIV status characteristics using contingency table X^2 tests for categorical variables and one-way analyses of variance (ANOVA) for continuous variables. Next, we tested for associations between survey year and sexual behaviors; condomless anal intercourse, numbers of condomless anal sex partners, and condom use. We conducted logit log-linear regression models to test the associations of survey year, HIV status and sexual behaviors, controlling for age and race. We included all main effects and 2-way interaction terms in the models. We treated these models as multivariable omnibus tests of association, with significant models followed by subsequent analyses between behaviors and years, partitioned by HIV status. In these analyses, we examined changes in behavior over time partitioned by HIV status groups using contingency table X^2 tests for categorical variables and general linear models for the continuous variable percent of condom use during anal sex.

We next examined differences for TasP beliefs and risk perceptions. As described above, we pooled the surveys across years and performed a principle components factor analysis to

create a linear composite representing the TasP beliefs. We calculated factor scores for the first principle component that represented TasP beliefs for use in an ANOVA comparing survey years with HIV status and engaging in condomless anal sex included as variables in the model. Similarly, we used ANOVA to compare survey years, HIV status and condomless anal sex groups on the perceived risks for HIV transmission. All models controlled for age and race.

For all analyses of categorical variables, pairwise differences between survey years were tested by proportional differences and for continuous variables we used least significant difference tests. Non-parametric and parametric, tests for linear trends were also performed across the survey years. Missing data were treated as random and we used a complete case approach, analyzing all available data (Harel, Pellowski, & Kalichman, 2012). In addition, we tested for differences and linear trends across time points. Statistical significance was defined in all analyses as $p < .05$.

Results

The demographic characteristics of men who completed cross-sectional surveys at the Atlanta Gay Pride in 1997, 2005, 2006, and 2015 are shown in Table 1, which also shows that survey years differed along demographic. However, there were no differences in HIV testing history or HIV infections across survey years.

Condomless Anal Sex

Table 2 shows the rates of sexual behaviors for men surveyed at the four years of gay pride festivals. Logit log-linear regression models testing the association between survey year, HIV status and sexual behaviors, controlling for age and race, indicated significant omnibus associations for: condomless receptive anal sex, $X^2 = 14.2$, $p < .01$; condomless insertive anal sex, $X^2 = 10.7$, $p < .06$; total condomless anal sex, $X^2 = 12.8$, $p < .05$; and number of male condomless anal sex partners, $X^2 = 63.2$, $p < .001$. Similarly, the omnibus generalized linear model for associations with percent of times condoms were used was also significant, Wald $X^2 = 19.2$, $p < .001$. Planned analyses examined sexual behaviors across survey years partitioned by HIV status.

There was a consistent pattern across years for both HIV negative and HIV positive men to demonstrate increased rates of condomless anal sex and increased numbers of sex partners from 1997 to 2015. For HIV negative/unknown HIV status men (see upper panel of Table 2), condomless anal sex increased from 43% in 1997 to 61% in 2015. In addition, 9% of HIV negative/unknown status men in 1997 reported two or more condomless anal sex partners compared to 33% in 2015. Across behaviors, the pattern of differences showed increasing rates of condomless anal sex, confirmed as statistically significant linear trends over survey years.

A similar pattern of increased condomless anal sex and numbers of partners was observed among HIV positive men (see lower panel Table 2); condomless anal sex increased from 25% of men in 1997 to 67% in 2015, and the rate of HIV positive men reporting two or more condomless anal sex partners in the previous six months increased from 9% in 1997 to

52% in 2015. The proportion of intercourse occasions protected by condoms among HIV positive men decreased from 82% in 1997 to 47% in 2015. The proportional differences across years, as well as the linear trends were statistically significant.

TasP beliefs and treatment-related risk perceptions

Figure 1 shows the mean factor scores for beliefs that HIV treatments are protective against HIV transmission among men who engaged in and did not engage in condomless anal sex at each survey year partitioned by HIV status group. Results comparing survey times, men who had and had not engaged in condomless anal sex and HIV status on TasP beliefs indicated a main effect for year of survey, $F(3, 1829) = 6.3$, $p < .01$; beliefs that HIV treatments are protective against HIV transmission increased over the four survey years. In addition, across all survey years, men who engaged in condomless anal sex were significantly more likely to endorse beliefs that HIV treatments are protective against HIV transmission, $F(1, 1829) = 9.3$, $p < .01$. Beliefs that treatments are protective did not differ for men who were HIV uninfected and HIV positive men and there were no significant interactions.

Figure 2 shows the mean treatment-related risk perceptions for condomless anal sex when an HIV positive partner has an undetectable HIV viral load. Results indicated significant differences across survey years, $F(1, 1829) = 32.9$, $p < .01$; the perceived risk of condomless anal sex with a man who has an undetectable HIV viral load decreased significantly over time. There was also a significant main effect for engaging in condomless anal sex, $F(1, 1829) = 40.2$, $p < .01$; men who engaged in condomless anal sex reported significantly lower perceived risks for HIV when a partner has an undetectable viral load. In addition, HIV status group significantly interacted with engaging in condomless anal sex across survey years and HIV status groups, $F(1, 1829) = 6.1$, $p < .01$; HIV positive men who engaged in condomless anal sex reported the lowest perceived risks and HIV positive men who did not engage in condomless anal sex held the highest perceived risks. However, there was also a significant 3-way interaction, $F(3, 1829) = 2.8$, $p < .05$; the differences between HIV positive men who did not and who did engage in condomless anal sex in 1997 were negligible and similar to HIV negative/unknown status men, whereas HIV positive men who engaged in condomless anal sex in 2005, 2006, and 2015 held the lowest perceived risks.

Discussion

The current study adds to the mounting evidence that substantial changes have occurred in community-held beliefs that condomless anal sex is safer in the era of HIV treatment as prevention. Across the 20 years represented in our cross-sectional surveys, beliefs shifted for both the view that HIV transmission risks are reduced when people living with HIV are treated with ART and for perceptions of risk conferred by condomless anal sex with an HIV positive man when his blood plasma viral load is undetectable. Treatment-related behavioral beliefs in this study paralleled a resurgence in condomless anal sex among MSM measured over nearly two decades. During that time, our cross-sectional surveys showed a doubling in rates of condomless receptive anal sex among uninfected MSM and more than triple the rate of insertive condomless anal sex among HIV positive men. Increases in men reporting two or more recent condomless anal sex partners were also observed for both uninfected and

HIV positive men. Increases occurred incrementally and following a linear trend over time. These findings are similar to other studies that show increases in condomless anal sex among HIV positive and HIV negative MSM (Pantalone, Tomassilli, Starks, Golub, & Parsons, 2015). Thus, as treatment-related beliefs continue to shift in gay communities, we may expect further increases in condomless anal sex.

There is compelling evidence that under the conditions of ART reductions in blood plasma viral load correspond to genital tract infectiousness and predict HIV transmission risks (Cohen et al., 2012). Nevertheless, HIV infections among MSM continue to rise despite wide-scale treatment access and viral suppression (Matthews et al., 2016). Several factors can undermine the preventive value of HIV treatments, including treatment refusal and incomplete adherence. Of particular importance are local genital tract inflammatory processes that increase HIV shedding in semen rendering an individual more infectious than is apparent from his blood plasma viral load (Kalichman, Diberto, & Eaton, 2008;Pilcher et al., 2006). Thus, increases in condomless anal sex and exposure to STI will ultimately diminish the prevention benefits of HIV treatments (Jansen, Schmidt, Drewes, Bremer, & Marcus, 2016;Katz, Dombrowski, Bell, Kerani, & Golden, 2016;Payne, Lawrence, Soni, Llewellyn, & Dean, 2016;Sood, Wagner, Jaycocks, Drabo, & Vardavas, 2013).

The results of this research should be considered in light of its methodological limitations. As our study relied on repeated cross-sectional venue surveys, our findings are limited by all of the shortcomings of self-reported sexual behavior, particularly under-reporting. Our repeated cross-sectional samples were of convenience and cannot be taken as representative of any population, including MSM in Atlanta. In addition, our surveys were conducted in one US city that is experiencing significant increased rates of HIV infections, which again does not represent other cities. Our data also represent multiple cross-sectional surveys rather than longitudinal data and therefore cannot be used to infer causal relations. Several aspects of the HIV epidemic have changed over the time the surveys were conducted beyond HIV treatments and their use for prevention, any of which could confound our results. For example, during this same time there has been a shift away from HIV testing linked to prevention counseling to only using HIV testing to detect infections (Centers for Disease Control and Prevention, 2003). Also, new prevention approaches other than TasP are available, most notably PrEP that was not approved before the most recent survey time, and may have influenced responses. Other potential confounds not measured in the surveys include condom fatigue, changes in testing access, and the fact that HIV is no longer considered a death sentence. These co-occurring community-level changes may therefore account for the observed increases in condomless sex. In addition, we do not know whether TasP beliefs vary over time for people receiving treatment versus those not receiving ART in these surveys. With these limitations in mind, our findings have implications for continued efforts to prevent HIV infections among MSM.

HIV treatments offer great hope for curtailing new HIV infections. Universal access to ART has the potential to reduce community-level blood plasma viral load, which could mean a reduction in community-level infectiousness. However, to maximize the HIV prevention benefits of ART, increased efforts to control co-occurring STI are required. Both HIV uninfected and HIV positive sexually active MSM should receive comprehensive sexual

health services that include routine screening for herpes simplex virus, HPV, syphilis and other pharyngeal, urethral and rectal STI (Mimiaga et al., 2008). Supportive services are needed to sustain increases in HIV treatment including transportation, drug assistance programs and housing. In addition, HIV positive men who are receiving ART should have access to HIV treatment adherence counseling in order to assure sustained viral suppression. In addition, while the CDC recommends sexually active HIV uninfected MSM to get HIV tested repeatedly each year, the recommendations for prevention counseling and other prevention services are no longer supported (Galletly, Pinkerton, & Petroll, 2008). In the absence of prevention counseling, which should include interventions for continued condom use and access to PrEP, repeated HIV testing represents an idle response for those who test HIV negative until the point they become infected. Reaping the public health benefits of ART for prevention will therefore require increased attention to resolving behavioral beliefs, reducing sexual risk behaviors and investment in prevention services (Holtgrave, Maulsby, Wehrmeyer, & Hall, 2012).

Acknowledgments

Funding: This study was funded by the National Institute on Drug Abuse Grant R01-DA033067 and a training grant from the National Institute of Mental Health T32-MH074387.

References

Alaei K, Paynter CA, Juan SC, Alaei A. Using PrEP, losing condoms? PrEP promotion may undermine safe sex. AIDS. 2016; 30:2753–2756. [PubMed: 27824624]

Amico R, McMahan V, Goicochea P, Vargas L, Marcus JL, Grant RM, Liu A. Supporting study product use and accuracy in self-report in the iPrEx study: next step counseling and neutral assessment. AIDS and Behavior. 2012; 16(5):1243–1259. [PubMed: 22460228]

Bavinton BR, Holt M, Grulich AE, Brown G, Zablotska IB, Prestage GP. Willingness to act upon beliefs about 'Treatment as Prevention' among Australian Gay and Bisexual Men. PLoS ONE. 2016; 11(1):e0145847. [PubMed: 26741143]

Catania JA, Gibson D, Chitwood D, Coates TJ. Methodological problems in AIDS behavioral research: Influences on measurement error and participation bias in studies of sexual behavior. Psychological Bulletin. 1990; 108:339–362. [PubMed: 2270232]

Centers for Disease Control and Prevention. Advancing HIV prevention: New strategies for a changing epidemic --- United States. Morbidity and Mortality Weekly Report. 2003; 52(15):329–332. [PubMed: 12733863]

Chen Y. Treatment-related optimistic beliefs and risk of HIV transmission: a review of recent findings (2009–2012) in an era of treatment as prevention. Current HIV/AIDS Reports. 2013; 10(1):79–88. [PubMed: 23239272]

Cohen MS, McCauley M, Gamble TR. HIV treatment as prevention and HPTN 052. Current Opinion in HIV AIDS. 2012; 7(2):99–105. [PubMed: 22227585]

Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, Fleming TR. Prevention of HIV-1 infection with early antiretroviral therapy. New England Journal of Medicine. 2011; 365(6):493–505. [PubMed: 21767103]

Crepaz N, Hart T, Marks G. Highly active antiretroviral therapy and high risk sexual behavior: A Meta-analytic review. Journal of the American Medical Association. 2004; 292:224–236. [PubMed: 15249572]

Fellows IE, Morris M, Birnbaum JK, Dombrowski JC, Buskin S, Bennett A, Golden MR. Correction: A new method for estimating the number of undiagnosed HIV infected based on HIV testing history, with an application to men who have sex with men in Seattle/King County, WA. PLoS One. 2015; 10(8):e0135878. [PubMed: 26266952]

Forsyth AD, Valdiserri RO. Reaping the prevention benefits of highly active antiretroviral treatment: policy implications of HIV Prevention Trials Network 052. Current Opinions in HIV AIDS. 2012; 7(2):111–116.

Galletly CL, Pinkerton SD, Petroll AE. CDC recommendations for opt-out testing and reactions to unanticipated HIV diagnoses. AIDS Patient Care STDS. 2008; 22(3):189–193. [PubMed: 18290754]

Hanif H, Bastos FI, Malta M, Bertoni N, Winch PJ, Kerrigan D. Where does treatment optimism fit in? Examining factors associated with consistent condom use among people receiving antiretroviral treatment in Rio de Janeiro, Brazil. AIDS and Behavior. 2014; 18(10):1945–1954. [PubMed: 24531794]

Harel O, Pellowski J, Kalichman S. Are we missing the importance of missing values in HIV prevention randomized clinical trials? Review and recommendations. AIDS and Behavior. 2012; 16(6):1382–1393. [PubMed: 22223301]

Holt M, Lea T, Murphy DA, Ellard J, Rosengarten M, Kippax SC, De Wit JB. Australian gay and bisexual men's attitudes to HIV treatment as prevention in repeated, national surveys, 2011–2013. PLoS ONE. 2014; 9(11):e112349. [PubMed: 25386943]

Holt M, Lea T, Schmidt HM, Murphy D, Rosengarten M, Crawford D, de Wit J. Increasing belief in the effectiveness of HIV treatment as prevention: Results of repeated, national surveys of Australian Gay and Bisexual Men, 2013-15. AIDS and Behavior. 2016; 20:1564–1571. [PubMed: 26803613]

Holtgrave DR, Maulsby C, Wehrmeyer L, Hall HI. Behavioral factors in assessing impact of HIV treatment as prevention. AIDS and Behavior. 2012; 16:1085–1091. [PubMed: 22491813]

Iwuji, C., Orne-Gliemann, J., Balestre, E., Larmarange, J., Thiebaut, R., Tanser, F., Okesola, N., et al. The impact of universal test and treat on HIV incidence in a rural South African population: ANRS 12249 TasP trial, 2012–2016; Paper presented at the Intrernational AIDS Conference; Durban, South Africa. 2016.

Jansen K, Schmidt AJ, Drewes J, Bremer V, Marcus U. Increased incidence of syphilis in men who have sex with men and risk management strategies, Germany, 2015. European Surveilance. 2016; 21(43):pii=30382.

Kalichman SC. Co-occurrence of treatment non-adherence and continued HIV transmission risk behaviors: Implications for positive prevention interventions. Psychosomatic Medicine. 2008; 70:593–597. [PubMed: 18519882]

Kalichman SC, DiBerto G, Eaton L. HIV Viral Load in Blood Plasma and Semen: Review and Implications of Empirical Findings. Sexually Transmitted Diseases. 2008; 35:55–60. [PubMed: 18217225]

Kalichman SC, Eaton L, Cain D, Cherry C, Fuhrel A, Kaufman M, Pope H. Changes in HIV treatment beliefs and sexual risk behaviors among gay and bisexual men, 1997–2002. Health Psychology. 2007a; 26(5):650–656. [PubMed: 17845117]

Kalichman SC, Eaton L, Cain D, Cherry C, Fuhrel A, Kaufman M, Pope H. Changes in HIV treatment beliefs and sexual risk behaviors among gay and bisexual men, 1997–2005. Health Psychology. 2007b; 26(5):650–656. [PubMed: 17845117]

Kalichman SC, Eaton L, Cherry C. Sexually transmitted infections and infectiousness beliefs among people living with HIV/AIDS: implications for HIV treatment as prevention. HIV Medicine. 2010; 11(8):502–509. [PubMed: 20201976]

Kalichman SC, Eaton L, White D, Cherry C, Pope H, Cain D, Kalichman MO. Beliefs about treatments for HIV/AIDS and sexual risk behaviors among men who have sex with men, 1997–2006. Journal of Behavioral Medicine. 2007; 30(6):497–503. [PubMed: 17690973]

Kalichman SC, Nachimson D, Cherry C, Williams E. AIDS treatment advances and behavioral prevention setbacks: preliminary assessment of reduced perceived threat of HIV-AIDS. Health Psychology. 1998; 17(6):546–550. [PubMed: 9848805]

Katz DA, Dombrowski JC, Bell TR, Kerani RP, Golden MR. HIV Incidence Among Men Who Have Sex With Men After Diagnosis With Sexually Transmitted Infections. Sexually Transmitted Disease. 2016; 43(4):249–254.

Laga M, Piot P. Prevention of sexual transmission of HIV: real results, science progressing, societies remaining behind. AIDS. 2012; 26(10):1223–1229. [PubMed: 22706008]

Matthews DD, Herrick AL, Coulter RW, Friedman MR, Mills TC, Eaton LA, Team PS. Running backwards: Consequences of current HIV incidence rates for the next generation of Black MSM in the United States. AIDS and Behavior. 2016; 20(1):7–16. [PubMed: 26267251]

Mimiaga MJ, Mayer KH, Reisner SL, Gonzalez A, Dumas B, Vanderwarker R, Bertrand T. Asymptomatic gonorrhea and chlamydial infections detected by nucleic acid amplification tests among Boston area men who have sex with men. Sexually Transmitted Diseases. 2008; 35(5):495–498. [PubMed: 18354345]

Newman CE, de Wit J, Persson A, Holt M, Slavin S, Kidd MR, Mao L. Understanding Concerns About Treatment-as-Prevention Among People with HIV who are not Using Antiretroviral Therapy. AIDS and Behavior. 2015; 19(5):821–831. [PubMed: 25432878]

Oldenburg CE, Barnighausen T, Tanser F, Iwuji CC, De Gruttola V, Seage GR 3rd, Harling G. Antiretroviral therapy to prevent HIV acquisition in serodiscordant couples in a hyperendemic community in rural South Africa. Clinical Infectious Diseases. 2016; 63(4):548–554. [PubMed: 27208044]

Pantalone DW, Tomassilli JC, Starks TJ, Golub SA, Parsons JT. Unprotected anal intercourse with casual male partners in urban Gay, Bisexual, and other men who have sex with men. American Journal of Public Health. 2015; 105(1):103–110. [PubMed: 25393176]

Park A. The End of AIDS. Time Magazine. 2014 Nov 20.

Payne L, Lawrence D, Soni S, Llewellyn C, Dean G. Investigating factors for increased gonorrhoea re-infection in men who have sex with men attending a genitourinary clinic: a qualitative study. Int J STD AIDS. 2016 [ePub ahead of print].

Pilcher CD, Eaton L, Kalichman S, Bisol C, de Souza Rda S. Approaching "HIV elimination": interventions for acute HIV infection. Current HIV/AIDS Reports. 2006; 3(4):160–168. [PubMed: 17032575]

Risher K, Mayer KH, Beyrer C. HIV treatment cascade in MSM, people who inject drugs, and sex workers. Current Opinion in HIV AIDS. 2015; 10(6):420–429. [PubMed: 26352393]

Schroder K, Carey MP, Vanable P. Methodological challenges in research on sexual risk behavior: I Item content, scaling, and data analytic options. Annals of Behavioral Medicine. 2003; 26:104–123. [PubMed: 14534028]

Schwartlander B, Stover J, Hallett T, Atun R, Avila C, Gouws E, Padian N. Towards an improved investment approach for an effective response to HIV/AIDS. Lancet. 2011; 377(9782):2031–2041. [PubMed: 21641026]

Sood N, Wagner Z, Jaycocks A, Drabo E, Vardavas R. Test-and-treat in Los Angeles: a mathematical model of the effects of test-and-treat for the population of men who have sex with men in Los Angeles County. Clinical Infectious Diseases. 2013; 56(12):1789–1796. [PubMed: 23487387]

Tanser F, Barnighausen T, Grapsa E, Zaidi J, Newell ML. High coverage of ART associated with decline in risk of HIV acquisition in rural KwaZulu-Natal, South Africa. Science. 2013; 339(6122):966–971. [PubMed: 23430656]

Wilson DP. HIV treatment as prevention: natural experiments highlight limits of antiretroviral treatment as HIV prevention. PLoS Medicine. 2012; 9(7):e1001231. [PubMed: 22807656]

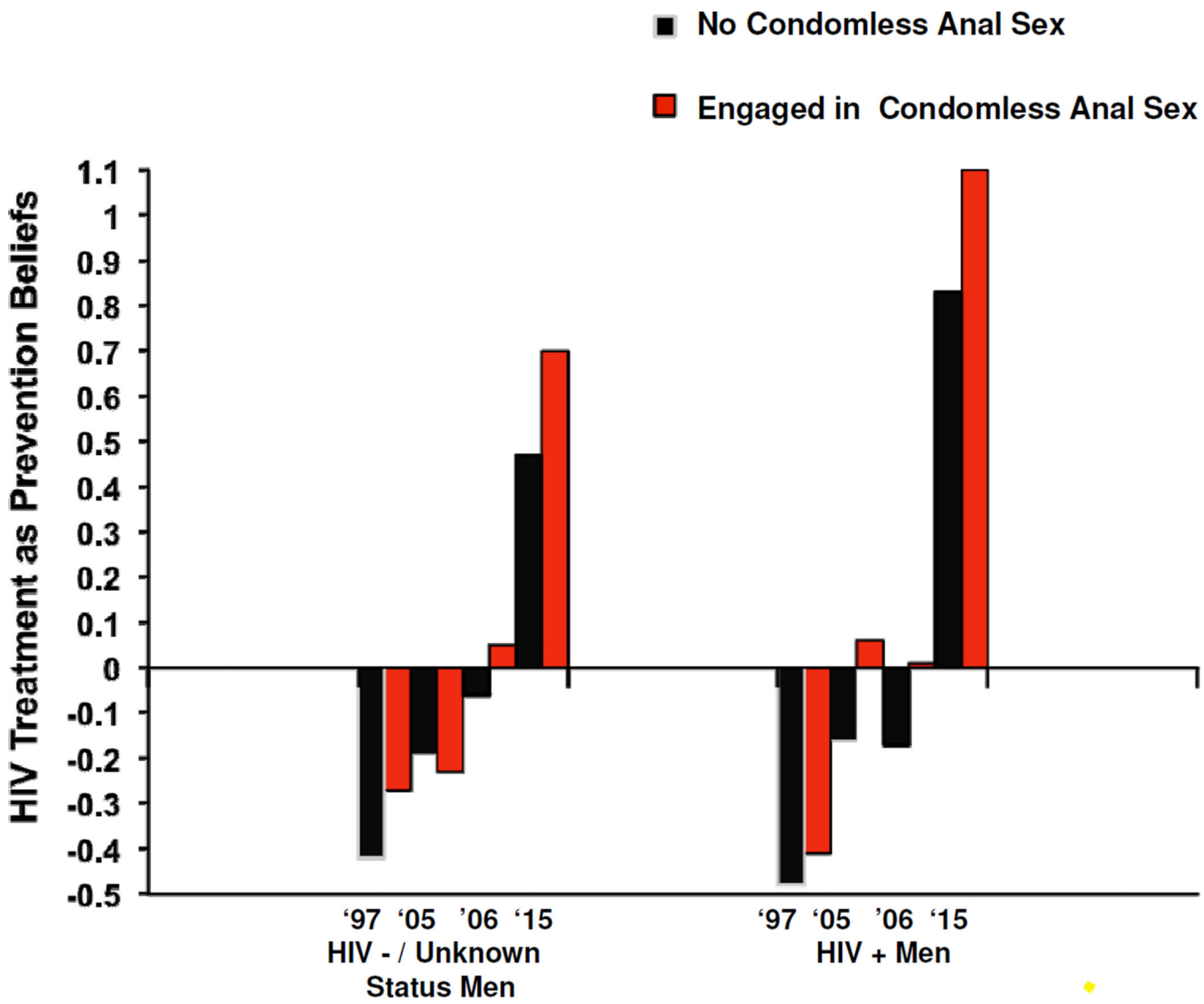

Figure 1.

Mean factor scores for treatment as prevention (TasP) beliefs among HIV negative/unknown status and HIV positive men who did not and who did engage in condomless anal intercourse, 1997, 2005, 2006, 2015.

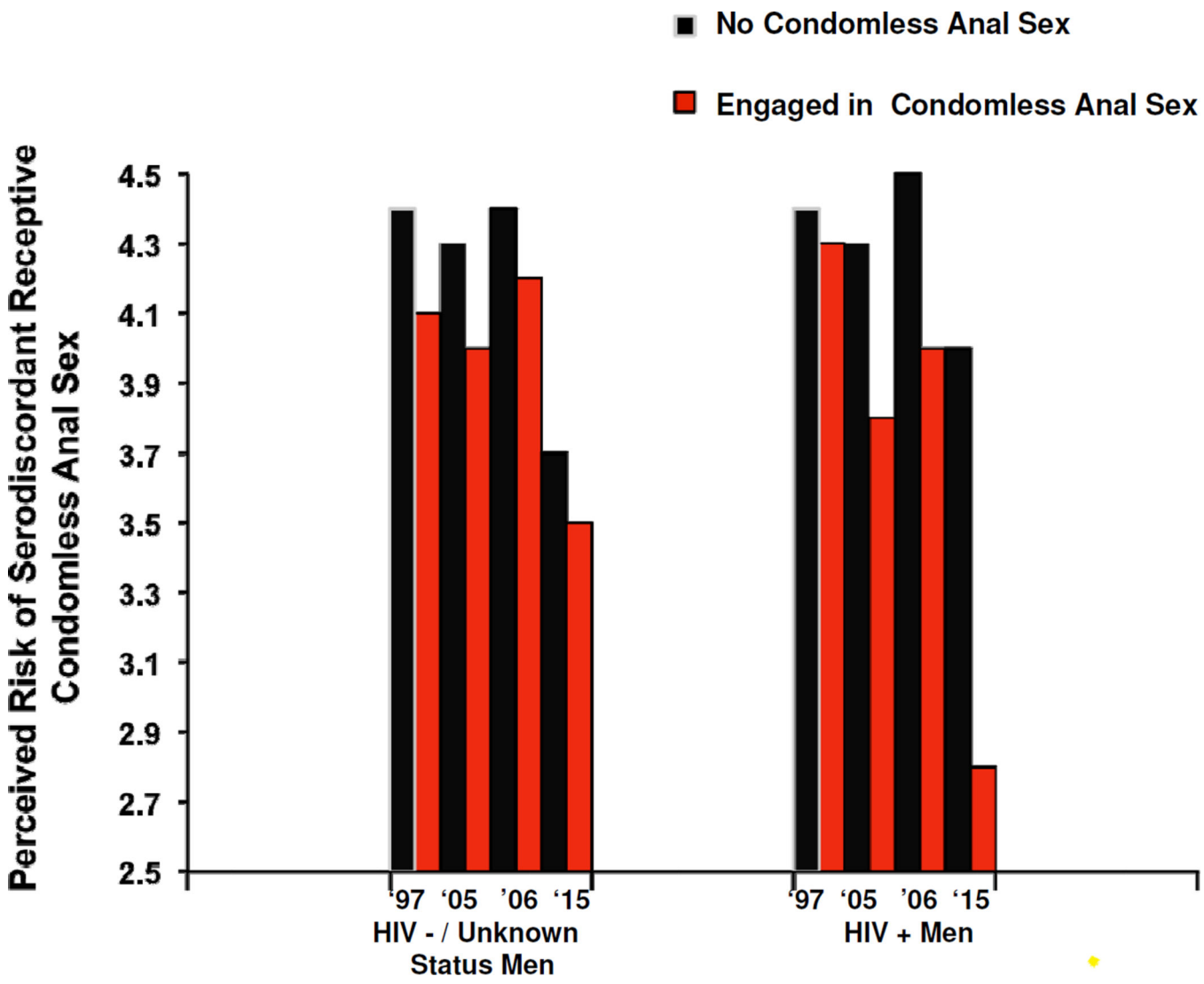

Figure 2.

Mean perceived risk for engaging in condomless receptive anal intercourse with an HIV positive partner who has an undetectable viral load among HIV negative/unknown status and HIV positive men who did not and who did engage in condomless anal intercourse, 1997, 2005, 2006, 2015.

Table 1

Characteristics of Men in Cross-Sectional Surveys at Atlanta Gay Pride Events, 1997, 2005, 2006 and 2015.

	1997 (N = 511)		2005 (N = 473)		2006 (N = 449)		2015 (N = 398)		
Characteristic	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**X^2**
Caucasian	430^a	85	374^a	81	171^b	39	384^a	97	
Minority	81	15	99	19	278	61	14	3	422.2**
Gay identified	479^a	94	433^a	92	388^b	86	336^a	85	25.3**
Employed	435^a	86	366^b	79	376^a	85	293^c	74	29.5**
Exclusively									11.0*
Partnered	217^a	43	236^b	51	175^a	40	167^a	42	
Tested for HIV	435	87	405	89	385	90	366	92	6.4
HIV Positive	67	14	63	14	71	17	66	17	3.5
	M	SD	M	SD	M	SD			F
Age	33.6^a	8.4	34.3^a	10.4	34.8^a	10.1	35.6^b	13.5	2.9*
Education	15.2^a	1.9	14.7^a	2.0	14.6^a	2.0	14.3^b	2.2	9.7**

Note:

* $p < .05$,

** $p < .01$,

^{a,b,c} values with different super scripts differ. $p < .05$; survey year 2006 was added to oversample African American MSM to racially diversify the study.

Table 2

Sexual Behavior in the Past Six Months among HIV Negative/Unknown Status and HIV Positive Men in Cross-Sectional Surveys at Atlanta Gay Pride Events, 1997, 2005, 2006 and 2015.

	HIV negative or unknown status									
	1997 (N = 431)		**2005 (N = 385)**		**2006 (N = 421)**		**2015 (N = 322)**			
Condomless and sex	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**X^2**	**Linear X^2**
Receptive	113^a	27	124^b	34	132^{b,c}	39	146^c	45	28.7**	19.7**
Insertive	148^a	35	154^{b,c}	43	131^{a,c}	38	156^a	48	14.5**	20.4**
Any	183^a	43	186^b	51	169^b	49	197^c	61	24.4**	24.6**
2 + partners	39^a	9	64^b	19	57^b	18	103^c	33	64.6**	25.7**
	M	SD	M	SD	M	SD	M	SD	F	Linear F
% condoms^d	56.7^a	43.0	56.2^a	40.5	52.8^a	41.2	42.4^b	38.7	6.6**	17.5**
	HIV Positive									
Condomless and sex	N	%	N	%	N	%	N	%	X^2	Linear X^2
Receptive	13^a	21	28^{b,c}	46	29^c	43	41^b	62	22.8**	28.4**
Insertive	10^a	16	22^b	36	35^b	52	34^b	52	23.1**	10.9**
Any	16^a	25	31^b	50	41^b	61	44^b	67	26.5**	27.5**
2 + partners	6^a	9	18^b	33	24^{b,c}	39	33^c	52	27.4**	56.8**
	M	SD	M	SD	M	SD	M	SD	F	Linear F
% condoms^d	82.1^a	28.9	50.2^b	39.2	42.0^c	38.1	47.6^c	36.5	11.5**	22.0**

Note:

* p < .05,

** p < .01;

^{a,b,c} values with different super scripts differ; p < .05;

^{d} Percent condom protected anal sex / total anal sex