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Predicting HIV Transmission Risk among HIV-Infected Patients Seen in Clinical Settings

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Running head: Predicting Transmission Risk

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Abstract

We assessed risk of transmission among 4,016 HIV-infected patients in primary care, including men who have sex with men (MSM, n=2,109), women (n=1,104) and men who had sex with women (MSW, n=803) in clinics in 15 cities across the US. A transmission risk act, assessed by computer assisted interviews, was defined as unprotected vaginal or anal sex with a partner who was HIV-uninfected or of unknown HIV status. MSM were more than twice as likely to report transmission risk acts than MSW (Odds Ratio [OR] =2.35; 95% Confidence Interval [CI] =1.84, 3.00; $p<0.001$). Women were also more likely to report transmission risk acts than MSW (OR =1.56; 95% CI =1.19, 2.05; $p<0.001$). Stimulant use was associated with transmission risk in all three groups ($p\leq.05$). MSM were more likely to use methamphetamines (8% versus 2% and 3% respectively), while MSW (17%) and women (12%, compared to 11% for MSM) were more likely to use cocaine. Clinical settings offer opportunities for preventing HIV transmission, particularly if interventions are tailored to sub-populations of HIV-infected patients.

Introduction

Clinical care settings offer opportunity for HIV "prevention with positives." Yet, prior research conducted with patients exiting primary HIV care visits in Ryan White CARE Act funded clinics found that this opportunity is frequently missed (Morin et al., 2004). Only six percent of patients had discussed specific sexual risk during their office visit, suggesting that both screening for risk and counseling for prevention of transmission were infrequent. Furthermore, HIV transmission risk counseling was reported significantly less often than other prevention counseling for adherence to antiretroviral therapy, emotional issues or diet and nutrition. Nonetheless, patients in clinics with written procedures for HIV prevention with positives were significantly more likely to report receiving such counseling (Myers et al., 2004).

In response to recommendations from both the Centers for Disease Control and Prevention (CDC, 2003) and the Institute of Medicine (Institute of Medicine, 2001), the Health Resources and Services Administration, which administers the Ryan White program, has sponsored a five-year initiative to develop and evaluate HIV prevention services in clinical settings. Fifteen sites received awards to tailor evidence-based prevention approaches to their settings and populations (see Malitz and Eldred in this issue). These projects have involved a variety of individual and group interventions delivered by providers, specialist or peers (see Koester and colleagues in this issue).

The goal of this analysis is to determine the frequency of transmission risk acts and the predictors of risk behavior among participants recruited at baseline in the fifteen clinics participating in the initiative. We also assess differences across subpopulations -- men and men who have sex with men (MSM), women, and men who have sex with women (MSW) -- to assess issues important for HIV prevention planning.

Methods

Survey interviews were conducted in 15 Ryan White-funded clinics between April 2004 and December 2006. The clinics were selected based on a competitive application process. Clinics were located in Chapel Hill, NC; Boston, MA; Baltimore, MD; New Your City, NY; Seattle, WA; Sacramento, CA; San Diego, CA; Birmingham, AL; Philadelphia, PA; Los Angeles, CA; Washington, DC; Decatur, GA; Miami, FL, Chicago, IL; and Tucson, AZ. Each site required local human subjects approval in addition to the approval obtained from the University of California, San Francisco, which serves as the cross site evaluation center.

Participants and Recruitment

A total of 4,016 HIV-infected patients completed standard cross site interviews as well as any site specific interviews. Inclusion criteria were HIV-infected status, receipt of primary care at the clinic, age of 18 years or older, and ability to provide informed consent. For the cross-site evaluation, we translated the interview instrument into Spanish, however this version was used at only one site. All other respondents were English-speaking. Sites had the option of adding additional inclusion requirements. The cross site evaluation survey took approximately 30 minutes to complete.

Recruitment and screening of potential respondents were undertaken exclusively in medical clinics serving HIV-infected clients. Sites used a variety of recruitment materials including brochures, posters, and project descriptions, as well as direct contact by study staff in clinics. In most cases, interested persons agreed to participate were briefly screened by project personnel to determine their self-reported HIV status as well as basic demographic and contact information. Then, eligible participants were scheduled for a baseline interview. Screening most

often took place in a private setting, usually in a room or quiet place in the clinic. Most sites used incentives to encourage participation in the evaluation portion of the project such as cash, a grocery voucher or gift certificate.

Measures

Assessment interviews were conducted using a combination of audio computer-assisted self-interviewing (ACASI) and computer-assisted personal interviewing (CAPI) procedures based on the Questionnaire Development System version 2.0 by Nova Research Co. (Bethesda, MD). ACASI allows respondents to listen to an item via headphones while reading the text of that item on the computer monitor. The respondent then enters a response directly into the computer. This approach is designed to decrease social desirability bias and thereby enhance validity of self-reports of sensitive behaviors and attitudes (Gribble, Miller, Rogers, & Turner, 1999; Turner et al., 1998). CAPI involves an interviewer reading items from a computer and allowing the respondent to make verbal responses that are entered directly into the computer by the interviewer. Both ACASI and CAPI eliminate a separate data entry process and may therefore reduce data errors.

Demographic Characteristics and Health Status Indicators: Detailed background and demographic items included participant age, race/ethnicity, gender, self-identified sexual orientation, relationship status, educational level, employment status, and income. In addition, health status indicators were assessed; including self-reported most recent CD4 count, HIV viral load, and current use of antiretroviral medication.

Sexual Behavior: A detailed interview was developed to assess sexual behavior over a six month recall period. Separate but equivalent versions of questions were developed for men and women, each with language tailored to be consistent with the participant's gender and sexual

orientation. The interview began with an introduction and definition of sexual terms to minimize ambiguity. Men were then asked if they had engaged in any sexual activity during the previous 6 months with men, women, or both and the number of partners of each gender. Women in this study were only asked about sex with men. Based on responses to these items, the computer-based interview asked pertinent questions about sexual behavior.

Participants were asked to provide the number of times they had engaged in insertive or receptive vaginal or anal sex with HIV-infected partners, HIV-uninfected partners and partners of unknown HIV status. Participants were also asked about the number of times they had used condoms (male or female) from the beginning to the end of penetration and the number of times sex was unprotected. Unprotected sex was limited in the questioning to any act of insertive or receptive anal or vaginal intercourse in which a participant did not use a condom, a definition that excludes risk acts produced by accidental condom slippage or breakage.

Substance Use: Use of legal and illegal substances was assessed over a 3 month recall period. Items included alcohol, cocaine/crack, sedatives, tranquilizers, stimulants (such as crystal methamphetamine), analgesics, inhalants, marijuana, hallucinogens, and heroin. Use of injected drugs was assessed over the past 30 days. Items included frequency of injection and whether a participant had lent a needle to someone else after using it.

Statistical Analysis

The primary aim of this analysis was to assess which participant characteristics were associated with sexual transmission risk behavior among men who have sex with men (MSM), women and MSW in this sample of HIV-infected individuals in care.

Risk Groups: For purposes of this analysis, men were considered MSM if they reported any sexual contact with other men in the past 6 months. Men were placed in the heterosexual

category if they only had sexual contact with women in the past 6 months. When men indicated they had had no sexual contact in the past 6 months, we categorized them based on their self-identified orientation. Women were categorized based on their-self identified gender. Participants identifying as transgender (n=69) were excluded from this analysis.

Transmission Risk Acts: For purposes of this analysis, transmission risk acts were defined as reports of unprotected anal or vaginal intercourse without the use of a condom with any HIV-uninfected or unknown status partners.

Coding Substance Use: Because alcohol and stimulants were specifically associated with risk in previous studies (G. Colfax et al., 2005; Halkitis, Parsons, & Stirratt, 2001; Koblin et al., 2003), we examined them separately. We aggregated the assessments of the remaining drugs into one variable labeled "other drug use." Because data for the stimulant and other drug use variables were skewed (i.e., most participants indicated no or little use), we dichotomized the responses into two indicator variables (0 = no use of substance; 1 = use of substance). Alcohol use was more prevalent so we created variables to code for three categories of usage: none, less than daily, and daily.

Analytical Approach: First, we selected participant characteristics that we hypothesized might be associated with sexual risk behavior based on prior research. We then examined the relative number and proportion of total sex acts and unprotected sex acts that were reported among MSM compared to MSW and women compared to MSW using chi-squared tests of homogeneity for categorical variables and non-parametric Wilcoxon rank-sum tests for continuous variables.

Next, we created univariable logistic regression models to assess which participant characteristics was associated with sexual risk behavior overall and among MSM, women and

MSW. We collapsed sexual risk data into a dichotomous indicator variable (0 = no transmission-risk sex acts; 1 = any transmission-risk sex acts). This indicator was used as the dependent variable in logistic regression models examining the effect of demographic characteristics (sexual identity, race, education, employment, age), health status (CD4 cell count, viral load, current use of antiretroviral therapy), and drug use (alcohol, stimulants). We modeled the relationship between participant characteristics and sexual risk behavior among MSM, women and MSW using multivariable logistic regression. Characteristics that were associated with sexual risk behavior at the $p<0.05$ were included in each of these models. We fit additional models using generalized estimating equations (GEE) to adjust for the clustered nature of data across sites. The estimates from these models were similar to those presented above.

Transmission Risk Estimates: Finally, we estimated the total number of new HIV infections due to sexual risk behavior among participants using the approach taken in assessing the impact of prevention with positives; based on published probabilities (Weinhardt et al., 2004), for each study participant, we estimated the probability that he or she would transmit HIV as the sum of the transmission probabilities for each sex act. Because we do not have information on sexual behavior with individual sex partners, it was necessary to assume that an individual's sexual behavior, and therefore the probability of transmission of HIV, was similar with sexual partners of the same gender and HIV status. Therefore, for each study participant, (i) we modeled the estimated number of HIV transmissions, T_{ij}, to HIV-uninfected male, HIV-uninfected female, unknown status male or unknown status female sex partners (j) using the following equation:

$$T_{ij} = (1-\lambda)n\left\{1-(1-(1-\mu)\alpha_a)^{a/n}(1-(1-\mu)\alpha_b)^{b/n}(1-(1-\mu)\alpha_c)^{c/n}(1-(1-\mu)\alpha_d)^{d/n}\right\}$$

In this equation, *n* denotes the number of sexual partners of a particular gender and HIV status, *a, b, c*, and *d* denote the number of unprotected sex acts (insertive and receptive anal and vaginal intercourse for heterosexual male participants and receptive anal and vaginal intercourse for female participants) with individuals of a particular gender and HIV status, HIV status, and α_a, α_b, α_c, and α_d represent the associated per-act transmission probabilities (0.0006 for unprotected receptive and vaginal intercourse, 0.001 for unprotected insertive vaginal intercourse, and 0.02 for unprotected insertive anal intercourse). The μ parameter represents the reduction in transmission because of antiretroviral therapy: μ was set at 0.50 for those who reported being on antiretroviral therapy and 0 otherwise. The λ parameter denotes the probability that the partner was already infected with HIV: λ was set to 0 for HIV-uninfected sexual partners, 0.01 for unknown HIV status opposite gender partners, and 0.30 for unknown HIV status male partners of men.

Results

Demographic and Health Status Characteristics: The overall sample contained 4,016 participants. Of these, 2,109 (52.5%) were classified as MSM, 1,104 (27.5%) as women and 803 (20.0%) as MSW. Table 1 displays participants' demographic characteristics, health status, and drug use within these three categories. African Americans made up the largest proportion of patients across categories of race and ethnicity (48%). Women and MSW were more likely to be African American (68% for both) than MSM (29%; $p<0.001$ for both). As expected, the majority of MSM self-identified as homosexual (84%), and most women and men who had sex with women only (MSW) identified as heterosexual (89% and 96%, respectively). However, approximately 8% of women compared to only 3% of MSW identified as gay or bisexual ($p<0.001$). Both MSM and women were more likely than MSW to be under 40 years of age

($p<0.001$ for both). MSM were more likely than MSW to have completed some college ($p<0.001$) and to be employed ($p<0.001$).

[Insert Table 1 about here]

Clinically, MSM were more likely than MSW to report that their current CD4 count was above 200 cell/mm^3 ($p<0.001$), although there were no significant differences across groups in reported viral load. Women were less likely than all men to be on antiretroviral therapy ($p<0.001$).

Substance use: Alcohol use was reported by 71% of MSM, 43% of women and 51% MSW. Women were less likely than MSW to report using alcohol ($p<0.001$), while MSM were more likely than MSW to report alcohol ($p<0.001$). Other drug use was reported by 32% of MSM, 16% of women and 23% of MSW. Women (14%) were significantly less likely than MSM (23%; $p<0.001$) or MSW (20%; $p\leq0.002$) to use stimulants. MSM were significantly more likely to use speed or cocaine and speed together (12%) than were MSW (4%; $p<0.001$) or women (2%; $p<0.001$). MSW (17%) reported using cocaine more often than women (12%; $p\leq0.014$) or MSM (11%; $p<0.001$).

Injection drug use: A small proportion (5%) of patients reported injecting drugs in the past 30 days. Compared to MSW (7%), fewer MSM (4%; $p<0.001$) and women (3%; $p<0.001$) reported injecting drugs in the past 30 days. Among those who injected drugs, neither frequency of injection nor the proportion who reported lending a used syringe to another injector varied significantly across groups. Out of the entire sample only 14 individuals reported sharing injection equipment.

[Insert Table 2 about here.]

Sexual Behavior: Table 2 shows the prevalence of self-reported sexual behaviors and unprotected sex in the last 6 months. Overall, 84% of MSM, 70% of women and 74% of MSW reported at least 1 sexual partner in the previous 6 months. MSM had more and women had fewer sexual partners compared to MSW ($p<0.001$ and $p=0.002$, respectively). Approximately 66% of MSM, compared to only 24% of women and 41% of MSW reported two or more sex partners in the past 6 months ($p<0.001$ for both relative to MSW).

About half of all individuals reported sex with an HIV-uninfected partner. MSM were more likely than women ($p<.001$) and MSW ($p<.001$) to report sex with partners of unknown status. Types of sexual acts also varied across groups. Almost two-thirds of sexually active MSM reported both anal insertive and anal receptive sex in the past 6 months. Approximately 80% of sexually active women and MSW reported vaginal sex, while approximately 20% of both groups reported anal sex.

Transmission Risk Acts: 23% of MSM, 17% of women and 11% of MSW reported transmission risk acts, i.e. unprotected anal or vaginal intercourse with an HIV-uninfected or unknown status partner in the last six months ($p<0.001$ for both MSM and women compared to MSW). Compared to MSW, MSM were more likely ($p<0.001$) and women were less likely ($p<.006$) to report sex with known HIV-infected partners.

Predictors of Transmission Risk Acts: Overall, MSM were more likely to report transmission risk acts than women [Odds Ratio (OR) =2.41; 95% Confidence Interval (CI) =1.85, 3.13; $p<0.001$] and women more likely to report transmission risk acts than MSW [OR =1.63; 95% CI =1.21, 2.19; $p<0.001$].

In univariable analyses among all participants, additional predictors of sexual transmission risk included having some college education (OR=1.36; 95% CI=1.15, 1.60;

p<0.001), younger age (>40 years; OR=0.48; 95% CI=0.41, 0.56; p<0.001), being employed (OR=1.74; 95% CI=1.48, 2.05; p<0.001), any use of alcohol (OR=1.94; 95% CI=1.62, 2.32; p<0.001 for less than daily and OR=2.60; 95% CI=1.82, 3.72; p<0.001 for daily use of alcohol), the use of stimulants (e.g., methamphetamines or cocaine; OR=2.44; 95% CI=2.04, 2.92; p<0.001) and not being on ART (OR=0.63; 0.51, 0.79; p<0.001). Compared to whites, African Americans and Latinos were significantly less likely to report sexual transmission risk acts (OR=0.55; 95% CI=0.46, 0.66; p<0.001 for African Americans and OR=0.68; 95% CI=0.53, 087; p=0.01 for Hispanic/Latino compared to Whites). Clinical status variables (CD4 and viral load) were not associated with risk.

Predictors of Risk among Men who have sex with Men: Table 3 presents multivariable predictors of transmission-risk behavior among MSM, women and MSW. In the multivariable model, alcohol and stimulant use were both strong predictors of risk. Men who drank alcohol daily (OR =2.07; p<0.01) or used stimulants (OR =2.26; p<0.001) were more than twice as likely to report risk as men who did not drink or use stimulants. Younger men (OR =0.54 for 40+ years; p<0.001) and employed men (OR =1.39; p<0.005) were also significantly more likely to report risk. African American MSM were less likely to report risk (OR =0.67; p<0.003).

[Insert Table 3 about here.]

*Predictors of Risk among Women***:** In the multivariable model predicting risk among women, stimulant use (OR =2.03; p<0.003) was also a strong predictor of risk. Moderate use of alcohol (OR =1.68; p<0.005) was associated with risk as was younger age (OR=0.52; p<.0002). Ethnicity, education, employment and ART use had no effect on reported risk.

*Predictors of Risk among Men who have sex with Women***:** MSW who had a college education (OR =2.16; p<0.003) and were employed (OR =1.65; p<0.05) were more likely to

report transmission risk. As with women and MSM, stimulant use (OR =1.69; $p<0.05$) was also a significant predictor of risk.

Epidemic Impact: Based on the self-reported sexual behaviors reported by the participants in this study, 37 at-risk (HIV-uninfected or serostatus unknown) sexual partners would be expected to acquire HIV as a result of sexual intercourse with study participants during the 6-month assessment period. As indicated in Table 4, partners of MSM accounted for 31 (83.8%) of these new HIV infections, the partners of MSW for 3 (8.1%), and the partners of women for 3 (8.1%). The mean number of new infections per study participant was also greater for MSM (14.8 per 1000 participants) than for MSW (3.6 per 1000) or women (2.3 per 1000).

These estimates were sensitive to the per-act transmission probability values used in the analysis: doubling these probabilities increased the total number of infections to 71, whereas halving them decreased the number of infections to 19. The results were also sensitive to the presumed effectiveness of antiretroviral therapy at reducing the probability of HIV transmission, ranging from 21 new infections (assuming that antiretroviral therapy completely eliminates transmission risk) to 51 new infections (assuming antiretroviral therapy has no effect on transmission risk). The results were not particularly sensitive to changes in the condom effectiveness parameter or to the prevalence of infection among women, MSW and MSM in the US.

Discussion

While the majority of HIV patients in these clinics were not engaged in transmission risk acts, the frequency of these reports provide a strong rationale for prevention with positives in clinical care settings. With 23% of MSM, 17% of women and 11% of MSW reporting transmission risk acts in the last six months, risk assessment and counseling could be cost-

efficient approach to HIV prevention in the US. Our modeling suggests that in these 15 clinics alone there may be an opportunity to prevent about 68 new infections in a year. If this same level of risk of transmission was found at the more than 2500 provider sites funded under Ryan White (Health Resources and Services Administration HIV/AIDS Bureau, 2004), this would equate to over 17,000 infections per year. Under these circumstances even interventions with modest efficacy in terms of behavior chance could have significant epidemic impact.

Issues facing MSM continue to be a challenge for HIV prevention in the US where a concentrated epidemic is being maintained at an unacceptably high level. Because of the level of transmission risk acts found among MSM in this sample our modeling suggests that the majority of new infections can be expected in this group. This finding is consistent with modeling from another large, but differently recruited, sample of HIV-infected adults (Weinhardt et al., 2004). Also, as in previous studies, our findings suggest that alcohol and stimulant use – particularly methamphetamine use – predict risk of transmitting HIV among MSM (Morin et al., 2005). There is growing evidence that stimulant users display decreased adherence to antiretroviral therapy and elevated viral load, which could lead to poorer heath outcomes and resistant virus, which in turn could be transmitted to others (Arnsten et al., 2002; G. N. Colfax et al., 2007; Ellis et al., 2003; Hinkin et al., 2006). Thus, developing specific protocols for screening for risk and counseling with MSM in clinical settings is recommended.

While the risk of transmission found in these clinics was lower for MSW and women, it was not insignificant. Importantly, risk among heterosexuals was also linked to stimulant use. Consistent with previous research (G. Colfax et al., 2005; Halkitis et al., 2001; Koblin et al., 2003), these findings suggest that stimulant use contributes significantly to risk of HIV transmission and that interventions designed to reduce or eliminate its use should be an important

component of primary HIV prevention. Our finding that risk was also associated with education and employment among MSW suggests that they may have the resources to provide cocaine in contexts where sex with women also occurs. Although ethnicity was not a significant predictor of risk for heterosexuals, the majority of respondents in this sample was African American, which is also important to understanding the context of transmission risk because of the challenges posed by cocaine use in some African American communities. Our preliminary analysis indicate that alcohol and substance use are synergistic in contributing to risk.

Women reported more unprotected sex with HIV-uninfected and status-unknown partners than did MSW. Because the probability of transmission from a woman to a man during an act of unprotected sex is lower than from a man to a woman in U.S. settings, this may also be evidence that heterosexuals are making decisions about sex based on their knowledge of transmission likelihood and, perhaps, the value of unprotected sex for intimacy and for a desire to have children.

Patients in all groups had more unprotected sex with other HIV-infected individuals than negative or unknown status partners, which may indicate some are using "serosorting" as a prevention strategy. This was particularly the case for MSM. However, in the context of drug and alcohol use, it may be more difficult to make strategic decisions about reducing risk.

This study has a number of limitations. Because of the competitive selection process there is no evidence that the 15 clinics are representative of all Ryan White-funded providers. This limits our ability to generalize results. Although the survey sample obtained reflects the demographic characteristics of Ryan White-funded clinics, participating clinics made a variety of approaches to patient contact resulting in the unavailability of subject-level participation rates. In addition, these findings are limited by the cross-sectional nature of the data. Longitudinal

designs are needed to prove, definitively, cause-and-effect relationships between contextual factors and the likelihood of transmission-risk sex. Finally, the findings are based on self reports of a stigmatized behavior. However, the use of computer-assisted interviewing should have minimized this potential bias.

While the findings from this study are cause for concern, fortunately, a variety of evidence-based approaches for prevention with positives are now available for clinic settings. A systematic review of HIV behavioral intervention found a number of interventions meeting the criteria of best evidence (Lyles et al., 2006). Significant intervention effects included increased condom use, reduction in number of unprotected sex acts, reduction in number of partners, reduction in drug use and needle sharing as well as reduction in sexually transmitted diseases. Many of the best-evidence interventions focus on prevention with positives. These include a group-level intervention provided by community-based facilitators (Kalichman, Rompa, & Cage, 2005; Kalichman et al., 2001), a group-level intervention provided by peer educators for African American women (Wingood et al., 2004), and a group level intervention provided by peer educators for MSM (Wolitski, Gomez, & Parsons, 2005; Wolitski, Parsons et al., 2005). Provider-base brief interventions in clinical care setting have also been found to be effective (Fisher et al., 2004; Richardson et al., 2004). In addition, individual-level interventions provide by trained specialists were found to be effective for high risk, drug-using youth (Rotheram-Borus et al., 2004), and more recently for diverse group of MSM and MSW and women based on a prevention case management model (The Healthy Living Project Team, 2007).

Finally, we believe our findings confirm the importance of involving people being seen in HIV primary care in the development and oversight of clinic based programs for prevention with positives. People living with HIV often express concern over the possibility of infecting others.

They are also keenly aware of the medical and psychological consequences of becoming infected. People living with HIV are in an ideal position to take the lead in responding to stigma and discrimination. Thus, forging partnerships with patients living with HIV has enormous potential to make prevention with positives a routine and meaningful part of quality HIV care.

REFERENCES

Arnsten, J. H., Demas, P. A., Grant, R. W., Gourevitch, M. N., Farzadegan, H., Howard, A. A., et al. (2002). Impact of active drug use on antiretroviral therapy adherence and viral suppression in HIV-infected drug users. *Journal of General Internal Medicine, 17*(5), 377-381.

CDC. (2003). *Advancing HIV Prevention: Interim Technical Guidance for Selected Interventions*. Atlanta: CDC.

Colfax, G., Coates, T. J., Husnik, M. J., Huang, Y., Buchbinder, S., Koblin, B., et al. (2005). Longitudinal patterns of methamphetamine, popper (amyl nitrite), and cocaine use and high-risk sexual behavior among a cohort of san francisco men who have sex with men. *Journal of Urban Health, 82*(1 Suppl 1), i62-i70.

Colfax, G. N., Vittinghoff, E., Grant, R., Lum, P., Spotts, G., & Hecht, F. M. (2007). Frequent methamphetamine use is associated with primary non-nucleoside reverse transcriptase inhibitor resistance. *AIDS, 21*(2), 239-241.

Ellis, R. J., Childers, M. E., Cherner, M., Lazzaretto, D., Letendre, S., & Grant, I. (2003). Increased human immunodeficiency virus loads in active methamphetamine users are explained by reduced effectiveness of antiretroviral therapy. *Journal of Infectious Diseases, 188*(12), 1820-1826.

Fisher, J. D., Cornman, D. H., Osborn, C. Y., Amico, K. R., Fisher, W. A., & Friedland, G. A. (2004). Clinician-initiated HIV risk reduction intervention for HIV-positive persons: Formative Research, Acceptability, and Fidelity of the Options Project. *Journal of Acquired Immune Deficiency Syndromes, 37 Suppl 2*, S78-87.

Gribble, J. N., Miller, H. G., Rogers, S. M., & Turner, C. F. (1999). Interview mode and measurement of sexual behaviors: methodological issues. *Journal of Sex Research, 36*, 16-24.

Halkitis, P. N., Parsons, J. T., & Stirratt, M. J. (2001). A double epidemic: crystal methamphetamine drug use in relation to HIV transmission among gay men. *Journal of Homosexuality, 41*(2), 17-35.

Health Resources and Services Administration HIV/AIDS Bureau. (2004). *Ryan White CARE Act Data Report*.

Hinkin, C. H., Barclay, T. R., Castellon, S. A., Levine, A. J., Durvasula, R. S., Marion, S. D., et al. (2006). Drug Use and Medication Adherence among HIV-1 Infected Individuals. *AIDS Behav*.

Institute of Medicine. (2001). *No Time to Lose: Getting More from HIV Prevention*. Washington, DC: National Academy of Sciences.

Kalichman, S. C., Rompa, D., & Cage, M. (2005). Group intervention to reduce HIV transmission risk behavior among persons living with HIV/AIDS. *Behavior Modification, 29*(2), 256-285.

Kalichman, S. C., Rompa, D., Cage, M., DiFonzo, K., Simpson, D., Austin, J., et al. (2001). Effectiveness of an intervention to reduce HIV transmission risks in HIV-positive people. *American Journal of Preventive Medicine, 21*(2), 84-92.

Koblin, B. A., Chesney, M. A., Husnik, M. J., Bozeman, S., Celum, C. L., Buchbinder, S., et al. (2003). High-risk behaviors among men who have sex with men in 6 US cities: baseline data from the EXPLORE Study. *American Journal of Public Health, 93*(6), 926-932.

Lyles, C. M., Kay, L. S., Crepaz, N., Herbst, J. H., Passin, W. F., Kim, A. S., et al. (2006). Best-

Evidence Interventions: Findings From a Systematic Review of HIV Behavioral Interventions for US Populations at High Risk, 2000-2004. *American Journal of Public Health*.

Morin, S. F., Koester, K. A., Steward, W. T., Maiorana, A., McLaughlin, M., Myers, J. J., et al. (2004). Missed Opportunities: Prevention With HIV-Infected Patients in Clinical Care Settings. *Journal of Acquired Immune Deficiency Syndromes, 36*(4), 960-966.

Morin, S. F., Steward, W. T., Charlebois, E. D., Remien, R. H., Pinkerton, S. D., Johnson, M. O., et al. (2005). Predicting HIV transmission risk among HIV-infected men who have sex with men: findings from the healthy living project. *Journal of Acquired Immune Deficiency Syndromes, 40*(2), 226-235.

Myers, J. J., Steward, W. T., Charlebois, E., Koester, K. A., Maiorana, A., & Morin, S. F. (2004). Written Clinic Procedures Enhance Delivery of HIV "Prevention With Positives" Counseling in Primary Health Care Settings. *Journal of Acquired Immune Deficiency Syndromes, 37 Suppl 2*, S95-S100.

Richardson, J. L., Milam, J., McCutchan, A., Stoyanoff, S., Bolan, R., Weiss, J., et al. (2004). Effect of brief safer-sex counseling by medical providers to HIV-1 seropositive patients: a multi-clinic assessment. *AIDS, 18*(8), 1179-1186.

Rotheram-Borus, M. J., Swendeman, D., Comulada, W. S., Weiss, R. E., Lee, M., & Lightfoot, M. (2004). Prevention for Substance-Using HIV-Positive Young People: Telephone and In-Person Delivery. *Journal of Acquired Immune Deficiency Syndromes, 37 Suppl 2*, S68-77.

The Healthy Living Project Team. (2007). Effects of a behavioral intervention to reduce risk of transmission among people living with HIV: the healthy living project randomized controlled study. *Journal of Acquired Immune Deficiency Syndromes, 44*(2), 213-221.

Turner, C. F., Ku, L., Rogers, S. M., Lindberg, L. D., Pleck, J. H., & Sonenstein, F. L. (1998). Adolescent sexual behavior, drug use, and violence: increased reporting with computer survey technology. *Science, 280*(5365), 867-873.

Weinhardt, L. S., Kelly, J. A., Brondino, M. J., Rotheram-Borus, M. J., Kirshenbaum, S. B., Chesney, M. A., et al. (2004). HIV transmission risk behavior among men and women living with HIV in 4 cities in the United States. *Journal of Acquired Immune Deficiency Syndromes, 36*(5), 1057-1066.

Wingood, G. M., DiClemente, R. J., Mikhail, I., Lang, D. L., McCree, D. H., Davies, S. L., et al. (2004). A randomized controlled trial to reduce HIV transmission risk behaviors and sexually transmitted diseases among women living with HIV: The WiLLOW Program. *Journal of Acquired Immune Deficiency Syndromes, 37 Suppl 2*, S58-67.

Wolitski, R. J., Gomez, C. A., & Parsons, J. T. (2005). Effects of a peer-led behavioral intervention to reduce HIV transmission and promote serostatus disclosure among HIV-seropositive gay and bisexual men. *AIDS, 19 Suppl 1*, S99-109.

Wolitski, R. J., Parsons, J. T., Gomez, C. A., Purcell, D. W., Hoff, C. C., & Halkitis, P. N. (2005). Prevention with gay and bisexual men living with HIV: rationale and methods of the Seropositive Urban Men's Intervention Trial (SUMIT). *AIDS, 19 Suppl 1*, S1-11.

Table 1. Demographic and Clinical Information (N=4016)
Note: Excludes Transgendered Individuals (n =71, 1% of the sample)

	MSM (n=2109)		Women (n=1104)		MSW (n=803)	
	N	**Percent**	**N**	**Percent**	**N**	**Percent**
Study Site (1 clinic unless otherwise specified)						
DeKalb County	175	8%	67	6%	53	7%
Philadelphia	0	0%	179	16%	0	0%
Tucson	224	11%	49	4%	25	3%
Boston	186	9%	0	0%	0	0%
Baltimore (x clinics)	223	11%	148	13%	102	13%
Los Angeles (2 clinics)	142	7%	47	4%	34	4%
Chicago (3 clinics)	49	2%	79	7%	45	6%
New York City	113	5%	182	16%	160	20%
Birmingham	234	11%	0	0%	0	0%
Sacramento (3 sites)	126	6%	54	5%	43	5%
San Diego	228	11%	34	3%	36	4%
Miami	30	1%	126	11%	135	17%
Chapel Hill	80	4%	88	8%	66	8%
Seattle	167	8%	51	5%	54	7%
Washington, D.C.	132	6%	0	0%	50	6%
Race/Ethnicity						
White	1086	51%	178	16%	124	15%
Black/African American	619	29%	755	68%	542	68%
Hispanic/Latino	309	15%	123	11%	117	15%
Other	95	5%	48	4%	20	2%
Sexual Orientation						
Homosexual	1771	84%	36	3%	3	<1%
Bisexual	275	13%	60	5%	20	2%
Heterosexual	25	1%	980	89%	772	96%
Unknown/No answer	38	2%	28	3%	8	1%
Age						
39 or less	858	41%	448	41%	158	20%
40 or more	1251	59%	656	59%	645	80%
Education Completed						
High school or less	1258	60%	842	76%	624	78%
Some college or more	851	40%	262	24%	178	22%
Unknown/No answer	0	0%	0	0%	1	<1%
Employment						

Unemployed	1015	48%	835	76%	578	72%
Employed	1092	52%	266	24%	225	28%
Unknown/No answer	2	<1%	3	<1%	0	0%
CD4 Cell Count						
Below 200	325	15%	155	14%	151	19%
200 or above	1399	66%	628	57%	417	52%
Unknown/No answer	385	18%	321	29%	235	29%
Most Recent Viral Load						
Undetectable	1203	57%	578	52%	423	53%
Detectable	697	33%	370	34%	289	36%
Unknown/No answer	209	10%	156	14%	91	11%
Currently on ART						
No	294	14%	202	18%	90	11%
Yes	1446	69%	661	60%	569	71%
Unknown/No answer	369	18%	241	22%	144	18%

Table 2. Sexual Behavior and Substance Use among Participants (N=4016)

	MSM n=2109		Women n=1104		MSW n=803	
	N	Percent	N	Percent	N	Percent
Sexual Activity in last 6 months						
Sexually Active	1778	84%	776	70%	591	74%
Sexual Partners[a]						
Mean (SD) number of partners	6.5 (13.4)		1.7 (2.6)		2.3 (4.2)	
Median [IQR]	2 [1, 6]		1 [1, 1]		1 [1, 2]	
Two or more sex partners	1178	66%	184	24%	241	41%
Serostatus of Partners						
One or more HIV+ Partner	1071	61%	291	38%	264	45%
One or more HIV- Partner	852	48%	397	51%	289	49%
One or more partners of unknown serostatus	680	39%	164	21%	126	22%
Type of sexual activity						
Any vaginal sex	80	4%	639	82%	482	82%
Any anal insertive sex	1050	59%	0	0%	104	18%
Male sexual partner(s)	1039	58%	0	0%	0	0%
Female sexual partner(s)	45	3%	0	0%	104	18%
Any anal receptive sex	1156	65%	152	20%	0	0%
Unprotected Sex in last 6 months						
Any unprotected vaginal or anal sex	842	40%	298	27%	164	20%
Any unprotected vaginal/anal sex with[b]						
HIV-infected partner	596	55%	138	48%	93	35%
HIV-uninfected partner	257	30%	125	31%	50	17%
Unknown serostatus Partner	295	43%	61	37%	41	33%
Injection drug use behavior in last 30 days[c]						
Injected any drug in past 30 days[c]	91	4%	35	3%	59	7%
Times injected in past 30 days[d]						
Mean (SD)	10.0 (14.6)		16.6 (27.8)		13.8 (21.4)	
Median [IQR]	5 [2, 10]		5 [2, 20]		4 [2, 12]	
Lent used paraphernalia	8	9%	4	11%	3	5%
Alcohol Use in last 3 months						
None	576	27%	595	54%	379	47%
Less than daily	1416	67%	445	40%	358	45%
Daily	94	4%	38	3%	50	6%
Unknown/No answer	23	1%	26	2%	16	2%
Stimulant Use in last 3 months						
No	1615	77%	939	85%	635	79%
Cocaine only	228	11%	133	12%	134	17%
Speed only	164	8%	14	1%	19	2%
Cocaine and speed	93	4%	10	1%	11	1%
Unknown/No answer	9	<1%	8	1%	4	<1%
Other Drug Use in last 3 months						

No	1427	68%	918	83%	617	77%
Yes	673	32%	178	16%	182	23%
Unknown/No answer	9	<1%	8	1%	4	<1%

[a] *Among those who are sexually active*
[b] *Among those with HIV- positive, HIV-uninfected or HIV-unknown status partners respectively*
[c] *Among all participants*
[d] *Among those who injected drugs in the past 30 days*

Table 3. Predictors of transmission risk sex – multivariable analysis (n=4016)

	MSM (n=2109)				Women (n=1104)				MSW (n=803)			
Predictor	**% HTR**	**Adjusted Odds Ratio**	**95% C.I.**	**p**	**% HTR**	**Adjusted Odds Ratio**	**95% C.I.**	**p**	**% HTR**	**Adjusted Odds Ratio**	**95% C.I.**	**p**
Race/Ethnicity												
White	26%	1.00	reference		21%	1.00	reference		15%	1.00	reference	
Black/African American	**19%**	**0.67**	**0.52, 0.87**	**0.002**	15%	0.76	0.50, 1.17	0.22	11%	0.81	0.45, 1.45	0.47
Hispanic/Latino	21%	0.78	0.56, 1.07	0.12	20%	1.17	0.64, 2.13	0.61	8%	0.59	0.25, 1.41	0.23
Other	22%	0.80	0.47, 1.36	0.42	10%	0.52	0.19, 1.46	0.21	20%	1.07	0.30, 3.76	0.92
Education Completed												
High school or less	22%	1.00	reference		16%	1.00	reference		9%	1.00	reference	
College or more	24%	1.01	0.82, 1.26	0.90	18%	1.20	0.82, 1.76	0.35	**18%**	**2.16**	**1.32, 3.52**	**0.002**
Age												
39 or less	30%	1.00	reference		22%	1.00	reference		15%	1.00	reference	
40 or more	**18%**	**0.54**	**0.43, 0.70**	**0.001**	**12%**	**0.52**	**0.37, 0.73**	**0.001**	10%	0.72	0.41, 1.25	0.24
Employment												
Unemployed	19%	1.00	reference		15%	1.00	reference		9%	1.00	reference	
Employed	**26%**	**1.39**	**1.11, 1.73**	**0.004**	21%	1.44	0.99, 2.11	0.06	**16%**	**1.65**	**1.02, 2.68**	**0.04**
Alcohol Use												
No	17%	1.00	reference		12%	1.00	reference		8%	1.00	reference	
Some	24%	1.26	0.97, 1.63	0.09	**21%**	**1.68**	**1.18, 2.41**	**0.004**	14%	1.29	0.73, 2.28	0.39
Daily	**35%**	**2.07**	**1.25, 3.41**	**0.005**	26%	2.18	0.96, 5.00	0.06	14%	1.46	0.58, 3.68	0.42
Stimulant Use												
No	19%	1.00	reference		14%	1.00	reference		9%	1.00	reference	

Yes	**36%**	**2.26**	**1.78, 2.86**	**0.001**	**28%**	**2.03**	**1.31, 3.13**	**0.002**	**17%**	**1.69**	**0.99, 2.89**	**0.05**
Most Recent Viral Load												
Undetectable	20%	1.00	reference		15%	1.00	reference		10%	1.00	reference	
Detectable	24%	1.00	0.78, 1.28	0.99	18%	0.94	0.64, 1.37	0.73	12%	1.00	0.60, 1.66	0.99
Currently on ART												
No	28%	**1.00**	**reference**		21%	1.00	reference		12%	1.00	reference	
Yes	**19%**	**0.73**	**0.54, 1.00**	**0.05**	14%	0.75	0.49, 1.16	0.19	10%	0.81	0.39, 1.67	0.56

Table 4. Results of Mathematic Modeling Analyses among 4016 Men and Women with HIV Estimating Number of Infections, Mean Infections per Participant, and Infections per Sexually Active Participant by Group

	Sample Size	Number Sexually Active	Total Infections	Mean Infections	Infections per Sexually Active Participant
MSM	2109	1178	31.1460334	0.0147822	0.0175372
Women	1104	776	2.5769059	0.0023236	0.0033250
MSW	803	591	2.8663423	0.0035740	0.0048582
All	4016	3145	36.5892816	0.0089614	0.0115314

Figure 1: Stimulant Use and Sexual Transmission Risk by Risk Group