

1 **Title**

2 Investigating A Sexual Network of Black Men Who Have Sex with Men: Implications for  
3 Transmission and Prevention of HIV Infection in the United States  
4

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36 **Conflicts of Interest and Source of Funding**

37 No conflicts of interest to report for any author.  
38

39 CBH is supported by the National Center for Advancing Translational Sciences  
40 (8KL2TR000084-05); LHW and EP are supported by the National Institute of Mental Health  
41 (1R01MH093275-01); and the National Institute for Allergy and Infectious Diseases provided  
42 support for JJE (5P30AI050410-13), SB, AS, and JK (5U01AI067854-01). The content is solely  
43 the responsibility of the authors and does not necessarily represent the official views of the NIH.  
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45

46 **Presentation of Work**

47 This work was presented at the 19th Conference on Retroviruses and Opportunistic Infections,  
48 March 5-8, 2012, in Seattle, WA (Abstract #1105).  
49

50 **Running Header**

51 HIV & Sexual Networks of Young, Black MSM

1 **ABSTRACT**

2 **Background:** HIV infections increased 48% among young, Black men who have sex with men  
3 (MSM) in the United States between 2006-2009. Incomplete understanding of this trend  
4 undermines prevention strategy development. We investigated a sexual network to characterize  
5 the risk environment in which young, Black MSM acquire HIV.

6 **Methods:** Persons reported to the state following diagnosis of HIV or syphilis were included,  
7 along with sexual partners. We used network mapping alongside descriptive and bivariate  
8 statistics to characterize network connections. Generalized linear models assessed predictors of  
9 having untraceable sex partners.

10 **Results:** The network included 398 individuals and 419 sexual relationships. Three-quarters  
11 were Black (n=299); 94% were MSM. Median age at first network appearance was 26 years and  
12 decreased over time (P<0.001). HIV prevalence was at least 29% (n=117); serostatus was  
13 unknown for 47% of the network, either because they were untraceable (n=150) or refused HIV  
14 testing (n=39). One in 5 network members diagnosed with HIV had a subsequent incident  
15 sexually transmitted infection. In multivariable models, one-time encounters increased the risk of  
16 having an untraceable partner (risk ratio 4.51, 95% CI, 2.27, 8.97), while being acutely HIV  
17 infected at diagnosis reduced it (RR 0.27, 95% CI, 0.08, 0.89).

18 **Conclusions:** HIV prevalence in this sexual network of young, Black MSM rivals that of sub-  
19 Saharan Africa, reflecting dramatically increased risk of acquiring HIV from the moment one  
20 entered the network. Prevention efforts for this population must consider the effect of sexual  
21 networks on HIV risk, and find ways of leveraging network structure to reduce transmission.

22

23 **Key words:** HIV, African-American, men who have sex with men, sexual networks

52 **INTRODUCTION**

53 Thirty years since its first cases were reported,<sup>1</sup> HIV remains a major global health problem.  
54 Though public consciousness of HIV has shifted towards the developing world, the epidemic in  
55 the United States (U.S.) continues to expand. In 2011, the Centers for Disease Control and  
56 Prevention (CDC) released new HIV incidence estimates for 2006-2009. The stable annual rate  
57 of approximately 50,000 new infections belies an uncomfortable finding: while the pace of  
58 infections amongst most risk groups has remained static or declined, estimated incidence  
59 among young, Black men who have sex with men (MSM) rose 48% across the four-year  
60 period.<sup>2</sup>

61  
62 North Carolina (NC) has experienced this trend first-hand. A 2005 outbreak of HIV among  
63 young, Black MSM college students raised awareness and prompted a reappraisal of existing  
64 prevention and testing messages.<sup>3</sup> Despite successful efforts to engage at-risk Black MSM on  
65 local levels,<sup>4</sup> large numbers of Black men continue to acquire HIV infection, statewide. In 2009,  
66 the rate of new diagnoses among persons aged 13 and older in NC was 22.5 cases per 100,000  
67 population, while the rate among Black men was nearly 5-fold higher, at 106.3 cases per  
68 100,000.<sup>5</sup> Among Black men, 72% of cases were attributable to sex between men.<sup>6</sup> These stark  
69 numbers underscore the need for more effective strategies to prevent HIV from spreading  
70 among those at greatest risk.

71  
72 Here, we present our retrospective investigation of an expansive sexual network in NC,  
73 predominantly made up of young, Black MSM. Using public health data collected for sexual  
74 partner contact tracing around cases of HIV and syphilis, we sought to characterize the risk  
75 environment in which Black MSM are becoming HIV-infected in NC. Our findings provide

76 context missing from the recent CDC report, and permit a reassessment of prevention needs in  
77 this population.

78

## 79 **METHODS**

80 Initial investigations centered around two Black MSM, aged 23 and 24, diagnosed with acute  
81 HIV infection (AHI) in October and November 2009, respectively. We define AHI as a  
82 combination of a positive HIV RNA with either a non-reactive enzyme immunoassay or a  
83 negative or indeterminate Western blot. NC's program for identifying AHI using nucleic acid  
84 testing on pooled plasma specimens has been previously described.<sup>7,8</sup> Both men had multiple  
85 contacts with previous AHI cases already engaged in care, and had an HIV-uninfected sex  
86 partner in common. These clients were the initial "nodes" of the network. The University of North  
87 Carolina at Chapel Hill's institutional review board approved the study concept and protocol.

88

### 89 **Behavioral Risk Information**

90 In NC, a mandatory, confidential, name-based system is used to report diagnoses of syphilis or  
91 HIV to the Department of Health and Human Services (NC-DHHS).<sup>9</sup> Each case is assigned to  
92 an officer of NC-DHHS's Partner Counseling and Referral Service (PCRS), who conducts  
93 voluntary interviews with each client and collects standardized information. Risk behaviors in the  
94 prior year are recorded, with special attention paid to the 8-week interval prior to diagnosis for  
95 AHI cases. Both traditional (e.g., injection drug use) and non-traditional (e.g., Internet sex-  
96 seeking) risks are recorded, along with all identifying information available for partners. PCRS  
97 officers then contact the client's partners, provide risk-reduction counseling, and offer either  
98 voluntary testing in the field or referral to a clinic for testing services. All infected partners are  
99 handled as additional cases, but contacts to uninfected partners are not investigated. Data are  
100 entered into a secured, centralized information management system. AHI cases are reviewed

101 twice monthly, and details are discussed to explore epidemiological links among cases.

102

### 103 **Network Linkages and Data Management**

104 One study team member experienced with PCRS records used standardized forms to  
105 retrospectively abstract demographic and sexual health data for each PCRS client and up to 20  
106 sexual partners. Characteristics of each partnership or “dyad” were also recorded. For partners  
107 that PCRS was unable to locate, the client’s description of the partner’s characteristics was  
108 used. No personal identifiers were abstracted. Instead, clients were assigned unique study  
109 identification numbers to assist with de-duplication. Individual-level demographic data included  
110 year of birth, gender, race/ethnicity, and sexual identity; sexual health data included available  
111 testing and diagnosis history for HIV and sexually transmitted infections (STIs).

112

113 Dyadic information for each reported sexual relationship included dates the partnership began  
114 and ended; the frequency of encounters; types of sexual activity with each partner; condom  
115 utilization; and where the client and partner met. To assess whether or not relationships  
116 overlapped with periods of heightened infectivity around the time of an AHI diagnosis,<sup>10,11</sup> we  
117 constructed a window surrounding the date of each AHI client’s first positive test result,  
118 beginning 28 days prior and lasting 90 days thereafter.

119

120 Clients were appended to the network until a censoring date of August 1, 2010, or until no  
121 additional partner data existed in NC-DHHS records, whichever was earlier. Diagrams of the  
122 network’s structure were produced using NetDraw version 2.089 and UCINET version 6.232  
123 (Analytic Technologies, Lexington, Kentucky).

124

### 125 **Statistical Analyses**

126 Demographic and sexual health data were assessed with descriptive statistics. Bivariate

127 analyses permitted us to characterize differences among HIV-infected, uninfected, and  
128 serostatus-unknown clients. Pearson's  $\chi^2$  test determined associations between categorical  
129 variables, with Fisher's exact test employed where appropriate. Differences among continuous  
130 variables were assessed with Wilcoxon rank-sum testing. We used a case-control analysis to  
131 determine which client, partner, or relationship characteristics were associated with having an  
132 untraceable sex partner, defined as having insufficient identifying information for the partner to  
133 be located by PCRS. Each sexual dyad served as a separate observation for this analysis, with  
134 client, partner, and relationship characteristics as covariates. Up to 20 dyads per client were  
135 included. Strengths of associations between each factor of interest and the outcome were  
136 assessed with log-linked bivariate generalized linear models (GLM) and statistically significant  
137 associations were included in multivariate GLM analyses. Robust standard errors were  
138 calculated using an adjustment for clustering in all models, since each client could be  
139 represented in multiple dyads. Significance was set at  $\alpha=0.05$  for all analyses, and all statistical  
140 testing utilized Stata/IC version 11.2 (StataCorp LP, College Station, Texas).

141

## 142 **RESULTS**

143 The final network included 365 men and 33 women; three quarters were Black ( $n=299$ ). Across  
144 all network members, the median age at the initial PCRS interview was 26 years (range, 16 to  
145 56); this decreased significantly over time, from 35.5 in 1995 to 24 in 2010 ( $p<0.001$  for trend).  
146 A similar trend was noted for the 29% of the network that was HIV-infected (2 women, 115  
147 men); median age at diagnosis fell from 36.5 in 1993 to 27 in 2010 ( $p<0.001$ ). Overall, 23% of  
148 the network was confirmed to be HIV-uninfected ( $n=92$ ). Serostatus could not be determined for  
149 47% of the network ( $n=189$ ), either because PCRS was unable to trace them ( $n=150$ ) or they  
150 refused HIV testing ( $n=39$ ). Fifty-eight percent of the network self-identified as MSM (217 MSM  
151 and 13 MSM who also reported sex with women), but when we included untraceable male  
152 partners who had sex with a male client ( $n=135$ ), the proportion of MSM increased to 92%.

153 Among the 209 clients for whom HIV status was known (Table 1), the majority were less than 30  
154 years old (78%); male (96%); Black (97%); and self-identified as MSM (90%). There were no  
155 significant differences in any characteristic between HIV-infected and uninfected clients.

156  
157 Figure 1 depicts the 398 network members and their sexual relationships. The network's final  
158 structure consisted of seven components, the largest of which contained 363 members (91% of  
159 the entire network). Sequential figures depicting sexual relationships, incident STIs, and HIV  
160 seroconversions over time can be found in the **Supplemental Digital Content**  
161 (<http://links.lww.com/QAI/A354>). Twenty-four individuals acquired HIV after initially appearing as  
162 uninfected contacts to known cases of HIV or syphilis, following a median of 1 year in the  
163 network (interquartile range [IQR], 0-3 years). Of these seroconverters (arrowheads), 14 were  
164 found to have established infection at the time of diagnosis (yellow) and 10 had AHI (red).  
165 Overall, 26 clients (22% of known HIV-infected persons) were diagnosed with AHI; all were  
166 detected through our statewide pooled nucleic acid screening program.<sup>7,8</sup>

167  
168 Indicators of sexual risk activity were frequently observed among HIV-infected clients following  
169 their diagnosis. Twenty-five of the 117 network members with HIV (21%) had an incident STI  
170 reported to the state following the date of their HIV diagnosis, after a median of 1.91 years  
171 (interquartile range, IQR, 1.08-2.85); all were MSM. Syphilis accounted for most of these STIs,  
172 with 28 cases diagnosed among 22 individuals; the other 3 men had gonorrhea.

173  
174 Of the 419 dyads in the network, there were only 27 in which the race of the client and partner  
175 differed (6%). We noted wide variation in partnership duration, with a median of 92 days (IQR,  
176 2-365). Over half of all relationships had occurred recently, between 2008-2010 (n=226, 54%),  
177 with another 42% distributed between 2003-2007 (n=177).

178

179 As shown in blue lines in Figure 1 and boldface in Table 2, there were 82 serodiscordant dyads,  
180 in which the HIV status of client and sex partner was confirmed to differ; 20% involved clients  
181 with AHI. We identified 18 relationships in which clients with AHI named sex partners who were  
182 HIV-infected, suggesting possible donor-recipient pairs. Approximately 40% of dyads involved  
183 chronically infected clients (n=167), again reflecting ongoing sexual activity among HIV-infected  
184 persons following diagnosis. One in five relationships linked HIV-infected clients to partners  
185 whose status could not be evaluated (n=96). In 40 dyads, it was not possible to determine  
186 clients' serostatus at the time of sexual activity, since diagnoses of established HIV infection  
187 were made *after* the relationship ended and no prior testing was on record.

188  
189 We compared characteristics of dyads featuring traceable versus untraceable partners, and  
190 found several significant differences (Table 3). Clients with untraceable partners more often  
191 reported encounters involving anal intercourse as the only sexual activity (P=0.01), whereas  
192 when both oral and anal sex occurred, partners were more often identifiable by PCRS (P=0.03).  
193 The number of sexual encounters with a partner influenced traceability, with one-time only  
194 partners being more difficult to locate (P<0.001). While the majority of clients reported use of  
195 condoms inconsistently or not at all, avoidance of condoms was more often reported by clients  
196 with traceable partners (P=0.04). Nearly one in four relationships began by meeting online, with  
197 a trend toward such partners being more difficult to trace (P=0.05). Partners met at bars or  
198 clubs were readily found by PCRS (P=0.03). In contrast, when clients met their partner at school  
199 or work, those individuals were more often untraceable (P=0.002), suggesting that clients may  
200 have been reticent to disclose identifying information for classmates or colleagues.

201  
202 Finally, we evaluated whether client, partner, or dyad-specific characteristics were associated  
203 with an outcome of having an untraceable partner (Table 4). Bivariate analyses revealed a  
204 significant association between having an untraceable partner and having a one-time sexual

205 encounter (risk ratio [RR] 4.44; 95% confidence interval [CI], 2.43, 8.14). Using recreational  
206 drugs during sex seemed to independently reduce the risk of having an untraceable partner (RR  
207 0.47; 95% CI, 0.29, 0.77). Being a client with AHI also reduced the risk of a partner being  
208 untraceable (RR 0.30; 95% CI, 0.15, 0.56), reflecting PCRS efforts to identify sexual contacts  
209 potentially exposed to HIV during the period of heightened infectivity. In a multivariate model,  
210 having a one-time sexual encounter (RR 4.51; 95% CI, 2.27, 8.97) and being acutely HIV  
211 infected (RR 0.27; 95% CI, 0.08, 0.89) had the strongest influences on the risk of having an  
212 untraceable partner.

213

## 214 **DISCUSSION**

215 We observed an extensive, dynamic sexual network with high HIV prevalence, overwhelmingly  
216 made up of Black MSM, whose members exhibited a steady decrease in age over time – both at  
217 their first appearance in a contact tracing investigation and at HIV diagnosis. The parallels  
218 between our findings and national trends suggest that this sexual network is a representative  
219 subunit of the HIV epidemic in the U.S., reflecting features that amplify HIV incidence among  
220 young MSM – especially those of color.

221

222 The likelihood of acquiring HIV depends on both the presence of HIV in the risk environment  
223 and engagement in behaviors placing one at risk for infection. Since multiple studies have  
224 shown that the types and frequencies of risk behaviors are similar between White and Black  
225 MSM,<sup>12-14</sup> it logically follows that the risk environment of Black MSM in the U.S. must account for  
226 their disproportionate burden of incident HIV. We noted several key features of the network that  
227 support this idea. First, the prevalence of HIV in this network was approximately 30%, although  
228 this is almost certainly an underestimate given that some serostatus-unknown network  
229 members are likely to be HIV-infected. To put this figure in perspective, in 2006 only 0.4% of the  
230 U.S. population was living with HIV, with nearly half of all infections acquired through male-to-

231 male sexual contact.<sup>15</sup> Among Blacks, the prevalence was 1.7% and among Black men, it  
232 reached 2.4%.<sup>15</sup> The likelihood of exposure to HIV within this network is comparable to the  
233 generalized epidemics of sub-Saharan Africa, where prevalence approaches 15-20%.<sup>16,17</sup>  
234 Furthermore, the risk for HIV acquisition in this network is probably much greater than in Africa,  
235 since anal intercourse is the most efficient route for HIV sexual transmission.<sup>18</sup> Second, the  
236 density of connections observed in the network was a likely contributor to the spread of HIV.<sup>19</sup>  
237 More than 220 sexual relationships occurred from 2008-2010, and we noted a number of  
238 possible transmission events from persons with acute and established HIV infection. Though  
239 high concentrations of virus in blood and body fluids make individuals with AHI maximally  
240 infectious to their partners,<sup>11,20</sup> persons with untreated chronic infection also transmit the virus,  
241 albeit less efficiently.<sup>10</sup> One in five dyads were serodiscordant, but when we included the 189  
242 clients whose HIV status was unknown, then nearly one out of every three relationships  
243 involved possible HIV exposures to uninfected persons. The frequency of serodiscordant  
244 partnerships is noteworthy, given recent evidence implicating inconsistent ascertainment of  
245 partner status as a key risk factor for HIV among Black MSM.<sup>14</sup> Third, we observed that men  
246 often rejoin the same sexual network from which they acquired HIV, creating opportunities to  
247 contract episodic STIs and thus increase the risk of HIV transmission to others.<sup>21</sup> Both syphilis  
248 and gonorrhea compromise mucosal barriers and increase the viral load of HIV-infected  
249 persons, thus potentiating HIV transmission.<sup>22</sup> And finally, the preference of clients to seek out  
250 same-race sex partners suggested assortative mixing patterns.<sup>23</sup> Recent work demonstrated a  
251 false perception among MSM of color that such preferential mixing offers protection against  
252 acquiring HIV.<sup>24</sup> In actuality, mathematical modeling shows assortative mixing is associated with  
253 explosive early rates of incident infection, often followed by multi-peak or prolonged epidemic  
254 periods.<sup>25</sup>  
255  
256 We showed that clients with AHI were less likely to have an untraceable partner, reflecting the

257 efforts of PCRS in locating partners potentially exposed during periods of heightened  
258 infectiousness. The long-standing success of our state's PCRS in identifying new cases of HIV<sup>9</sup>  
259 highlights the pivotal role that partner notification services may have as novel ARV-based  
260 prevention and treatment strategies are implemented nationally. Through fieldwork, PCRS  
261 officers could readily identify high-risk uninfected individuals and make appropriate referrals to  
262 assess candidacy for pre-exposure prophylaxis (PrEP). Established relationships with  
263 experienced HIV care providers would enable direct, timely linkage to care – as demonstrated  
264 by our statewide acute HIV screening program. “Real-time” reconstruction of sexual networks,  
265 using bioinformatics methods and centralized PCRS data, could permit earlier intervention with  
266 clients appearing in contact tracing investigations multiple times over many years. Incorporation  
267 of network analysis would require adjustments to existing PCRS methods, but the ability to  
268 “target” deployment of resources may have greater impact than the generalized prevention  
269 efforts currently in place.<sup>26</sup> Though CDC has encouraged partner notification services to be  
270 included as part of comprehensive HIV prevention and surveillance programs,<sup>27</sup> less than half of  
271 Americans diagnosed with HIV are offered such services<sup>28</sup> – meaning that untold numbers of  
272 uninfected and infected sexual contacts miss key opportunities for connection to prevention and  
273 treatment resources, nationwide.

274  
275 This study has limitations. A variety of socioeconomic and societal factors unmeasured by our  
276 study also act to concentrate HIV in disadvantaged populations, of which young, Black men  
277 make up a disproportionately large segment.<sup>29-31</sup> This is only one of many sexual networks in  
278 NC, and its structure and characteristics may not be entirely generalizable to others. We were  
279 unable to uniformly obtain viral genetic sequence data necessary to confirm HIV transmission  
280 events suggested by our epidemiological data, and we lacked sufficient clinical information to  
281 estimate the proportion of HIV-infected clients who were virologically suppressed on  
282 antiretrovirals. And finally, our calculations are based on the assumption that each partner was

283 unique, but overlap could exist among untraceable partners and with clients in the network. It is  
284 also likely that at least some of the serostatus-unknown members are actually HIV-infected. If  
285 de-duplication led to a decrease in the total number of network members, and the number of  
286 individuals with HIV was greater than we observed, then the prevalence of HIV in the network  
287 could in fact be substantially higher than our conservative estimate of 29%.

288  
289 In summary, our investigation of a large sexual network provides context missing from national  
290 incidence statistics, and yields insight into the characteristics of the risk environment in which  
291 young, Black MSM are becoming HIV-infected. The confluence of high HIV prevalence,  
292 serodiscordant relationships, comorbid STIs, assortative mixing, and involvement in sexual  
293 networks at younger ages creates a risk environment in which fewer lapses in safer-sex  
294 behaviors are needed before these young, Black MSM become HIV-infected. Although sobering,  
295 these findings allow us to reflect on existing challenges and refocus our efforts more  
296 strategically. Through the development and application of combined structural, behavioral, and  
297 biomedical HIV prevention strategies tailored for this population, we can reduce the spread of  
298 HIV among these men of color.

299

### 300 **Acknowledgements**

301 This work was presented at the 19th Conference on Retroviruses and Opportunistic Infections  
302 (CROI), March 5-8, 2012 (poster 1105). We thank the NC-DHHS Communicable Disease  
303 Branch: Delbert Williams, PhD, John Barnhart, MPH, Todd Vanhoy, Rhonda Ashby, and the  
304 Disease Intervention Specialists that serve the people of NC. We also appreciate the assistance  
305 provided by Peter Mucha, PhD and Sonia Napravnik, PhD.

306

### 307 **Funding/Support**

308 CBH is supported by the National Center for Advancing Translational Sciences  
309 (8KL2TR000084-05); LHW and EP are supported by the National Institute of Mental Health  
310 (1R01MH093275-01); and the National Institute for Allergy and Infectious Diseases provided  
311 support for JJE (5P30AI050410-13), SB, AS, and JK (5U01AI067854-01). The content is solely  
312 the responsibility of the authors and does not necessarily represent the official views of the NIH.

313

#### 314 **Author Contributions**

315 *Conceived and designed the study:* CBH MSC LBHW JJE PAL SB AS.

316 *Acquired and organized data:* SB, AS, EP, EMF, PAL, JK, CBH.

317 *Analyzed and interpreted data:* CBH, LBHW, MSC, JJE.

318 *Wrote the first draft of the manuscript:* CBH, MSC, LBHW.

319 *Critical review of the manuscript for important intellectual content:* MSC, JJE, LBHW, EMF, PAL,  
320 SB, AS, EP, JK.

321 *ICMJE criteria for authorship read and met:* CBH SB PAL AS EP JK EMF JJE MSC LBHW.

322 *Agree with manuscript results and conclusions:* CBH SB PAL AS EP JK EMF JJE MSC LBHW.

323

#### 324 **Competing Interests**

325 No author has relevant competing interests to report.

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FIGURE CAPTION:

**Figure 1.** A Sexual Network of Black Men Who Have Sex with Men, North Carolina, 1989-2010

The final network consisted of 365 men (circles) and 33 women (inverted triangles). The seven separate components of the network are shown; the largest contains 363 nodes, or 91% of all network members. Of the 117 HIV-infected clients, 24 became HIV-infected after initially appearing in the network as uninfected contacts to known cases of HIV or syphilis (arrowheads); 10 were diagnosed with acute HIV (red symbols) and 14 with established, chronic HIV (yellow symbols). Thick blue lines indicate the 82 confirmed relationships in which one partner was HIV-infected and the other uninfected at the time of sex.

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**Table 1.** Characteristics of Clients with Confirmed HIV Status

Characteristics* (No. Responding)	Number (%) of Subjects or Median (IQR) <sup>†</sup>			P-value <sup>‡</sup>
	Total (N=209)	HIV-Infected (n=117)	Uninfected (n=92)	
Age in years (n=208)	25 (22-28.5)	26 (23-31)	25 (21-28)	0.13
<20	18 (8.7)	7 (6.0)	11 (12.1)	0.41
20-29	144 (69.2)	75 (64.1)	69 (75.8)	
30-39	36 (17.3)	30 (25.6)	6 (6.6)	
40-49	9 (4.3)	5 (4.3)	4 (4.4)	
≥50	1 (0.5)	0	0	
Gender (n=209)				0.05
Female	9 (4.3)	2 (1.7)	7 (7.6)	
Male	200 (95.7)	115 (98.3)	85 (92.4)	
Race/Ethnicity (n=208)				0.20
Black	202 (97.1)	111 (94.9)	91 (100)	
White	3 (1.4)	3 (2.6)	0	
Hispanic	2 (1.0)	2 (1.7)	0	
Asian	1 (0.5)	1 (0.9)	0	
Sexual orientation (n=208)				0.55
Homosexual	187 (89.9)	103 (88.0)	84 (92.3)	
Bisexual	20 (9.6)	13 (11.1)	7 (7.7)	
Heterosexual	1 (0.5)	1 (0.9)	0	
Employed (n=65)	52 (80.0)	38 (79.2)	14 (82.4)	1.00
College or university student (n=67)	13 (19.4)	8 (16.3)	5 (27.8)	0.31

\* A total of 209 subjects with confirmed human immunodeficiency virus (HIV) status were included. The number of respondents with data for each item varied.

† IQR indicates interquartile range.

‡ Wilcoxon rank-sum testing was used to compare medians. Pearson's  $\chi^2$  test was used for categorical variables, with Fisher's exact test employed where appropriate. P-values <0.05 were considered statistically significant.

**Table 2.** Opportunities for Sexual Transmission of HIV across All Dyads

Client Serostatus at Time of Sex	Partner Serostatus at Time of Sex*			Total
	Uninfected	Infected	Unknown	
Uninfected	66	<b>21</b>	82	169
Infected, acute <sup>†</sup>	<b>16</b>	18	9	43
Infected, chronic <sup>‡</sup>	<b>45</b>	35	87	167
Possibly infected <sup>§</sup>	16	6	18	40
<i>Total</i>	<i>143</i>	<i>80</i>	<i>196</i>	<i>419</i>

\* Underlined numbers indicate relationships where **no** opportunity for HIV transmission occurred. Boldfaced numbers designate the number of partnerships in which the serostatus was confirmed to be discordant. Partners with unknown serostatus include both those who were untraceable by PCRS and those who were identifiable but refused HIV testing.

† A window period for acute HIV infection was defined from 28 days preceding the date of diagnosis to 90 days thereafter. Sexual relationships that occurred during this window were counted as having had exposure to an acutely HIV infected client.

‡ To be counted as a chronic infection at the time of the sexual relationship, a client had to be diagnosed with HIV infection (seronegative or seropositive) more than 90 days prior to the starting date of the relationship.

§ "Possibly infected" refers to clients with fully reactive enzyme immunoassay and Western blot HIV testing results **following** the completion of a partnership. In these situations, it was not possible to accurately determine what the client's serostatus was at the time of the sexual relationship.

**Table 3.** Characteristics of 419 Dyads in Sexual Network

Characteristics*		Number (%) of Dyads or Median		P-value <sup>†</sup>
		Traceable Partner (n=266)	Untraceable Partner (n=153)	
Age difference between partner and client <sup>‡</sup>	Median	3	4	0.13
	Range	-28 to 32	-4 to 17	
	Interquartile range	-1 to 7	1 to 9	
Type of sexual behavior	Oral	21 (10.3)	5 (5.4)	0.19
	Anal	55 (27.0)	39 (41.9)	<b>0.01</b>
	Vaginal	14 (6.9)	5 (5.4)	0.80
	Oral and anal	114 (55.9)	39 (41.9)	<b>0.03</b>
	Oral and vaginal	0	5 (5.4)	
Frequency of sexual encounters	One time only	82 (40.1)	80 (80.8)	<b>&lt;0.001</b>
	2-5 times	48 (33.8)	12 (12.1)	<b>&lt;0.001</b>
	More than 5 times	37 (26.1)	7 (7.1)	<b>&lt;0.001</b>
Condom utilization	Never	59 (43.7)	12 (26.7)	<b>0.04</b>
	Inconsistent	53 (39.3)	25 (55.6)	0.06
	Always	23 (17.8)	8 (17.8)	0.91
How partners met	Online	69 (40.6)	31 (52.5)	0.05
	At school or work	18 (10.6)	16 (27.1)	<b>0.002</b>
	Through friend or roommate	22 (12.9)	3 (5.1)	0.10
	Unknown/couldn't recall	24 (14.1)	2 (3.4)	<b>0.03</b>
	Bar or club	18 (10.6)	1 (1.7)	<b>0.03</b>
	Non-sexual physical venue	8 (4.7)	4 (6.8)	0.54
	Sex venue	5 (2.9)	2 (3.4)	1.0
	Phone chat line	4 (2.4)	0	
At church	2 (1.2)	0		

\* A total of 419 dyads were examined in this study. The number of respondents with data for each item varied, reflected in column totals for each characteristic.

† Wilcoxon rank-sum testing was used to compare medians. Indicator (dummy) variables were used with Pearson's  $\chi^2$  test to calculate P-values for individual categories.

‡ Positive numbers indicate that sex partners were older than the client, and negative numbers show that the client was older than the sex partner. For dyads with traceable partners, n=211; for those with untraceable partners, n=43.

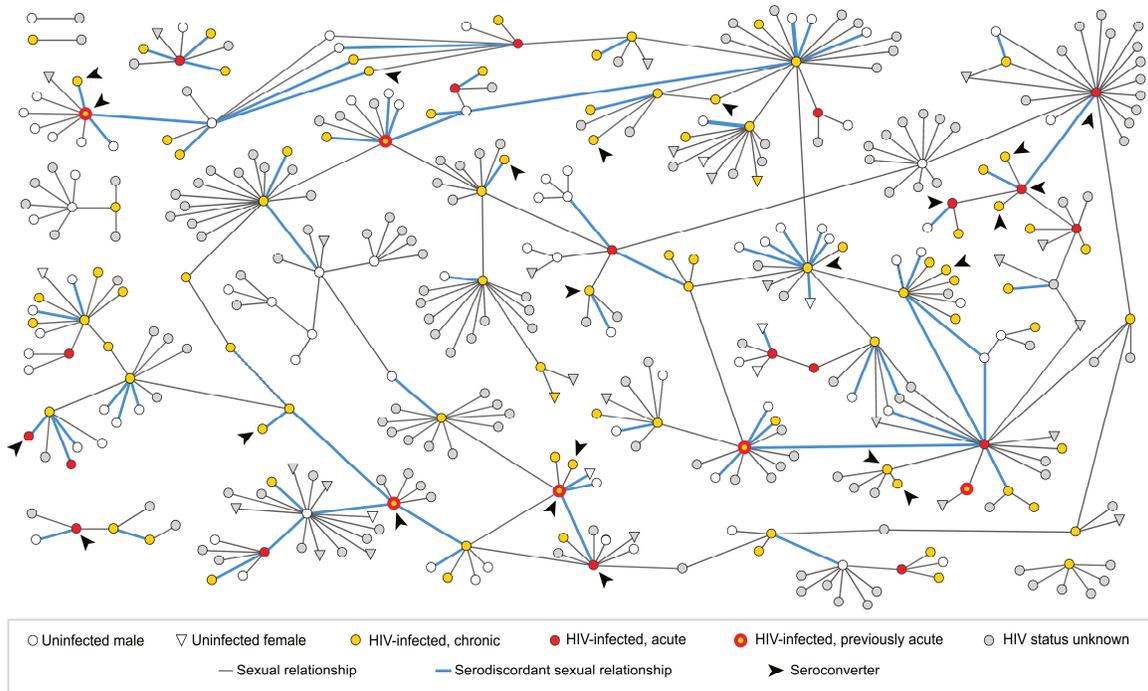
**Table 4.** Client, Sex Partner, and Relationship-Level Predictors of Having an Untraceable Sex Partner

	<b>Characteristics* (No. Responding)</b>	<b>RR<sup>†</sup> (95% CI)</b>	<b>P-value</b>	<b>Adjusted RR<sup>‡</sup> (95% CI)</b>	<b>P-value</b>
<i>Client</i>	Age (n=419)	0.98 (0.95, 1.02)	0.31		
	Black race (n=419)	1.67 (0.86, 3.24)	0.13		
	Acutely HIV infected (n=419)	0.30 (0.15, 0.56)	<b>&lt;0.001</b>	0.27 (0.08, 0.89)	<b>0.031</b>
	Recreational drug use around time of sex (n=314)	0.47 (0.29, 0.77)	<b>0.003</b>	0.61 (0.36, 1.06)	0.08
	Internet user (n=389)	1.14 (0.65, 1.99)	0.65		
<i>Sex Partner</i>	Age (n=297)	1.00 (0.95, 1.04)	0.85		
	Race differs from client (n=330)	2.06 (0.98, 4.31)	0.06		
<i>Relationship</i>	Met offline (n=203)	0.81 (0.39, 1.72)	0.59		
	One-time encounter (n=333)	4.44 (2.43, 8.14)	<b>&lt;0.001</b>	4.51 (2.27, 8.97)	<b>&lt;0.001</b>
	Index was receptive partner for anal intercourse (n=203)	1.94 (1.01, 3.75)	0.05		
	Year sexual relationship ended (n=419)	0.96 (0.90, 1.02)	0.17		

\* A total of 419 dyads were included; the number of dyads for which specific data existed varied and is noted above.

† RR indicates risk ratio, here reflecting the risk of being an unreachable sex partner.

‡ Adjusted risk ratios for a multivariate generalized linear model including acute HIV status of the index, frequency of sexual encounters, and use of recreational drugs around the time of sex.



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