



Awareness, Willingness, and Perceived Efficacy of Pre-exposure Prophylaxis among Adolescent Sexual Minority Males

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Abstract Despite the approval of PrEP for adolescents by the FDA in 2018, little is known about the awareness and attitudes about PrEP use among adolescent sexual minority males, who are at the greatest risk for HIV. We analyzed baseline data from the MyPEEPS Mobile study, a multi-site randomized controlled trial evaluating the effectiveness of a mobile behavioral HIV prevention intervention. A substantial proportion (68.2%) of study participants (ages 13–18) had previously heard about PrEP, and an overwhelming majority (90.8%) reported willingness to take PrEP, to prevent HIV. On the other hand, only about one third (34.6%) of participants indicated that taking a daily HIV pill would be “very” or “completely” effective in preventing HIV when having sex without a condom. These findings

suggest that high awareness and willingness to use PrEP across various adolescent subgroups present opportunities for increased PrEP advocacy among this young age group.

Keywords Pre-exposure prophylaxis (PrEP) · Human immunodeficiency virus (HIV) · Adolescents · Awareness · Willingness · Perceived efficacy

Background

Approximately 40,000 individuals in the USA acquire HIV annually, with gay and bisexual men accounting

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for two thirds of new cases [1]. To reduce the risk of infection among high-risk individuals, pre-exposure prophylaxis (PrEP), the use of antiretroviral drugs for HIV prevention, is recommended as an evidence-based biomedical prevention strategy [2]. When taken daily, PrEP can reduce the risk of acquiring HIV by up to 99% [3]. Due to its high efficacy, PrEP is championed by health experts across the globe as a critical tool for preventing new HIV transmissions [4].

Since its approval by the FDA in 2012, PrEP use has dramatically increased in the USA. From 2014 to 2016, the number of PrEP users increased 470%, from 13,748 to 78,360 [5, 6]. However, current figures on PrEP uptake indicate that it is used by far fewer high-risk individuals than expected. For example, an estimated 492,000 men who have sex with men (MSM) in the USA would benefit from PrEP based on risk behaviors [7]. While uptake has rapidly increased since 2012, relatively few PrEP users are non-white [6]. In the USA, black individuals represent 10.1% of PrEP users, despite having the greatest risk for HIV transmission and representing 44% of new cases; whites and Hispanics make up 74.5% and 11.7% of PrEP users, respectively [8].

Given these disparities, recent sexual health studies have focused on trends in PrEP use, awareness, and attitudes among vulnerable populations; however, the focus has been on adult MSM, whereas rates of new infections are rising in some young MSM (YMSM) groups [9]. In particular, there is limited research available on PrEP awareness and attitudes among adolescent YMSM who are just beginning to consider and/or engage in sexual behavior that may put them at risk of acquiring HIV. PrEP access for adolescents is an issue of growing concern, with 21% of new HIV infections in the USA affecting individuals aged 13–24 [9]. When the FDA approved Truvada for PrEP in 2012, youth under age 18 were neither included in its approval nor mentioned in clinical guidelines for the prescription of PrEP. In May 2018, the FDA approved PrEP for HIV prevention among adolescents [10]. As PrEP becomes more available to adolescents, it is important to optimize prevention and uptake efforts by examining what factors influence their understanding of and willingness to use PrEP for HIV prevention. Sociodemographic and behavioral factors could play a role in shaping the knowledge and perception of PrEP among this age group. Regional policy differences regarding PrEP, including state guidelines for minors' consent to preventative HIV services, might also influence adolescents' awareness of PrEP.

The current study examined awareness and attitudes about PrEP among US adolescent sexual minority males, ages 13–18. We analyzed baseline data from the MyPEEPS Mobile study, a multi-site randomized controlled trial evaluating the effectiveness of a mobile adaptation of a group-based behavioral HIV prevention intervention [11]. The aims of this analysis herein were to (1) describe PrEP awareness, perceived efficacy, and willingness to use PrEP among a diverse sample of adolescent sexual minority males and (2) assess whether demographic or behavioral characteristics are associated with PrEP awareness, perceived efficacy, or willingness to use it.

Methods

Recruitment

Participants in the MyPEEPS Mobile study were recruited primarily through online advertisements and posts aimed at “guys interested in other guys” on social media sites, including Snapchat, Facebook, Twitter, and Instagram. We recruited nationally, with specific hubs by region in New York City, Birmingham, Chicago, and Seattle. Flyers and palm cards were also distributed during community events targeting LGBT youth in these four cities.

Interested individuals were screened in-person or over the phone and were included if they were 13–18 years old, self-reported HIV negative or unsure of their status, assigned male sex at birth, and identified as male or genderqueer/genderfluid (not female). Participants had to have either kissed another male in the past or planned to engage in sexual activity with another male in the next year. Those who lived too far to travel to the nearest study site were given the option to participate remotely, completing surveys online. Enrollment in this study required informed consent, which was obtained in-person or through an online video call. Study protocols were reviewed and approved by the Institutional Review Board of Columbia University [12].

Measures

The baseline visits included completion of an online questionnaire administered remotely or in-person. Survey items asked about basic demographics such as age,

education, living situation, as well as sexual behaviors and HIV prevention experiences and related attitudes.

PrEP-Related Measures

To measure PrEP awareness, participants were asked, “Before today, have you ever heard of PrEP (Pre-exposure Prophylaxis)?” (0 = No, 1 = Yes). To gauge willingness to use PrEP, we asked, “Would you take one pill a day to prevent HIV?” (0 = No, 1 = Yes). To measure perceived efficacy, respondents were asked, “How well do you think taking a daily HIV pill would work in preventing HIV when having sex without a condom?” On a five-point scale, participants indicated that PrEP (0) would not work at all, (1) would work a little, (2) would work somewhat, (3) would work very well, or (4) would work completely. We recoded these values dichotomously so that perceived efficacy is represented by the belief that PrEP would work “very well” or “completely” (0 = would work somewhat, a little, or not at all; 1 = would work very well or completely).

Sociodemographic Characteristics

We dichotomized the age groups into early-middle adolescence (ages 13–16 years) versus later (ages 17–18 years), as we expected older adolescents to be differentiated from younger on the outcomes of interest. Participants were asked about parents’ educational attainment; responses were combined such that this variable represented the parent with the higher level of education (0 = less than a bachelor’s degree, 1 = completed bachelor’s degree or higher). Participants reported their primary race (e.g., American Indian, Asian, Black, multiracial, Native Hawaiian, White, or something else) and in terms of ethnicity, whether they identify as Hispanic/Latino/Latinx. We then grouped those who identified as American Indian ($n = 33$), Native Hawaiian ($n = 9$), or “something else” ($n = 84$) as “some other race” to obtain enough power to represent this group, given the low number of observations for American Indian and Native Hawaiian groups.

State Laws for Minors’ Consent to PrEP

As of 2017, 17 states (Alabama, Alaska, Arkansas, California, Colorado, Delaware, Idaho, Iowa, Kansas, Louisiana, Mississippi, Montana, New York, North Carolina, Oklahoma, Pennsylvania, and South Carolina)

had written guidelines allowing minors access to PrEP without parental consent [13, 14]. Participants were categorized by whether they lived in a state with explicit language in statutes or regulations granting minors access to PrEP without parental consent (0 = lives in state with no consent laws, 1 = lives in state with explicit consent laws).

Sexual Behavior, HIV Testing, and Relationship Status

Participants reported if they had ever had oral, vaginal, or anal sex (0 = No, 1 = Yes), and if they had ever been tested for HIV (0 = No, 1 = Yes). Participants also reported their current relationship status through the following question, “Are you currently dating someone, such as a boyfriend, girlfriend, or someone else?” (0 = No, 1 = Yes).

Analysis

Data were analyzed with SPSS (version 26) [15]. We first examined study variables using descriptive statistics and then tested the association between sociodemographic and behavioral variables and whether respondents demonstrated awareness, perceived efficacy, or willingness to use PrEP, using Pearson’s chi-square test. To determine significant differences for group comparisons, adjusted residuals were calculated using a post hoc test. We then analyzed the relationships between our PrEP-related measures to assess whether participants’ awareness of PrEP was associated with their willingness to use or perceived efficacy of PrEP. Next, we examined PrEP-related variables using multivariable logistic regression for variables that were significant at the 0.05 level in bivariate analysis.

Results

Demographics

MyPEEPS study participant demographics ($N = 761$) are summarized in Table 1, representing data collected between June 2018 and April 2020. The mean age of participants was 16.22 years ($SD = 1.36$), with nearly half (47.2%) of participants in the 17–18 age category. The largest proportion of respondents (35.2%) identified as white, followed by black (20.0%). Multiracial and “other” race made up 19.6% and 16.8% of the study

Table 1 Characteristics and awareness of willingness to use, and perceived efficacy of PrEP among adolescent sexual minority males

	Total		Awareness of PrEP		Willingness to use PrEP				Perceived efficacy of PrEP					
	<i>n</i>	(%)	<i>n</i>	(%)	X^2	<i>P</i> *	<i>n</i>	(%)	X^2	<i>P</i>	<i>n</i>	(%)	X^2	<i>P</i>
Total	761	(100.0)	512	(68.2)			691	(90.8)			260	(34.6)		
Age					27.92	<0.001			0.10	0.752			3.84	0.050
13–16	402	(52.8)†	236	(59.7)‡			359	(91.1)‡			124	(31.4)‡		
17–18	359	(47.2)	276	(77.5)			322	(90.4)			136	(38.2)		
Race					1.10	0.894			9.85	0.043			6.040	0.171
White	264	(35.2)	180	(68.7)			241	(92.0)			104	(39.7)		
Black	150	(20.0)	102	(70.3)			129	(89.0)			47	(32.4)		
Multiracial	147	(19.6)	102	(69.4)			137	(93.8)			44	(29.9)		
Asian	63	(8.4)	41	(65.1)			51	(81.0)			25	(39.7)		
Some other race	126	(16.8)	82	(65.6)			114	(91.2)			38	(30.4)		
Ethnicity					5.59	0.018			3.42	0.065			0.61	0.433
Non-Hispanic	449	(59.2)	287	(64.8)			395	(89.2)			158	(35.7)		
Hispanic/Latino	310	(40.8)	224	(73.0)			285	(93.1)			101	(32.9)		
Parental education					4.71	0.030			1.45	0.228			2.26	0.133
Less than bachelor's degree	367	(51.5)	236	(65.0)			324	(89.5)			119	(32.8)		
Completed bachelor's degree or higher	346	(48.5)	249	(72.6)			316	(92.1)			131	(38.2)		
State laws for minors' consent to PrEP					4.68	0.031			0.19	0.659			0.03	0.865
Lives in state with no consent laws	427	(56.1)	274	(64.9)			384	(91.2)			145	(34.4)		
Lives in state with explicit consent laws	334	(43.9)	238	(72.3)			297	(90.3)			115	(35.0)		
Relationship status					0.08	0.780			0.02	0.902			2.09	0.148
Single	547	(72.9)	375	(68.6)			496	(90.8)			198	(36.2)		
In a relationship	203	(27.1)	137	(67.5)			185	(91.1)			62	(30.5)		
Sexual activity					44.39	<0.001			1.07	0.300			4.00	0.046
Has had oral, anal, or vaginal sex	541	(72.0)	407	(75.2)			494	(91.5)			199	(36.8)		
Has not had any sex before	210	(28.0)	105	(50.0)			187	(89.0)			61	(29.0)		
Tested for HIV					25.10	<0.001			1.04	0.307			8.32	0.004
Never	499	(66.4)	310	(62.1)			456	(91.6)			155	(31.1)		
At least once	252	(33.6)	202	(80.2)			225	(89.3)			105	(41.7)		
Used PrEP														
Never	726	(96.7)												
At least once	25	(3.3)												

Bold values denotes statistical significance at $p < .05$ level

**P* value of the Pearson's chi-square test

†Column percentage, missing cases excluded to show valid percent

‡Row percentage, missing cases excluded to show valid percent

sample, respectively. Approximately 40.8% of participants self-identified as Hispanic/Latino/Latinx. Over half (51.5%) indicated their mother and/or father had not completed at least a bachelor's degree. Our study

sample represented individuals from 49 US states, Washington, D.C., and Puerto Rico; 43.9% of participants lived in states with explicit laws or guidelines for minors' consent to PrEP. Most (72.9%) indicated not

Table 2 Examining the relationship between awareness of, willingness to use, and perceived efficacy of PrEP among adolescent sexual minority males

	Total		Awareness of PrEP				Willingness to use PrEP			
	<i>n</i>	(%)	<i>n</i>	(%)	χ^2	<i>P</i> *	<i>n</i>	(%)	χ^2	<i>P</i>
Total	761	(100.0)	512	(68.2)			681	(90.8)		
Perceived efficacy of PrEP					23.99	< 0.001			5.61	0.018
PrEP would be “very” or “completely” effective	260	(34.6)	207	(27.6)			245	(32.7)		
PrEP would be “somewhat effective” or less	491	(65.4)	305	(40.6)			436	(58.1)		
Willingness to use PrEP					14.66	< 0.001				
Willing to use PrEP	681	(90.8)	479	(63.9)						
Unwilling to use PrEP	69	(9.2)	33	(4.4)						

Bold values denote statistical significance at the $p < .05$ level

**P* value of the Pearson’s chi-square test

being in a relationship at baseline, and about two thirds (66.4%) had never been tested for HIV. The majority (72.0%) of respondents reported engaging in oral, anal, or vaginal sex; 28.3% of the sample reported having insertive anal sex (topping) without a condom, and 33.5% indicated having receptive anal sex (bottoming) without a condom. Only 3.3% of participants reported using PrEP.

Awareness of PrEP

Over two-thirds (68.2%) of MyPEEPS participants had previously heard about PrEP before enrolling in the study (Table 1). In bivariate analyses, race and relationship status were not associated with awareness of PrEP. Older age, Hispanic ethnicity, living in states with explicit laws for minors’ access to PrEP, higher parental education, sexual initiation, and history of HIV testing were all associated with PrEP awareness ($p < .05$).

Table 3 Multivariable regression between adolescent sexual minority male’s awareness of PrEP and their sociodemographic and behavioral characteristics

Predictor	aOR	95% CI	Sig.
Age	1.70	(1.19, 2.42)	0.004
Hispanic ethnicity	1.58	(1.10, 2.27)	0.013
Parental education	1.85	(1.30, 2.63)	0.001
State laws for minors’ consent to PrEP	1.27	(0.90, 1.79)	0.172
Ever had sex	2.32	(1.59, 3.40)	< 0.001
Ever tested for HIV	1.86	(1.24, 2.80)	0.003

Bold values statistical significance at the $p < .05$ level

When examining the relationship between PrEP-related measures (Table 2), we found that awareness of PrEP was associated with both willingness to use PrEP ($p < 0.001$) and perceived efficacy of PrEP ($p < 0.001$).

Using a multivariable logistic regression model (Table 3), we found that adolescent males were more likely to have heard of PrEP if they were older (adjusted odds ratio [aOR] = 1.70, $p = 0.004$), Hispanic (aOR = 1.58, $p = 0.013$), had a parent with a bachelor’s degree (aOR = 1.85, $p = 0.001$), ever had sex before (aOR = 2.32, $p < 0.001$), or ever tested for HIV (aOR = 1.86, $p = 0.003$). No difference was found by HIV testing history or living in a state with explicit laws for minors’ consent to PrEP.

Willingness to Use PrEP

- An overwhelming majority (90.8%) reported willingness to take a once-a-day pill, such as PrEP, to prevent HIV (Table 1). Only race was found to be associated with willingness to use PrEP ($p = 0.043$), with post hoc tests indicating that Asian participants were less likely to report willingness to use PrEP

Table 4 Multivariable regression between adolescent sexual minority male’s perceived efficacy of PrEP awareness and their sociodemographic and characteristics

Predictor	aOR	95% CI	Sig.
Ever had sex	1.26	(0.87, 1.80)	0.219
Ever tested for HIV	1.49	(1.07, 2.07)	0.017

Bold values denote significance at the $p < .05$ level

than other racial groups. As willingness to use PrEP was not associated with other characteristics, multi-variable analysis was not conducted. When examining the relationship between willingness to use PrEP and perceived efficacy (Table 2), a significant association was found between both measures ($p = 0.018$).

Perceived Efficacy of PrEP

Only about one third (34.6%) of participants indicated that taking a daily HIV pill would be “very” or “completely” effective in preventing HIV when having sex without a condom (Table 1). No association was found between perceived efficacy of PrEP and age, race/ethnicity, parental education, state consent laws, or relationship status. Participants who had engaged in sex or been tested for HIV at least once were more likely to report perceived efficacy of PrEP ($p < .05$).

In a logistic regression model (Table 4), we found that participants who had ever tested for HIV were more likely to report high perceived efficacy of PrEP (aOR = 1.49, $p = 0.017$). No significant relationship was observed between perceived efficacy of PrEP and having sex.

Discussion

Given the potential to increase PrEP uptake among young sexual minority men, detailing their awareness and attitudes about PrEP may help inform HIV prevention strategies for this population. Our sample was unique in comparison with previous PrEP studies [16–18] in that we had a younger age threshold, including respondents below age 18. Additionally, this sample comprised a racially, socioeconomically, and geographically diverse cohort of adolescent sexual minority males in the USA, of which 76.0% were racial/ethnic minorities and 51.5% had parents who had not completed a bachelor’s degree.

Among study participants, a majority (68.2%) reported prior awareness of PrEP, indicating that most adolescents in our national sample had heard of PrEP. This frequency exceeds those reported in recent studies measuring PrEP awareness among adult MSM (67.5% in Strauss et al.; 63% in Zhang et al.) [19, 20] and is concurrent with an increased awareness among MSM

over recent years [21]. However, differences between subgroups highlight opportunities for raising awareness. Younger adolescents and those without college-educated parents were significantly less likely to be aware of PrEP. Similarly, studies among adult MSM have found education to be positively associated with PrEP knowledge and awareness [16, 17]. Awareness of PrEP was lower among adolescent sexual minority males who had not yet engaged in sex or been tested for HIV. Similar results are reported among adult MSM in Kahle et al., where knowledge of PrEP was found to correlate with testing for HIV in the past year [17]. These findings suggest that efforts should focus on promoting awareness among younger sexual minority males of lower family educational status, those who have not yet had sex, and those not yet tested for HIV to raise awareness to promote self-management of sexual health. When promoting a safer sex developmental trajectory for youth, PrEP education should ideally take place before sexual initiation and needing to get tested.

In our sample, awareness of PrEP was associated with both perceived efficacy and willingness to use PrEP. A similar relationship between PrEP knowledge and willingness to use PrEP is reported in the literature [17]. These results suggest prevention programs that raise awareness of PrEP may increase willingness and perceived efficacy among this age group. Our analysis found Hispanic/Latino participants to be more likely to have heard about PrEP compared with non-Hispanic participants, which is in contrast to prior reports of minority race/ethnicity as a predictor for less awareness of PrEP [17, 22]. In our study, however, higher awareness among Hispanic/Latino participants did not translate to higher willingness or perceived efficacy in this subgroup. These findings underline opportunities for programs to capitalize on this group’s awareness to promote more favorable attitudes toward PrEP.

Our analysis also highlighted greater awareness of PrEP among participants living in states with laws or statutes permitting minors’ access to PrEP without parental consent. These laws may also reflect a more supportive context for youth, more generally, and/or greater access to sexual health resources for youth. Although providers in states without these laws can often still prescribe PrEP to minors, the inclusion of written state guidelines may be one opportunity to promote awareness of using PrEP for HIV prevention among adolescents. With the recent FDA approval of PrEP for use among at-risk adolescents, the distinction

between regional and federal policy differences regarding PrEP may warrant further investigation.

An overwhelming majority (90.8%) of participants in our sample indicated willingness to take PrEP to prevent HIV. This finding is supported by the literature, where most MSM indicate willingness to use a daily pill to prevent HIV [17, 23, 24]. However, the rate of willingness to use PrEP among adolescents is considerably higher than those described in the literature among adult MSM (48–61% in Patrick et al.; 55.3% in Holloway et al.) [23, 24]. While these studies show favorable acceptability of PrEP for HIV prevention, this is not to be confused with intention to take PrEP [18]. Compared with adult MSM, adolescents' greater willingness to take PrEP may result from this age group being less aware of deterring factors like cost, side effects, and required medical follow-ups when taking PrEP. One report by Grov et al., focusing on willingness to take PrEP among adult MSM, found no association with age, race/ethnicity, income, or relationship status [25]. In our sample, no behavioral characteristics were associated with willingness to take PrEP, though race had a significant association. Specifically, Asian respondents reported less willingness to take PrEP compared with other races, highlighting a possible racial gap in acceptability of PrEP. This reflects a growing need for prevention in this subgroup, given that an increase in HIV diagnoses among Asian MSM is driving the current HIV epidemic in their racial group [26]. Overall, generally high rates of PrEP willingness across participant subgroups reinforce the potential for increased PrEP uptake among minors of different backgrounds.

Only about one third (34.6%) of study participants believed PrEP would be "very" or "completely" effective in preventing HIV when having sex without a condom. This rate is lower than the observed perceived efficacy of PrEP among adult MSM (53.6% said PrEP "at least 75% effective" in Rendina et al.; 87.5% said PrEP offers at least "a lot of protection" in Siegel and Meunier) [18, 27]. In addition to access barriers, less confidence in the efficacy of PrEP among adolescents may partly explain the low rate of PrEP uptake in this sample (3.3%). These results suggest HIV prevention interventions can do more to educate adolescents about PrEP effectiveness in preventing HIV.

Results also indicate higher perceived efficacy of PrEP among those who tested for HIV prior to the study and among those who were sexually active. Increasing testing for HIV among sexually active adolescents could

present an opportunity to provide accurate information about PrEP efficacy and reinforce beliefs that PrEP is safe and effective. However, no causal relationship between knowledge or perceived efficacy of PrEP and testing among adults or adolescents has been identified in the literature. We found an association between perceived efficacy and willingness to take PrEP, which is consistent with the literature where findings consistently associate strong beliefs of PrEP efficacy with willingness to take PrEP [18, 28].

Limitations

Social desirability bias may have influenced how participants responded to questions, considering the sensitive nature of some MyPEEPS survey topics, resulting in a potential inflation of the overall levels of PrEP awareness, willingness to use it, and perceived efficacy. As convenience sampling was used for recruitment, there is also the risk of sampling and selection biases. As most participants lived in urban or suburban areas, this sample may not reflect dynamics in rural areas. While this may simply reflect where self-identified sexual minority youth live, future studies should investigate PrEP-related measures among adolescents in less urbanized populations.

As PrEP was not the primary focus of the original MyPEEPS study, PrEP-related survey items were not as detailed as some other studies [29, 30]. Awareness and willingness were represented by dichotomous variables which may simplify participants' more complicated attitudes about PrEP. When asking about willingness to use PrEP, the MyPEEPS survey did not address issues like access, cost, perceived HIV risk, or potential side effects- factors that have been shown to influence attitudes toward PrEP [16]. A mixed-methods approach could provide greater insight on how adolescents conceptualize benefits and barriers for PrEP uptake.

Our variable for state laws for minors' consent to PrEP is based on limited information from government agencies regarding minors' access to PrEP in 2017 [13, 14]. While no state prohibits the prescription of PrEP to minors without parental consent, little is known about the impact these policies have on adolescents' awareness and access to PrEP [31]. Considering the lack of transparency in these laws, further research is needed to outline state differences in PrEP access and how this affects the awareness, attitudes, and health outcomes of adolescent sexual minority males.

Conclusion

These findings provide insight on awareness of, willingness to use, and perceived efficacy of PrEP among a diverse sample of adolescent sexual minority males. Despite low rates of PrEP utilization, high awareness and willingness to use PrEP across various adolescent subgroups reveal opportunities for increased PrEP advocacy among this young age group. Because awareness and attitudes of PrEP are likely to change over time as PrEP initiatives expand and new PrEP-related challenges emerge, it is crucial to continue observing these constructs among adolescents to more effectively address obstacles to PrEP uptake and HIV prevention, particularly for young sexual minority men at high risk of HIV acquisition.

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Compliance with Ethical Standards

Human Subjects Protection Statement The study was reviewed by the Institutional Review Board of Columbia University (IRB-AAAQ6500, Rebecca Schnall, Principal Investigator). Under this Institutional Review Board, the study met the regulatory guidelines for the protection of human subjects and involves no more than minimal risk (45 CFR 46.404/21 CFR 50.51; i.e., “Section 404”). No parental permission was obtained because each of the criteria for waiving parental permission apply (45 CFR 46.408(c)).

References

- Centers for Disease Control and Prevention. HIV in the United States and dependent areas. 2017; Available from: <https://www.cdc.gov/hiv/statistics/overview/atag glance.html>. Accessed 16 October 2019.
- Donnell D, Baeten JM, Bumpus NN, Brantley J, Bangsberg DR, Haberer JE, et al. HIV protective efficacy and correlates of tenofovir blood concentrations in a clinical trial of PrEP for HIV prevention. *J Acquir Immune Defic Syndr*. 2014;66(3):340–8.
- 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):151ra125.
- Rivet Amico K, Bekker LG. Global PrEP roll-out: recommendations for programmatic success. *Lancet HIV*. 2019;6(2):e137–e140.
- Kamitani E, Wichser ME, Adegbite AH, Mullins MM, Johnson WD, Crouch PC, et al. Increasing prevalence of self-reported HIV pre-exposure prophylaxis use in published surveys: a systematic review and meta-analysis. *AIDS*. 2018;32(17):2633–5.
- Huang YA, Zhu W, Smith DK, Harris N, Hoover KW. HIV pre-exposure prophylaxis, by race and ethnicity - United States, 2014–2016. *Morb Mortal Wkly Rep*. 2018;67(41):1147–50.
- Smith DK, van Handel M, Wolitski RJ, Stryker JE, Hall HI, Prejean J, et al. Vital signs: estimated percentages and numbers of adults with indications for pre-exposure prophylaxis to prevent HIV acquisition — United States, 2015. *Morb Mortal Wkly Rep*. 2015;64(46):1291–5.
- Bush S, et al. *Racial characteristics of FTC/TDF for pre-exposure prophylaxis users in the U.S. in 2016 ASM Microbe*. Boston; 2016.
- Centers for Disease Control and Prevention, *HIV and Youth*. 2019.
- Gilead Sciences, U.S. *Food and Drug Administration approves expanded indication for Truvada® (Emtricitabine and Tenofovir Disoproxil Fumarate) for reducing the risk of acquiring HIV-1 in adolescents*. 2018
- Schnall R, Kuhns LM, Hidalgo MA, Powell D, Thai J, Hirshfield S, et al. Adaptation of a group-based HIV risk reduction intervention to a mobile app for young sexual minority men. *AIDS Educ Prev*. 2018;30(6):449–62.
- Kuhns LM, Garofalo R, Hidalgo M, et al. A randomized controlled efficacy trial of an mHealth HIV prevention intervention for sexual minority young men: MyPEEPS mobile study protocol. *BMC Public Health*. 2020;20(1):65.
- New York City Department of Health and Mental Hygiene. In: N.Y.S.D.o.H.A. Institute, editor. *HIV testing, reporting and confidentiality in New York State 2017–18 update: fact sheet and frequently asked questions*. New York; 2018.
- Centers for Disease Control and Prevention, *Minors' consent laws for HIV and STD services*. 2018
- IBM SPSS Statistics for Windows, Version 26.0*. Released 2019, IBM Corp: Armonk.
- Bauermeister JA, Meanley S, Pingel E, Soler JH, Harper GW. PrEP awareness and perceived barriers among single young men who have sex with men. *Curr HIV Res*. 2013;11(7):520–7.
- Kahle EM, Sullivan S, Stephenson R. Functional knowledge of pre-exposure prophylaxis for HIV prevention among participants in a web-based survey of sexually active gay, bisexual, and other men who have sex with men: cross-sectional study. *JMIR Public Health Surveill*. 2018;4(1):e13.
- Rendina HJ, et al. Distinguishing hypothetical willingness from behavioral intentions to initiate HIV pre-exposure prophylaxis (PrEP): findings from a large cohort of gay and bisexual men in the U.S. *Soc Sci Med*. 2017;171:115–23.
- Strauss BB, Greene GJ, Phillips G. Exploring patterns of awareness and use of HIV pre-exposure prophylaxis among young men who have sex with men. *AIDS Behav*. 2017;21(5):1288–98.
- Zhang HL, Murthy B, Johnston B, Mortiboy M, Wu J, Samsa GP, et al. Public awareness of HIV pre-exposure

- prophylaxis in Durham, North Carolina: results of a community survey. *N C Med J.* 2019;80(1):7–11.
21. Delaney KP, et al. Awareness and use of PrEP appear to be increasing among internet samples of US MSM. In: *Conference on Retroviruses and Opportunistic Infections (CROI 2016)*. Boston; 2016.
 22. Fallon SA, Park JN, Ogbue CP, Flynn C, German D. Awareness and acceptability of pre-exposure HIV prophylaxis among men who have sex with men in Baltimore. *AIDS Behav.* 2017;21(5):1268–77.
 23. Holloway IW, Tan D, Gildner JL, Beougher SC, Pulsipher C, Montoya JA, et al. Facilitators and barriers to pre-exposure prophylaxis willingness among young men who have sex with men who use geosocial networking applications in California. *AIDS Patient Care STDs.* 2017;31(12): 517–27.
 24. Patrick R, Forrest D, Cardenas G, Opoku J, Magnus M, Phillips G II, et al. Awareness, willingness, and use of pre-exposure prophylaxis among men who have sex with men in Washington, DC and Miami-Dade County, FL: national HIV behavioral surveillance, 2011 and 2014. *Acquir Immune Defic Syndr.* 2017;75(3):S375–82.
 25. Grov C, Whitfield THF, Rendina HJ, Ventuneac A, Parsons JT. Willingness to take PrEP and potential for risk compensation among highly sexually active gay and bisexual men. *AIDS Behav.* 2015;19(12):2234–44.
 26. Centers for Disease Control and Prevention, *HIV and Asians*. 2019
 27. Siegel K, Meunier É. Awareness and perceived effectiveness of HIV treatment as prevention among men who have sex with men in New York City. *AIDS Behav.* 2019;23(7):1974–83.
 28. Peng P, et al. A global estimate of the acceptability of pre-exposure prophylaxis for HIV among men who have sex with men: a systematic review and meta-analysis. *AIDS Behav.* 2017;22(4):1063–74.
 29. Santa Maria D, Gallardo KR, Narendorf S, Petering R, Barman-Adhikari A, Flash C, et al. Implications for PrEP uptake in young adults experiencing homelessness: a mixed methods study. *AIDS Educ Prev.* 2019;31(1):63–81.
 30. Becquet V, Nouaman M, Plazy M, et al. Sexual health needs of female sex workers in Côte d'Ivoire: a mixed-methods study to prepare the future implementation of pre-exposure prophylaxis (PrEP) for HIV prevention. *BMJ Open.* 2020;10(1):e028508.
 31. Culp L, Caucci L. State adolescent consent laws and Implications for HIV pre-exposure prophylaxis. *Am J Prev Med.* 2013;44(1):S119–24.

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