

App-Based Sexual Partner Seeking and Sexually Transmitted Infection Outcomes: A Cross-Sectional Study of HIV-Negative Men Who Have Sex With Men Attending a Sexually Transmitted Infection Clinic in Los Angeles, California

Michelle A. DeVost, MPH,* Matthew R. Beymer, PhD,*† Robert E. Weiss, PhD,‡
Chelsea L. Shover, BA,*§ and Robert K. Bolan, MD*

Background: Gay, bisexual, and other men who have sex with men (MSM) face higher rates of sexually transmitted infections (STIs) compared with the general population. The association between venues where sexual partners are met and STI transmission is dynamic and poorly understood, especially among those who use geosocial networking (GSN) apps. This study aimed to determine whether there is a difference in STI incidence between MSM who met their last sexual partner through a GSN app and MSM who met their last partner via other venues.

Methods: Data were analyzed from HIV-negative MSM attending the Los Angeles LBGT Center between August 2015 and July 2016 (n = 9499). Logistic regression models were used to investigate the relationship between STI incidence and whether or not an individual met his last partner through a GSN app.

Results: No relationship was detected between STI incidence and whether one's last sexual partner was met via GSN app. However, an association was detected between STI incidence and having used GSN apps to meet sexual partners in the past 3 months. A dose-response relationship was observed between the number of venues used to meet partners and testing positive for any STI (adjusted odds ratio, 1.08; 95% confidence interval, 1.02–1.14).

Conclusions: The relationship between how people meet sexual partners and STI acquisition is much more nuanced than previously thought. Geosocial networking apps do not inherently expose users to high-risk reservoirs of STIs, but further understanding of the complexity of sexual networks and networking methods is warranted, given increasing rates of STIs.

Gay, bisexual, and other men who have sex with men (MSM) are disproportionately burdened with gonorrhea, chlamydia, syphilis, and HIV when compared to the general population in the United States. Despite composing approximately 2% of the US population,^{1,2} MSM make up more than 27% of all cases of gonorrhea³ and 10% to 20% of chlamydia infections nationwide.⁴ Each of these sexually transmitted infections (STIs) increases an individual's susceptibility to HIV, which also continues to disproportionately impact MSM.⁵

Previous studies have examined the prevalence of geosocial networking (GSN) app use among MSM and the associations between GSN app use and indicators of high-risk sexual behavior. It is estimated that as many as half of all MSM in the United States have used a GSN app to meet sexual partners, and this proportion is even higher among MSM younger than 35 years.^{6,7} Frequency and duration of app use, number of sexual partners, STI history, and sexualized profile photographs have all been associated with sexual risk behaviors among MSM who use GSN apps.^{7–10} In addition, meeting sexual partners through multiple venues, for example, both online and in person, is associated with increased behavioral risk taking.¹¹ Self-reported sexual risk behaviors, however, may not be accurate predictors for actual STI outcomes.¹² It is also important to note that such broad venue categories as “online” or “in person” each includes a diverse array of specific sites.

Despite increasing public health interest in the effects of GSN apps on STI rates, most research to date has relied on self-reported sexual behaviors as a surrogate for the risk of current STIs. To our knowledge, only one previous study has examined the association between GSN app use and medical STI testing outcomes. In 2014, Beymer et al.¹³ analyzed data from 7184 HIV-negative MSM who sought STI testing or treatment at the Los Angeles Gay & Lesbian Center (now the Los Angeles LGBT Center). The study found that the odds of testing positive for either gonorrhea or chlamydia were higher among those who used GSN apps in the past 3 months—alone or in combination with other venues—compared with those who did not use apps to facilitate sexual encounters. This early study had several limitations. It controlled for demographics and substance use, but it did not control for an individual's number of sexual partners. This limitation is key because GSN app use may be correlated with number of partners, so meeting sexual partners through GSN apps may not be fundamentally any riskier than through any other venue. In addition, the 2014 study investigated the impact of how sexual partners were met in the last 3 months, but there were no data available at the time about how one's most recent partner was met. Geosocial networking app use in the last 3 months by itself may be a poor proxy for whether sex with app-met partners is associated with

From the *Department of Health and Mental Health Services, Los Angeles LGBT Center; and †David Geffen School of Medicine and Departments of ‡Biostatistics and §Epidemiology, Jonathan and Karin Fielding School of Public Health, UCLA, Los Angeles, CA

Conflict of Interest and Sources of Funding: M.R.B. was supported by the UCLA Postdoctoral Fellowship Training Program in Global HIV Prevention Research (Carrier and Gorbach, principal investigators; T32MH080634). R.E.W. was supported by the Center for HIV Identification, Prevention, and Treatment through National Institute of Mental Health Grant P30MH058107 and the UCLA Center for AIDS Research through Grant 5P30AI028697, Core H.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text, and links to the digital files are provided in the HTML text of this article on the journal's Web site (<http://www.stdjournal.com>).

Correspondence: Michelle A. DeVost, MPH, Los Angeles LGBT Center, 1625 N. Schrader Blvd, Los Angeles, CA 90028-6213.
E-mail: sdevost@lalgbtcenter.org.

Received for publication August 4, 2017, and accepted November 21, 2017.
DOI: 10.1097/OLQ.0000000000000770

Copyright © 2017 American Sexually Transmitted Diseases Association
All rights reserved.

higher risk than sex with partners met through other means. Because people met sexual partners through multiple venues in a 3-month window, it remained unclear which venues were actually linked to STI transmission.

In their 2012 study on condom use by partner type among young MSM who use the GSN app Grindr, Rice et al.¹⁰ analyzed data from participants' most recent sexual encounter. This study was conducted at a time when GSN app users were early adopters of the technology, a population that may differ from average users today. Although Rice et al. did not investigate the relationship between meeting one's last partner through a GSN app and testing positive for STIs, using data from the most recent sexual partner allowed for an event-level investigation of the impact of GSN app use, minimizing the mixing of effects that contribute to risk outcomes.

This study has 4 objectives. First, we will perform a replication analysis to determine if the results of the 2014 study by Beymer et al.¹³—that meeting sexual partners through GSN apps in the past 3 months is associated with STI acquisition—are observed in the current sample. Second, we will determine whether an association exists between meeting one's most recent sexual partner through a GSN app and STI test outcomes. Because many clients get tested more than once per year, the third objective is to identify potential trends in episodic risk that may exist between how an individual met his most recent sexual partner (via GSN app vs. through another venue) and his STI outcomes using repeated-measurements data. Fourth, we will examine the number of sites where sexual partners are met as an alternative explanation for any findings of this study in the context of the existing literature.

MATERIALS AND METHODS

The Los Angeles LGBT Center (the Center) is a community-based organization that primarily serves lesbian, gay, bisexual, and transgender (LGBT) individuals at multiple sites throughout the Los Angeles metropolitan area. Its 2 STI testing clinics serve more than 16,000 unique clients each year. When a client visits the Center for STI testing, demographic data such as age, race/ethnicity, and educational background are collected during the registration process. Each client then meets face-to-face with an STI testing counselor to complete a sexual health risk assessment that includes questions about the client's STI history, history of substance use, knowledge and utilization of post-exposure prophylaxis (PEP) and pre-exposure prophylaxis (PrEP), and most recent sexual encounter.

A laboratory technician performs a throat swab and collects a sample of the client's blood. Each client is also instructed to self-collect a urine sample and a rectal swab. The urine and rectal specimens are tested for both *Chlamydia trachomatis* (chlamydia) and *Neisseria gonorrhoeae* (gonorrhea), and the throat specimen is tested for gonorrhea only (Aptima Combo 2 Assay; Hologic, Inc, Bedford, MA). A rapid plasma reagent assay is performed to test for syphilis (ASI Rapid Plasma Reagent Carbon Antigen Test; Arlington Scientific, Inc, Springville, UT). An on-site rapid HIV antibody screening test (INTSI HIV-1/HIV-2 Rapid Antibody Test; BioLytical Laboratories, Inc, Richmond, VA) performed on the blood sample. If the rapid result is negative, a remnant sample is sent for an HIV nucleic acid amplification test at an offsite laboratory (Aptima HIV-1 RNA Qualitative Assay; Hologic, Inc). If the rapid HIV antibody test result is positive, a second antibody test (UniGold Recombigen HIV-1/2 or OraQuick ADVANCE Rapid HIV-1/2 Antibody Test) is performed. If the second rapid test result is negative, then a confirmatory nucleic acid amplification test is ordered, and if both rapid test results are positive, the individual is immediately linked to HIV medical care.

Clients were included in the study if they (1) were classified as cisgender MSM; (2) received testing for gonorrhea, chlamydia,

syphilis, and/or HIV between August 2015 and July 2016; (3) reported that their most recent sexual partner was male; (4) reported how they met their most recent sexual partner; and (5) reported venues where sexual partners were met over the past 3 months. For the purposes of this study, clients were defined as MSM if they reported that their birth sex and gender identity are both male, and they either self-identified as gay/bisexual or disclosed that their most recent sexual partner was male. Clients were excluded from analysis if they self-reported their serostatus as HIV positive, because research has documented behavioral changes in sexual risk taking among MSM who have been diagnosed with HIV.^{14,15} The sample includes 9499 unique individuals who met these criteria during the study period.

The 5 outcomes measured in these analyses are testing positive for gonorrhea, testing positive for chlamydia, receiving a new diagnosis of syphilis, receiving a new HIV diagnosis, and testing positive for any 1 or more of these 4 STIs. These outcomes were recorded as binary variables. All infection variables were coded as positive if an individual tested positive at any anatomic site. To replicate the results of the 2014 study by Beymer et al., the first predictor we investigated was whether individuals used GSN apps to meet sexual partners in the past 3 months, either alone or in combination with other venues. This information was collected by a question in the sexual health risk assessment that asked "Where did you meet your sexual partner(s) in the last 3 months? (Check all that apply)," followed by a list of 20 specific sites and a write-in field for "other." The second predictor was whether individuals used a GSN app to meet their most recent sexual partner, determined by asking each client if his last partner was "found through phone apps (Grindr, Scruff, etc)." The 3-month and last-partner models were each fit separately, adjusting for age group, race/ethnicity, education, substance use in the past year, and number of sexual partners in the past 3 months.

Where we use the word "venues," we refer to the broad categories of sexual partner meeting places: in-person, online, or GSN apps. To describe the specific meeting places within each venue type, we use the word "sites." To investigate the effect of the number of sites where sexual partners are met on STI outcome, we defined the number of sites as any combination of 20 specific sites where people met their sexual partners. These included 8 in-person sites (bar/club, party/mixer, through a friend, school, work, gym, street, and bathhouse/sex club), 6 social networking or dating websites (Facebook, Manhunt, Adam4Adam, Craigslist, Match, and OkCupid), 6 GSN apps (Grindr, Scruff, Jack'd, Growlr, Tinder, and Badoo), and a write-in field for additional responses. Write-in responses were analyzed and included in each individual's total number of sites used. These specific site data were only available for how individuals met sexual partners within the past 3 months.

Statistical Methods

Logistic regression models were used to model STI positivity as a function of each of the 2 sexual networking criteria under investigation: first, whether an individual has used GSN apps to meet sexual partners in the last 3 months, and second, whether he met his last sexual partner through a GSN app. These models controlled for age group (18–24, 25–29, 30–39, and 40 years or older), race/ethnicity (black or African American, Hispanic or Latino, Asian or Pacific Islander, white, and other), highest educational level (high school graduate or below, some college, college degree or beyond), substance use (meth, ecstasy, and nitrates) in the past year, and number of sexual partners in the last 3 months. These covariates were chosen because each has been shown to be associated with STI/HIV incidence.^{16–19} For any clients who had multiple STI screening

visits during the study period, only data from their first visit were used in the development of these models.

Repeated-measurements analyses were performed using generalized linear mixed models, also adjusting for age, race/ethnicity, education, substance use, and number of sexual partners in the past 3 months. These models were developed using data from all STI testing visits for individuals included in this study—regardless of whether they tested only once ($n = 7918$) or multiple times ($n = 1581$) during the study period—so long as they answered the risk assessment questions about their use of GSN apps and their last sexual partner at each visit. Logistic regression models were then used to investigate the role of the number of sites where sexual partners were met on STI outcomes, again using age, race/ethnicity, education, substance use, and number of sexual partners in the past 3 months as covariates in each model.

We hypothesized that, compared with those who have had multiple recent sexual partners, individuals who report having just 1 sexual partner in the past 3 months may have STI outcomes more closely associated with the site where their partner was met. Thus, to further investigate the role of sexual partner meeting venues in STI acquisition, we also performed logistic regression analyses using the subset of individuals in the sample who report having only a single sexual partner in the past 3 months. Aside from the replication analyses (because the original study had not controlled for number of partners) and the analysis performed on those who reported only 1 partner in the past 3 months, all multivariable analyses performed for this study controlled for number of sexual partners in the past 3 months.

All analyses were performed using SAS software, version 9.4 (SAS Institute, Cary, NC).

Ethics

The study received approval from the University of California, Los Angeles South General Institutional Review Board (institutional review board number: 00004474; project number: 17-000231).

RESULTS

The mean (SD) age of the individuals in the sample was 33 (9.8) years (median, 31 years; interquartile range, 26–38 years). Non-Hispanic white and Hispanic individuals compose the 2 largest racial/ethnic groups in the sample at 44% and 32%, respectively (Table 1). Fifty-eight percent of the sample had earned a college degree, 17% reported that they had completed some college, 8% had completed high school/GED or less, and 17% did not report their highest level of educational attainment.

When asked about the venues through which they have met sexual partners in the past 3 months, 41% reported that they exclusively met sexual partners in person during that period, 5% reported meeting sexual partners either online only or both online and in person, and 47% reported that they met sexual partners through GSN apps either alone or in combination with online and in-person venues. When asked about their most recent sexual experience, 15% of the sample reported having met their last sexual partner through a GSN app, 2% met their last sexual partner online, and 83% reported that they met their last sexual partner in person.

Sexual Partners in the Last 3 Months—Baseline Analyses

Twenty-seven percent of those who reported using GSN apps to meet sexual partners in the past 3 months tested positive for any STI at their initial visit, whereas only 23% of those who did not use apps to meet sexual partners within the past 3 months had any positive STI outcomes at baseline ($P < 0.0001$). App users

TABLE 1. Demographics of the Sample of Clients Seeking STI Testing at the Los Angeles LGBT Center, August 2015 to July 2016 ($n = 9499$)

	n	%
Age group, y		
18–24	1856	20
25–29	2638	28
30–39	3012	32
40+	1993	21
Race/ethnicity		
Black or African American	673	7
Hispanic or Latino	3036	32
Asian or Pacific Islander	841	9
White	4208	44
Other	578	6
Unknown	163	2
Education level		
High school graduate or below	746	8
Some college	1621	17
College degree or beyond	5522	58
Unknown	1610	17
No. sexual partners in the past 3 mo Mean (SD)/median (IQR)	4.87 (7.53)	3 (2–5)
Ecstasy use		
Yes	1086	11
No	8401	88
Declined	12	0
Meth use		
Yes	434	5
No	9052	95
Declined	13	0
Nitrite use		
Yes	1556	16
No	7931	83
Declined	12	0
Past 3 mo		
Met partners in person only	3910	41
Met partners online only	307	3
Met partners through apps only	2141	23
Met partners in person and online only	137	1
Met partners in person and through apps only	1931	20
Met partners online and through apps only	206	2
Met partners in person, online, and through apps	154	2
Other	713	8
Last partner		
Met in person	7894	83
Met online	177	2
Met through an app	1428	15
Total	9499	100

were more likely to have tested positive for gonorrhea ($P = 0.0007$), chlamydia ($P = 0.001$), and a new diagnosis of syphilis ($P = 0.03$) compared with non-app users, but they were no more likely to have a positive HIV test result.

Controlling just for demographic and substance use variables, logistic regression models suggest that there is an association between app use in the past 3 months and increased odds of STIs, as seen in the study by Beymer et al.¹³ When also controlling for the number of sexual partners in the past 3 months, however, this association is only seen for gonorrhea (Table 2). (Table 1, Supplementary Material, <http://links.lww.com/OLQ/A224>).

Most Recent Sexual Partner—Baseline Analyses

Individuals who reported that they met their most recent sexual partner through a GSN app had the same overall rate of

STI positivity as individuals who reported meeting their most recent partner through other means (26% among those who met their last partner through a GSN app and 25% among those who did not; $P = 0.25$). The positivity rates of gonorrhea (14%; $P = 0.73$), chlamydia (14% among those who met their last partner through a GSN app and 12% among those who did not; $P = 0.23$), new syphilis diagnosis (1%; $P = 0.53$), and new HIV diagnosis (1%; $P = 0.58$) were also not significantly different between the 2 groups. Logistic regression models showed no difference in the odds of testing positive for gonorrhea, chlamydia, syphilis, HIV, or any STI overall between individuals who met their last sexual partner through a GSN app and those who did not when controlling for all demographic variables, substance use, and number of sexual partners in the past 3 months (Table 2) (Table 1, Supplementary Material, <http://links.lww.com/OLQ/A224>).

Repeated-Measures Analyses

Of the 9499 unique individuals in the sample, 1581 (17%) returned to the Center for multiple testing visits during the 12 months of the study period. The mean (SD) number of visits per client during the study period was 1.2 (0.4). Among these repeat-visit clients, 90% had 2 testing visits, 9% had 3 testing visits, and the remaining 1% had either 4 or 5 testing visits during the 12 months of observation.

Generalized linear mixed modeling across 11,265 total visits for all individuals in this study showed that whether an

individual had met sexual partners via GSN apps in the past 3 months is only associated with testing positive for gonorrhea, yet whether an individual met their most recent sexual partner through a GSN app did not influence their odds of testing positive for any STI when controlling for demographics, substance use, and number of sexual partners in the past 3 months (adjusted odds ratio [aOR], 1.08; 95% confidence interval [CI], 0.94–1.23; Table 3). Despite confirming that there were no substantive differences between single-visit testers and multivisit testers in terms of the outcome and primary predictor variables, we also performed repeated-measures analyses that included only multivisit testers, and these model results were consistent with those observed when including all individuals. All repeated-measures analyses also controlled for number of testing visits. Because individuals who take PrEP may differ from those who do not in terms of sexual partner seeking and STI risk, follow-up analyses were performed on the subset of individuals in our sample who have had a PrEP intake visit and at least one PrEP follow-up visit. The generalized linear mixed model results for this subset of the sample were uniformly consistent with those among the full sample.

All analyses that included where an individual met their most recent sexual partner as a predictor were repeated while controlling for last-partner relationship type (main partner vs. other), and model results were consistent with those initially observed. That is, no association was detected between meeting one's most recent sexual partner through a GSN app and testing positive for STI when adjusting for last-partner relationship type.

TABLE 2. Unadjusted and Adjusted Odds Ratios and 95% CIs of Testing Positive for Any STI (Initial Visits Only), August 2015 to July 2016 (n = 9499)

	Any STI		
	Unadjusted OR (95% CI)	3-mo AOR (95% CI)	Last-Partner AOR (95% CI)
Past 3 mo			
Met partners via GSN apps	1.28 (1.16–1.40)	1.19 (1.07–1.33)	—
Did not meet partners via GSN apps	1.00	1.00	—
Last partner			
Met via GSN app	1.08 (0.95–1.23)	—	1.09 (0.95–1.26)
Did not meet via GSN app	1.00	—	1.00
Age group, y			
18–24	2.10 (1.80–2.44)	1.98 (1.65–2.38)	2.02 (1.69–2.42)
25–29	1.90 (1.65–2.20)	1.76 (1.50–2.08)	1.78 (1.51–2.10)
30–39	1.49 (1.29–1.72)	1.46 (1.24–1.71)	1.48 (1.26–1.73)
40+	1.00	1.00	1.00
Race/ethnicity			
Black or African American	1.69 (1.42–2.02)	1.71 (1.40–2.08)	1.69 (1.39–2.06)
Hispanic	1.30 (1.17–1.45)	1.22 (1.08–1.38)	1.21 (1.06–1.37)
Other	1.09 (0.94–1.25)	0.98 (0.84–1.15)	0.98 (0.84–1.15)
White	1.00	1.00	1.00
Education level			
High school graduate or below	1.00	1.00	1.00
Some college	1.03 (0.85–1.25)	1.03 (0.85–1.26)	1.03 (0.85–1.25)
College degree or beyond	0.73 (0.61–0.86)	0.84 (0.70–1.01)	0.84 (0.71–1.01)
Ecstasy use			
No	1.00	1.00	1.00
Yes	1.46 (1.27–1.68)	1.24 (1.05–1.47)	1.24 (1.05–1.46)
Meth use			
No	1.00	1.00	1.00
Yes	1.82 (1.49–2.22)	1.36 (1.07–1.74)	1.38 (1.08–1.76)
Nitrite use			
No	1.00	1.00	1.00
Yes	1.39 (1.23–1.56)	1.16 (1.00–1.34)	1.18 (1.02–1.36)
No. partners (past 3 mo)	1.02 (1.01–1.02)	1.02 (1.01–1.02)	1.02 (1.01–1.03)

Bold text indicates statistical significance.

OR indicates odds ratio.

TABLE 3. Generalized Linear Mixed Modeling Outcomes: ORs and 95% CIs of Testing Positive for Gonorrhea, Chlamydia, Syphilis, or HIV by GSN App Use (Including Repeated Visits), August 2015 to July 2016 (n = 9499, Number of Visits = 11,265)

	Met Partners Via GSN App in the Last 3 mo (Reference = No)		Met Most Recent Partner Via GSN App (Reference = No)	
Gonorrhea	1.23 (1.09–1.39)	P = 0.0008	1.00 (0.85–1.18)	P = 0.98
Chlamydia	1.14 (1.00–1.29)	P = 0.06	1.08 (0.90–1.28)	P = 0.41
Syphilis	0.74 (0.50–1.10)	P = 0.14	0.97 (0.56–1.69)	P = 0.92
HIV	1.06 (0.68–1.64)	P = 0.81	1.44 (0.82–2.54)	P = 0.20
Any STI	1.24 (1.12–1.37)	P < 0.0001	1.08 (0.94–1.23)	P = 0.27

Bold text indicates statistical significance.

OR indicates odds ratio.

Sites Used for Meeting Sexual Partners

Of 21 possible sites (including 20 specific in-person, on-line, and app-based sites and up to 1 additional write-in site) where sexual partners were met in the past 3 months, the maximum number of sites reported by any individual was 11. Again controlling for age, race/ethnicity, education, substance use, and number of sexual partners in the past 3 months, for each additional site in the total number of sites where sexual partners were met in the past 3 months, there is an 8% increase in the odds of testing positive for any STI overall (aOR, 1.08; 95% CI, 1.02–1.14). In particular, the odds of testing positive for gonorrhea increase by 9% with each additional site used to meet sexual partners (aOR, 1.09; 95% CI, 1.01, 1.17), although no association was detected for chlamydia, syphilis, or HIV individually, all else equal.

We also investigated site-specific STI positivity among all sites where people met sexual partners in the past 3 months and observed substantial variability in STI incidence across all 20 sites. The number of sites where sexual partners were met in the past 3 months and the number of sexual partners in the past 3 months are positively correlated ($P < 0.0001$). Because individuals who report having just 1 sexual partner in the past 3 months may have STI outcomes more closely associated with the site where their partner was met, we performed logistic regression analyses of the subset of individuals with a single sexual partner in the past 3 months (n = 1825). The results of these analyses also showed that whether that partner was met through a GSN app was not significantly associated with STI outcomes.

DISCUSSION

The logistic regression and generalized linear mixed model results of this study consistently show a lack of association between use of GSN apps to meet one's last sexual partner and STI positivity. The findings of this study also replicate those of Beymer et al.¹³ in 2014 in that there does seem to be an association between app use in the past 3 months and testing positive for gonorrhea and chlamydia. However, controlling for the number of sexual partners in the past 3 months eliminates any observed relationship between app use and chlamydia. Lastly, we found that the number of sites where sexual partners were met was significantly related to STI incidence, showing that the relationship between GSN apps and STI acquisition is more nuanced than previously thought.

Geosocial networking apps have marked a new era of increased efficiency in meeting sexual partners, but that efficiency does not specially imbue the apps with increased levels of risk. Just as previous studies have found that an individual's number of sexual partners is associated with STI risk,²⁰ so is the number of sites used to meet sexual partners. The number of app, online, and in-person sites an individual uses to meet sexual partners is a greater determinant of STI risk than the particular sites. The

dose-response relationship observed between number of sites used to meet sexual partners and STI incidence hints at the complexity of the shifting landscape of sexual risk.

This study has several limitations. The study may not be generalizable to all MSM in Los Angeles County in that it does not include those who never undergo STI screening and those who do but not at the Center. There are many reasons why an individual would choose not to test at the Los Angeles LGBT Center, including geographical limitations—Los Angeles is so large that despite the Center's central location in the city, it is far away for many—and discomfort with the idea of seeking services at an LGBT-focused organization.

Risk assessments were conducted in face-to-face interviews with sexual health counselors, so there may be a higher likelihood for social desirability bias in the self-reported data. The Center, however, prioritizes the cultural competence of its staff, and the counselors are experienced in addressing the needs of each client holistically, so this bias is likely minimal.

It is possible that some sexual partner meeting sites have been misclassified. When clients were asked about the characteristics of their most recent sexual partner, they were asked whether their last partner was “found through phone apps (Grindr, Scruff, etc).” The authors propose that future risk assessments follow up by asking, “If yes, what app did you use?” By distinguishing between which apps are being used at the last sexual encounter, we will be better able to appropriately identify distinct networks of sexual risk. Although we do not have the data to investigate these sexual networks, they are key to understanding the nuance and complexity of the relationship between STI risk and the array of venues where MSM meet sexual partners. In addition, there is substantial variability between specific sites within each of the 3 venues (in person, online, and GSN app). Each venue includes sites that may be associated with differing rates of partner seeking; for example, people may use bars/clubs to meet sexual partners more than gyms.

Study strengths included a large sample size, a diverse sample by age, race/ethnicity, and the use of actual STI test results rather than self-reported STI histories. The most important implication of this study is that meeting sexual partners through GSN apps alone is not an appropriate proxy for sexual risk, although the number of sites where sexual partners are met may be. Geosocial networking apps are part of a shifting landscape of MSM community connection and sexual partner seeking, and they demonstrate the need for MSM-focused sexual health interventions and education to continue to evolve just as quickly. Apps themselves do not increase the risk of STI acquisition, but they are part of a constellation of tools and behaviors through which people may put themselves and their partners at increased risk and which mark a need for STI prevention. Because meeting sexual partners through GSN apps is already highly stigmatized by popular press and public health messaging, it is particularly

important that health researchers and practitioners keep this complexity in mind and push back against that narrative. We must take care not to further stigmatize the constituent elements of navigating sex within an already-stigmatized community.

REFERENCES

1. Grey JA, Bernstein KT, Sullivan PS, et al. Estimating the population sizes of men who have sex with men in US states and counties using data from the American Community Survey. *JMIR Public Health Surveill* 2016; 2:e14.
2. Purcell DW, Johnson CH, Lansky A, et al. Estimating the population size of men who have sex with men in the United States to obtain HIV and syphilis rates. *Open AIDS J* 2012; 6:98–107.
3. Centers for Disease Control and Prevention. 2016 Sexually Transmitted Diseases Surveillance—Gonorrhea [updated September 26, 2017]. Available at: <https://www.cdc.gov/std/stats16/gonorrhea.htm>. Accessed October 2017.
4. Centers for Disease Control and Prevention. 2016 Sexually Transmitted Diseases Surveillance—Chlamydia [updated September 26, 2017]. Available at: <https://www.cdc.gov/std/stats16/chlamydia.htm>. Accessed October 2017.
5. Fleming DT, Wasserheit JN. From epidemiological synergy to public health policy and practice: The contribution of other sexually transmitted diseases to sexual transmission of HIV infection. *Sex Transm Infect* 1999; 75:3–17.
6. Phillips G 2nd, Magnus M, Kuo I, et al. Use of geosocial networking (GSN) mobile phone applications to find men for sex by men who have sex with men (MSM) in Washington, DC. *AIDS Behav* 2014; 18:1630–1637.
7. Lehmilller JJ, Ioerger M. Social networking smartphone applications and sexual health outcomes among men who have sex with men. *PLoS One* 2014; 9:e86603.
8. Lorimer K, Flowers P, Davis M, et al. Young men who have sex with men's use of social and sexual media and sex-risk associations: Cross-sectional, online survey across four countries. *Sex Transm Infect* 2016; 92:371–376.
9. Winetrobe H, Rice E, Bauermeister J, et al. Associations of unprotected anal intercourse with Grindr-met partners among Grindr-using young men who have sex with men in Los Angeles. *AIDS Care* 2014; 26:1303–1308.
10. Rice E, Holloway I, Winetrobe H, et al. Sex risk among young men who have sex with men who use Grindr, a Smartphone geosocial networking application. *J AIDS Clin Res* 2012; (Suppl 4).
11. Hull P, Mao L, Prestage G, et al. The use of mobile phone apps by Australian gay and bisexual men to meet sex partners: An analysis of sex-seeking repertoires and risks for HIV and STIs using behavioural surveillance data. *Sex Transm Infect* 2016; 92:502–507.
12. Al-Tayyib AA, McFarlane M, Kachur R, et al. Finding sex partners on the Internet: What is the risk for sexually transmitted infections? *Sex Transm Infect* 2009; 85:216–220.
13. Beymer MR, Weiss RE, Bolan RK, et al. Sex on demand: Geosocial networking phone apps and risk of sexually transmitted infections among a cross-sectional sample of men who have sex with men in Los Angeles County. *Sex Transm Infect* 2014; 90:567–572.
14. Gorbach PM, Drumright LN, Daar ES, et al. Transmission behaviors of recently HIV-infected men who have sex with men. *J Acquir Immune Defic Syndr* 2006; 42:80–85.
15. Vallabhaneni S, McConnell JJ, Loeb L, et al. Changes in seroadaptive practices from before to after diagnosis of recent HIV infection among men who have sex with men. *PLoS One* 2013; 8:e55397.
16. Buchacz K, McFarland W, Kellogg T, et al. Amphetamine use is associated with increased HIV incidence among men who have sex with men in San Francisco. *AIDS* 2005; 19:1423–1424.
17. Buchbinder SP, Vittinghoff E, Heagerty PJ, et al. Sexual risk, nitrite inhalant use, and lack of circumcision associated with HIV seroconversion in men who have sex with men in the United States. *J Acquir Immune Defic Syndr* 2005; 39:82–9.
18. Plankey MW, Ostrow DG, Stall R, et al. The relationship between methamphetamine and popper use and risk of HIV seroconversion in the multicenter AIDS cohort study. *J Acquir Immune Defic Syndr* 2007; 45:85–92.
19. Centers for Disease Control and Prevention. HIV Surveillance Report - Diagnoses of HIV Infection in the United States and Dependent Areas, 2015. Areas, 2015. Vol. 27. Atlanta, GA: CDC; 2016.
20. Rosenberg ES, Sullivan PS, DiNenno EA, et al. Number of casual male sexual partners and associated factors among men who have sex with men: Results from the National HIV Behavioral Surveillance system. *BMC Public Health* 2011; 11:189–197.