

# How Different are Men Who Do Not Know Their HIV Status from Those Who Do? Results from an U.S. Online Study of Gay and Bisexual Men

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**Abstract** We compared self-described HIV-positive (31.6 %,  $n = 445$ ), HIV-negative (56.8 %,  $n = 801$ ), and HIV-unknown (11.6 %,  $n = 164$ ) gay and bisexual men on sociodemographic and behavioral characteristics. Participants from across the U.S. were enrolled via a popular sexual networking website to complete an online survey. In total, 44.8 % of HIV-negative and HIV-unknown men said they had not been tested for HIV in the CDC-recommended last 6 months. HIV-unknown men significantly differed from HIV-negative and HIV-positive men in sexual behavior and HIV status disclosure patterns. HIV-unknown men were more willing than HIV-negative men to take PrEP; however, HIV-unknown men were significantly less likely than others to have health insurance or a primary care provider. Given the observed differences, researchers should consider analyzing men who are HIV-unknown distinctly from HIV-negative and HIV-positive men.

**Resumen** Comparamos hombres auto-descritos como gay y bisexuales (GBM), VIH-positivo (31.6 %,  $n = 445$ ), VIH-negativo (56.8 %,  $n = 801$ ), y VIH-desconocido

(11.6 %,  $n = 164$ ) en características sociodemográficas y conductuales. Participantes de todo los EE.UU. fueron inscritos a través de un sitio web popular de redes sexuales para completar una encuesta en línea. En total, el 44.8 % de los hombres VIH-negativo y VIH-desconocido reportaron no haberse realizado la prueba para detectar el VIH dentro de los últimos 6 meses recomendados por el CDC. Hombres VIH-desconocido difirieron significativamente de hombres VIH-negativo y VIH-positivo en comportamiento sexual y patrones de revelación de su estado de VIH. Hombres VIH-desconocido estuvieron más dispuestos a tomar PrEP que hombres VIH-negativo; sin embargo, hombres VIH-desconocido fueron significativamente menos propensos a tener un seguro médico o proveedor de atención primaria. Dadas las diferencias observadas, los investigadores deben considerar analizar los hombres VIH-desconocido de un modo distinto de los hombres VIH-negativo y VIH-positivo.

**Keywords** HIV testing · Men who have sex with men · Gay and bisexual men · Condomless anal sex · HIV status disclosure

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## Introduction

HIV continues to be a public health crisis among gay, bisexual, and other men who have sex with men (GBMSM) [1, 2]. Although HIV incidence has plateaued or declined in many groups such as injection drug users and heterosexuals [3], incidence among GBMSM is once again on the rise and increased by 12 % between 2009 and 2013 [4]. This disparity is even more pronounced among men of color, especially young men of color [4, 5].

In an effort to stave off new HIV transmissions, the CDC recommended annual HIV testing for the population in general [2], whereas they recommend sexually active GBMSM be tested every 3–6 months [6]. Data from several studies suggest significant proportions of GBMSM have not been tested for HIV in accordance with these recommendations [7–10]. A CDC analysis of the National HIV Behavioral Surveillance System (NHBS) data from 21 U.S. cities found, among HIV-negative or unknown status MSM, one-third had not been tested for HIV in the past 12 months [11]. Among men who said they had been tested in the last 12 months, 5 % were newly diagnosed with HIV as part of NHBS. Their data also showed that among HIV-negative and unknown status men, only 31 % had tested in the past 3 months.

Having a confirmed HIV-positive status can facilitate rapid integration into HIV care [7], including the use of antiretroviral therapies to improve an individual's health while simultaneously reducing his infectiousness to others [12]. In addition, knowing one's status—whether HIV-positive or HIV-negative—can help an individual to make informed decisions about behavioral strategies to reduce HIV transmission risks [13] such as serosorting [11–17], strategic positioning [14–16, 18], selectively having only oral sex or mutual masturbation [18–20], using condoms with partners who do not share the same HIV status, or “biomed-sorting” [i.e., restricting behaviors to partners who are taking HIV antiretroviral medications—either HIV-positive but have undetectable viral loads, or HIV-negative and taking pre-exposure prophylaxis (PrEP)] [21]. Researchers estimate that eight transmissions would be averted for every 100 persons newly aware of their HIV infection as a result of HIV treatment combined with reductions in risk behavior [22].

Much of the available research on men of unknown HIV status involves sex partners whose status was unknown to a participant because it was not discussed/disclosed [17, 23–28]. There is less known about how men who themselves identify their HIV status as unknown differ from both HIV-negative and HIV-positive individuals with regard to sexual behavior as well as socio-demographic characteristics. CDC NHBS data found that younger age and higher levels of both income and education were associated with knowing one's HIV status [11], while race and ethnicity were not. Instead, within many studies—and perhaps out of interest in conserving statistical power, limiting degrees of freedom, and simplifying results—HIV status is often dichotomized in whereby HIV-positive individuals are compared to those who are not known to be HIV-positive [29–33]. This effectively combines HIV-negative and men who do not know their status into a singular group when in fact these men may be characteristically different from each other.

Given that there is limited research in which HIV-unknown men are investigated as a distinct subgroup, the present study compared self-described HIV-negative, HIV-positive, and HIV-unknown men from a large U.S. national sample of GBMSM. Our goal was to compare these three groups based on socio-demographic and behavioral characteristics. Using these findings, we sought to inform researchers with regard to how they compare participants based on HIV status, as well as to inform HIV prevention providers about how to engage HIV-unknown men in HIV-testing and routine sexual health care.

## Method

### Participants and Procedures

For a 1-month period, starting on August 6, 2014, the research team advertised on a popular, cost-free sexual networking website for GBMSM selected because of its diverse membership with regard to age, race, ethnicity, and HIV status. Our ad read, “Adventurous sex life?” and indicated that participants could receive compensation for joining in a research study. Those clicking the ad were directed to our secure survey in a separate browser window. The first page of the survey contained the informed consent. The informed consent indicated the survey they were taking had no incentive, but the survey would screen them for other studies for which they could be compensated if they joined. The survey took approximately 10 min to complete. Procedures were approved by the City University of New York (CUNY) Institutional Review Board.

Our ad was clicked 10,192 times. Of these, 7327 closed the browser window without proceeding, 2598 provided consent and started the survey, and 267 declined to give consent and were routed to the end of the survey. Of those providing consent, 4 said they were under the age of 18 and were routed to the end of the survey. We excluded those who said they lived outside of the U. S. ( $n = 99$ ), those who said they were not born male ( $n = 6$ ), those who said their current gender identity was not male ( $n = 13$ ), and self-identified heterosexuals ( $n = 27$ ). Of the remaining 2449 individuals who started the survey, 1410 (57.5 %) completed it. Participants resided in 48 of the 50 states as well as Puerto Rico (none were from Montana or Vermont). We did not record any duplicate IP addresses, nor did we receive duplicate contact information among those who were found preliminary eligible for one of our ongoing research studies. It is worth noting that the survey itself was not incentivized and anyone deemed preliminary eligible for a research study would have to present themselves in-person for additional screening prior to enrollment (and thus an incentive) for any research studies.

## Measures

Participants responded to questions regarding demographic characteristics such as age, race or ethnicity, sexual identity, relationship status, whether they had health insurance, and whether they had a primary care provider. Participants in a relationship were asked to indicate their partner's gender as well as whether their partner had disclosed her/his HIV status.

Response options for participants' HIV-status were "HIV-negative," "HIV-positive," and "I do not know" (herein labeled "HIV-unknown"). HIV-negative and HIV-unknown individuals were also asked how long ago they received their last HIV test results. These men were also presented with information about HIV PrEP [34, 35] and asked follow up questions about whether they had ever heard of PrEP and whether they would take PrEP if it were at least 90 % effective.

All participants responded to a variety of questions regarding their sexual behavior and substance use in the past 3 months. These included the number of casual male partners and anal sexual behavior with and without a condom (insertive and receptive) separately for partners "who told you they had the same HIV status as you" (original emphasis) and partners "whose HIV status you did not know or who told you they were a different HIV status than you." Participants indicated where they had recently met male sex partners from a list of 12 types of venues, whether they had consumed five or more alcoholic beverages (i.e., heavy drinking) in one sitting in the last 7 days, and whether they had used club drugs (i.e., ketamine, ecstasy/MDMA, GHB, cocaine, methamphetamine) in the last 90 days.

## Analytic Plan

Where appropriate, Chi square, ANOVA, and Kruskal–Wallis tests were used to compare HIV-positive, HIV-negative, and HIV-unknown men on sociodemographic and behavioral characteristics. As a post hoc for significant Chi square tests, partial Chi square (i.e., paired tests, HIV-negative vs. HIV-positive, HIV-negative vs. HIV-unknown, HIV-positive vs. HIV-unknown) was used. Finally, multinomial logistic regression was used to compare the three groups. Based on the bivariate associations and conceptual relevance, independent variables of interest for these models included race (White vs. non-White), sexual identity (gay vs. bisexual), having health insurance (yes vs. no), having a primary care provider/physician (yes vs. no), age (under 40 vs. over 40, selected because 40 approximated the mean age of the sample), club drug use in the previous 90 days (yes vs. no), and reporting sexual behavior with 9 or greater casual male partners in the

previous 90 days. This operational definition of highly sexually active was based on prior research [30, 35–37], including a probability-based sample of urban GBMSM [38, 39] that found 9 partners was 2–3 times the average number of sexual partners among sexually active GBMSM in a 90 day period. This approach allowed for direct comparisons in how various demographic and behavioral characteristics were associated uniquely with being HIV-positive, HIV-negative, and HIV-unknown status.

## Results

The majority (56.8 %,  $n = 801$ ) were HIV-negative, 31.6 % ( $n = 445$ ) were HIV-positive, and 11.6 % ( $n = 164$ ) indicated they were HIV-unknown. In total, 31.7 % were men of color, 27.1 % were in a relationship, 22.3 % were bisexual and 77.7 % were gay. Mean age was 40.2 years ( $SD = 12.5$ ). Table 1 reports sociodemographic differences by HIV status. Significant differences were observed for race and ethnicity, sexual identity, having health insurance, having a primary care provider/physician, and age. Although there were no significant differences in whether one was in a relationship or not, a significantly larger proportion of HIV-unknown men in relationships said they did not know the HIV status of their main partner (39.6 %) compared with HIV-positive (12.4 %) and HIV-negative (10.0 %) men. In addition, among those in a relationship, 27.1 % of HIV-unknown men and 25.1 % of HIV-negative men said their partner was female or transgender, compared with only 8.1 % among HIV-positive men.

Significantly more HIV-unknown men (43.9 %) had not been tested in the last year compared with HIV-negative men (15.4 %). Interestingly, there may be some incongruence between self-reported HIV status and HIV testing behavior—3.7 % of self-described HIV-negative men said they had never been tested for HIV, whereas 4.3 % of HIV-unknown men said they had tested for HIV in the previous 3 months. HIV-negative and HIV-unknown men were equally likely to have heard of PrEP (62.6 % overall); however, a significantly larger proportion of HIV-unknown men said they would be willing to go on PrEP compared to HIV-negative men (83.9 vs. 74.6 %).

Table 2 reports behavioral differences between the three groups of men. There were no significant differences in whether they had engaged in sex with another male in the past 3 months (91.2 % overall), or whether participants had engaged in binge drinking in the past 7 days (31.2 % overall). In terms of where participants reported meeting male sex partners, there were no significant differences in ten out of the twelve venues—a significantly larger proportion of men who were HIV-unknown reported partners

**Table 1** Sociodemographic differences between self-reported HIV-negative, HIV-positive, and HIV-unknown/unsure gay and bisexual men

	Self-reported HIV status						$\chi^2$	<i>p</i>	Post hoc
	A. Negative <i>n</i> = 801		B. Positive <i>n</i> = 445		C. Unknown <i>n</i> = 164				
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%			
Race or ethnicity							32.92	<0.001	A ≠ B
Black	70	8.7	84	18.9	22	13.4			
White	587	72.5	266	59.8	114	65.5			
Latino	89	11.1	55	12.4	19	11.6			
Multiracial or other	61	7.6	40	9	9	5.5			
Sexual identity							41.30	<0.001	A, C ≠ B
Gay	580	72.4	392	88.1	123	75.0			
Bisexual	221	27.6	53	11.9	41	25.0			
Currently in a relationship									
Yes	279	34.8	137	30.8	48	29.3	3.23	0.20	
No	522	65.2	608	69.2	116	70.7			
Main partner's HIV status (among <i>n</i> = 464 currently in relationship)							104.86	<0.001	A ≠ B ≠ C
Partner told me s/he is HIV-positive	28	10.0	61	44.5	4	8.3			
Not certain	28	10.0	17	12.4	19	39.6			
Partner told me s/he is HIV-negative	223	79.9	59	43.1	25	52.1			
Main partner's gender is male (among <i>n</i> = 463 valid responses)									
No	70	25.1	11	8.1	13	27.1	17.86	<0.001	B ≠ A, C
Yes	209	74.9	125	91.9	35	72.9			
Has health insurance									
No	120	15.0	51	11.5	43	26.2	20.33	<0.001	C ≠ A, B
Yes	681	85.0	394	88.5	121	73.8			
Has a primary care provider/physician									
No	219	27.3	31	7.0	77	47.0	125.48	<0.001	A ≠ B ≠ C
Yes	582	72.7	414	93.0	57	53.0			
How long ago was last HIV-test (non-HIV-positive men only)									
Within the last 3 months	326	40.7	–	–	7	4.3	249.96	<0.001	
3–6 months ago	187	23.3	–	–	13	7.9			
6–12 months ago	135	16.9	–	–	20	12.2			
More than a year ago	123	15.4	–	–	72	43.9			
Never tested	30	3.7	–	–	52	31.7			
Ever heard or PrEP (non-HIV-positive men only)									
No, never	280	36.4	–	–	68	42.2	1.929	0.17	
Yes	489	63.6	–	–	93	57.8			
Would take PrEP if it were 90 % effective (non-HIV-positive men only)									
No	195	25.4	–	–	26	16.1	6.231	0.01	
Yes “Definitely” or “Probably”	574	74.6	–	–	135	83.9			
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>	Post hoc
Age in years	41.4	13.1	44.1	11.1	37.9	12.1	15.91	<0.001	A ≠ B ≠ C

via bathhouses (20.1 vs. 16.2 % among HIV-positive and 13.0 % among HIV-negative) and partners via adult bookstores (21.3 vs. 15.5 % among HIV-positive and 11.9 % among HIV-negative). Significantly more HIV-positive men (15.7 %) reported club drug use in the last

90 days, compared to HIV-unknown (12.5 %) and HIV-negative (7.4 %) men.

HIV-unknown men reported significantly more casual male sex partners (*Mdn* = 7) than HIV-negative men (*Mdn* = 5) and HIV-positive men (*Mdn* = 5) in the last

**Table 2** Behavioral differences between self-reported HIV-negative, HIV-positive, and HIV-unknown/unsure gay and bisexual men

	Self-reported HIV status						$\chi^2$	<i>p</i>	Post hoc
	A. Negative <i>n</i> = 801		B. Positive <i>n</i> = 445		C. Unknown <i>n</i> = 164				
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%			
Sexually active with a male partner, <3 months									
No	62	7.8	45	10.1	9	5.5	3.954	0.14	
Yes	738	92.3	399	89.9	154	94.5			
Binge drank in last 7 days									
No	535	69	306	70.2	101	63.9	2.159	0.34	
Yes	240	31	130	29.8	57	36.1			
Has done club drugs in last 90 days <sup>a</sup>									
No	742	92.6	375	84.3	143	87.2	21.97	<0.001	A ≠ B, C
Yes	59	7.4	70	15.7	21	12.8			
Locations where has met male sex partners, <3 months									
Social networking website	105	13.1	50	11.2	30	18.3	5.24	0.07	
Gay bar or club	136	17.0	77	17.3	36	22.0	2.37	0.31	
Sex party	87	10.9	62	13.9	27	16.5	5.16	0.08	
Bathhouse	104	13.0	72	16.2	33	20.1	6.44	0.04	A ≠ C
Public cruising	95	11.9	69	15.5	35	21.3	11.14	0.004	A ≠ C
Adult bookstore	94	11.7	59	13.3	28	17.1	3.57	0.17	
Gym	60	7.5	37	8.3	14	8.5	0.19	0.91	
Scruff (app)	115	14.4	70	15.7	25	15.2	5.02	0.08	
Grindr (app)	257	32.1	120	27.0	56	34.1	4.55	0.10	
Other mobile app	85	10.6	47	10.6	25	15.2	3.17	0.20	
Adam4Adam.com	663	82.8	360	80.9	140	85.4	1.76	0.41	
Other hook-up website	284	35.5	158	35.5	61	37.2	0.19	0.91	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>H</i>	<i>p</i>	Post hoc
Proportion of casual male partners, <3 months, who <u>told</u> were same HIV status	0.79	0.33	0.49	0.39	0.59	0.39	179.81	<0.001	A ≠ B ≠ C
Proportion of casual male partners, <3 months, who <u>told</u> were different or HIV status or did not disclose	0.21	0.33	0.52	0.29	0.42	0.39	182.06	<0.001	A ≠ B ≠ C
	<i>Mdn</i>	<i>IQR</i>	<i>Mdn</i>	<i>IQR</i>	<i>Mdn</i>	<i>IQR</i>	<i>H</i>		Post hoc
Number of casual male partners, <3 months	5	2–10	5	2–10	7	3–15	15.10	0.001	A, B ≠ C
With casual male partners of the same HIV status, <3 months, number of times... <sup>b</sup>									
Anal insertive, no condom	1	0–3	2	0–6	2	0–4	26.86	<0.001	A ≠ B, C
Anal insertive, condom	0	0–3	0	0–1	0	0–2	22.53	<0.001	A ≠ B
Anal receptive, no condom	1	0–3	2	0–6	2	0–7	54.82	<0.001	A ≠ B, C
Anal receptive, condom	1	0–3	0	0–1	1	0–3	19.03	<0.001	A ≠ B, C
With casual male partners of different or unknown HIV status, <3 months, number of times... <sup>b</sup>									
Anal insertive, no condom	0	0–3	1	0–3	1	0–5	2.78	0.25	
Anal insertive, condom	0	0–2	0	0–2	0	0–2	0.53	0.77	
Anal receptive, no condom	0	0–2	2	0–5	1	0–3.75	56.60	0.001	A ≠ B, C
Anal receptive, condom	0	0–2	0	0–2	0	0–2	1.24	0.54	

*H* Kruskal–Wallis test, *Mdn* median, *IQR* interquartile range

<sup>a</sup> Club drugs include ketamine, ecstasy/MDMA, GHB, cocaine, or methamphetamine

<sup>b</sup> Note valid *n* shifts as data are nested among participants who reported having casual male partners of the same or different/unknown HIV status

3 months. All three groups significantly differed with regard to the average proportion of casual male sex partners who “told them they were the same HIV status” (0.79 among HIV-negative, 0.59 among HIV-unknown, and 0.49 among HIV-positive).

For sexual behavior with casual male partners believed to be the same HIV status, HIV-negative men reported significantly fewer acts of insertive and receptive condomless anal sex (CAS) and significantly more acts of anal receptive acts with condoms than did HIV-positive or HIV-unknown men. HIV-negative men also reported a significantly greater number of anal insertive acts with a condom than HIV-positive men. In contrast, HIV-unknown men and HIV-positive men did not significantly differ on the number of acts (insertive or receptive, with and without a condom) with partners they perceived to be the same status as themselves.

There were fewer significant differences with regard to anal sexual behavior with partners believed to be a different or unknown HIV status. HIV-negative men reported significantly fewer receptive CAS acts than HIV-positive and HIV-unknown men. Meanwhile, there were no significant differences in the number of anal insertive acts with and without a condom as well as the number of anal receptive acts with a condom.

Table 3 presents the results of a multinomial logistic regression, with HIV status as the dependent variable. As seen in Section A of Table 3, compared to HIV-unknown men, HIV-positive men had significantly greater odds of being non-White, self-identifying as gay, having a primary care provider, being over age 40, and having used club drugs in the previous 90 days. Compared to HIV-unknown men, HIV-positive men had significantly lower odds of reporting 9 or more male partners in the prior 90 days. Compared to HIV-unknown men, HIV-negative men had significantly greater odds of reporting a primary care provider and being over age 40. Compared to HIV-unknown men, HIV-negative men had significantly lower odds of reporting 9 or more male partners in the prior 90 days.

In Section B of Table 3, compared to HIV-negative men, HIV-positive men had significantly greater odds of being non-White, self-identifying as gay, having a primary care provider, being aged 40 or older, and having used club drugs in the previous 90 days.

## Discussion

Using data from a national U.S. online study of gay and bisexual men recruited via a sexual networking website, we found 11.6 % said they were unsure of their HIV status. In addition, and similar to another study of GBMSM on a social networking app [7], 28.7 % of HIV-negative and

HIV-unknown men said they had not been tested for HIV in the past 12 months, as recommended by the CDC [2]. More conservative CDC recommendations suggested that sexually active GBMSM be tested every 3–6 months [6]. In our data, 44.8 % of HIV-negative and HIV-unknown had not been tested for HIV in the last 6 months, and 65.5 % had not been tested in the last 3 months. At 8.5 %, the proportion of men in our study who said they had never been tested for HIV was much higher than the age-adjusted 2.6 % (1.4 % unadjusted) proportion observed in New York City surveillance data [8]. Providers seeking to engage GBMSM in testing might be well served to use both the Internet and geosocial/sexual networking apps to identify discretely men who have not been tested recently and mail them at-home HIV testing kits for personal use [40].

In most research with GBMSM, those who are unsure of their HIV status are in the minority, as was the case with the present study. However, given our large sample size, we were sufficiently powered to statistically compare these men to HIV-positive and HIV-negative participants. Often, HIV status is dichotomized such to compare HIV-positive men against other men not known to be HIV-positive. Our findings suggest that HIV-unknown men differ from both HIV-positive and HIV-negative men in meaningful ways that warrant their analysis as a distinct third group whenever possible. Primarily, their sexual behavior was different (they report more partners than others), as were their patterns of HIV status disclosure. HIV-unknown men reported a smaller proportion of their partners to be the same HIV status than HIV-negative men, but a larger proportion than HIV-positive men. Likewise, HIV-unknown men reported a smaller proportion of their partners to be different/unknown status than HIV-positive men, but a larger proportion than HIV-negative men. Although our findings indicate it would be wise to maintain HIV-unknown participants as a third unique group, we do highlight the utility of dichotomizing the HIV status of *partners*. For example, because it is virtually impossible to know the actual risk of HIV transmission when an HIV-negative person has CAS with an HIV-unknown person, it makes practical sense—from an epidemiological perspective—to consider risk equivalent for CAS with HIV-unknown or HIV-positive partners.

It may not be surprising that men who said they were unsure of their HIV status were significantly less likely than others to have been tested for HIV. These men were also less likely than others to have health insurance or a primary care provider. The lack of HIV testing among these men may be a symptom of structural barriers with regard to access to health care. That is, in spite of government-sponsored free and low cost HIV-testing available in many cities across the U.S., other facets of engagement

**Table 3** Multinomial logistic regression contrasting HIV-negative, HIV-positive, and HIV-unknown/unsure gay and bisexual men

	HIV-positive men			HIV-negative men		
	AOR	<i>p</i>	95 % CI	AOR	<i>p</i>	95 % CI
<i>Section A</i> Referent outcome group: men who did not know their HIV status						
Race is Non-White						
Yes	<b>2.25</b>	<0.001	1.47–3.44	1.03	0.89	0.70–1.51
Self-identified as gay						
Yes	<b>3.28</b>	<0.001	2.02–5.33	1.07	0.75	0.72–1.59
Has health insurance						
Yes	1.39	0.22	0.82–2.37	1.50	0.07	0.96–2.34
Has a primary care provider						
Yes	<b>10.20</b>	<0.001	6.06–17.24	<b>1.79</b>	0.003	1.22–2.64
Is aged 40 or older						
Yes	<b>2.33</b>	<0.001	1.55–3.51	<b>1.47</b>	0.038	1.02–2.12
Has used club drugs in the last 90 days						
Yes	<b>1.96</b>	0.02	1.09–3.55	0.74	0.29	0.43–1.29
Had sex with 9 or more casual male partners in last 90 days						
Yes	<b>0.56</b>	0.004	0.37–0.83	<b>0.53</b>	<0.001	0.37–0.76
<i>Section B</i> Referent outcome group: HIV-negative men						
Race is Non-White						
Yes	<b>2.19</b>	<0.001	1.67–2.88			
Self-identified as gay						
Yes	<b>3.07</b>	<0.001	2.18–4.33			
Has health insurance						
Yes	0.93	0.72	0.62–1.39			
Has a primary care provider						
Yes	<b>5.68</b>	<0.001	3.70–8.77			
Is aged 40 or older						
Yes	<b>1.58</b>	0.001	1.206–2.07			
Has used club drugs in the last 90 days						
Yes	<b>2.65</b>	<0.001	1.76–3.98			
Had sex with 9 or more casual male partners in last 90 days						
Yes	1.05	0.71	0.80–1.38			

All independent variables are coded “1 = yes” and “0 = no”

AOR adjusted odds ratio

Bold values indicate significance at  $p < 0.05$

in care, such as lower access to health insurance and a primary care provider, may present barriers to engaging these men in HIV testing (i.e., a component of routine medical care). Alternatively, their self-described HIV-unknown status could result from the fact that they have not tested recently.

Familiarity with PrEP was high for both HIV-negative and HIV-unknown men (63.0 % overall); however, HIV-unknown men were significantly more likely than HIV-negative men to express interest in taking PrEP. This could suggest that many of these men may assume they are HIV-negative and want to remain so, or that they have a higher degree of risk perception and hence interest in PrEP. In order to take PrEP, one must be engaged in routine medical

care and regular HIV and STI testing. Thus, getting men who do not know their HIV status on PrEP would also effectively engage them in routine HIV testing. This would protect these men against HIV infection during instances of CAS, which were significantly higher among these participants compared with other groups. However, there remains the challenge of less insurance coverage and lower access to a primary care provider. To ameliorate this dilemma, federal, state, and local municipalities might be well served to follow an example illustrated by New York State. In 2014, Governor Andrew Cuomo announced the Pre-Exposure Prophylaxis Assistance Program (PrEP-AP), which facilitates access to PrEP for low-income individuals, including those who do not have health insurance [41].

With regard to identifying men who do not know their HIV status or are unsure, our findings suggest that many of the traditional venues used for HIV prevention and outreach (e.g., gay bars/clubs, social networking websites, mobile apps) would be equally effective given that HIV-unknown men were equally likely as HIV-positive and HIV-negative men to use these venues to meet sex partners. We also found that these men were significantly more likely than others to meet partners via public cruising and bathhouses. This suggests services such as on-site rapid HIV testing in bathhouses might be useful to identify men who do not know their status [42].

### Limitations and Future Directions

The strengths of our study should be understood in light of its limitations. The quantitative survey allowed the research team to gather data across a wide range of variables; however, questions were limited in the interest of brevity and responses were closed-ended. Participants were asked to indicate their sexual behaviors with partners who told them they were the same HIV status as themselves as well as partners who were different or of unknown status. For HIV-negative and HIV-positive men, these questions were likely easy to understand. For men who did not know their status, it may have been more difficult for them to interpret questions regarding partners who told them they were the “same” HIV status. It could be that partners also said they did not know their status. We do not know the extent that HIV-unknown participants believed their own status to be HIV-positive (though undiagnosed) or HIV-negative (but not entirely sure) and thus made assumptions about seroconcordance and serodiscordance. Given that 83 % of HIV-unknown men expressed interest in PrEP, it is likely that most of these men believed themselves to be HIV-negative. Qualitative data might be useful in future studies to help determine how HIV-unknown men perceive their status and thus how they navigate seroadaptive behaviors such as serosorting [11–17] and strategic positioning [14–16, 18]. Further, instead of asking participants about partners who “told you they were the same HIV status as you,” perhaps more direct measurement such as “partners who told you they were HIV-negative,” “HIV-positive,” “partners who told you they did not know their status” and “partners who did not tell you their HIV status” would have been more clear for participants to understand. That being said, researchers will still face the challenge of determining how to code for seroconcordance and serodiscordance when the participant is himself HIV-unknown.

Because our data were cross-sectional, we cannot determine the extent to which men’s sexual behavior was

driving their beliefs about their HIV status (i.e., men who had previously engaged in risky sex would be more apt to say they are unsure of their HIV status as a result) or vice versa (i.e., a participant does not know his status, and thus does not know which behaviors he can engage in—such as serosorting and strategic positioning—that would reduce HIV infection/transmission potential).

Although online surveys can enhance anonymity, responses were self-reported. Findings were based on an online sample of men recruited from a single sexual-networking website, thus limiting generalizability. Although our sample was more racially and ethnically diverse than previous studies having used similar procedures on other MSM sexual-networking websites [43–46], it could have been more racially and ethnically diverse. In total, 57.5 % of those starting our survey completed it, which was on par with many online studies of MSM [43, 44, 46–49]; however, a large number of individuals clicked our banner ad, taking them to the landing page for our survey, and closed the browser window before beginning the survey. We do not have data on these individuals and cannot attest to the number of accidental clicks versus individuals who were genuinely not interested in being a participant. Although there was no incentive to participate in this online study, our survey’s aim was to recruit/screen for larger incentivized research studies, and this might have motivated individuals to complete the survey more than once. We believe, however, that serial responses were rare. In order to be paid for a larger study, one would have to present for a face-to-face assessment in which their eligibility would be verified and their contact information would be recorded. Although a tech savvy individual can reset his IP address [50–53], we recorded no duplicate IP addresses. Because participants were recruited via a sexual networking website, they do not represent all gay and bisexual men. Our sample may be skewed toward more sexually active and sexually risky individuals, which might contribute to a greater number of men who do not know their HIV status. Further, among men in relationships, a high percentage said they did not know their partner’s HIV status (39.6 % of HIV-unknown men, 12.4 % of HIV-positive, and 10.0 % of HIV-negative). This, too, may be a factor of where participants were recruited and mutually monogamous men may not be well represented in this study.

Our findings suggest that HIV-unknown men may warrant analyses as a separate group from HIV-negative and HIV-positive men; however, this is not to suggest that HIV-unknown men are by any means a monolithic group. There are likely a number of reasons why individuals would identify themselves as HIV-unknown, and these reasons are likely associated with their own differences in demographic and behavioral factors. People may identify as unknown as a result of a variety of behavioral (e.g.,



higher levels of or more recent risk behavior, less frequent or recent testing) and psychological (e.g., less confidence in the stability of one's HIV-negative status, higher perceptions of risk for HIV) factors. These varying reasons underlying one's perceived HIV-unknown status might be associated with different demographic or behavioral profiles.

## Conclusion

In this online study of GBM, more than a quarter of HIV-negative and HIV-unknown men had not been tested for HIV in the past year, and nearly one-half had not been tested in the last 6 months. Men who said they did not know their HIV status significantly differed from HIV-negative and HIV-positive men in multiple and meaningful ways, including sexual behavior and HIV status disclosure patterns. The magnitude of these differences suggests researchers may be well advised to analyze men who are HIV-unknown distinctly from HIV-negative and HIV-positive men whenever their sample size permits. Given that men who were HIV-unknown were more likely than HIV-negative men to be willing to take PrEP, this may effectively serve as a bridge to engaging these men in regular HIV-testing and sexual health care; however, it would be necessary to overcome structural barriers regarding access to health insurance and a primary care provider—both of which were significantly lower among HIV-unknown men. Local, state, and governmental programs that facilitate access to PrEP for low income and uninsured individuals may be an effective means by which to engage HIV-unknown men as well as prevent onward HIV transmission.

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## Compliance with Ethical Standards

**Conflicts of interest** The authors declare that they have no conflict of interest.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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

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