

UCLA

UCLA Previously Published Works

Title

Brief Report

Permalink

<https://escholarship.org/uc/item/1692m83c>

Journal

J AIDS Journal of Acquired Immune Deficiency Syndromes, 74(1)

ISSN

1525-4135

Authors

Holloway, Ian W
Dougherty, Ryan
Gildner, Jennifer
[et al.](#)

Publication Date

2017

DOI

10.1097/qai.0000000000001164

Peer reviewed

PrEP Uptake, Adherence, and Discontinuation Among California YMSM Using Geosocial Networking Applications

Ian W. Holloway, MSW, MPH, PhD,* Ryan Dougherty, BS,* Jennifer Gildner, MS,*
Sean C. Beougher, MA,* Craig Pulsipher, MSW, MPP,† Jorge A. Montoya, PhD,‡
Aaron Plant, MPH,‡ and Arleen Leibowitz, PhD*

Abstract: We investigated pre-exposure prophylaxis (PrEP) uptake, adherence, and discontinuation among young app-using men who have sex with men in California (N = 761). Approximately, 9.7% of participants had ever used PrEP; 87% of those deemed good candidates for screening (indicated by a Centers for Disease Control and Prevention risk index score ≥ 10) were not current or past users. PrEP use was associated with higher income [adjusted odds ratio (aOR): 4.13; confidence interval (CI): 1.87 to 9.12], receptive condomless anal sex (aOR: 3.41; CI: 1.71 to 6.78), HIV-positive sex partners (aOR: 2.87; CI: 1.53 to 5.38), popper use (aOR: 3.47; CI: 1.96 to 6.13), and recent sexually transmitted infection diagnosis (aOR: 2.90; CI: 1.64 to 5.13). Some users (41.5%) wanted help remembering to take PrEP. The top reason for discontinuation was concern about long-term side effects (33.0%). Young men who have sex with men app users are prime candidates for PrEP, despite low uptake. Apps may be useful tools for PrEP information dissemination, adherence monitoring, and support.

Key Words: PrEP, PrEP uptake, PrEP adherence, PrEP discontinuation, young men who have sex with men, geosocial networking applications

(*J Acquir Immune Defic Syndr* 2017;74:15–20)

INTRODUCTION

Across the US, cities, counties, and states are developing plans for “Getting to Zero” new HIV infections.^{1,2} These plans rely on 2 strategies: (1) routinizing HIV testing in high-risk communities, linking to care those who test positive, and suppressing viral load among those who are already

HIV-positive; and (2) avoiding new infections using a variety of prevention approaches, such as pre-exposure prophylaxis (PrEP). Unfortunately, although much is known about increasing and sustaining engagement in HIV care, less is known about uptake of, adherence to, and the factors that support or hinder long-term use of PrEP.³

In California, as elsewhere in the US, HIV incidence is increasing among young men who have sex with men (YMSM), especially YMSM of color.⁴ Recent estimates attribute two-thirds of all new HIV infections to men who have sex with men (MSM),^{4,5} with nearly one-third of those infected aged 20–29 years.⁴ Studies suggest that YMSM who use geosocial networking apps (GSN apps) may be at increased risk for HIV⁶ because of their having higher numbers of sex partners,⁷ more frequent condomless anal sex (CAS),^{8–10} and greater incidence of sexually transmitted infections (STIs)^{7,10,11} compared to those who do not use GSN apps.

Although some research into willingness to engage in PrEP has focused on GSN app users,¹² there are relatively few studies that measure PrEP uptake in this demographic, and research examining PrEP usage has been largely limited to participants in clinical settings.^{13–17} Although PrEP uptake is increasing, overall estimates remain low, with previous studies finding fewer than 5% of sampled MSM having ever taken it.^{18–24} These estimates, however, are mostly based on findings from studies in eastern cities,^{23,25,26} leaving estimates on PrEP uptake among YMSM in California—the state with the largest number of new HIV infections each year²⁷—largely unknown.

Although PrEP is recommended by the Centers for Disease Control and Prevention (CDC) for high-risk MSM,²⁸ past studies document numerous barriers to uptake among YMSM, including cost, availability, and fears of risk compensation (ie, increased risk behavior triggered by decreased perception of risk).^{29–31} Data from clinical trials suggest factors influencing PrEP use and adherence are not well-identified,³² and questions remain about how to motivate uptake of and sustain adherence to PrEP for HIV prevention.³³ This study sought to understand current rates and correlates of PrEP uptake, adherence, and discontinuation among YMSM who use GSN apps.

METHODS

Participants and Procedures

This analysis used data from an online survey conducted from July 9 to August 20, 2015. Participants were

Received for publication May 30, 2016; accepted August 8, 2016.

From the *Department of Social Welfare, Luskin School of Public Affairs, University of California, Los Angeles, CA; †AIDS Project Los Angeles, Los Angeles, CA; and ‡Sentient Research, Los Angeles, CA.

Supported by California HIV/AIDS Research Program (CHRP; Grant RP15-LA-007); the Center for HIV Identification, Prevention, and Treatment (CHIPTS; NIMH Grant MH58107); the UCLA Center for AIDS Research (CFAR; NIAID Grant AI028697); and the National Center for Advancing Translational Sciences through UCLA (CSTI; Grant UL1TR000124). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

The authors have no conflicts of interest to disclose.

Correspondence to: Ian W. Holloway, MSW, MPH, PhD, Department of Social Welfare, Luskin School of Public Affairs, University of California, 3250 Public Affairs Building, Box 951656, Los Angeles, CA 90095-1656 (e-mail: holloway@luskin.ucla.edu).

Copyright © 2016 Wolters Kluwer Health, Inc. All rights reserved.

recruited through several popular GSN apps using pop-up messaging and banner ads targeting users aged 18–29 years in California. YMSM interested in the study completed an eligibility screener confirming they were HIV-negative, a California resident, and between 18 and 29 years; it also confirmed their sex at birth as male and that they had male sex partners within the past 5 years. Completing the survey took approximately 20 minutes. Participants were compensated with \$20 electronic gift cards for their time. All study procedures were approved by the UCLA North Campus Institutional Review Board.

Measures

The survey queried demographic information, including race/ethnicity, age, gender identity, sexual orientation, sexual behavior, current employment, highest level of education, annual income, current insurance coverage, homelessness in the past 12 months, and US citizenship. Questions regarding sexual risk behavior in the past 6 months included number of male sexual partners, number of instances of receptive CAS, and insertive CAS with an HIV-positive partner, number of HIV-positive partners, and ever exchanging sex for money. Other risk factors measured were STI diagnoses in the past year, substance use in the last 6 months, last HIV/STI test, and perceived risk for and concern about contracting HIV.

Using 6 of these risk measures, we calculated the MSM risk index based on the CDC's recommendations.³⁴ This risk index considers age, number of male partners, HIV-positive partners, receptive CAS, insertive CAS with an HIV-positive partner, and methamphetamine use as factors in calculating a risk score (which can range from 0 to 45). Those with scores ≥ 10 on this scale warrant evaluation for intensive HIV prevention services, including PrEP. Participants were also asked if they had ever taken PrEP. Those who had taken PrEP were asked if they were current users and about their experience using PrEP; those who had stopped taking PrEP were asked why.

Data Analysis

Bivariate χ^2 tests were performed comparing demographics and risk behaviors of those who had ever versus those who had never taken PrEP to determine variables of interest for multivariate modeling. In cases where sample size was too small, Fisher exact test was performed. We used the Benjamini and Hochberg procedure, which ranks *P*-values from most to least significant, to control for false discovery at the 0.05 significance level.³⁵ Statistically significant variables at the bivariate level were included in a multivariate logistic regression model of PrEP uptake; stepwise regression was used to arrive at the final model.

RESULTS

We screened 3868 survey respondents, of which 1777 met our inclusion criterion. Our final sample of complete surveys included 761 California MSM aged 18–29 years who were sexually active in the past 5 years and had never been

diagnosed with HIV/AIDS. Less than 10% of participants (9.7%) reported ever taking PrEP, with 71.6% of those who had ever taken PrEP being current users. Mean participant age was 23 years (SD = 3.2) with a smaller percentage of younger participants (age 18–24 years) having ever taken PrEP (48.6%) compared to older participants (age 25–29 years) (63.2%, $P < 0.05$). The sample was racially/ethnically diverse, and there were no statistically significant differences in PrEP uptake by race/ethnicity. Most men were identified as gay (81.9%); among PrEP users, nearly all were gay identified (97.3%). Among those who had ever taken PrEP, 55.4% reported annual salaries \geq \$30,000 compared to those who had never taken PrEP (28.5%). A higher percentage of those who had ever taken PrEP were currently insured (86.5%) compared to those who had never used PrEP (74.1%; $P < 0.05$).

In general, PrEP users engaged in higher levels of HIV-risk behavior than non-PrEP users. A greater percentage of those who had ever used PrEP reported 6 or more sexual partners within the past 6 months (71.6%) compared to those who had never used PrEP (37.0%; $P < 0.001$). Similarly, greater percentages of PrEP users reported recent receptive CAS (82.4%) and insertive CAS with an HIV-positive partner (43.2%) than those who had never taken PrEP (52.4% and 22.0%, respectively; $P < 0.001$). Higher percentages of PrEP users reported using poppers (63.5% vs. 21.5%) and other illicit drugs in the last 6 months (41.9% vs. 16.9%; $P < 0.001$ in both cases) and testing positive for an STI within the past year (55.4% vs. 19.5%; $P < 0.001$) compared to those who had never taken PrEP. A full list of bivariate correlates of PrEP uptake is listed in Table 1.

Multivariate Correlates of PrEP Uptake

After adjusting for other variables in the model, those making \geq \$30,000 had greater odds of being PrEP users compared to those making $<$ \$10,000 per year [adjusted odds ratio (aOR): 4.13, confidence interval (CI): 1.87 to 9.12, $P < 0.001$]. Receptive CAS in the last 6 months was positively associated with PrEP use (aOR: 3.41, CI: 1.71 to 6.78, $P < 0.001$). Those who reported sex with an HIV-positive partner in the last 6 months had greater odds of being PrEP users compared to those without an HIV-positive partner (aOR: 2.87, CI: 1.53 to 5.38, $P = 0.001$). YMSM who used poppers in the last 6 months had greater odds of being a PrEP user compared to those who did not use poppers (aOR: 3.47, CI: 1.96 to 6.13, $P < 0.001$). Finally, an STI diagnosis in the past year was associated with being a PrEP user (aOR: 2.90, CI: 1.64 to 5.13, $P < 0.001$). Table 2 contains multivariate results.

Reasons for PrEP Initiation and PrEP Adherence

For those who had ever taken PrEP ($n = 74$), the top 5 reasons for initiating PrEP were as follows: (1) wanting to worry less about getting HIV (71.6%), (2) having more than 1 sexual partner (66.2%), (3) not always using condoms (52.7%), (4) having sex with people whose HIV status the participant did not know (50.0%), and (5) disliking condoms

TABLE 1. Participant Characteristics Among YMSM in California by PrEP Use (N = 761)

Variable	Total	Ever Used PrEP	Never Used PrEP	χ^2 (P)*
	N (%)	N (%)	N (%)	
Total	761 (100.0)	74 (9.7)	687 (90.3)	
Demographic characteristics				
Age				6.0 (0.02)
18–24	470 (61.8)	36 (48.6)	434 (63.2)	
25–29	291 (38.2)	38 (51.4)	253 (36.8)	
Race/ethnicity				6.1 (0.11)
White	165 (21.7)	23 (31.1)	142 (20.7)	
Black/African American	193 (25.4)	19 (25.7)	174 (25.3)	
Hispanic/Latino	243 (31.9)	16 (21.6)	227 (33.0)	
Other/mixed	160 (21.0)	16 (21.6)	144 (21.0)	
Gender identity				(0.29)
Male	742 (97.5)	73 (98.6)	669 (97.4)	
Other	19 (2.5)	1 (1.4)	18 (2.6)	
Sexual orientation				13.5 (0.001)
Gay	623 (81.9)	72 (97.3)	551 (80.2)	
Bisexual	120 (15.8)	1 (1.4)	119 (17.3)	
Other	18 (2.4)	1 (1.4)	17 (2.5)	
Education				4.3 (0.12)
Less than high school	45 (5.9)	1 (1.4)	44 (6.4)	
Completed high school	155 (20.4)	12 (16.2)	143 (20.8)	
Some college and above	556 (73.1)	60 (81.1)	496 (72.2)	
Employment				4.4 (0.22)
Employed full-time	311 (40.9)	38 (51.4)	273 (39.7)	
Employed part-time	170 (22.3)	13 (17.6)	157 (22.9)	
Full-time student	181 (23.8)	13 (17.6)	168 (24.5)	
Other	99 (13.0)	10 (13.5)	89 (13.0)	
Income				19.5 (<0.001)
<\$9999	186 (24.4)	10 (13.5)	176 (25.6)	
\$10,000–29,999	275 (36.1)	21 (28.4)	254 (37.0)	
>\$30,000	237 (31.1)	41 (55.4)	196 (28.5)	
Current insurance	573 (75.3)	64 (86.5)	509 (74.1)	5.5 (0.02)
Homeless in the last 12 mo	54 (7.1)	7 (9.5)	47 (6.8)	0.7 (0.41)
US citizen	684 (89.9)	68 (91.9)	616 (89.7)	0.1 (0.81)
Sexual risk and protective factors				
6 or more male sex partners in the last 6 mo	307 (40.3)	53 (71.6)	254 (37.0)	
Had receptive anal sex with a man without a condom in the last 6 mo	421 (55.3)	61 (82.4)	360 (52.4)	24.4 (<0.001)
Had an HIV positive male partner in the last 6 mo	99 (13.0)	26 (35.1)	73 (10.6)	35.5 (<0.001)
Had insertive anal sex without a condom with an HIV-positive man in last 6 mo	183 (24.0)	32 (43.2)	151 (22.0)	16.5 (<0.001)
Ever exchanged sex for money, drugs, or place to stay	90 (11.8)	11 (14.9)	79 (11.5)	0.7 (0.39)
Last HIV test				49.8 (<0.001)
<6 mo ago	426 (56.0)	70 (94.6)	356 (51.8)	
6–12 mo ago	144 (18.9)	2 (2.7)	142 (20.7)	
>12 mo ago	97 (12.7)	2 (2.7)	95 (13.8)	
I have never been tested	94 (12.4)		94 (13.7)	
STI diagnosis in the past year	175 (23.0)	41 (55.4)	134 (19.5)	48.6 (<0.001)
Last STI test				46.0 (<0.001)
<6 mo ago	397 (52.2)	66 (89.2)	331 (48.2)	
6–12 mo ago	160 (21.0)	6 (8.1)	154 (22.4)	
>12 mo ago	112 (14.7)	2 (2.7)	110 (16.0)	
I have never been tested	92 (12.1)		92 (13.4)	
How would you rate your risk of getting HIV				29.0 (<0.001)

(continued on next page)

TABLE 1. (Continued) Participant Characteristics Among YMSM in California by PrEP Use (N = 761)

Variable	Total	Ever Used PrEP	Never Used PrEP	χ^2 (P)*
	N (%)	N (%)	N (%)	
Low	315 (41.4)	18 (24.3)	297 (3.2)	
Moderate	318 (41.8)	30 (40.5)	288 (41.9)	
High	94 (12.4)	23 (31.1)	71 (10.3)	
How concerned are you about becoming infected with HIV				3.9 (0.14)
Not concerned	197 (25.9)	16 (21.6)	181 (26.3)	
Somewhat concerned	235 (30.9)	18 (24.3)	217 (31.6)	
Very concerned	329 (43.2)	40 (54.1)	289 (42.1)	
HIV-risk score based on CDC screener				25.3 (<0.001)
Low (<10)	237 (31.1)	4 (5.4)	233 (33.9)	
High (\geq 10)	524 (68.9)	70 (94.6)	454 (66.1)	
Substance use (last 6 mo)				
Alcohol	589 (77.4)	60 (81.1)	529 (77.0)	0.6 (0.43)
Marijuana/pot	334 (43.9)	35 (47.3)	299 (43.5)	0.4 (0.53)
Poppers	195 (25.6)	47 (63.5)	148 (21.5)	61.7 (<0.001)
Illicit drug use (ie, heroin, cocaine/crack, methamphetamine/crystal, GHB, ecstasy/MDMA/Molly, ketamine/K)	147 (19.3)	31 (41.9)	116 (16.9)	26.8 (<0.001)

*Fisher exact test was performed where cell sizes were small.

GHB, gamma-hydroxybutyric acid; MDMA, Methylenedioxymethamphetamine.

(32.4%). Smaller percentages reported having PrEP recommended to them by a doctor or health care provider (29.7%), a friend (23.0%), or a sex partner (12.2%).

Among current PrEP users (n = 53), 92.5% reported taking PrEP 6–7 days per week. However, 41.5% indicated that they wanted help remembering to take PrEP. The average amount participants spent on PrEP, including clinical ancillary costs, was \$88 monthly. Half (50.9%) received financial assistance and a quarter (24.5%) indicated wanting additional help paying for PrEP.

Reasons for Discontinuing PrEP

Among those who discontinued PrEP (n = 21), the top 5 reasons for discontinuing were as follows: (1) being concerned about the consequences of long-term PrEP use (33.3%), (2) being unable to afford a prescription for PrEP (28.6%), (3)

using other strategies to reduce HIV risk (23.8%), (4) forgetting to take PrEP everyday (23.8%), and (5) being unable to afford the required medical visits for PrEP (19.0%).

DISCUSSION

PrEP implementation is crucial to advancing the goals of the National HIV/AIDS Strategy³⁶ and forthcoming California statewide plan for “Getting to Zero.”³⁷ Our study provides insights into current rates and correlates of PrEP uptake and reasons for initiation and discontinuation of PrEP among YMSM who use GSN apps. Overall, PrEP uptake remains low (9.7%), which is consistent with other studies of YMSM.^{18,23} Although uptake is increasing, much remains to be done to increase PrEP usage among this high-priority population.³⁸

In our multivariate analysis, higher income was significantly associated with PrEP usage. These results, coupled with those indicating discontinuation of PrEP related to cost, underscore the need for programs and policies that offset the cost of taking PrEP. Programs that seek to enroll YMSM in insurance, along with co-payment assistance programs,³⁹ are 2 strategies to reduce barriers among low-income YMSM. Several states, including New York, Colorado, and Washington, have implemented publicly funded programs to pay for PrEP—a strategy that ultimately may be cost-saving.⁴⁰

The remaining correlates of PrEP uptake were related to individual risk behaviors, such as receptive CAS, sex with an HIV-positive partner, and popper use, which often accompanies high-risk sexual behaviors.⁴¹ Although these cross-sectional results do not necessarily represent risk compensation among PrEP users, they may indicate PrEP is reaching many YMSM who are good candidates, as both CAS and sex with HIV-positive partners are screening

TABLE 2. Multivariate Logistic Regression Analysis of PrEP Uptake Among YMSM in California (N = 698)*

	Odds Ratio	95% CI	P
Annual income			
<\$10,000	Ref.		
\$10,000–29,000	1.35	0.59 to 3.12	0.478
\$30,000 or more	4.13	1.87 to 9.12	<0.001
Receptive CAS in the last 6 mo	3.41	1.71 to 6.78	<0.001
HIV positive partner in the last 6 mo	2.87	1.53 to 5.38	0.001
Substance use in the last 6 mo: poppers	3.47	1.96 to 6.13	<0.001
Any STI diagnosis in the past year	2.90	1.64 to 5.13	<0.001

*Sixty-three individuals were excluded because of missing income.

questions on the CDC’s tool to evaluate for intensive HIV prevention services.²⁸ The CDC tool omits popper use as a screening question, although recommended in predicting HIV incidence among MSM.³⁴

Although not statistically significant in multivariate modeling, a greater percentage of PrEP users perceived themselves at high risk for HIV compared to non-PrEP users. These results point to the need for targeted strategies for identifying YMSM candidates for PrEP based on their risk perception and behavioral risk profile. In our study, 87% of those deemed good candidates for PrEP screening (indicated by a score ≥ 10 on the CDC risk index) were not current or past PrEP users. Although it is important to educate and encourage health providers to ask their patients about sexual risk and PrEP, using GSN apps to disseminate information regarding PrEP, including where to go for PrEP, is warranted.

Self-reported PrEP adherence was high in our sample (>90%)—efficacy studies with MSM show that PrEP can be up to 96% effective even when taken only 4 times weekly⁴²—and may overestimate actual adherence, especially in light of the fact that nearly one-quarter of former users stated that difficulty remembering to take PrEP was a reason they discontinued it. Technology-supported adherence methods that have been successful in increasing antiretroviral adherence may also be leveraged to support PrEP adherence.^{43,44}

This study is among the first to measure PrEP uptake among a sample of YMSM in California. Data point to the need for increasing PrEP uptake through targeted messaging to YMSM GNS app users engaged in high-risk sexual behaviors. Developing programs and policies that offset the cost for low-income YMSM is a high priority for increasing PrEP uptake. This sample is not representative of all YMSM who use GSN apps and all data relies on self-report. Further research using medical records to track PrEP uptake and/or more sophisticated measures of adherence is warranted. Despite limitations, this study points to the importance of increased outreach to YMSM using GSN apps for PrEP information dissemination and adherence monitoring and support.

REFERENCES

1. New York State Department of Health. *Blueprint to End AIDS*. New York State Department of Health; 2015.
2. Getting to Zero San Francisco. Available at: <http://www.gettingtozerosf.org/>. Accessed May 6, 2016.
3. Doblecki-Lewis S, Cohen S, Liu A. Clinical treatment options infectious diseases: update on PrEP implementation, adherence, and advances in delivery. *Cur Treat Options Infect Dis*. 2015;7:101–112.
4. Eckert V, Chavez GF, Mark KE, et al. *California HIV/AIDS Epidemiological Profile, 2009 Update*. Sacramento, CA: California Department of Public Health, Office of AIDS; 2012.
5. Office of AIDS Research. *HIV/AIDS Surveillance in California*. Sacramento, CA: California Department of Public Health; 2012.
6. Landovitz RJ, Tseng CH, Weissman M, et al. Epidemiology, sexual risk behavior, and HIV prevention practices of men who have sex with men using GRINDR in Los Angeles, California. *J Urban Health*. 2013;90:729–739.
7. Lehmler JJ, Ioeberger M. Social networking smartphone applications and sexual health outcomes among men who have sex with men. *PLoS One*. 2014;9:e86603.
8. Rendina HJ, Jimenez RH, Grov C, et al. Patterns of lifetime and recent HIV testing among men who have sex with men in New York city who use Grindr. *AIDS Behav*. 2014;18:41–49.

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. Holloway IW, Pulsipher CA, Gibbs J, et al. Network influences on the sexual risk behaviors of gay, bisexual and other men who have sex with men using geosocial networking applications. *AIDS Behav*. 2015;19 (suppl 2):112–122.
11. 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.
12. Goedel WC, Halkitis PN, Greene RE, et al. Correlates of awareness of and willingness to use pre-exposure prophylaxis (PrEP) in gay, bisexual, and other men who have sex with men who use geosocial-networking smartphone applications in New York city. *AIDS Behav*. 2016;20:1435–1442.
13. Cohen SE, Vittinghoff E, Bacon O, et al. High interest in pre-exposure prophylaxis among men who have sex with men at risk for HIV-infection: baseline data from the US PrEP demonstration project. *JAIDS*. 2015;68:439–448.
14. Liu AY, Vittinghoff E, Chillag K, et al. Sexual risk behavior among HIV-uninfected men who have sex with men participating in a tenofovir preexposure prophylaxis randomized trial in the United States. *JAIDS*. 2013;64:87–94.
15. Marcus JL, Glidden DV, Mayer KH, et al. No evidence of sexual risk compensation in the iPrEx trial of daily oral HIV preexposure prophylaxis. *PLoS One*. 2013;8:e81997.
16. Tripathi A, Whiteside YO, Duffus WA. Perceptions and attitudes about preexposure prophylaxis among seronegative partners and the potential of sexual disinhibition. *South Med J*. 2013;106:558–564.
17. Whiteside YO, Harris T, Scanlon C, et al. Self-perceived risk of HIV infection and attitudes about preexposure prophylaxis among sexually transmitted disease clinic attendees in South Carolina. *AIDS Patient Care STDs*. 2011;25:365–370.
18. Bauermeister JA, Meanley S, Pingel E, et al. PrEP awareness and perceived barriers among single young men who have sex with men in the United States. *Curr HIV Res*. 2013;11:520–527.
19. Hood JE, Buskin SE, Dombrowski JC, et al. Dramatic increase in preexposure prophylaxis use among MSM in Washington state. *AIDS*. 2016;30:515–519.
20. Krakower DS, Mimiaga MJ, Rosenberger JG, et al. Limited awareness and low immediate uptake of pre-exposure prophylaxis among men who have sex with men using an internet social networking site. *PLoS One*. 2012;7:e33119.
21. Liu AY, Kittredge PV, Vittinghoff E, et al. Limited knowledge and use of HIV post- and pre-exposure prophylaxis among gay and bisexual men. *JAIDS*. 2008;47:241–247.
22. Mayer KH, Oldenburg CE, Novak DS, et al. Early adopters: correlates of HIV chemoprophylaxis use in recent online samples of US men who have sex with men. *AIDS Behav*. 2015;20:1489–1498.
23. Rucinski KB, Mensah NP, Sepkowitz KA, et al. Knowledge and use of pre-exposure prophylaxis among an online sample of young men who have sex with men in New York City. *AIDS Behav*. 2013;17:2180–2184.
24. Scanlin K, Mensah NP, Salcuni P, et al. Increasing PrEP use among men who have sex with men, New York city, 2013–2015. Paper presented at: Conference on Retroviruses and opportunistic infections February 22–February 25, 2016; Boston, MA.
25. Mimiaga MJ, Case P, Johnson CV, et al. Preexposure antiretroviral prophylaxis attitudes in high-risk Boston area men who report having sex with men: limited knowledge and experience but potential for increased utilization after education. *JAIDS*. 2009;50:77–83.
26. Dolezal C, Frasca T, Giguere R, et al. Awareness of post-exposure prophylaxis (PEP) and pre-exposure prophylaxis (PrEP) is low but interest is high among men engaging in condomless anal sex with men in Boston, Pittsburgh, and San Juan. *AIDS Educ Prev*. 2015;27:289–297.
27. Center for Disease Control and Prevention. *HIV Surveillance Report, 2014*. Center for Disease Control and Prevention; 2015;26.
28. Center for Disease Control and Prevention. *Preexposure Prophylaxis for the Prevention of HIV Infection in the United States—2014 Clinical Practice Guideline*. Center for Disease Control and Prevention; 2014.
29. Pérez-Figueroa RE, Kapadia F, Barton SC, et al. Acceptability of PrEP uptake among racially/ethnically diverse young men who have sex with men: the p18 study. *AIDS Educ Prev*. 2015;27:112–125.

30. Brooks RA, Kaplan RL, Lieber E, et al. Motivators, concerns, and barriers to adoption of preexposure prophylaxis for HIV prevention among gay and bisexual men in HIV-serodiscordant male relationships. *AIDS Care*. 2011;23:1136–1145.
31. Kubicek K, Arauz-Cuadra C, Kipke MD. Attitudes and perceptions of biomedical HIV prevention methods: voices from young men who have sex with men. *Arch Sex Behav*. 2015;44:487–497.
32. Amico KR. Adherence to preexposure chemoprophylaxis: the behavioral bridge from efficacy to effectiveness. *Curr Opin HIV AIDS*. 2012;7:542–548.
33. Baeten JM, Haberer JE, Liu AY, et al. Pre-exposure prophylaxis for HIV prevention: where have we been and where are we going? *JAIDS*. 2013;63(suppl 2):S122–S129.
34. Smith DK, Pals SL, Herbst JH, et al. Development of a clinical screening index predictive of incident HIV infection among men who have sex with men in the United States. *JAIDS*. 2012;60:421–427.
35. Benjamini Y, Hochberg Y. Controlling the false discovery rate—a practical and powerful approach to multiple testing. *J Royal Stat Soc*. 1995;57:289–300.
36. White House Office of National AIDS Policy. *National HIV/AIDS Strategy for the United States: Updated to 2020 [Internet]*. 2015; Available at: <https://www.aids.gov/federal-resources/national-hiv-aids-strategy/nhas-update.pdf>. Accessed Mar 25, 2016.
37. California Department of Public Health. Laying a Foundation for getting to Zero: California's integrated HIV surveillance, *Prev Care Plan*. 2016; Available at: <http://www.cdph.ca.gov/programs/aids/Pages/GettingtoZeroCalifornia.aspx>. Accessed May 26, 2016.
38. Center for Disease Control and Prevention. *Vital Signs: Estimated Percentages and Numbers of Adults with Indications for Preexposure Prophylaxis to Prevent HIV Acquisition—United States, 2015*. Center for Disease Control and Prevention; 2015.
39. Gilead. Truvada for PrEP medication assistance program. Available at: <http://www.gilead.com/responsibility/us-patient-access/truvada%20for%20prep%20medication%20assistance%20program>. Accessed October 10, 2016.
40. Paltiel AD, Freedberg KA, Scott CA, et al. HIV preexposure prophylaxis in the United States: impact on lifetime infection risk, clinical outcomes, and cost-effectiveness. *Clin Infect Dis*. 2009;48:806–815.
41. Kipke MD, Weiss G, Ramirez M, et al. Club drug use in Los Angeles among young men who have sex with men. *Subst Use Misuse*. 2007;42:1723–1743.
42. Anderson PL, Glidden DV, Liu A, et al. Emtricitabine-tenofovir concentrations and pre-exposure prophylaxis efficacy in men who have sex with men. *Sci Transl Med*. 2012;4:151. ra125.
43. Dowshen N, Kuhns LM, Johnson A, et al. Improving adherence to antiretroviral therapy for Youth Living with HIV/AIDS: a pilot study using personalized, interactive, daily text message Reminders. *J Med Internet Res*. 2012;14:e51.
44. Horvath KJ, Michael Oakes J, Simon Rosser BR, et al. Feasibility, acceptability and preliminary efficacy of an online peer-to-peer social support ART adherence intervention. *AIDS Behav*. 2013;17:2031–2044.