

# HIV Care Providers' Intentions to Prescribe and Actual Prescription of Pre-Exposure Prophylaxis to At-Risk Adolescents and Adults

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## Abstract

Pre-exposure prophylaxis (PrEP) is indicated for use in US adults, and little is known about clinician intentions to prescribe and actual prescription of PrEP to adolescents younger than 18. Fifty-six clinicians who care for HIV-infected and at-risk youth completed an anonymous online survey in 2014. Primary outcomes were (1) intentions to prescribe PrEP to adolescents and adults in four risk categories [men who have sex with men (MSM), transgender women, heterosexuals with multiple partners of unknown HIV status, heterosexuals with HIV-infected partners]; and (2) actual prescription of PrEP to adolescents and adults in these risk groups. Independent variables included clinician characteristics, experience prescribing nonoccupational postexposure prophylaxis, familiarity with and knowledge of PrEP and PrEP guidance, attitudes toward PrEP, and facilitating factors for prescribing PrEP and incorporation of PrEP guidance into practice. Variables associated with intention to prescribe (“very likely to prescribe” vs. other responses) and actual prescription of PrEP stratified by age and risk category were identified in logistic regression models. Mean age was 45.9 years (standard deviation 10.7); 64% were physicians. More clinicians reported high intention to prescribe PrEP to adult versus adolescent MSM ( $p=0.02$ ) and transgender women ( $p=0.001$ ). Variables associated with intention to prescribe and prescription of PrEP differed by age and risk category. In adolescents, those variables included positive beliefs, higher number of facilitating factors, and fewer barriers to PrEP prescription. Designing strategies based on these findings that address both facilitating factors and barriers to PrEP prescription may improve PrEP uptake by at-risk youth.

**Keywords:** adolescents, pre-exposure prophylaxis, HIV, clinicians, prevention, patient care

## Introduction

**O**RAL PRE-exposure prophylaxis (PrEP)—the use of antiretroviral medication by HIV-uninfected people to prevent acquisition of HIV infection—significantly decreased the risk of HIV among men who have sex with men (MSM),<sup>1</sup> heterosexuals,<sup>2,3</sup> and injection drug users.<sup>4</sup> In response to published studies demonstrating the efficacy of PrEP, the US Centers for Disease Control and Prevention (CDC) released interim guidance for the use of PrEP in MSM

in 2011,<sup>5</sup> heterosexuals in 2012,<sup>6</sup> and injection drug users in 2013<sup>7</sup> to aid clinicians who were considering prescribing PrEP to adults. Following the US Food and Drug Administration (FDA) approval of a combination antiretroviral medication (tenofovir/emtricitabine; TDF-FTC) for use as PrEP in adults, the US Public Health Service released clinical guidelines for prescribing PrEP to adults in 2014.<sup>8</sup>

Although PrEP is only approved and recommended for use in adults, clinicians may consider prescribing PrEP to adolescents because US adolescents are significantly impacted

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by HIV. In 2015, 4.4% of new HIV infections were diagnosed in 13- to 19-year olds, while an additional 18% of infections were diagnosed in 20- to 24-year olds<sup>9</sup>—many of whom likely acquired HIV as adolescents. Not only would youth at risk of HIV benefit from PrEP, but PrEP is acceptable to high-risk adolescents and young adults—including MSM, women, and transgender women.<sup>10–13</sup> In two US open-label studies of PrEP, daily oral HIV prevention was reported to be acceptable to most MSM ages 18–22<sup>14</sup> and ages 15–17 years.<sup>15</sup> Thus, PrEP is an acceptable intervention for adolescents and young adults and could help decrease the rates of HIV in this vulnerable age group. However, clinicians must be willing to prescribe PrEP in order for youth to have access to it.

Prescribing PrEP to adolescents younger than 18 is associated with unique barriers and considerations for clinicians<sup>16</sup> because the medication is not approved for this age group and these youth are under the legal age of majority. The use of medication in an age group other than that for which it was officially approved by a regulatory body (such as the FDA) is considered “off-label” use; such prescribing is acceptable and common, particularly in pediatrics.<sup>17</sup> The FDA-approved medication for PrEP, TDF-FTC, is currently approved for use in the treatment of HIV-1 infection in adolescents.<sup>18</sup> Although studies have described clinician intentions to prescribe and actual prescription of PrEP,<sup>19–24</sup> participants were predominantly clinicians who care for adults.

Thus, little is known about clinician intentions to prescribe PrEP to adolescents younger than 18 and whether these intentions are different from those toward prescribing PrEP to adults 18 and older. Even less is known about modifiable factors that impact clinician intentions to prescribe PrEP to adolescents. Such information is critical to the design of interventions to improve clinician adoption of PrEP, which is necessary to the successful use of this innovation by youth at risk of HIV. Therefore, we examined intention to prescribe, and actual prescription of, PrEP to adolescents younger than 18 and adults 18 and older, as well as factors associated with prescribing intentions and behaviors, among clinicians who care for HIV-infected and at-risk youth. This target population was chosen because these clinicians have expertise with the medications used for PrEP and contact with potential PrEP candidates (sexual partners of their HIV-infected patients); therefore, these clinicians are likely to be early adopters of PrEP use in adolescents and serve as opinion leaders for other clinicians with respect to PrEP use in youth.

## Materials and Methods

The current study was the quantitative phase of a mixed methods study designed to describe clinician attitudes toward, and practices around, PrEP use in youth. Participants were recruited through the National Institutes of Health-funded Adolescent Medicine Trials Network for HIV/AIDS Interventions (ATN), a research network that includes clinicians who provide clinical care to HIV-infected and at-risk adolescents. Potential participants were clinicians (defined as physicians, nurse practitioners, and physician assistants) who were based at one of the 14 US locations and provided care to HIV-infected youth. The ATN provided names and contact information for clinicians affiliated with the network. Clinicians who participated in the earlier portions of the study were excluded from the survey study.

Eligible clinicians ( $n=90$ ) received an e-mail inviting them to participate, which included a unique link to an Internet-based survey (SurveyMonkey®, San Mateo, CA). This platform recorded anonymous responses while allowing tracking of nonresponders. Reminder e-mails were sent to incomplete responders or nonresponders every 3 weeks (up to four reminders). Responses were collected between January and April 2014. The study received Institutional Review Board approval from the first author’s institution with a waiver of the requirement for written informed consent.

Survey items were informed by the results of the qualitative phase of the study,<sup>16,25</sup> the Theory of Planned Behavior and Diffusion of Innovations Theory,<sup>26,27</sup> and literature review. The overall survey assessed PrEP-related attitudes and practices related to caring for youth ages 13–24 years. The primary outcomes were (1) intentions to prescribe PrEP to at-risk adults ( $\geq 18$  years of age) and at-risk adolescents ( $< 18$  years of age) in four risk groups: MSM, transgender women who have sex with men (transgender women), heterosexuals with multiple partners of unknown HIV status, and heterosexuals with HIV-infected partners; and (2) actual prescription of PrEP to adults and adolescents in these risk groups. For each age and risk group combination (i.e., adult MSM, adolescent MSM, etc.), intention to prescribe PrEP was measured with a single item (“How unlikely or likely are you to offer PrEP to the following patients?”). Responses were measured on a 5-point Likert-type scale ranging from “very unlikely to prescribe” to “very likely to prescribe.” Actual prescription of PrEP (“Have you ever prescribed PrEP to the following patients?”) was measured as “yes/no.”

Independent variables included demographics, professional and practice characteristics, experience prescribing nonoccupational postexposure prophylaxis (nPEP) for HIV, experience discussing PrEP with patients, self-rated familiarity with and objectively measured knowledge about PrEP and the CDC interim PrEP guidance, attitudes toward PrEP and implementation of PrEP, and facilitating factors for prescribing PrEP and incorporating the CDC interim PrEP guidance into practice. At the time that the survey was administered, the CDC interim guidance for PrEP use in heterosexually active adults<sup>6</sup> and adult MSM<sup>5</sup> were in use. Knowledge about PrEP and the CDC interim PrEP guidance (for MSM and heterosexuals) were each measured with a 5-item scale, with response options of “true/false/I don’t know.”

The remaining scales, developed from the findings of our qualitative study<sup>16,25</sup> and defined during survey development, used a 5-point Likert-type response format. Items assessing barriers to PrEP were asked both with respect to prescribing PrEP to a patient of any age (patient-level barriers and provider-level barriers) and specifically with respect to prescribing PrEP to adolescents younger than 18 (barriers related to PrEP use in patients younger than 18). The inclusion of specific items within each scale was based on the results of the formative qualitative phase of the study.<sup>16,25</sup> Cronbach’s alphas for independent variable scales ranged from 0.66 to 0.85 (Table 1). Scale scores were created by calculating the mean response to scale items.

Descriptive analyses were performed to examine the independent variables and outcomes: intentions to prescribe PrEP and actual prescription of PrEP. For analysis, responses for the outcomes related to intentions to prescribe PrEP were dichotomized into “very likely to prescribe” versus all other

TABLE 1. SURVEY SCALES FOR INDEPENDENT VARIABLES

Scale	Cronbach's alpha <sup>a</sup>	No. of items	Mean scale score (SD) [range]
Knowledge about PrEP	N/A	5	3.5 (1.1) [1–5]
Knowledge about the CDC PrEP guidance	N/A	5	3.4 (1.2) [1–5]
Patient-level barriers to prescribing PrEP <sup>b,d</sup>	0.66	4	3.3 (0.9) [1–5]
Provider-level barriers to prescribing PrEP <sup>b,e</sup>	0.84	16	2.7 (0.6) [1–4]
Barriers related to PrEP use in patients younger than 18 <sup>b,f</sup>	0.85	10	2.9 (0.8) [1–4]
Attitudes toward cost and resource issues related to prescribing PrEP <sup>b</sup>	0.77	8	2.9 (0.7) [2–5]
Cost and insurance factors impacting clinician likelihood of prescribing PrEP <sup>b</sup>	0.80	4	2.8 (1.1) [1–5]
Facilitating factors for prescription of PrEP <sup>c,g</sup>	0.79	8	4.1 (0.7) [2–5]
Facilitating factors for use of the CDC interim PrEP guidance <sup>c,h</sup>	0.85	6	4.2 (0.6) [3–5]

<sup>a</sup>Items included in constructs with Cronbach's alpha of "N/A" were summed to create an index score reflecting number of correct knowledge items.

<sup>b</sup>Higher score indicates participant endorsement of more barriers.

<sup>c</sup>Higher score indicates greater endorsement of facilitating factors.

<sup>d</sup>"Patient-level barriers to prescribing PrEP" included items assessing concerns about: disclosure of patient's sexual orientation or risk behaviors through medical insurance billing, adolescent ability to understand risks/benefits of PrEP, patient's unwillingness to take daily medication for prevention.

<sup>e</sup>"Provider-level barriers to prescribing PrEP" included items assessing concerns about: personal ethical concerns, provider ability to provide sufficient information for a patient to provide informed consent for PrEP, ability of subgroups of youth to adhere to PrEP (homeless, those with mental health or substance use disorders, participants in transactional sex), ensuring patients are HIV uninfected, development of viral resistance, patients selling or sharing PrEP, risk compensation, short- and long-term side effects, use in pregnancy, real-world effectiveness, negative attitudes of colleagues toward PrEP, and organizational support for providing PrEP.

<sup>f</sup>"Barriers related to PrEP use in patients younger than 18" included items assessing concerns about: whether PrEP can be prescribed without parental involvement, negative reactions from parents toward adolescent PrEP users, need to involve parents in the event of side effects, negative publicity associated with prescribing to adolescents, need for social services interventions in adolescents at sufficient risk of HIV to warrant PrEP, bone health, off-label use, ability of adolescents to adhere to PrEP and follow-up visits, and ability of adolescents to understand the limits of protection afforded by PrEP.

<sup>g</sup>"Facilitating factors for prescription of PrEP" included: education of the general community, pharmacists, and primary care providers; guidance on behavioral interventions to be delivered with PrEP; having personal experience prescribing PrEP; ability to electronically prescribe PrEP; having an anonymous clinic site; and having an electronic medical record.

<sup>h</sup>"Facilitating factors for use of the CDC interim PrEP guidance" included: incorporation of the guidance into the electronic medical record; inclusion of guidance about counseling about development of viral resistance with intermittent PrEP use, use of PrEP in pregnancy and couples attempting to conceive; additional research supporting benefits of PrEP in youth; and having personal experience using the guidance.

CDC, Centers for Disease Control and Prevention; PrEP, pre-exposure prophylaxis; SD, standard deviation.

responses because the distribution of responses was skewed. To compare clinician intentions to prescribe to adult patients overall versus adolescent patients overall, we summed the responses for the four items measuring intention to prescribe to adults and then calculated the mean for these responses across all respondents to create a mean summed score for intention to prescribe to adults of all risk categories. The same steps were followed to calculate a mean summary score for intention to prescribe to adolescents of all risk categories. A Sign test for paired data was used to compare intentions to prescribe PrEP to adults versus adolescents. McNemar's test was used to compare actual prescription of PrEP to adults versus adolescents.

To examine factors associated with intention to prescribe PrEP and actual prescription of PrEP across patient ages and risk groups, we used logistic regression with generalized estimating equations. Because the survey items assessed intention to prescribe and actual prescription of PrEP by age and risk categories as described above, we derived a composite binary outcome variable with repeated measurements by combining the eight age- and risk-specific individual outcomes for intention to prescribe. Patient age and risk groups were then included as independent variables, in addition to the other independent variables described above. Independent variables associated with intention to prescribe with  $p < 0.10$  in univariable models were entered into the

multi-variable model, and variables that were associated with intention to prescribe PrEP at  $p < 0.05$  in the multi-variable model were retained in the final model. The same process was used to examine factors associated with actual prescription of PrEP across patient ages and risk groups.

We next examined factors that were associated with intention to prescribe PrEP, and actual prescription of PrEP, to each age and risk group combination. Univariable logistic regression modeling was used to examine relationships between independent variables and intentions to prescribe PrEP and actual prescription of PrEP to adults and adolescents in the different risk groups. Independent variables associated with outcomes with  $p < 0.10$  in univariable analyses were entered into separate multi-variable logistic regression models for each outcome (intention to prescribe PrEP to adults and adolescents, stratified by risk group; i.e., MSM, transgender women, heterosexuals with multiple partners, and heterosexuals with known HIV-infected partners).

Univariable and multi-variable logistic regression models were used to examine independent variables associated with (1) intention to prescribe PrEP to adults in all of the risk groups combined; (2) intention to prescribe PrEP to adolescents in all of the risk groups combined; (3) actual prescription of PrEP to adults; and (4) actual prescription of PrEP to adolescents. Variables that were associated with outcomes at  $p < 0.05$  in the multi-variable models were retained in the final models.

**Results**

*Participant characteristics*

Of 90 clinicians contacted for participation in the study, 6 were ineligible and 28 did not respond. Therefore, 56 clinicians (physicians and nurse practitioners) of 84 eligible were included in this analysis (67% response rate). Mean participant age was 45.9 years [standard deviation (SD) 10.7; Table 2]. Half ( $n=27$ ; 50%) self-described as non-Hispanic white race; 43 (77%) reported female gender at birth. Most ( $n=36$ ; 64%) were physicians, with 13 (37%) of these reporting subspecialty training in adolescent medicine. Mean length of time working with HIV-infected or at-risk youth was 13.6 years (SD, 8.9; range, 0.5–33 years).

The mean lower age limit of patients in clinicians' overall practices was 8.4 years (SD, 7.3; range, 0–27 years), and the mean upper age limit of patients was 34.4 years (SD, 22.8; range, 0–100 years). Mean percentage of patients younger than 18 in clinicians' overall practices was 37.7 (SD, 29.0;

range, 0–98); four participants reported seeing no patients younger than 18. Participants reported providing care to an average of 13.9 (SD 14.6) adolescents younger than 18 and 7.9 (SD 10.6) HIV-infected adolescents younger than 18 per week. More than half of participants reported being “very familiar” with the use of PrEP, and a greater percentage of participants reported this degree of familiarity with the CDC interim guidance for use of PrEP in MSM versus heterosexuals (57% vs. 32%).

*Intention to prescribe PrEP by age and risk category*

As shown in Table 3, significantly more clinicians reported being “very likely” to prescribe PrEP in the future to an adult versus adolescent MSM ( $n=66\%$  vs.  $54\%$ ;  $p=0.02$ ) and transgender woman ( $70\%$  vs.  $50\%$ ;  $p=0.001$ ), but not a heterosexual with partners of unknown HIV status or known HIV-infected partner. When intention to prescribe across all four risk categories was examined, intention to prescribe

TABLE 2. PARTICIPANT AND PRACTICE CHARACTERISTICS (N=56)

Characteristics	No. (%) <sup>a,b</sup>	Mean (SD) [range]
Age (years)		45.9 (10.7) [28–66]
Race/ethnicity		
Non-Hispanic white	27 (50)	
Non-Hispanic black or African American	12 (22)	
Hispanic	7 (13)	
Non-Hispanic multiple races	2 (4)	
Other	6 (11)	
Gender at birth		
Female	43 (77)	
Training background		
Physician	36 (64)	
Nurse practitioner	20 (36)	
Physician specialty <sup>c</sup>		
Family medicine, pediatrics, internal medicine, immunology without subspecialty training	6 (17)	
Subspecialty training in adolescent medicine, any specialty	13 (37)	
Subspecialty training in infectious diseases, pediatric specialty	9 (26)	
Subspecialty training in infectious diseases, other specialty training	7 (20)	
Primary practice location		
Urban	55 (98)	
Suburban	1 (2)	
Years worked with HIV-infected or at-risk youth		13.6 (8.9) [0.5–33]
Age range of patients seen in clinician's overall practice		
Lower age limit		8.4 (7.3) [0–27]
Upper age limit		34.4 (22.8) [0–100]
Percentage of patients in clinician's overall practice younger than 18		37.7 (29.0) [0–98] <sup>d</sup>
No. of adolescents younger than 18 seen per week		13.9 (14.6) [0–60]
No. of HIV-infected adolescents younger than 18 seen per week		7.9 (10.6) [0–50]
Self-rated familiarity with use of PrEP and CDC interim PrEP guidance		
Very familiar with use of PrEP	29 (55)	
Very familiar with CDC guidance for PrEP use in men who have sex with men	30 (57)	
Very familiar with CDC guidance for PrEP use in heterosexuals	17 (32)	
Experience prescribing PrEP		
Ever prescribed PrEP to an adult (18 or older)	35 (63)	
Ever prescribed PrEP to an adolescent (younger than 18)	22 (39)	

<sup>a</sup>Numbers vary due to missing values.

<sup>b</sup>Percent may not add to 100% due to rounding.

<sup>c</sup>Participants could select more than one area of specialty training.

<sup>d</sup>Four participants reported seeing no patients younger than 18.

CDC, Centers for Disease Control and Prevention; PrEP, pre-exposure prophylaxis; SD, standard deviation.

TABLE 3. CLINICIAN REPORTED INTENTION TO PRESCRIBE AND ACTUAL PRESCRIPTION OF PRE-EXPOSURE PROPHYLAXIS

Risk category	Intention to prescribe PrEP N (%) very likely to prescribe PrEP			Actual prescription of PrEP N (%) who ever prescribed PrEP		
	Adult (18 and older)	Adolescent (younger than 18)	p	Adult (18 and older)	Adolescent (younger than 18)	p
	MSM	33 (66)	27 (54)	<b>0.02</b>	27 (54)	15 (29)
Transgender woman who has sex with men	35 (70)	25 (50)	<b>0.001</b>	10 (20)	5 (10)	0.06
Heterosexual with multiple partners of unknown HIV status	26 (52)	20 (40)	0.06	6 (12)	5 (10)	1.0
Heterosexual with known HIV-infected sexual partner	39 (78)	36 (72)	0.13	14 (27)	7 (14)	0.07

MSM, men who have sex with men; PrEP, pre-exposure prophylaxis.

was higher for all adults versus all adolescents (18.0 [SD 2.8] vs. 17.2 [SD 3.3],  $p=0.0007$ ).

#### Factors associated with intention to prescribe PrEP: overall

In multi-variable modeling, suburban practice location (vs. urban;  $p=0.0001$ ), lower knowledge about the CDC PrEP guidance ( $p=0.04$ ), lower endorsement of cost and insurance factors impacting clinician likelihood of prescribing PrEP ( $p=0.02$ ), patient age  $\geq 18$  years (vs.  $<18$  years;  $p=0.0003$ ), and patient risk groups of heterosexual with HIV-infected partner (vs. heterosexual with multiple partners;  $p<0.0001$ ), MSM (vs. heterosexual with multiple partners;  $p=0.02$ ), and transgender woman (vs. heterosexual with multiple partners;  $p=0.007$ ) were associated with greater intention to prescribe PrEP (Table 4).

Results of univariable models for factors associated with intention to prescribe, and actual prescription of, PrEP to adults and adolescents by risk group are shown in Tables 5, 6, 8, and 9.

#### Factors associated with intention to prescribe PrEP to adults

MSM and transgender woman. No variables were associated with intention to prescribe PrEP to an adult MSM and transgender woman in multi-variable models (Table 5).

Heterosexual with multiple partners. In multi-variable models, being a nurse practitioner (vs. a physician;  $p=0.008$ ) was associated with greater intention to prescribe PrEP to adult heterosexuals with multiple partners, while having an older “lower age limit” seen in the practice was associated with lower intention to prescribe PrEP to an adult heterosexual with multiple partners ( $p=0.03$ ) (Table 5).

Heterosexual with HIV-infected partner. In multi-variable modeling, being a nurse practitioner (vs. physician;  $p=0.04$ ) and having fewer barriers related to PrEP use in adolescents younger than 18 ( $p=0.04$ ) were associated with greater intention to prescribe PrEP to an adult heterosexual patient with an HIV-infected partner (Table 5).

Summary measure. In multi-variable models, lower knowledge about the CDC interim PrEP guidance was associated with greater intention to prescribe PrEP to an adult ( $p=0.03$ ) (Table 5).

#### Factors associated with intention to prescribe PrEP to adolescents

Men who have sex with men. In multi-variable models, greater endorsement of facilitating factors for prescribing

TABLE 4. INDEPENDENT VARIABLES ASSOCIATED WITH CLINICIAN INTENTION TO PRESCRIBE PRE-EXPOSURE PROPHYLAXIS OVERALL: RESULTS OF UNADJUSTED AND ADJUSTED LOGISTIC REGRESSION MODELS

Variable <sup>a</sup>	Unadjusted OR (95% CI) <sup>b</sup>	Adjusted OR (95% CI) <sup>c</sup>
Nurse practitioner (vs. physician)	2.26 (0.93–5.46)	
<b>Suburban practice location (vs. urban)</b>	<b>4.76 (3.03–7.69)</b>	<b>9.09 (3.03–33.33)</b>
<b>Lower knowledge about CDC PrEP guidance</b>	1.02 (1.00–1.03)	<b>1.02 (1.00–1.04)</b>
More barriers related to cost and resource issues	1.64 (0.94–2.87)	
<b>Lower endorsement of cost and insurance factors impacting clinician likelihood of prescribing PrEP</b>	1.41 (0.94–2.13)	<b>1.79 (1.11–2.86)</b>
<b>Patient age <math>\geq 18</math> years (vs. <math>&lt;18</math> years)</b>	<b>1.69 (1.28–2.23)</b>	<b>1.85 (1.33–2.58)</b>
Risk group (vs. heterosexual with multiple partners)		
<b>Heterosexual with HIV-infected partner</b>	<b>3.52 (2.12–5.85)</b>	<b>4.18 (2.40–7.27)</b>
<b>MSM</b>	<b>1.76 (1.10–2.81)</b>	<b>1.91 (1.11–3.28)</b>
<b>Transgender woman</b>	<b>1.76 (1.17–2.65)</b>	<b>1.91 (1.19–3.07)</b>

<sup>a</sup>Variables in bold are significant in the adjusted model ( $p<0.05$ ).

<sup>b</sup>ORs presented are significant at  $p<0.10$  and were entered into the adjusted logistic regression model. ORs and CIs in bold are significant at  $p<0.05$ .

<sup>c</sup>ORs in bold were significant in the adjusted model ( $p<0.05$ ). Nonsignificant variables were not included in the final model.

CDC, Centers for Disease Control and Prevention; CI, confidence interval; MSM, men who has sex with men; OR, odds ratio; PrEP, pre-exposure prophylaxis.

TABLE 5. INDEPENDENT VARIABLES ASSOCIATED WITH CLINICIAN INTENTION TO PRESCRIBE PRE-EXPOSURE PROPHYLAXIS TO ADOLESCENTS YOUNGER THAN 18: RESULTS OF UNADJUSTED AND ADJUSTED LOGISTIC REGRESSION MODELS

<i>Risk category</i>	<i>Variable<sup>a</sup></i>	<i>Unadjusted OR (95% CI)<sup>b</sup></i>	<i>Adjusted OR (95% CI)<sup>c</sup></i>
MSM	<b>Greater endorsement of facilitating factors for prescribing PrEP</b>	<b>2.73 (1.05–7.10)</b>	<b>2.73 (1.05–7.10)</b>
	Lower percentage of patients younger than 18 in overall practice	1.02 (1.00–1.04)	
	Fewer provider-level barriers to prescribing PrEP	2.27 (0.86–5.88)	
	Fewer barriers related to PrEP use in patients younger than 18	2.13 (0.96–4.55)	
	Greater endorsement of facilitating factors for use of CDC guidance	2.37 (0.88–6.42)	
Transgender woman	<b>Fewer provider-level barriers to prescribing PrEP</b>	<b>3.33 (1.18–9.09)</b>	<b>3.33 (1.18–9.09)</b>
	Lower endorsement of cost and insurance factors impacting clinician likelihood of prescribing PrEP	<b>1.92 (1.08–3.57)</b>	
Heterosexual with multiple partners	<b>Belief that a multi-disciplinary team is not necessary to deliver PrEP</b>	<b>4.67 (1.03–21.07)</b>	<b>4.67 (1.03–21.07)</b>
Heterosexual with HIV-infected partner	<b>Nurse practitioner (vs. physician)</b>	4.80 (0.94–24.61)	<b>9.76 (1.3–73.59)</b>
	<b>Lower endorsement of cost and insurance factors impacting clinician likelihood of prescribing PrEP</b>	<b>2.08 (1.04–4.17)</b>	<b>4.55 (1.59–14.29)</b>
	<b>Greater endorsement of facilitating factors for prescription of PrEP</b>	2.79 (0.99–7.90)	<b>7.40 (1.74–31.58)</b>
	Fewer barriers related to PrEP use in patients younger than 18	<b>2.94 (1.06–8.33)</b>	
Summary measure of all risk categories	<b>More barriers related to cost and resource issues</b>	<b>2.63 (1.03–6.71)</b>	<b>5.92 (1.70–20.64)</b>
	<b>Fewer provider-level barriers to prescribing PrEP</b>	<b>2.94 (1.08–8.33)</b>	<b>7.14 (1.85–33.33)</b>

<sup>a</sup>Variables in bold are significant in the adjusted model ( $p < 0.05$ ).

<sup>b</sup>ORs presented are significant at  $p < 0.10$  and were entered into the adjusted logistic regression model. ORs and CIs in bold are significant at  $p < 0.05$ .

<sup>c</sup>ORs in bold were significant in the adjusted model ( $p < 0.05$ ). Nonsignificant variables were not included in the final model.

CDC, Centers for Disease Control and Prevention; CI, confidence interval; MSM, men who have sex with men; OR, odds ratio; PrEP, pre-exposure prophylaxis.

TABLE 6. INDEPENDENT VARIABLES ASSOCIATED WITH CLINICIAN INTENTION TO PRESCRIBE PRE-EXPOSURE PROPHYLAXIS TO ADULT PATIENTS AGE 18 AND OLDER: RESULTS OF UNADJUSTED AND ADJUSTED LOGISTIC REGRESSION MODELS

<i>Risk category</i>	<i>Variable<sup>a</sup></i>	<i>Unadjusted OR (95% CI)<sup>b</sup></i>	<i>Adjusted OR (95% CI)<sup>c</sup></i>
MSM	Lower knowledge about CDC PrEP guidance	1.61 (0.93–2.78)	
Transgender woman	Lower knowledge about CDC PrEP guidance	1.67 (0.94–2.94)	
Heterosexual with multiple partners	<b>Nurse practitioner (vs. physician)</b>	<b>5.83 (1.56–21.87)</b>	<b>7.22 (1.68–30.93)</b>
	<b>Older age for lower limit of age of patients in practice</b>	<b>0.92 (0.84–1.00)</b>	<b>0.90 (0.81–0.99)</b>
	Lower knowledge about CDC PrEP guidance	<b>1.69 (1.01–2.86)</b>	
Heterosexual with HIV-infected partner	More barriers related to cost and resource issues	2.19 (0.90–5.32)	
	<b>Nurse practitioner (vs. physician)</b>	7.73 (0.90–66.39)	<b>11.61 (1.16–115.81)</b>
	<b>Fewer barriers related to PrEP use in adolescents younger than 18</b>	3.03 (0.96–9.09)	<b>4.55 (1.08–20.00)</b>
	Lower endorsement of cost and insurance factors impacting clinician likelihood of prescribing PrEP	1.92 (0.93–4.00)	
Summary measure of all risk categories	<b>Lower knowledge about CDC PrEP guidance</b>	<b>1.82 (1.08–3.13)</b>	<b>1.82 (1.08–3.13)</b>
	Greater endorsement of cost and resource issues impacting prescription of PrEP	<b>2.55 (1.01–6.43)</b>	
	Nurse practitioner (vs. physician)	3.33 (0.99–11.22)	
	Older age for lower limit of age of patients in practice	0.93 (0.85–1.01)	

<sup>a</sup>Variables in bold are significant in the adjusted model ( $p < 0.05$ ).

<sup>b</sup>ORs presented are significant at  $p < 0.10$  and were entered into the adjusted logistic regression model. ORs and CIs in bold are significant at  $p < 0.05$ .

<sup>c</sup>ORs in bold were significant in the adjusted model ( $p < 0.05$ ). Nonsignificant variables were not included in the final model.

CDC, Centers for Disease Control and Prevention; CI, confidence interval; MSM, men who have sex with men; OR, odds ratio; PrEP, pre-exposure prophylaxis.

PrEP was associated with greater intention to prescribe PrEP to an adolescent MSM ( $p=0.04$ ) (Table 6).

**Transgender woman.** In multi-variable modeling, having fewer provider-level barriers was associated with greater intention to prescribe PrEP to an adolescent transgender woman ( $p=0.02$ ) (Table 6).

**Heterosexual with multiple partners.** In multi-variable models, clinician report that a multi-disciplinary team is not necessary for the delivery of PrEP was associated with greater intention to prescribe PrEP to an adolescent heterosexual with multiple partners ( $p=0.045$ ) (Table 6).

**Heterosexual with HIV-infected partner.** In multi-variable models, being a nurse practitioner (vs. physician;  $p=0.03$ ), lower endorsement of cost and insurance factors impacting clinician likelihood of prescribing PrEP ( $p=0.005$ ), and greater endorsement of facilitating factors for prescribing PrEP ( $p=0.007$ ) were associated with greater intention to prescribe PrEP to an adolescent heterosexual with an HIV-infected partner (Table 6).

**Summary measure.** When considering all adolescent risk categories combined, endorsing more barriers related to cost and resource issues ( $p=0.005$ ) and having fewer provider-level barriers to prescribing PrEP ( $p=0.005$ ) were associated with greater intention to prescribe PrEP to an adolescent (Table 6).

#### Actual prescription of PrEP by age and risk category

A higher percentage of clinicians reported having ever prescribed PrEP to an adult versus an adolescent, although the difference did not reach statistical significance (63% vs.

39%,  $p=0.08$ ) (Table 3). Clinicians were significantly more likely to have prescribed PrEP to an adult versus an adolescent MSM (54% vs. 29%;  $p<0.001$ ).

#### Factors associated with actual prescription of PrEP: overall

In multi-variable modeling, having discussed PrEP with patients who are HIV infected ( $p=0.007$ ) and HIV uninfected ( $p<0.001$ ), having fewer provider-level barriers to prescribing PrEP ( $p=0.048$ ), patient age  $\geq 18$  years (vs.  $<18$  years;  $p=0.0006$ ), patient risk groups of heterosexual with HIV-infected partner (vs. heterosexual with multiple partners;  $p=0.034$ ), and MSM (vs. heterosexual with multiple partners;  $p<0.0001$ ) were associated with increased odds of having prescribed PrEP (Table 7).

#### Factors associated with actual prescription of PrEP to adults

**Men who have sex with men.** In multi-variable models, having prescribed nPEP to an adult two or more times (vs. 0–1 time) was associated with increased odds of having prescribed PrEP to an adult MSM ( $p<0.001$ ) (Table 8).

**Transgender woman.** In multi-variable models, non-Hispanic white race (vs. all other race/ethnicity;  $p=0.02$ ), lower percentage of patients younger than 18 in the practice ( $p=0.04$ ), and having prescribed nPEP to an adult two or more times (vs. 0–1 time;  $p=0.02$ ) were associated with increased odds of having prescribed PrEP to an adult transgender woman (Table 8).

**Heterosexual with multiple partners.** In multi-variable models, no independent variables were associated with

TABLE 7. INDEPENDENT VARIABLES ASSOCIATED WITH ACTUAL CLINICIAN PRESCRIPTION OF PRE-EXPOSURE PROPHYLAXIS OVERALL: RESULTS OF UNADJUSTED AND ADJUSTED LOGISTIC REGRESSION MODELS

Variable <sup>a</sup>	Unadjusted OR (95% CI) <sup>b</sup>	Adjusted OR (95% CI) <sup>c</sup>
<b>Urban practice location (vs. suburban)</b>	<b>1.99 (1.31–3.01)</b>	
Prescribed nPEP $\geq 2$ times to adults age 18 and older (vs. 0–1 time)	<b>5.26 (1.64–16.67)</b>	
Prescribed nPEP $\geq 2$ times to patients younger than 18 (vs. 0–1 time)	2.22 (0.98–5.00)	
<b>Discussed PrEP with HIV-infected patients <math>\geq 2</math> times (vs. 0–1 time)</b>	<b>20.00 (3.22–100.00)</b>	<b>12.5 (1.96–100.00)</b>
<b>Discussed PrEP with HIV-uninfected patients <math>\geq 2</math> times (vs. 0–1 time)</b>	<b>10.00 (3.70–25.00)</b>	<b>7.14 (2.94–20.00)</b>
Belief that behavioral interventions are not necessary for PrEP delivery	2.99 (0.84–10.70)	
Greater number of HIV-infected patients younger than 18 cared for by clinician per week	1.03 (1.00–1.07)	
Older upper age of patients in overall practice	<b>1.02 (1.00–1.03)</b>	
<b>Fewer provider-level barriers to prescribing PrEP</b>	<b>2.27 (1.19–4.17)</b>	<b>2.08 (1.01–4.35)</b>
<b>Patient age <math>\geq 18</math> years (vs. <math>&lt;18</math> years)</b>	<b>2.09 (1.38–3.15)</b>	<b>2.60 (1.51–4.48)</b>
Risk group (vs. heterosexual with multiple partners)		
<b>Heterosexual with HIV-infected partner</b>	<b>2.12 (1.05–4.27)</b>	<b>2.38 (1.07–5.28)</b>
<b>MSM</b>	<b>5.82 (2.93–11.60)</b>	<b>8.49 (3.68–19.60)</b>
Transgender woman (vs. heterosexual with multiple partners)	1.41 (0.55–3.64)	1.48 (0.51–4.30)

<sup>a</sup>Variables in bold are significant in the adjusted model ( $p<0.05$ ).

<sup>b</sup>ORs presented are significant at  $p<0.10$  and were entered into the adjusted logistic regression model. ORs and CIs in bold are significant at  $p<0.05$ .

<sup>c</sup>ORs in bold were significant in the adjusted model ( $p<0.05$ ). Nonsignificant variables were not included in the final model except as part of a grouped analysis (i.e., transgender woman vs. heterosexual with multiple partners).

CDC, Centers for Disease Control and Prevention; CI, confidence interval; MSM, men who have sex with men; nPEP, nonoccupational postexposure prophylaxis; OR, odds ratio; PrEP, pre-exposure prophylaxis.

TABLE 8. INDEPENDENT VARIABLES ASSOCIATED WITH ACTUAL CLINICIAN PRESCRIPTION OF PRE-EXPOSURE PROPHYLAXIS TO ADULT PATIENTS AGE 18 AND OLDER: RESULTS OF UNADJUSTED AND ADJUSTED LOGISTIC REGRESSION MODELS

<i>Risk category</i>	<i>Variable<sup>a</sup></i>	<i>Unadjusted OR (95% CI)<sup>b</sup></i>	<i>Adjusted OR (95% CI)<sup>c</sup></i>	
MSM	<b>Prescribed nPEP ≥2 times to adults age 18 and older (vs. 0–1 time)</b>	<b>10.00 (2.70–33.33)</b>	<b>10.00 (2.70–33.33)</b>	
	Discussed PrEP with HIV-uninfected patients ≥2 times (vs. 0–1 time)	<b>5.26 (1.19–20.00)</b>		
	Older upper age of patients in overall practice	1.03 (1.00–1.07)		
	Ever prescribed nPEP to patients younger than 18 (vs. never prescribed)	3.03 (0.92–10.00)		
Transgender woman	<b>Non-Hispanic white (vs. any other race/ethnicity)</b>	5.26 (0.97–25.00)	<b>12.50 (1.52–100.00)</b>	
	<b>Lower percentage of patients younger than 18 in overall practice</b>	1.03 (1.00–1.05)	<b>1.04 (1.01–1.08)</b>	
	<b>Prescribed nPEP ≥2 times to adults age 18 and older (vs. 0–1 time)</b>	<b>10.00 (1.20–100.00)</b>	<b>20.00 (1.67–250.00)</b>	
	Male gender at birth	4.13 (0.96–17.77)		
	Years since graduation from professional school	<b>1.07 (1.00–1.13)</b>		
	Years working with HIV-infected or at-risk youth	1.09 (1.00–1.18)		
	Nurse practitioner (vs. physician)	0.16 (0.02–1.36)		
	Older upper age of patients in overall practice	<b>1.03 (1.00–1.06)</b>		
	More barriers related to cost and resource issues	<b>0.28 (0.10–0.83)</b>		
	Fewer provider-level barriers to prescribing PrEP	2.86 (0.86–9.09)		
	Fewer barriers related to PrEP use in adolescents younger than 18	2.08 (0.88–5.00)		
	Prescribed nPEP to adolescents younger than 18 ≥6 times (vs. never)	6.67 (0.70–50.00)		
Heterosexual with multiple partners	Fewer provider-level barriers to prescribing PrEP	4.17 (0.89–20.00)		
Heterosexual with HIV-infected partner	<b>More HIV-infected patients younger than 18 cared for per week</b>	<b>1.06 (1.00–1.13)</b>	<b>1.06 (1.002–1.13)</b>	
	<b>Prescribed nPEP ≥2 times to adults age 18 and older (vs. 0–1 time)</b>	<b>7.69 (1.54–50.00)</b>	<b>7.69 (1.27–50.00)</b>	
	Ever prescribed nPEP to patients younger than 18 (vs. never prescribed)	<b>3.70 (1.03–14.29)</b>		
	Non-Hispanic white (vs. any other race/ethnicity)	3.33 (0.88–12.50)		
	Greater number of youth younger than 18 cared for per week	1.04 (0.99–1.08)		
	Older upper age of patients in overall practice	1.03 (1.00–1.06)		
	Discussed PrEP with HIV-uninfected patients ≥2 times (vs. 0–1 time)	6.25 (0.73–50.00)		
	Greater endorsement of facilitating factors for use of CDC guidance	2.77 (0.88–8.68)		
	Summary measure of all risk categories	<b>Ever prescribed nPEP to an adolescent younger than 18 (vs. never prescribed)</b>	5.00 (1.28–20.00)	<b>7.14 (1.47–33.33)</b>
		<b>Fewer provider-level barriers to prescribing PrEP</b>	2.94 (0.99–9.09)	<b>4.00 (1.12–14.29)</b>
Prescribed nPEP 0–1 time to adults age 18 and older (vs. ≥2 times)		<b>0.02 (0.00–0.22)</b>		
Older upper age of patients in overall practice Nurse practitioner (vs. physician)		<b>1.04 (1.00–1.09)</b> 0.27 (0.06–1.21)		

<sup>a</sup>Variables in bold are significant in the adjusted model ( $p < 0.05$ ).

<sup>b</sup>ORs presented are significant at  $p < 0.10$  and were entered into the adjusted logistic regression model. ORs and CIs in bold are significant at  $p < 0.05$ .

<sup>c</sup>ORs in bold were significant in the adjusted model ( $p < 0.05$ ). Nonsignificant variables were not included in the final model.

CI, confidence interval; nPEP, nonoccupational postexposure prophylaxis; MSM, men who have sex with men; OR, odds ratio; PrEP, pre-exposure prophylaxis.

having prescribed PrEP to an adult heterosexual with multiple partners (Table 8).

increased odds of having prescribed PrEP to an adult heterosexual with an HIV-infected partner (Table 8).

Heterosexual with HIV-infected partner. In multi-variable modeling, caring for more HIV-infected youth per week ( $p = 0.04$ ) and having prescribed nPEP to an adult two or more times (vs. 0–1 time;  $p = 0.03$ ) were associated with

Summary measure. When experience prescribing PrEP to adults in all risk categories was examined with multi-variable modeling, having ever prescribed nPEP (vs. never prescribed) to an adolescent ( $p = 0.01$ ) and having fewer



provider-level barriers to prescribing PrEP ( $p=0.03$ ) were associated with increased odds of having prescribed PrEP to an adult (Table 8).

#### Factors associated with actual prescription of PrEP to adolescents

**Men who have sex with men.** In multi-variable modeling, having ever prescribed nPEP to an adolescent (vs. never prescribed;  $p=0.004$ ) and clinician report that a behavioral intervention is not a necessary part of PrEP delivery ( $p=0.02$ ) were associated with increased odds of having prescribed PrEP to an adolescent MSM (Table 9).

**Transgender woman.** In multi-variable modeling, greater time since graduation from professional school ( $p=0.03$ ) and having fewer provider-level barriers to prescribing PrEP ( $p=0.03$ ) were associated with increased odds of having prescribed PrEP to an adolescent transgender woman (Table 9).

**Heterosexual with multiple partners.** No variables were associated with having prescribed PrEP to an adolescent

heterosexual with multiple partners in multi-variable modeling (Table 9).

**Heterosexual with an HIV-infected partner.** In multi-variable modeling, greater number of HIV-infected youth younger than 18 cared for per week was associated with increased odds of having prescribed PrEP to a heterosexual adolescent with an HIV-infected partner ( $p=0.03$ ) (Table 9).

**Summary measure.** When considering all adolescent risk groups combined in multi-variable modeling, having prescribed nPEP to an adult two or more times (vs. 0–1 time) was associated with increased odds of having prescribed PrEP to an adolescent ( $p=0.02$ ) (Table 9).

#### Discussion

In this study of clinicians who care for HIV-infected and at-risk youth, we found differences in intention to prescribe and actual prescription of PrEP by patient age and risk category, as well as differences in the factors associated with intention to prescribe and actual prescription of PrEP by

TABLE 9. INDEPENDENT VARIABLES ASSOCIATED WITH ACTUAL CLINICIAN PRESCRIPTION OF PRE-EXPOSURE PROPHYLAXIS TO ADOLESCENTS YOUNGER THAN 18: RESULTS OF UNADJUSTED AND ADJUSTED LOGISTIC REGRESSION MODELS

Risk category	Variable <sup>a</sup>	Unadjusted OR (95% CI) <sup>b</sup>	Adjusted OR (95% CI) <sup>c</sup>
MSM	<b>Ever prescribed nPEP to an adolescent younger than 18 (vs. never prescribed)</b>	<b>7.14 (1.85–25.00)</b>	<b>12.50 (2.27–50.00)</b>
	<b>Belief that behavioral interventions are not necessary for PrEP delivery</b>	6.18 (0.99–38.48)	<b>14.83 (1.56–141.48)</b>
	Fewer provider-level barriers to prescribing PrEP	<b>3.33 (1.14–10.00)</b>	
	Prescribed nPEP $\geq 2$ times to adults age 18 and older (vs. 0–1 time)	<b>9.09 (1.79–50.00)</b>	
	Lower endorsement of cost and insurance factors impacting clinician likelihood of prescribing PrEP	1.75 (0.95–3.33)	
Transgender woman	Fewer barriers related to PrEP use in patients under age 18	2.00 (0.92–4.35)	
	<b>Years since graduation from professional school</b>	1.09 (1.00–1.18)	<b>1.24 (1.02–1.51)</b>
	<b>Fewer provider-level barriers to prescribing PrEP</b>	<b>7.14 (1.09–50.00)</b>	<b>50.00 (1.54–1000)</b>
Heterosexual with multiple partners	Fewer barriers related to PrEP use in patients younger than 18	<b>3.23 (1.00–10.00)</b>	
	Greater number of patients younger than 18 cared for by clinician per week	1.04 (0.99–1.10)	
	Greater number of HIV-infected patients younger than 18 cared for by clinician per week	1.06 (1.00–1.13)	
Heterosexual with HIV-infected partner	Belief that behavioral interventions are not necessary for PrEP delivery	6.83 (0.87–53.77)	
	<b>Greater number of HIV-infected patients younger than 18 cared for by clinician per week</b>	<b>1.07 (1.01–1.14)</b>	<b>1.07 (1.01–1.14)</b>
	Greater knowledge about PrEP	2.11 (0.88–5.06)	
Summary measure of all risk categories	<b>Prescribed nPEP <math>\geq 2</math> times to adults age 18 and older (vs. 0–1 time)</b>	<b>14.29 (1.54–100.00)</b>	<b>14.29 (1.54–100.00)</b>
	Fewer provider-level barriers to prescribing PrEP	4.17 (1.16–14.29)	
	Fewer barriers related to PrEP use in patients younger than 18	2.13 (0.90–5.00)	

<sup>a</sup>Variables in bold are significant in the adjusted model ( $p < 0.05$ ).

<sup>b</sup>ORs presented are significant at  $p < 0.10$  and were entered into the adjusted logistic regression model. ORs and CIs in bold are significant at  $p < 0.05$ .

<sup>c</sup>ORs in bold were significant in the adjusted model ( $p < 0.05$ ). Nonsignificant variables were not included in the final model.

CI, confidence interval; MSM, men who have sex with men; nPEP, nonoccupational postexposure prophylaxis; OR, odds ratio; PrEP, pre-exposure prophylaxis.

patient age and risk category. To our knowledge, this is the first study to compare intentions to prescribe and actual prescription of PrEP to adolescents and adults. We found that clinicians reported higher intention to prescribe, and more experience prescribing, PrEP to adults versus adolescents, and several modifiable factors, such as provider-level barriers and concerns about cost and insurance coverage, were associated with intention to prescribe PrEP to youth. Understanding the attitudes of clinicians who provide care to both HIV-infected and at-risk youth is important because these clinicians are likely to be early adopters of PrEP for use in youth as well as opinion leaders for other clinicians. Therefore, the information learned from these clinicians is important to the design of interventions to support the successful implementation of PrEP among youth.

In this study, significantly more clinicians reported high intention to prescribe PrEP to adult versus adolescent MSM and transgender women. In our overall model, suburban practice location, lower knowledge about the CDC PrEP guidance, lower endorsement of cost and insurance factors impacting clinician likelihood of prescribing PrEP, patient age  $\geq 18$  years, and patient risk groups of heterosexual with HIV-infected partner, MSM, and transgender woman (vs. heterosexual with multiple partners) were all associated with greater intention to prescribe PrEP. When we examined age and risk group combinations individually, greater endorsement of facilitating factors for prescribing PrEP was associated with greater intention to prescribe PrEP to adolescent MSM and heterosexuals with HIV-infected partners, suggesting that clinicians with higher intention to prescribe PrEP to youth may be more aware of factors that would make prescribing PrEP easier.

Consistent with the Theory of Planned Behavior,<sup>26</sup> endorsing fewer barriers (provider-level barriers and barriers to PrEP use in patients younger than 18) was associated with greater intention to prescribe PrEP. The belief that a multidisciplinary team is not necessary to deliver PrEP was associated with higher intention to prescribe PrEP to adolescent heterosexuals with multiple partners. This perception may exist because several publications about PrEP implementation describe delivering PrEP in the setting of a multidisciplinary team.<sup>28–30</sup>

Lower endorsement of cost and insurance factors impacting clinician likelihood of prescribing PrEP was associated with greater intention to prescribe PrEP, suggesting that removing barriers related to cost and reimbursement may improve clinician intention to prescribe PrEP to youth. Clinicians who have incorporated PrEP into their practices report that managing PrEP-related cost and insurance issues was time-consuming for clinicians and staff.<sup>31</sup> Physician prescribing behaviors may be influenced by cost,<sup>32,33</sup> and for some clinicians, cost may be one of the most important factors in considering prescribing PrEP.<sup>34</sup> Contrary to what would be expected, endorsing more barriers related to cost and resource issues was associated with intention to prescribe PrEP to adolescents. Clinicians with higher intention to prescribe PrEP to youth may be more aware of potential cost and resource barriers to prescribing.

Interestingly, lower knowledge about the CDC PrEP guidance (as objectively measured in this study) was associated with greater intention to prescribe PrEP to adults. Clinicians who are more aware of the content of the guidance may have lower intention to prescribe PrEP if the recom-

mendations contained within the guidance are perceived to be barriers. High perceived complexity of a guideline or perceived lack of compatibility with one's practice are barriers to adoption of guidelines, such as the CDC interim PrEP guidance.<sup>25</sup>

We found that a higher percentage of clinicians reported having prescribed PrEP to adults compared with adolescents, and significantly more clinicians had prescribed PrEP to adult MSM compared with adolescent MSM. This is consistent with the findings of our prior qualitative study.<sup>16</sup> In our overall model, having more experience discussing PrEP with both HIV-infected and HIV-uninfected patients (which would be an expected precursor to prescribing), endorsing fewer provider-level barriers, patient age  $\geq 18$  years, and risk groups of heterosexual with HIV-infected partner and MSM (vs. heterosexual with multiple partners) were associated with greater odds of having prescribed PrEP. When we examined age/risk group combinations separately, having more experience with prescribing nPEP was associated with greater odds of having prescribed PrEP to several age and risk groups. Clinicians who have prescribed nPEP have contact with high-risk HIV-uninfected patients who may benefit from PrEP. Users of nPEP report higher risk sexual behaviors<sup>35,36</sup> and have high rates of HIV seroconversion.<sup>36,37</sup> Thus, nPEP use can be an indicator of someone who may be a good candidate for PrEP.<sup>38,39</sup>

The belief that behavioral interventions are not necessary to deliver PrEP was associated with having prescribed PrEP to an adolescent MSM. Behavioral interventions (e.g., counseling about condom use or other risk-reduction behaviors) were integral components of the landmark studies establishing the efficacy of PrEP,<sup>1–4</sup> suggesting that PrEP may be maximally effective when delivered with a behavioral intervention. Prior studies show that HIV-infected youth face a variety of psychosocial issues,<sup>40</sup> which may contribute to their lower rates of adherence to antiretroviral therapy when compared to adults.<sup>41</sup> Similarly, recent data suggest that adolescents face greater challenges with adherence to PrEP than adults<sup>15</sup> and thus may require a higher degree of behavioral support than older PrEP users. However, because delivering a behavioral intervention would require more clinician or staff time than merely writing a prescription for PrEP, this may be perceived by clinicians as a barrier to the provision of PrEP.

Endorsing fewer provider-level barriers was associated with greater odds of having prescribed PrEP to adolescent transgender women and adults overall. Clinician report of fewer perceived barriers to prescribing PrEP has been associated with having received more patient requests for PrEP or having prescribed PrEP.<sup>19</sup> Although many barriers to prescribing PrEP are similar when considering prescribing to adults and adolescents, clinicians have reported additional barriers that are specific to providing PrEP to adolescents,<sup>16</sup> which may negatively impact intention to prescribe PrEP.

Clinicians who reported caring for more HIV-infected adolescents per week had higher odds of having prescribed PrEP, consistent with prior studies of primarily adult-focused clinicians, in which intention or actual prescription of PrEP was associated with caring for more HIV-infected patients.<sup>21,42,43</sup> Because these clinicians are caring for more HIV-infected patients, they likely have access to more HIV-uninfected partners in serodiscordant relationships who

would benefit from PrEP and thus more opportunities to prescribe PrEP. In addition, many clinicians who provide care to HIV-infected patients perceive prescribing PrEP to the sexual partners of these patients to be within the scope of their practice.<sup>44</sup>

Our study is subject to a number of limitations. First, our sample size was small. However, we had a fairly high response rate, supporting validity of the findings, and our findings provide pilot data to help inform future larger studies. Second, we recruited participants through a single research network. However, these clinicians are likely to be among the earliest adopters of PrEP for use in youth because of their expertise in the care of adolescents and their familiarity with the use of the medication used for PrEP for treatment of HIV-infected youth. Information about the composition of the clinician's practice with respect to patient risk categories was not assessed; therefore, clinicians may have reported not having prescribed PrEP to patients in certain risk categories (i.e., MSM) because they did not have access to that patient population.

### Conclusions

Among this sample of clinicians who care for both HIV-infected and at-risk youth, clinicians reported greater intention to prescribe PrEP to adults compared with adolescents, and we identified a number of modifiable factors associated with intention to prescribe and actual prescription of PrEP to adolescents that should be addressed to increase provision of PrEP to youth. Decreasing perceived provider-level barriers and barriers related to PrEP use in patients younger than 18 are important steps in improving access to PrEP for adolescents. Because cost and insurance factors were associated with lower intention to prescribe PrEP to youth, ensuring that costs associated with the PrEP medication and necessary follow-up visits and laboratory studies are covered by insurance is critical to improving clinician intention to prescribe PrEP to youth.<sup>45</sup> Because more experience prescribing nPEP was associated with actual prescription of PrEP, improving clinician education about nPEP (particularly given changes in recommended nPEP regimens<sup>46</sup>) and implementing clinical support measures (such as decision support within electronic medical records) may lead to increased experience with nPEP and thus increased willingness to prescribe PrEP. Finally, our finding that perceiving that (1) multi-disciplinary teams and (2) behavioral interventions are not necessary for delivering PrEP were associated with intention to prescribe and actual prescription of PrEP suggests that clinicians view these elements as barriers to prescribing PrEP. To address this potential barrier to PrEP prescription, brief, streamlined, and effective behavioral interventions that can be delivered with PrEP need to be developed and disseminated. In addition, development and dissemination of successful strategies for delivering PrEP in settings that may not have the optimal infrastructure of a multi-disciplinary team are needed if PrEP is to be incorporated outside of specialty clinic settings, which is critical to improving youth access to this intervention.

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### Author Disclosure Statement

No competing financial interests exist.

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