Risk factors for HIV infection among men who have sex with men

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Objectives: Risk factors for HIV acquisition were examined in a recent cohort of men who have sex with men (MSM).

Design: A longitudinal analysis of 4295 HIV-negative MSM enrolled in a randomized behavioral intervention trial conducted in six US cities.

Methods: MSM were enrolled and assessed for HIV infection and risk behaviors semi-annually, up to 48 months.

Results: In multivariate analysis, men reporting four or more male sex partners, unprotected receptive anal intercourse with any HIV serostatus partners and unprotected insertive anal intercourse with HIV-positive partners were at increased risk of HIV infection, as were those reporting amphetamine or heavy alcohol use and alcohol or drug use before sex. Some depression symptoms and occurrence of gonorrhea also were independently associated with HIV infection. The attributable fractions of high number of male partners, use of alcohol or drugs before sex, and unprotected receptive anal intercourse with unknown status partners and the same with presumed negative partners accounted for 32.3, 29.0, 28.4 and 21.6% of infections, respectively.

Conclusions: The challenge is to develop strategies to identify men in need. Interventions are needed to help men reduce their number of sexual partners, occurrences of unprotected anal intercourse, alcohol or drug use before sex and address other mental health issues.

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Introduction

In the United States, men who have sex with men (MSM) continue to be the group comprising the largest proportion of new HIV infections [1]. In the early years of the epidemic, the incidence of HIV infection among MSM in the epicenters in the United States peaked at a high of 8 to 10% per year [2] and then fell to below 1% in the late 1980s and early 1990s [3]. Consistently through this time period, the main sexual risk behavior for HIV infection among MSM has been unprotected anal intercourse, with higher risk associated with receptive intercourse in comparison with insertive intercourse [4–15]. In addition to high-risk sexual risk behaviors, studies examining risk factors for

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HIV incidence have found independent associations with increased number of partners; substance use including amphetamine, nitrite inhalent and cocaine use; and sexually transmitted infections including syphilis, gonorrhea, and herpes simplex virus type 2 [4,8,10–14,16–19]. A recent publication to examine risk factors for HIV infection among MSM recruited in the mid 1990s also found a lack of circumcision significantly associated with HIV acquisition controlling for sexual risk behaviours [18].

From 1999 to 2003, the EXPLORE Study was conducted to test a behavioral intervention in preventing acquisition of HIV infection among MSM in the United States. The purpose of this analysis was to determine risk factors for HIV acquisition in one of largest cohorts of MSM recruited in recent years. The cohort was recruited and followed during a time period of increases in the prevalence of risk behaviors and HIV incidence in MSM communities [3,20–22]. Furthermore, in contrast to behavioral data collected in previous cohorts, the data on risk factors in the EXPLORE Study were collected using computer-assisted self-interviewing technology as a means to minimize under-reporting of risk behaviors.

Materials and methods

This study was carried out in six cities in the United States: Boston, Massachusetts; Chicago, Illinois; Denver, Colorado; New York, New York; San Francisco, California; and Seattle, Washington. Details regarding the methods and results of the randomized trial have been published elsewhere [23,24]. The protocol, outcome measures and interview details are available from the EXPLORE website (www.explorestudy.org). The study was approved by the institutional review boards at each of the participating institutions and participants provided written informed consent.

Study population

Study participants were recruited at each site from January 1999 to February 2001. Men were eligible if they were negative for HIV antibodies, 16 years or older, and reported having engaged in anal intercourse with one or more men in the past year. Men were excluded if they reported a mutually monogamous relationship for two or more years with a male partner known to be HIV seronegative. These behavioral eligibility criteria were established to specifically recruit a population of high-risk MSM for the intervention study using HIV incidence as the primary outcome of interest. Recruitment strategies included outreach in streets, at dance clubs, bars, bathhouses, sex clubs, health clubs and adult video stores. Advertising campaigns were conducted in each city, with emphasis in the gay media. Participants also came to the study through internet sites, community forums, community agencies, and referrals from other study participants and clinics.

Assessments

As described previously [23,24], following informed consent, trained interviewers collected information on respondents' demographics and history of sexually transmitted infections (STIs). Audio-computer-assisted self-interviewing (ACASI) technology was used to collect data on depressive symptoms, alcohol and drug use, and sexual behaviors. Participants were asked about sexual behaviors in the prior 6 months with partners of each HIV serostatus type (negative, positive, and unknown). The serostatus of a partner was based on participant's reports of what they believe to be the serostatus of a partner (e.g. a negative partner would be a partner who told the participant they were negative and the participant had no reason to doubt it). After completing the interviews, participants received HIV pre-test counseling and blood specimens were collected for HIV antibody testing.

Approximately 2 weeks after being screened, participants underwent post-test counseling to receive their HIV test result. Participants with a positive test result at the baseline were referred for medical and social services. Men who were negative for HIV antibodies at the baseline interview were asked to enroll in the trial.

Follow-up visits were scheduled every 6 months, up to 48 months, and consisted of behavioral surveys using both face-to-face interviews and the ACASI technology. All sexual behavior outcomes were collected by ACASI. To further mitigate against participants' under-reporting of risk behaviors due to social desirability, no study staff had access to any ACASI risk behavior data for any participant, including during counseling sessions. Blood specimens were collected for testing for HIV antibodies.

Antibodies to HIV were detected by enzyme-linked immunosorbent assay. Sera shown to be reactive after a first test were retested in duplicate. Repeatedly reactive samples were confirmed through western blot assay or immunofluorescence assay. Participants with a positive test result at any follow-up visit were referred for medical and social services.

Statistical analysis

We conducted an observational analysis of data from a controlled trial. We adopted proportional hazards regression models of HIV seroconversion on the discrete time scale of twice-yearly visits. With this approach, the behavior variables were assessed at the same time that the blood was drawn for seroconversion testing, and refer to the previous 6-month time period. Additionally, since the behavioral variables were time-varying, the values of these covariates could change from one 6-month interval to the next.

To accommodate missing data, we applied the last-value-carried forward convention to the time-varying covariates except for indicators for the sexually transmitted diseases of chlamydia and gonorrhea. Although the randomized trial did not find a statistically significant effect on risk of HIV infection [24], all the analyses were stratified by study site and randomization arm.

Among covariates under consideration, depression was evaluated using a shortened version (seven items) of the Center for Epidemiologic Studies depression scale [25]. As a cut-off point has not been established for this shortened version, the score was divided in quartiles for analysis purposes with a higher score indicating more depressive symptoms. A primary partner was defined as someone who the participant has lived with or seen a lot, and to whom he felt a special commitment. Alcohol use in the previous 6 months was categorized as light (three or less drinks/day on no more than 1–2 days/week), moderate (four or five drinks/day on no more than 1–2 days/week, or one to five drinks/day on 3–6 days/week, or one to three drinks/day on a daily basis) or heavy (four or more drinks every day or six or more drinks on a typical day when drinking) [26,27]. Use of alcohol or drugs before sex was measured by the question 'In the last 6 months, about how often did you get high or have a few drinks immediately before or during sex?' with answer choices of never, occasionally, often, or all of the time. For the purposes of this analysis 'never' was coded as 'no' and the remaining categories were coded as 'yes'. Drug use was evaluated by questions on drugs used in the previous 6 months, including marijuana, poppers, hallucinogens, sniffed cocaine, amphetamines, crack cocaine, smoked heroin or any injection drug use. Each drug was entered into the model. We also tested a model using two other drug variables: (1) number of different drugs used (categorized as: no drugs used, only one kind of drug, two different drugs or three or more different drugs); or (2) three drugs found to be associated with high-risk sexual risk behaviour [26]: amphetamine, nitrites or cocaine use, (categorized as: yes to any of them, no to all of them).

To identify predictors for HIV seroconversion, we first conducted univariate regression for each covariate. All covariates were then considered in a multivariate proportional hazards model and assessed using backward elimination with stay criteria set at $P = 0.05$. Note that an individual visit with missing data on any candidate covariate did not contribute to the model selection procedure. For this reason, we refined the estimation of the final model by considering only the predictors identified. We further examined the relationship between risk factors for HIV infection and sexual risk behaviors with single-predictor logistic regression models adjusting for randomization arm and visit. We employed the generalized estimating equations approach to account for the within-subject correlation of the repeated measures over time [28,29].

We adapted the approach of Kooperberg and Petitti [30] for logistic regression to obtain estimates for population attributable risk. It should be noted that population attributable risk estimates for individual predictors based on a multiplicative model may total more that 100%. Consequently, they are best interpreted as estimating the relative importance of various risk factors. All analyses were conducted using SAS Version 8.2 (SAS Institute Inc., Cary, North Carolina, USA).

Results

Study population

The mean age of the 4295 enrolled participants was 34.0 years and 19.0% were 25 years of age or younger. Almost three-quarters (72.5%) of the men were white, 15.2% were Latino and 6.5% were African-American. Over one-third (35.8%) had less than a college degree. At baseline, the median number of partners was seven (25th percentile, three; 75 percentile, 18). About half of the men reported that they were in a primary relationship with a male sex partner. Of each of the three different partner serostatus types (negative, positive and unknown), the largest proportion of men reported having unknown status partners. Over two-thirds (69.1%) reported any unprotected anal intercourse, 48.0% reported unprotected receptive anal intercourse and 54.9% reported unprotected insertive anal intercourse. Unprotected oral sex with ejaculation was reported by 45.4% of the men. Heavy alcohol use, any non-injection drug use and injection drug use were reported by 11.0, 64.7 and 10.2% of men, respectively. At baseline, 72.1% of men reported using alcohol or drugs before having sex, 14.2% of men had scores in the highest two quartiles on the symptoms of depression scale and 15.4% of men reported having an STI in the prior 6 months.

Predictors of HIV acquisition

The overall HIV incidence in the study cohort was 2.1 per 100 person-years [95% confidence interval (CI), 1.9–2.4]. In univariate analysis of demographic variables, younger age, lower education and being Hispanic were associated with an increased risk of seroconversion (Table 1). With regard to male partners, in univariate analysis, men reporting having four or more male sex partners were more likely to become HIV infected in comparison with men who reported one or no partners. Men with an HIV-positive or unknown status primary partner or no primary partner were more likely to become HIV infected in comparison with men with an HIV-negative primary partner. Men who reported unprotected receptive anal intercourse with any serostatus partner were at increased risk of becoming HIV infected, as were men who reported unprotected insertive anal intercourse or unprotected oral sex with ejaculation with HIV-positive or unknown status partners. The use of non-injection drugs, drugs by injection, heavy alcohol

Table 1. Risk factors for HIV seroconversion, The EXPLORE Study, 1999–2003.

Variable	*N* at baseline	No. sero-Converters[a]	Univariate HR	Univariate 95% CI	Multivariate HR	Multivariate 95% CI	Attributable risk (%)
Age							
≤ 25	747	50	1.51	1.05, 2.17	[b]		
26–30	879	67	1.62	1.16, 2.26			
31–35	882	67	1.61	1.15, 2.24			
≥ 36	1605	75	REF				
Race/ethnicity							
Black	268	24	1.39	0.90, 2.15	1.99	1.27, 3.11	5.0
Hispanic	607	52	1.44	1.05, 1.99	REF		
Asian/PI, Native American, Other	236	12	0.84	0.47, 1.52	REF		
White	3001	171	REF		REF		
Education							
≤ high school/ged	366	33	2.34	1.59, 3.65	[b]		
some college	1068	83	1.87	1.32, 2.66			
college degree	1482	91	1.42	1.01, 2.00			
post college or more	315	15	REF				
Depression scale (score 7–28)							
7–12	2170	116	REF		REF		
13–17	1346	94	1.94	1.45, 2.56	1.48	1.12, 1.96	11.1
18–22	442	33	1.96	1.33, 2.89	REF		
23–28	139	16	2.44	1.47, 4.03	REF		
In last 6 months							
No. of male sex partners							
0 or 1	324	5	REF		REF		
2 or 3	714	19	1.58	0.89, 2.81	REF		
4–9	1329	73	2.84	1.72, 4.69	1.58	1.06, 2.36	32.3
≥ 10	1743	162	5.23	3.26, 8.40	1.81	1.23, 2.68	
Primary partner							
HIV-negative	1320	72	REF		[b]		
HIV unknown status	389	23	1.90	1.15, 3.15			
HIV-positive	271	23	2.92	1.90, 4.50			
No primary partner	2076	139	1.91	1.42, 2.55			
Unprotected oral sex with							
Ejaculation with HIV-positive or unknown status partners	1138	95	2.26	1.74, 2.93	[b]		
Unprotected receptive anal intercourse with:							
HIV positive partners	242	43	9.39	7.07, 12.46	3.40	2.25, 5.14	18.3
HIV unknown status partners	1019	124	5.69	4.43, 7.30	2.85	2.12, 3.84	28.4
HIV negative partners	1308	121	1.96	1.53, 2.51	1.92	1.38, 2.68	21.6
Unprotected insertive anal intercourse with:							
HIV positive partners	429	58	4.69	3.53, 6.22	1.59	1.05, 2.40	8.7
HIV unknown status partners	1303	133	2.44	1.90, 3.15	[b]		
HIV negative partners	1343	115	1.09	0.85, 1.41	0.52	0.37, 0.74	
Injection drug use	413	35	2.23	1.49, 3.33	[b]		
Non-injection drug use							
Marijuana	1900	153	1.91	1.49, 2.45	[b]		
Poppers	1512	144	2.46	1.92, 3.15	[b]		
Amphetamines	527	67	3.98	3.06, 5.16	1.96	1.44, 2.69	16.3
Hallucinogens	977	91	2.06	1.59, 2.68	[b]		
Cocaine or crack	831	88	2.24	1.72, 2.93	[b]		
Alcohol use							
None	428	23	REF		REF		
Light	1935	109	1.21	0.79, 1.87	REF		
Moderate	1316	84	1.45	0.92, 2.28	REF		
Heavy	419	41	2.75	1.62, 4.66	1.97	1.32, 2.96	6.1
Use of alcohol or drugs before sex	2952	205	2.54	1.83, 3.53	1.58	1.09, 2.29	29.0
Self-reported STDs							
Chylamydia	175	20	2.24	1.17, 4.26	[b]		
Gonorrhea	132	21	4.63	2.82, 7.61	2.49	1.47, 4.22	4.3

[a]No. of seroconverters based on distribution of variables at baseline.
[b]Not included in final multivariate model. HR, hazard ratio; CI, confidence interval; PI, Pacific Islander; STD, sexually transmitted disease.

and alcohol or drugs before sex were associated with an increase risk of HIV infection. Finally, self-reported sexually transmitted diseases and higher scores on the symptoms of depression scale were significantly associated with an increase risk of HIV infection.

In multivariate analysis, the only demographic variable which remained significantly associated with an increased risk of HIV infection was Black race/ethnicity (Table 1). With regard to sexual risk behaviors, men reporting four or more male sex partners, unprotected receptive anal

intercourse with any serostatus partner and unprotected insertive anal intercourse with HIV-positive partners were at increased risk of HIV infection. Only one sexual risk variable, unprotected insertive anal intercourse with an HIV-negative partner, was significantly associated with a decreased risk of HIV infection. The substances remaining independently associated with an increased risk of HIV infection in multivariate analysis were amphetamines and heavy alcohol use, as was use of alcohol or drugs before sex. Only the second quartile on the symptoms of depression scale remained significantly associated with risk of HIV infection, as was self-reported occurrence of gonorrhea. We substituted the amphetamine use variable with two different measures of drug use (see Methods section) in the model. Neither of the variables was found to be significantly associated with HIV infection and did not change the estimates for the other covariates.

Based on studies reporting higher HIV prevalence among African-American MSM [31,32] but not higher levels of risk behaviour [31], we conducted exploratory bivariate analyses of Black race/ethnicity with the sexual risk behaviors which were significantly associated with an increased risk of HIV infection (four or more male partners, unprotected receptive anal intercourse with positive, negative or unknown status partners, unprotected insertive anal intercourse with positive partners). Black men were significantly less likely to report unprotected receptive anal intercourse with negative partners [hazard ratio (HR), 0.50; 95% CI, 0.40–0.62) and less likely to report four or more male partners (HR, 0.73; 95% CI, 0.60–0.88) in comparison with all other men. The percentage of Black men reporting any other sexual risk behavior was not significantly different from all other men (data not shown).

We also conducted an exploratory analysis to better understand the findings of an increased risk of HIV infection with unprotected receptive anal intercourse with an HIV-negative partner but a decreased risk with unprotected insertive anal intercourse with a negative partner. Men who reported unprotected insertive anal intercourse with a negative partner had a similar profile with regard to number of partners, primary partners and drug and alcohol use as men who reported unprotected receptive anal intercourse with a negative partner. However, men who reported unprotected receptive sex with an HIV-negative partner were significantly more likely to report the two highest sexual risk behaviors, unprotected receptive sex with an HIV-positive ($P < 0.0001$) or unknown status ($P < 0.0001$) partners in comparison with men who did not report unprotected receptive sex with an HIV-negative partner. In contrast, men who report unprotected insertive anal sex with an HIV-negative partner were not more likely to report these two high-risk sexual behaviors (unprotected receptive with positive: $P = 0.41$; with unknown status: $P = 0.37$) in comparison with men who did not report unprotected insertive anal sex with an HIV-negative partner.

Attributable risk analysis

Having four or more male sex partners accounted for the largest proportion of seroincidence (32.3%), followed by over one-quarter of seroincidence accounted for by alcohol or drug use before sex (29.0%) and by unprotected receptive anal intercourse with unknown status partners (28.4%) (Table 1). Just over one-fifth of seroincidence (21.6%) was accounted for by unprotected receptive anal intercourse with partners believed to be HIV negative and 18.3% of incidence was accounted for by unprotected receptive anal intercourse with positive partners. The use of amphetamines and self-reported symptoms of depression accounted for 16.3 and 11.1% of seroincidence, respectively. Although self-reported occurrence of gonorrhea had a relative hazard of over two, the attributable risk was only 4.3%, reflecting the low prevalence of gonorrhea.

Discussion

Overall, the men enrolled in the EXPLORE cohort were at high risk of HIV infection, as indicated by their reported risk behaviors at baseline [23] and the observed HIV seroincidence of 2.1 per 100 person-years. It has been well-documented throughout the epidemic and confirmed in this study that among MSM, unprotected receptive anal intercourse, particularly with an HIV-positive partner, has highest risk for HIV seroconversion [12,14,15,33]. Of concern from a prevention perspective is the magnitude of risk associated with unprotected receptive anal intercourse with partners who were believed to be HIV negative. This level of risk could be explained by unrecognized infection by the partner, and those partners who were recently infected may have been highly infectious. A recent study of MSM in five US cities found that 48% of men found to HIV infected were unaware of their HIV infection [32]. This level of risk associated with HIV-negative partners could also be explained by a lack of communication about HIV serostatus, and thus presumptions about serostatus. In fact, analysis of the EXPLORE data at baseline indicated that poor communication skills with a partner about having safer sex were significantly associated with high-risk sexual behaviours [34]. Reports in the literature of the percentage of MSM who disclose their HIV infection status to sexual partners range widely from 23 to 57%, depending on HIV serostatus, perceived serostatus of the partner and relationship status of the partner [35–39].

At the same time, we found that men who reported unprotected insertive anal intercourse with an HIV-negative partner were at lower risk of HIV infection. Further examination of the data indicated that this group

of men may engage in a different set of other sexual behaviors compared with men who have receptive intercourse. Given that mixtures of sexual behaviors differ among men, such results should be approached with caution with regard to prevention messages.

This study also found that the use of alcohol or drugs before sex and overall use of amphetamines and heavy alcohol were independent predictors of seroconversion. The use of amphetamines, particularly methamphetamine, has increased among MSM over the last few years, and in addition, alcohol use is highly prevalent among MSM [40]. The relationships between substance use, high-risk sexual behaviors and HIV infection are complex. Both amphetamine use and heavy alcohol use have been shown to be associated with high-risk sexual behaviours [27,40–45], as was observed in exploratory analysis in this study (data not shown). Several studies have demonstrated an independent association of amphetamine use and heavy alcohol use and risk of HIV infection [8,14,46,47]. In the EXPLORE Study, the independent association of these substance use-related variables with HIV infection could be explained by several factors. First, those using substances could be those who had a higher frequency of unprotected intercourse or higher condom failure rates. For example, Stone *et al*. [48] reported an increase in condom failure (slippage and breakage) rates among MSM using amphetamines or heavy alcohol. Risk behaviors may also have been under-reported among participants who used substances. There also may have been some physiological effects of some substances, such as amphetamines, which could facilitate acquisition of HIV, including prolongation of sex or trauma to the anus or rectum. Finally, there also is evidence that amphetamines may interfere with adherence to antiretroviral treatment or the effectiveness of antiretroviral treatment [49,50]. Thus, if amphetamine-using EXPLORE participants chose HIV-infected partners who were also using amphetamines, these partners may have been highly infectious due to a reduction in the effectiveness of their antiretroviral treatment.

The only self-reported STI found to be independently associated with risk of HIV infection in the EXPLORE cohort was occurrence of gonorrhea. During follow-up, 1.4 to 2.3% of men reported having gonorrhea during any one 6-month period. Evidence is limited about the role of gonorrhea, as opposed to ulcerative STIs, in the acquisition of HIV among MSM. In multivariate analysis, some studies found that gonorrhea was associated with increased risk of HIV seroconversion [9,13,51], but another study did not [16,52]. This increase in risk associated with a non-ulcerative STI could be a result of disruption of mucous membranes due to local inflammation or activation and recruitment of CD4 cells at the mucosal surface.

As observed in other studies, Black men were at increased risk of HIV infection [31,32] and at the same time, were less or no more likely to report HIV sexual risk behaviours [31]. It may be that levels of social desirability about reporting risk behaviors differ by race/ethnicity, even with the use of ACASI technology. There are other factors, not measured in this study, which may explain differences in HIV incidence by race/ethnicity, including the prevalence of genetic polymorphisms for HIV susceptibility [53] or prevalence of STIs [54,55] as well as behavioral factors such as partner selection within high prevalence networks. Exploration of other factors, perhaps through qualitative ethnographic techniques, may provide more comprehensive information for planning critically needed prevention strategies.

The preponderance of studies has not shown an association between depression and high-risk sexual behaviour [56–62] or with HIV infection [47]. In this study, the association between HIV infection and the highest scores of depressive symptoms did not remain significant once controlling for other risk factors. It is unclear why men with some symptoms were found to be at higher risk. These men may be the least likely to be receiving services for their symptoms. As with substance use, depressive symptoms in this group may be a marker for an increase in risk behaviors due to unmeasured factors or an increased in frequency of unprotected intercourse.

The men in the EXPLORE cohort are not necessarily representative of MSM in the six cities. The eligibility criteria were established to enroll a high-risk study sample for a trial with an HIV infection endpoint. Furthermore, generalizability is limited since Black and Latino men, younger men and those of lower socio-economic status were less likely to enroll in the study, were more likely to not be eligible due to behavioral risk and were more likely to be HIV-infected at screening [23].

The attributable risk analysis indicates which factors could have largest impact on reducing the occurrence of new HIV infections among MSM. Of most importance is the reduction in the number of sexual partners, a factor which accounted for 32% of the incident infections, as well as reduction in alcohol and drug use in combination with sex and overall amphetamine use. However, interventions must address the evidence that a 'syndemic' of multiple health and mental health issues – HIV risk behaviors, substance use and depressive symptoms – is occurring among MSM [56]. MSM affected by this syndemic may not be receiving the services they need and current HIV prevention programs need to be adapted or changed to focus on substance use and abuse and other mental health issues, along with HIV risk reduction, in order have an impact within various subpopulations.

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Appendix

The EXPLORE Study Team

For each group/site the data is presented as site principal investigator, followed by names of staff, listed in alphabetic order.

Protocol co-chairs: Beryl Koblin, Margaret Chesney and Thomas Coates

Boston's Fenway Community Health Center and the Latin American Health Institute: Kenneth Mayer (site principal investigator), Felipe Agredano, Eduardo Aguilu, Rodrigo Barahona, Keith Bell, Christine Borges, Manual Burnias, Mark Cayabayab, Dan Church, Allison Cohn, Yvonne Colon, Janet Dargon, Nancy DeSousa, Judy Erdman, Josh Gagne, Eliza Goodhue, Juan Jimenez, William Johnson, Robert Knauz, Wilfred Labiosa, Ana Lara, Darren LeBlanc, Vin Longo, Marc Manseau, Marshall Miller, Matthew Mimiaga, Elie Mohns, Arnel Montenegro, David Pantalone, Oscar Patino, Tracey Rogers, Edual Ruiz, Steve Safren, Liz Salomon, Julio Silva, Laura van der Leeden, Rodney VanDerwarker, and Curt Weber.

Chicago's Howard Brown Community Health Center: David McKirnan (site principal investigator), Althea Batticks, Jason Bird, Liz Bradshaw, Robert Brown, Tom Buckingham, Toni Buckingham, Kelly Carson, Irene Chubinsky, Scott Clark, Scott Cook, Jeff Eichholz, Erica Gaffold, Sanford Gaylord, Mark Hartfield, David Henry, Brent Hope, Dale Gluth, Shane Gosselink, Jenny Hopwood, Laura Hosto, Jennifer Howard, D. J. Jacques, Heather Jandura, Susan Killelea, Andy Knight, Simone Koehlinger, Melissa Kohnke, Felicity LaBoy, Han Lee, Kandis Martin, Nicole Martin, Michele McGrady, Cheron McNeal, Denise Miles, Gino Moore, Michael Munn, Jose Narvaez, Aisha Nawab, Arlette Oblaza, Kevin O'Keefe, Liz Perez, Elisse Pertiller, Kelly Picketts, Borris Powell, Chris Powers, Bart Ramey, Ingrid Rodriguez, Laurez Rutledge, Porfirio Sanchez, Michael Saven, Chris Schmidt, Mark Schulze, Jim Skinner, David Snyder, Al Sorrese, Justin St. Andre, Gerry Taranzo, Ted Taylor, Sonia Torres, Kristin Vanfossan, Gregory Victorianne, and Erik Wetz.

Denver Public Health: Franklyn Judson (site principal investigator), Misty Aas, Ramon Armendariz, Chloe Bailey, Brian Bost, Julie Caine, David Cline, Stuart Cooper, Kent Curtis, Beth Deyo, John Douglas, Michael Furhman, Rene Gonzalez, Jeff Hiller, Paul Huber, Sharon Huber, Ken Miller, Philip Osteen, Laurie Peter, Doug Robinson, Dave Ward, Tim Wright, and Andrew Yale.

New York Blood Center: Beryl Koblin (site principal investigator), Anne Aldrich, Louise Austin, Lynne Bartell, Jane Bensel, Roberta Bernet, Damian Bird, Adam Bonilla, Carolyn Booher, Michael Camacho, Bradley Clark, Kent Curtis, Nikki Englert, Tonya Flores, George Gates, Corinne Geller, Octavio Gonzalez, Denise Goodman, Krista Goodman, Joshua Hinson, Sean Lawrence, Thomas Lee, Jay Loeffel, Angelo Luna, Larry Metzger, Carolle Morris, Patrick O'Quinn, Eric Ortiz, Ofiji Parris, Alfredo Perez, Terrence Precord, Alberto Rodriguez, Jason Santiago, Craig Siulinski, Leah Strock, Paul Teixeira, Eric Torres, Francesca Valenti, Curt Weber, Avery White, and Jess Zimmerman.

San Francisco Department of Public Health: Susan Buchbinder (site principal investigator), Grant Colfax (site co-principal investigator), Jonas Abella, Mike Ahern, Ari Bacharat, Alba Barreto, Christopher Boyden-DeShazer, Jesse Brooks, Meredith Broome, Tony Buckman, David Colbert, Emily Cole, Alfonso Diaz, Michael Edgar, Beth Faraguna, Paige Fratesi, Vincent Fuqua, Reggie Gage, Anjali Garg, Dale Gluth, Ted Guggenheim, Gavin Hall, Thomas Knoble, Rachel Langdon, Irene Lee, Jennifer Lessard, Nicole Lightburn, Tim Matheson, Corvette Moore, Mario Moreno, Paul O'Malley, Jennifer Owen, Jesus Perez, Robin Rifkin, Chris Rubino, Mateo Rutherford, Jennifer Sarche, Georgia Schreiber, Rob Schwarz, Craig Siulinski, John Stryker, Jason Tomasian, Jim Touchstone, Seth Watkins, Sarah Wheeler, Belinda Van, and Allison Zerbe.

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Center for AIDS Prevention Studies: Margaret Chesney and Thomas Coates (principal investigators), Patrick Barresi, Kevin Filocamo, Cliff Leonardi, Scott Stumbo, and Matthew Troy.

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Central Laboratory: Karen Anderson, Rhonda Canotal, Yao Tsing Chow, Naana Cleland, Dale Dondero, Barryett Enge, Eileen Liu, Chip Sheppard, Brent Sugimoto, Sean Watson.