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PrEP Awareness, Uptake, Barriers, and Correlates Among Adolescents Assigned Male at Birth Who Have Sex with Males in the U.S.

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Abstract

In May 2018, the US Food and Drug Administration approved daily oral pre-exposure prophylaxis (PrEP) for adolescents under age 18. Although this is an important step toward HIV prevention for adolescents assigned male at birth who have sex with males (AMSM), limited research exists to gauge their awareness of PrEP as a prevention option. Additionally, the attitudes and perceived barriers regarding PrEP among this population have not been well studied. We conducted an online survey from February to April 2018, in which 219 AMSM age 15–17 read a description of PrEP, and then answered questions about PrEP awareness, perceived barriers, and demographic and behavioral correlates. A slight majority (54.8%) had heard of PrEP before, and 56.1% did not know how they would access PrEP. Of those who had heard of PrEP, 2.5% had ever used it. Most had first learned about PrEP online, through media or geosocial networking (GSN) applications to meet male partners. Those who had heard of PrEP were more likely to be older, to have used GSN applications, and to have greater HIV knowledge. Not knowing how to access PrEP was predicted by having had more partners, lower HIV knowledge, and never having talked to a provider about PrEP. Believing that one could not afford PrEP was predicted by greater perceived risk of HIV. Findings suggest moderate awareness of PrEP among AMSM, that youth at greater risk of HIV may perceive greater barriers, and that online spaces can play a significant role in increasing PrEP knowledge and reducing implementation barriers.

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Keywords

Adolescent sexual behavior; Sexual and gender minorities; Men who have sex with men; Pre-exposure prophylaxis; HIV/AIDS; Sexual orientation

Introduction

Adolescents assigned male at birth who have sex with males (AMSM; e.g., gay and bisexual adolescent males, gender-queer, or non-binary youth assigned male at birth) in the U.S. are disproportionately affected by HIV, accounting for nearly two-thirds (63.4%) of new infections among all adolescents under age 18 from 2010 to 2014 (Ocfemia, Dunville, Zhang, Barrios, & Oster, 2018). In 2016, 94% of diagnosed HIV infections among 13–17-year-old males in the U.S. were attributed to male-to-male sexual contact (CDC, 2018a). Despite these alarming statistics, to date, there has been a dearth of effective HIV prevention interventions for this population (CDC, 2017a) and most states do not require school-based sex education to include sexual health information specific to sexual or gender minority youth (Guttmacher Institute, 2018).

Daily oral pre-exposure prophylaxis (PrEP), or Truvada, was approved by the US Food and Drug Administration (FDA) for biomedical HIV prevention in adults in 2012 (CDC, 2018b). When taken as prescribed, it is over 90% effective at reducing sexual transmission of HIV among adults (CDC, 2018b). PrEP has untapped potential to curb infection rates among AMSM (Pace, Siberry, Hazra, & Kapogiannis, 2013). In fact, one model predicted that, if PrEP was targeted effectively to AMSM shortly following debut of anal sex, 27.8% of new HIV infections could be prevented in this demographic (Goodreau et al., 2018). Recognizing PrEP's potential, some jurisdictions permitted its off-label use for high-risk youth (e.g., New York State Department of Health, 2015). Informed by studies that demonstrated the safety, acceptability, and tolerability of daily oral PrEP in South African adolescents (Gill et al., 2017) and AMSM in the U.S. (Hosek et al., 2017), PrEP was approved in the U.S. in May 2018 for use in at-risk minors weighing at least 77 lb or 35 kilograms (U.S. Food and Drug Administration, 2018). Although this potent HIV prevention tool is now available for one of the groups at highest risk, the extent to which AMSM are even aware of PrEP has only recently been documented in the literature (Thoma & Huebner, 2018). A better understanding of these youth's awareness and perceived barriers to PrEP uptake is needed to inform PrEP implementation and adolescent sexual health promotion.

To date, our knowledge on PrEP awareness, uptake, and barriers has largely emerged from research focused on adult populations affected by HIV, including young adult men who have sex with men (YMSM) and transgender women. Overall, this body of work suggests that awareness was very low immediately following PrEP's approval but has increased over time. For instance, in one study conducted in 2012, only 27% of YMSM reported awareness of PrEP (Bauermeister, Meanley, Pingel, Soler, & Harper, 2013). Data from an HIV prevention trial for YMSM collected from June 2013–March 2015 revealed that PrEP awareness at baseline increased by 10% each month, resulting in 67.5% awareness across the total sample (Strauss et al., 2017). Even higher PrEP awareness rates (74%–85.5%) have been reported

among men using geosocial networking (GSN) applications like Grindr (Goedel, Halkitis, Greene, & Duncan, 2016; Holloway et al., 2017b). One study of 14–18-year-old AMSM found that only 16% were aware of PrEP in 2015 (Thoma & Huebner, 2018), and trends in the literature on YMSM suggest adolescents' awareness may have risen since then.

Although awareness rates are increasing, self-reported uptake among YMSM and transgender women is relatively low, with individual studies reporting that 1–17.5% used PrEP; higher rates were seen among those who met one or more CDC criteria for PrEP (Bauermeister et al., 2013; Khanna et al., 2016; Kuhns, Hotton, Schneider, Garofalo, & Fujimoto, 2017; Kuhns et al., 2016; Marks et al., 2017; Morgan, Moran, Ryan, Mustanski, & Newcomb, 2018; Rucinski et al., 2013; Strauss et al., 2017; Wilson, Chen, Pomart, & Arayasirikul, 2016). Among adolescents, an analysis of claims data from U.S. pharmacies revealed that only 1.5% of filled prescriptions for PrEP between 2012 and 2017 were for adolescents under 18, 83.5% of which were for girls (Magnuson, Hawkins, & Mera, 2018). In addition, a study of over 600 AMSM aged 14–18 found low rates of uptake, with 0.5% reporting lifetime use of PrEP (Thoma & Huebner, 2018).

Research on YMSM and transgender women suggests that a variety of demographic, social, structural, and sexual health factors are linked with PrEP awareness (Bauermeister et al., 2013; Holloway et al., 2017a; Khanna et al., 2016; Kuhns et al., 2017; Marks et al., 2017; Morgan et al., 2018; Rucinski et al., 2013; Strauss et al., 2017), and it is possible that similar patterns may emerge among adolescent samples. For example, older age, connections to or identification with the gay community, and socioeconomic indicators such as educational attainment and access to sexual healthcare have been associated with PrEP awareness among YMSM and transgender women (Bauermeister et al., 2013; Khanna et al., 2016; Kuhns et al., 2017; Marks et al., 2017; Rucinski et al., 2013; Strauss et al., 2017). Moreover, in comparison to studies that recruited general online samples or from the community, higher levels of PrEP awareness have been observed among samples of young adults recruited from GSN applications for MSM (Goedel et al., 2016; Holloway et al., 2017b) which may promote awareness through paid PrEP advertisements or user disclosure of PrEP use on their profiles. Although associated with similar factors as awareness, having used PrEP appears more closely linked to access to healthcare and risk indicators: perceived risk of HIV, engagement in various HIV risk behaviors, and testing positive for STIs (Holloway et al., 2017a; Kuhns et al., 2017; Marks et al., 2017).

Research on AMSM's perspectives on PrEP has only recently begun to emerge, and data on their awareness and uptake, in particular, is lacking. Some studies on PrEP awareness and uptake have reported on samples that include minor adolescent MSM (Arrington-Sanders et al., 2016; Khanna et al., 2016; Morgan et al., 2018; Thoma & Huebner, 2018), but these did not differentiate between youth above and below the age of majority in their reporting. Compared to young adults, minor adolescents exist in vastly different developmental and biopsychosocial circumstances and with differing legal rights and access to HIV preventative and medical care (Hosek et al., 2016), which can impact their PrEP awareness, use, and perceived or experienced barriers. Some of the only research on sexual and gender minority (SGM) adolescents' views on PrEP to date has focused on their comprehension of, reasoning about, and willingness to participate in hypothetical randomized controlled trials (RCTs)

testing PrEP adherence (Fisher, Arbeit, Dumont, Macapagal, & Mustanski, 2016; Fisher, Fried, Desmond, Macapagal, & Mustanski, 2017; Fisher, Fried, Ibrahim Puri, Macapagal, & Mustanski, 2018). Using online surveys and focus groups, one line of research presented participants with vignettes describing PrEP RCTs and then asked participants about their perceived risks, benefits, and barriers to participation in these trials (Fisher et al., 2016, 2017, 2018a). Commonly cited obstacles to participation were not specific to the study itself and instead reflected general barriers to healthcare and medication adherence for SGM adolescents that would likely occur outside of a research study. Specifically, youth voiced concerns about PrEP's side effects, difficulties making regular doctor visits for lab work associated with PrEP use, and reluctance to discuss SGM identity or sex with male partners with their parents and healthcare providers due to fear of punishment or stigma. Adolescents who were not out to their parents about their SGM identity were more likely to cite such concerns relative to youth who were out (Fisher et al., 2016). Apart from outness, these studies did not examine associations between other participant characteristics and adolescents' PrEP concerns.

Taken together, although the recent approval of PrEP for adolescents in the U.S. holds great promise for stemming the tide of HIV infections among AMSM, relatively little research has investigated their point of view on PrEP. Such basic information on adolescents' awareness and perceived barriers is critical to informing successful PrEP implementation in this population and sexual health education and promotion among AMSM. The goal of the present study was to describe PrEP awareness, use, and perceived barriers among AMSM. We also sought to examine sociodemographic, informational, attitudinal, and behavioral factors associated with PrEP awareness and perceived barriers.

Method

Participants

From February to April 2018, we recruited participants for a larger study on GSN application use and sexual health in SGM adolescents. Participants were recruited from social media and research participant registries. Social media advertisements targeted adolescents aged 15–18 who listed interests relevant to SGM youth (e.g., pop culture figures, SGM-related organizations). Those recruited from registries received an e-mail from the research team that included a brief description of the new study opportunity and a URL to the eligibility screener. Clicking on the advertisement or on the URL in the recruitment e-mail directed the individual to a brief eligibility survey hosted on REDCap, a secure web application for managing online surveys. Eligible individuals were assigned male at birth; identified as a sexual minority (i.e., gay, bisexual, queer, questioning/unsure) and/or endorsed attraction to male partners; reported having had sexual contact with a partner of any gender; lived in the U.S.; and could read English. The entire sample consisted of 302 15–18-year-olds, and for the purposes of this study, we restricted the analytic sample to the 219 participants under age 18.

Eligible individuals were e-mailed the URL to the study, whereas ineligible individuals were informed that the research team would contact them if they were eligible (rather than immediately informing them of their ineligibility) to deter multiple entries. After clicking on

the URL, participants reviewed an online consent form and upon confirming consent were routed to the survey, which lasted approximately 45–60 min. Participants who completed the survey and whose data passed the study’s validation protocol (Grey et al., 2015) received a \$30 electronic gift card. Procedures were approved by the university’s Institutional Review Board with a waiver of parental permission.

Measures

Sociodemographic Characteristics—Participants completed items assessing age, race and ethnicity, birth-assigned sex, gender identity, sexual orientation, sexual orientation disclosure (i.e., “outness”) to parents, and highest level of parents’ education. Several variables were dichotomized for analysis: race/ethnicity (non-Hispanic White vs. racial/ethnic minority), sexual orientation (gay vs. not gay-identified), and outness (out vs. not out). Further, the highest level of mother’s and father’s education was converted into one dichotomous variable reflecting highest level of parents’ education (i.e., college or graduate degree vs. high school or less).

Sexual Health, Perceived Risk of HIV, and Sexual Healthcare Experiences—Participants were asked questions regarding their sexual history and HIV/STI risk behaviors. Regarding their sexual history, participants were asked to select whether they had sex with “only guys,” “mostly guys but some girls,” “guys and girls equally,” “mostly girls but some guys,” or “only girls.” Then, they were asked to report their number of partners of different genders. Participants also responded to items assessing numbers of lifetime sex partners and unprotected receptive and insertive anal sex partners who were assigned male at birth. A dichotomous variable “ever had condomless anal sex” was derived from the latter two items for analyses. Finally, one item asked whether participants had ever used a GSN application for gay, bisexual, or queer guys who like guys (yes vs. no).

Perceived risk of HIV was assessed with two questions asking about their perceived likelihood of becoming infected with HIV (1 = extremely unlikely, 5 = extremely likely) as well as how frequently they worried about getting infected with HIV (1 = none of the time, 5 = all of the time; Napper, Fisher, & Reynolds, 2012). Participants were also asked whether they had ever discussed PrEP with a healthcare provider: “In the past I have spoken to a doctor, nurse, or other healthcare provider about pre-exposure prophylaxis (PrEP) to prevent HIV infection.” Response options were on a 5-point scale (1 = *never*, 5 = *always*) and were dichotomized for analysis (ever vs. never). The final item related to HIV/STI risk asked whether participants had ever been tested for HIV in their lifetime. Response options were “yes,” “no,” or “I don’t know.”

HIV Knowledge—In order to assess HIV knowledge, we used an adaptation of a scale reported in Janulis, Newcomb, Sullivan, and Mustanski (2018). Fourteen items reflected facts and myths about HIV (e.g., “Using a latex condom can lower a person’s chance of getting HIV,” “A person will not get HIV if they are taking antibiotics.”) Participants were asked to select “false,” “true,” or “I don’t know” in response to each item. Incorrect responses and responses of “I don’t know” were given a score of 0, and correct responses

were given a score of 1, such that higher sum scores reflected higher levels of HIV knowledge.

PrEP Awareness, Use, and Barriers—PrEP awareness, use, and barriers were assessed with a 7-item measure (Bauermeister et al., 2013). We introduced these items by presenting participants with the following background information about PrEP written by the study team: “The next couple of questions will be about what you know about and whether you use pre-exposure prophylaxis (PrEP), also known as Truvada. PrEP is a pill that you can take by mouth every day that can reduce your chances of being infected with HIV by up to 92%. PrEP is approved for adults and has to be prescribed by a doctor, and PrEP will probably be approved for teens soon. In some places, teens can get PrEP if they talk to their doctor about it. PrEP can be covered by health insurance, but not always. Minor side effects of PrEP include headaches, diarrhea and fatigue. These side effects often go away after stopping the medication. When people first start taking PrEP, their doctors watch them closely to make sure PrEP is safe for them.”

After reading this statement, participants completed the measure from Bauermeister et al. (2013). First, participants were asked if they had heard of PrEP prior to taking this survey. Response options were “yes” or “no.” Those who responded “yes” were then asked to identify their source of information from the following response options: “a friend,” “the media,” “a medical provider,” “a sex partner,” “online,” “an app,” or “other.” Those who chose “other” were prompted to provide a write-in response. Participants who indicated that they had previous knowledge of PrEP were also asked if they had ever taken PrEP prior to having sex (“yes,” “no”), and whether they had any friends who had taken PrEP prior to sex as a prevention strategy (“yes,” “no,” “not sure”). Finally, all participants were asked to rate their agreement with three PrEP-related perceived barriers: “I would not take PrEP drugs because I am concerned about their side effects,” “I would know how to get PrEP drugs if I wanted them” (reverse coded), and “I could not afford PrEP drugs.” Participants answered these final three questions using a 4-point scale (1 = strongly disagree, 4 = strongly agree).

Data Analysis

Data were analyzed using SPSS 25. Descriptive statistics were computed for all variables. Correlations examined relationships between PrEP awareness, use, and barriers and sociodemographic characteristics, knowledge/attitudes, and sexual health factors. Predictor variables that correlated with any of the PrEP outcome variables at $p < .05$ were entered into a series of multivariable regression models examining the associations between PrEP awareness and barriers, attitudinal and sexual behavior factors, and demographic factors including age, race/ethnicity, sexual orientation, and parental education. Regression type was matched to outcome variable structure: logistic for binary outcomes (PrEP awareness, use, and friends’ use of PrEP), and linear regressions for continuous outcomes (PrEP barriers). Data described in this manuscript are publicly available at <https://doi.org/10.21985/N25N2C>.

Results

Sample Characteristics

Participant characteristics are given in Table 1. Participants ranged in age from 15 to 17 years (M age = 16.38, SD = 0.74) and 39.3% identified as a racial or ethnic minority. Most participants identified as cisgender men (94.1%) and gay (74.9%), were out to at least one parent (71.7%), and had only ever had sex with male partners (79.9%). Of the 165 participants who had ever had anal sex with a male partner, 76.4% had ever had condomless anal sex (66.1% had condomless receptive sex; 50.3% had condomless insertive sex). Twenty-three percent of participants (n = 50) reported ever having an HIV test, and of those, all reported an HIV-negative status except one, who reported they did not know the results of their most recent test. Nine percent of the sample had ever spoken to a healthcare provider about PrEP. Participants lived in 43 states reflecting all four geographic regions of the country (South 33.3%, West 21.9%, Northeast 13.2%, Midwest 31.5%; CDC, 2017b). PrEP awareness did not differ by geographic location.

PrEP Awareness, Use, and Perceived Barriers

Over half (54.8%; n = 120) of the sample had heard about PrEP before participating in the study. Out of those who had heard of PrEP, most first heard of PrEP online (43.3%, n = 52), through the media (25.8%, n = 31), or through apps (16.7%, n = 20). Those who provided write-in responses to this item that did not fit into the above categories indicated that they heard of PrEP in health class or sex education (n = 5), research studies (n = 2), and either work or volunteer experiences in the healthcare field (n = 2). Few (2.5%, n = 3) had ever taken PrEP, and 10.8% (n = 13) reported that their friends had ever taken PrEP. All participants were then asked about perceived barriers to PrEP, and of those who responded to these items, 17.5% (n = 37) agreed or strongly agreed that they would not take PrEP due to concerns about side effects; 56.1% (n = 120) agreed or strongly agreed that they would not know how to access PrEP if they wanted it; and 50.5% (n = 102) agreed or strongly agreed that they could not afford PrEP.

Associations Between PrEP Awareness, Use, Barriers, and Participant Characteristics

Bivariate correlations (Table 2) indicated that having heard of PrEP prior to participating in the study was significantly associated with older age, identifying as gay versus a non-monosexual identity, ever having used a GSN application to meet male partners, greater perceived risk of HIV, greater HIV knowledge, ever having been tested for HIV, and having never engaged in condomless anal sex. Having taken PrEP was significantly associated with a greater number of lifetime sex partners, greater number of condomless insertive anal sex partners, and having spoken to a healthcare provider about PrEP. Having had peers take PrEP was associated with having talked to a provider about PrEP and having never had condomless anal sex. Number of condomless insertive anal sex partners was not significantly correlated with any other outcome variable. Number of condomless receptive anal sex partners was not significantly correlated with any outcome variable.

Regarding potential barriers to PrEP uptake, reluctance to take PrEP due to concerns about side effects was significantly associated with fewer lifetime sex partners, lower perceived

risk of HIV, lower HIV knowledge, never having heard of PrEP before the study, and believing that they would not know how to access PrEP if they wanted it. Not knowing how to access PrEP was significantly associated with identifying as a racial/ethnic minority, lower HIV knowledge, never having talked to a healthcare provider about PrEP, never having heard of PrEP before the study, and the belief that they could not afford PrEP. Finally, believing that one could not afford PrEP was associated with having parents who had less than a college education, not having heard of PrEP before the study, and having had condomless anal sex. Outness to parents was not significantly correlated with any of the outcome variables and as such was not carried forward into regression models. Overall, significant correlations were small to moderate in size.

Regression Models

As all sexual risk behavior variables were significantly and positively correlated with each other, we tested different regression models to examine which variable would provide the best fit. Lifetime sex partners were ultimately included as a predictor variable in the final models as it was inclusive of both receptive and insertive anal sex partners and all participants, whereas history of condomless anal sex only reflected a subset of participants. Results from regression models on the outcomes of PrEP awareness and barriers are presented in Table 3. A multivariable logistic regression model revealed that those who had heard about PrEP were more likely to be older; to identify as gay than as bisexual, queer, or another non-monosexual identity; to have somewhat fewer lifetime sex partners; to have used GSN applications; and to have greater HIV knowledge compared to those who had not heard of PrEP, $\chi^2(10, N=188) = 41.81, p < .001$. HIV testing and perceived risk of HIV was no longer significant. The model on friends who had ever taken PrEP was not statistically significant ($p = .70$), and the model on PrEP use failed to converge as too few people had ever used PrEP.

As barriers to PrEP uptake were all significantly correlated with having heard of PrEP before the study, multivariable linear regression analyses were restricted to the sample of youth who had previously been aware of PrEP. The model on not knowing how to access PrEP if one wanted it was significant, $F(10, 99) = 2.68, p = .006$, and perceived lack of access was uniquely predicted by greater lifetime sex partners, having never spoken to a healthcare provider about PrEP, and lower HIV knowledge. The model on concerns about being able to afford PrEP was significant, $F(10, 92) = 2.06, p = .035$, and uniquely predicted by greater perceived risk of HIV. Finally, the model on reluctance to take PrEP because of concerns about side effects was not statistically significant ($p = .117$).

Discussion

The approval of PrEP for those under age 18 in the US holds great promise in reducing new HIV infections among high-risk adolescents. However, the extent to which AMSM are aware of this HIV prevention tool and their perceived barriers have not been well studied. To our knowledge, this is among the first studies that has documented PrEP awareness among a sample comprised exclusively of minor AMSM, and contributes to the limited literature describing youth's perceived barriers to PrEP. Our findings suggest moderate levels of PrEP

awareness among our participants, and that more youth were concerned about their ability to access and afford PrEP than about its side effects.

PrEP awareness was higher among AMSM compared to studies of YMSM conducted shortly before (Rucinski et al., 2013) and after PrEP's initial FDA approval (Bauermeister et al., 2013). Awareness was also substantially higher in our sample compared to data collected from AMSM in 2015 (Thoma & Huebner, 2018). Most adolescents who had heard of PrEP reported learning about it through popular media or online. This cohort of SGM adolescents may be more aware of PrEP than youth in earlier studies given that, in recent years, it has been the focus of several large public health campaigns (e.g., CDC's Act Against AIDS; PrEP 4 Love in Chicago; PrEP for Sex in New York). In addition, use of GSN applications was the strongest predictor of PrEP awareness in our regression model. Although the association between GSN application use and PrEP awareness has not been studied directly to date, samples of YMSM recruited from GSN apps (Goedel et al., 2016; Holloway et al., 2017b) reported the highest awareness of PrEP relative to other studies of YMSM and transgender women recruited from other sources (e.g., Khanna et al., 2016; Kuhns et al., 2017; Strauss et al., 2017). As it is not uncommon for popular applications like Grindr and Scruff to display advertisements for PrEP and for users to disclose their PrEP status on their profiles (Newcomb, Mongrella, Weis, McMillen, & Mustanski, 2016), such applications may present a learning opportunity for the growing number of adolescents who use them (Macapagal et al., 2018). It could also be that the relationship between PrEP awareness and GSN application use reflects stronger ties to the SGM community, which itself has predicted PrEP awareness in previous research (Khanna et al., 2016; Kuhns et al., 2017). Nevertheless, as SGM adolescents demonstrate high rates of sexual health information seeking online relative to heterosexual, cisgender teens (Palmer et al., 2013), online advertisements, public health campaigns, and PrEP resources should tailor their content to SGM adolescents in order to increase awareness in this group.

Unsurprisingly, the percentage of adolescents who reported ever using PrEP was extremely low. Our 2.5% uptake rate was similar to some studies of YMSM (Bauermeister et al., 2013; Khanna et al., 2016; Marks et al., 2017; Rucinski et al., 2013) and higher than filled prescription rates among adolescents (Magnuson et al., 2018) and a prior study of AMSM (Thoma & Huebner, 2018). Regarding bivariate correlates of PrEP uptake, users reported having more lifetime partners, more condomless insertive anal sex partners, and having discussed PrEP with a healthcare provider. Consistent with past work (Holloway et al., 2017a; Kuhns et al., 2017; Marks et al., 2017), such proximal indicators related to HIV risk may be better predictors of PrEP uptake than sociodemographic characteristics or factors such as HIV knowledge, which were not associated with PrEP use among our sample. In addition, having friends who had ever taken PrEP, but not PrEP awareness, was significantly correlated with talking to a healthcare provider about PrEP. Peers could be influential in promoting PrEP awareness and subsequently youth's willingness to discuss PrEP with a provider. The correlation between awareness of peers' use of PrEP and engagement in PrEP discussions with a healthcare provider could also reflect a subset of youth who live in a culture or environment in which PrEP is discussed more openly. However, given the few adolescents who had used PrEP and whose friends had used PrEP in our study, these interpretations are merely speculative. Additional research should investigate characteristics

of substantially larger samples of adolescent PrEP users relative to non-users and the role of peer norms and SGM-affirming adolescent healthcare experiences in promoting PrEP awareness and use.

Regarding perceived barriers to PrEP use, less than 20% of youth indicated that side effect concerns would prevent them from taking PrEP. In contrast, in another study 42% of AMSM endorsed concerns about PrEP's minor side effects in the context of a hypothetical RCT (Fisher, Fried, Ibrahim Puri, et al., 2018). Instead, most of our sample was concerned about being able to access and afford PrEP. Our regression analyses suggest that relative to their counterparts, AMSM who had less sexual healthcare engagement, were less informed about HIV, and had more sex partners perceived greater barriers to accessing PrEP. In addition, youth who perceived themselves to be at greater risk of HIV were more likely to believe they could not afford PrEP. Together, these findings are concerning and suggest that youth in greater need of PrEP may be less likely to obtain it.

Although PrEP access and cost are certainly barriers for many adults (Bauermeister et al., 2013), they are particularly salient for minor adolescents, many of whom may depend on their parents for health insurance and financial resources. Previous research indicates that SGM adolescents are concerned about structural factors and logistics surrounding PrEP access, such as their ability to obtain medication refills and attend doctor visits for laboratory work related to PrEP, as well as the prospect of parental discovery of the medications (Fisher et al., 2016, 2017, 2018a). Moreover, other research on healthcare access among AMSM revealed concerns that a provider may disclose their sexual orientation identity or same-gender sexual behavior to their parents if they attempt to access AMSM-specific sexual healthcare (Fisher, Fried, Macapagal, & Mustanski, 2018b). In addition, AMSM who communicated more frequently with their parents about HIV, and who perceived their parents to communicate about HIV in an open, honest, and trustworthy manner, were more likely to be aware of PrEP, underscoring the importance of parent-child sexual health communication (Thoma & Huebner, 2018). Research on real-world PrEP implementation in minor adolescents should continue to investigate the role of parents and structural barriers in youth's ability to access and adhere to PrEP. Additionally, the feasibility of alternative delivery methods that may circumvent said barriers (e.g., injectable or on-demand PrEP instead of daily oral PrEP) and youth's interest in such methods should be explored (US Department of Health and Human Services, 2017). Future efforts to design PrEP messaging for adolescents should proactively address concerns about access and cost (e.g., inform youth about medication assistance programs; that PrEP can be covered by insurance but may appear on insurance statements seen by one's parents; ways to obtain PrEP even if their parents are not aware or accepting of their sexual identity or behavior) and information about PrEP should be embedded in school-based sex education when possible.

Limitations

There were several limitations to our study. Data were gathered from a cross-sectional survey, and as such we cannot infer causality. Participants received only a brief paragraph with PrEP information before completing the PrEP measure, and it is possible that with more detailed information about PrEP, their responses to the questions could have changed.

For example, the description did not include the fact that minor side effects often dissipate while taking the medication, which, if provided, could have mitigated participants' concerns about side effects. Moreover, the description preceding the PrEP items used a conservative estimate of PrEP's effectiveness (up to 92%; CDC, 2018b) whereas others report 94–99% reductions in HIV risk depending on the number of doses taken per week (Anderson et al., 2012). It is possible that this more conservative estimate could have adversely impacted participants' interest in or willingness to take PrEP. Our advertisements reflected imagery and terms related to the SGM community and several recruitment efforts were targeted at SGM adolescents who had previously expressed interest in or participated in HIV prevention research. Thus, our findings may not be generalizable to adolescents who might feel uncomfortable participating in research or responding to such advertisements (e.g., youth who are not out to their parents or who live in more socially conservative environments). That said, as more research opportunities in HIV prevention and sexual health in minor MSM have become available in the past several years, study participation presents an important opportunity for MSM to learn about PrEP.

In addition, these data were collected in the context of a larger study, which precluded us from examining PrEP awareness, knowledge and misconceptions, and barriers in more depth, and from assessing related variables such as health insurance status, prior experience or self-efficacy independently navigating sexual or MSM-specific healthcare, or motivation to seek out PrEP. In our analyses, we used lifetime sex partners as an indicator of sexual risk instead of condomless anal sex, which is used to determine PrEP candidacy. Not all of our participants had engaged in anal sex, which may reflect their relative youth compared to studies of PrEP awareness among older samples of MSM. Future research should examine multiple sexual risk indicators and their associations with PrEP awareness, uptake, and barriers among adolescents. Finally, as the sample of youth who had ever used PrEP was very small, findings involving this variable should be interpreted with caution as they may not be representative of the population of U.S. adolescent PrEP users; however, this number was similar to recent research on filled PrEP prescriptions for adolescents (Magnuson et al., 2018). Nevertheless, these findings are a necessary first step toward better understanding the PrEP landscape among an adolescent population at high risk of HIV.

Conclusion and Future Directions

PrEP awareness, knowledge, and use among adolescent populations are relatively uncharted territory. Research is direly needed to quickly and efficiently increase uptake within MSM. Our study suggests some initial directions that future researchers and public health professionals might follow to accomplish this important goal. First, promoting PrEP and providing PrEP education to youth through social media campaigns posted on both GSN applications for MSM and general social media platforms (i.e., Instagram, Snapchat) would be an important first step, given how influential our study found online spaces including GSN sites to be over awareness. Second, addressing barriers associated with PrEP uptake, in particular demystifying how to access PrEP prescriptions and cost assistance programs, might increase MSM's likelihood of engaging with healthcare providers about PrEP and their sexual health more generally. Although PrEP awareness did not vary by geographic location, continuing to monitor PrEP awareness and barriers among MSM living in

different regions and urban versus rural areas will be critical in targeting sexual health promotion efforts as these factors are hampering PrEP uptake in adults. Third, figuring out productive ways to bring parents into the discussion of their adolescents' sexual health might positively impact interest in, and eventual adherence to, a PrEP regimen (Thoma & Huebner, 2018). Finally, increasing awareness and decreasing stigma associated with PrEP among adolescents in public health campaigns and in sex education could create positive peer norms that, in turn, might influence the acceptability of PrEP use. These routes require future scientific inquiry, and HIV researchers should prioritize them as a means to establish parity in accessibility of PrEP for adult and adolescent SGMs. Six years of access for the former has already shown how much at-risk youth have to gain.

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Table 1

Descriptive statistics ($N = 219$)

	n	%
Race/ethnicity		
Asian	9	4.1
Black	14	6.4
Hispanic/Latino/x	30	13.7
Other	33	15.1
White (non-Hispanic/Latino/x)	133	60.7
Sexual orientation		
Bisexual	37	16.9
Gay	164	74.9
Mostly straight	1	0.5
Pansexual	8	3.7
Queer	4	1.8
Questioning/unsure	5	2.3
Gender identity		
Genderqueer or gender non-conforming	13	6.0
Cisgender man	206	94.1
Outness to parents/guardians		
Not out to parents	61	27.9
Out to at least one parent	157	71.7
I do not want to answer	1	0.5
Highest level of parental education, if known ($n = 213$)		
Less than college degree	98	46.0
College degree or higher	115	54.0
Gender of sexual partners		
Only guys	175	79.9
Mostly guys but some girls	29	13.2
Guys and girls equally	8	3.7
Mostly girls but some guys	4	1.8

Only girls	3	1.4
Ever used hookup apps for MSM		
Yes	154	70.3
No	65	29.7
Lifetime HIV testing		
No	153	69.9
Yes	50	22.8
I don't know	15	6.8
I don't want to answer	1	0.5
Ever talked to healthcare provider about PrEP (<i>n</i> = 210)		
Never	191	91.0
Rarely	11	5.2
Sometimes	7	3.3
Often	1	0.5
Ever heard about PrEP before today		
Yes	120	54.8
No	99	45.2
How did you first learn about PrEP (<i>n</i> = 120)		
Online	52	43.3
The media	31	25.8
An app	20	16.7
Other	9	7.5
A medical provider	4	3.3
A sex partner	2	1.7
A friend	2	1.7
Ever taken PrEP prior to having sex?		
No	117	97.5
Yes	3	2.5
Friends ever taken PrEP? (<i>n</i> = 120)		
No	58	48.3
Not sure	49	40.8
Yes	13	10.8

	M	SD
Perceived barriers to taking PrEP (range 1.00–4.00)		
Concern about side effects	1.90	0.75
Would not know how to get PrEP if I wanted	2.64	0.84
Could not afford PrEP	2.53	0.81
Perceived risk of HIV (range 1.00–4.50)	2.28	0.89
HIV knowledge (range 1.00–14.00)	10.00	2.41
	Mdn	IQR
HIV risk factors		
Lifetime sex partners ($n = 219$; range 0–50)	2.00	4.00
Lifetime AMAB anal sex partners ($n = 207$, range 0–45)	1.00	2.00
AMAB partners, unprotected receptive anal sex ($n = 165$, range 0–44)	1.00	2.00
AMAB partners, unprotected insertive anal sex ($n = 165$, range 0–15)	1.00	1.00

Differing Ns in individual sections due to survey branching logic and/or participants' selecting "I don't know" or "I don't want to answer" AMAB assigned male at birth

Correlations between PrEP awareness and barriers, sociodemographic characteristics, sexual health, HIV knowledge, and attitudes in AMSM (N = 219)

Table 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1. Ever heard about PrEP ^d	1																			
2. Ever taken PrEP ^d	-.e	1																		
3. Friends ever taken PrEP ^d	-.e	-.06	1																	
4. Would not take PrEP—side effects	-.30 ^c	-.01	-.12	1																
5. Would not know how to get PrEP	-.29 ^c	.01	-.18	.21 ^b	1															
6. Could not afford PrEP	-.21 ^b	-.01	-.22	.12	.21 ^b	1														
7. Age	.22 ^c	.11	-.05	-.09	-.04	-.03	1													
8. Racial/ethnic minority ^d	-.02	-.02	.00	.08	.14 ^a	.11	.08	1												
9. Parent(s) with college degree ^d	-.01	.04	-.03	.02	-.02	-.25 ^c	.01	-.03	1											
10. Identifies as gay ^d	.15 ^a	-.06	.08	-.11	.04	-.05	-.09	-.07	.03	1										
11. Out to parents ^d	-.06	.01	-.06	-.11	.06	-.05	-.06	-.09	.07	-.03	1									
12. Ever used GSN apps ^d	.27 ^c	.08	.02	.00	-.02	.11	.14 ^a	.09	-.09	.09	-.03	1								
13. Ever tested for HIV ^d	.21 ^b	.12	.18	-.11	-.12	.04	.14 ^a	.05	.00	.04	.19 ^b	.22 ^b	1							
14. Talked to provider about PrEP	.11	.45 ^c	.25 ^a	-.05	-.14 ^a	-.10	.06	-.04	.14	.12	-.13	.01	.26 ^c	1						
15. Lifetime sex partners	.03	.23 ^a	.08	-.15 ^a	.08	.03	.17 ^a	.03	-.05	-.04	.01	.27 ^c	.23 ^c	.06	1					
16. Condomless receptive anal sex partners	-.15	.13	-.17	-.07	-.04	.02	.07	-.04	-.03	.04	.02	.11	.20 ^a	.00	.58 ^c	1				
17. Condomless insertive anal sex partners	-.14	.38 ^c	-.16	-.11	.05	.07	.07	.01	-.05	-.01	.02	.10	.04	.18 ^a	.49 ^c	.20 ^a	1			
18. Ever had condomless anal sex ^d	-.16 ^a	.11	-.35 ^b	.12	.15	.22 ^b	.04	.10	-.16 ^a	.01	-.03	.11 ^a	.09	.04	.20 ^b	.23 ^b	.28 ^c	1		
19. HIV knowledge	.28 ^c	.13	-.06	-.22 ^b	-.17 ^a	-.12	.12	-.07	-.02	.10	.01	.21 ^b	.16 ^a	.05	.09	.00	-.02	-.0	1	
20. Perceived risk of HIV	.14 ^a	.14	.01	-.17 ^a	.10	.12	.06	.14 ^a	-.16 ^a	.09	.03	.10	.20 ^b	.03	.22 ^c	.13	-.02	.08	.07	1

For Pearson correlations conducted on two dichotomous variables, results generalize to the Phi coefficient, which provides the same test of independence as the Chi-square test. Race: 0 = non-Hispanic White, 1 = racial/ethnic minority; parental education: 0 = less than college degree, 1 = undergraduate or graduate degree; sexual orientation: 0 = does not identify as gay (e.g., bisexual), 1 = identifies as gay;

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0 = not out to parents, 1 = out to parents; app use: 0 = never used GSN apps, 1 = ever used GSN apps; HIV testing: 0 = never tested for HIV, 1 = ever tested for HIV, condomless anal sex: 0 = never had, 1 = ever had.

^cNo correlation coefficient produced because items only given to participants who endorsed "ever heard of PrEP." Ns in cells range from 61 to 219 due to item branching logic and responses of "I don't want to answer".

^a $p < .05$;

^b $p < .01$;

^c $p < .001$;

^ddichotomous variable

Table 3

Adjusted odds ratios, regression coefficients, and 95% confidence intervals for PrEP awareness and barriers among AMSM

Predictor	Ever heard of PrEP (<i>n</i> = 188) ^a	Would not know how to access PrEP (<i>n</i> = 110) ^b	Could not afford PrEP (<i>n</i> = 103) ^b
Age	1.98** [1.23, 3.18]	0.14 [-0.08, 0.36]	0.05 [-0.19, 0.29]
Racial/ethnic minority	0.63 [0.32, 1.25]	-0.02 [-0.33, 0.30]	0.25 [-0.08, 0.57]
Parent with college degree	0.84 [0.43, 1.66]	0.03 [-0.26, 0.32]	-0.26 [-0.57, 0.05]
Identifies as gay	2.12* [1.00, 4.48]	0.19 [-0.18, 0.56]	-0.07 [-0.44, 0.31]
Lifetime sex partners	0.96* [0.91, 1.00]	0.03* [0.003, 0.05]	-0.02 [-0.04, 0.01]
Ever used GSN apps	3.54*** [1.65, 7.58]	0.35 [-0.04, 0.73]	0.35 [-0.05, 0.76]
Ever tested for HIV	1.73 [0.73, 4.11]	-0.10 [-0.45, 0.24]	0.12 [-0.25, 0.48]
Talked to provider about PrEP	2.23 [0.52, 9.53]	-0.69** [-1.18, -0.20]	-0.37 [-0.87, 0.13]
HIV knowledge	1.20** [1.03, 1.39]	-0.07* [-0.14, -0.001]	-0.01 [-0.08, 0.07]
Perceived risk of HIV	1.34 [0.89, 2.02]	0.08 [-0.10, 0.27]	0.20* [0.00, 0.39]
Constant	-14.431	0.234	0.774

As vary due to missing cases; analyses on PrEP barriers restricted to sample of AMSM who had ever heard of PrEP. Dichotomous predictors coded as follows. Race: 0 = non-Hispanic White, 1 = racial/ethnic minority; parental education: 0 = less than college degree, 1 = undergraduate or graduate degree; sexual orientation: 0 = does not identify as gay (e.g., bisexual), 1 = identifies as gay; app use: 0 = never used GSN apps, 1 = ever used GSN apps; HIV testing: 0 = never tested for HIV, 1 = ever tested for HIV

* *p* .05;

** *p* .01;

*** *p* .001

^aOdds ratios (OR);

^bRegression coefficients (B)