

RESEARCH ARTICLE

Healthcare practitioner experiences and willingness to prescribe pre-exposure prophylaxis in the US

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Abstract

Background and objectives

Less than 10 percent of the more than one million people vulnerable to HIV are using pre-exposure prophylaxis (PrEP). Practitioners are critical to ensuring the delivery of PrEP across care settings. In this study, we target a group of prescribers focused on providing HIV care and seeking up-to-date information about HIV. We assessed their experiences prescribing PrEP, whether these experiences differed by clinical specialty, and examined associations between willingness to prescribe PrEP as a “best first step” and different hypothetical prescribing scenarios.

Setting and methods

Between March and May 2015, we circulated a paper survey to 954 participants ((652 of whom met our inclusion criteria of being independent prescribers and 519 of those (80%) responded to the survey)) at continuing medical education advanced-level HIV courses in five locations across the US on practitioner practices and preferences of PrEP. We employed multivariable logistic regression analysis for binary and collapsed ordinal outcomes.

Results

Among this highly motivated group of practitioners, only 54% reported ever prescribing PrEP. Internal medicine practitioners were 1.6 times more likely than infectious disease practitioners to have prescribed PrEP (95% CI: 0.99–2.60, $p = .0524$) and age, years of

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training, and sex were significantly associated with prescribing experience. Based on clinical vignettes describing different hypothetical prescribing scenarios, practitioners who viewed PrEP as the first clinical step for persons who inject drugs (PWID) were twice as likely to have also considered PrEP as the first clinical option for safer conception, and vice-a-versa (95% CI: 1.4–3.2, $p < .001$). Practitioners considering PrEP as the first preventive option for MSM were nearly six times as likely to also consider PrEP as the first clinical step for PWID, and vice-a-versa (95% CI: 2.28–13.56, $p = .0002$).

Conclusions

Our findings indicate that even among a subset of HIV-focused practitioners, PrEP prescribing is not routine. This group of practitioners could be an optimal group to engage individuals that could most benefit from PrEP.

Introduction

HIV prevention in the US has received renewed political attention with heightened goals to eradicate the virus by 2030 [1]. The latest US Preventive Services Task Force recommendation on pre-exposure prophylaxis (PrEP) underscores its important role in this effort [2]. The once-daily medications are recommended for men who have sex with men (MSM), persons who inject drugs (PWID), and heterosexually active men and women who are behaviorally vulnerable to HIV [2, 3]. However, only 8 percent of the estimated 1.2 million people vulnerable to HIV are using PrEP [2, 4, 5].

Structural barriers, such as practitioner prescribing practices and comfort with PrEP, could be important influences on PrEP implementation across clinical settings. The “purview paradox,” i.e. the notion that neither HIV practitioners nor primary care physicians consider PrEP to fall within their clinical purview, may explain the slow adoption of PrEP among practitioners [6–13]. Given PrEP is to be used by individuals who do not have HIV, primary care and family physicians likely have a central role in facilitating access to PrEP among individuals particularly vulnerable to the virus.

Treating different priority groups also adds another layer of complexity to practitioner PrEP prescribing practices. For example, studies have found varying levels of confidence and willingness among practitioners to prescribe PrEP across patient groups, with practitioners expressing greater inclination to prescribe to MSM than to behaviorally vulnerable heterosexuals or PWID [14–16]. Moreover, routine risk assessments occur infrequently in primary care, which can influence practitioner prescribing of PrEP if patients are not assessed for HIV risk [11, 17].

In this study, we target a group of prescribers focused on providing HIV care and seeking up-to-date information about HIV (as evidenced by their attendance of an advanced HIV continuing medical education course). We assessed their experiences prescribing PrEP, whether these experiences differed by clinical specialty, and examined associations between willingness to prescribe PrEP as a “best first step” and different hypothetical prescribing scenarios.

We hypothesized that there would be differences in experience prescribing PrEP by practitioner specialty (infectious disease, internal medicine, family medicine) and between practitioner opinions on offering PrEP as a “best first step” and different hypothetical risk scenarios

((MSM, sero-different heterosexuals seeking conception (comprised of one person with HIV and one without HIV), and PWID)).

Methods

Study design

In collaboration with the International Antiviral Society-USA (IAS-USA), between March and May 2015, we circulated a voluntary paper survey to 954 participants at continuing medical education (CME) advanced-level HIV courses in five locations across the US: San Francisco, CA, Los Angeles, CA, New York, NY, Washington, DC, and Chicago, IL. We surveyed participants before the course session on PrEP. We did not provide incentives for survey completion. We included in our sample only practitioners who could independently prescribe, including physicians ((Doctors of Medicine [MDs]) or Doctors of Osteopathic Medicine [DOs]), nurse practitioners (NPs), and physician assistants (PAs). The Boston University Medical Center Institutional Review Board (IRB) determined this study to be HIPPA exempt in accordance with 45 CFR 46.101. As per IRB stipulations, we included a consent statement at the top of the survey form.

We used $\alpha = 0.05$ for all statistical tests and set β at 0.20 (or a power of 0.80) when assessing sample size, which indicated adequate power at a total sample size of 450 to detect small effects (0.14–0.15) between prescriber categories (first hypothesis) and clinical views in prescribing PrEP as a “best first step” across different high risk scenarios (second hypothesis).

Survey measures

We used published data and clinical opinion to develop a 17-item survey instrument to assess practitioner practices and preferences of PrEP and other prevention options for groups vulnerable to HIV ([S1 File](#)) [18–21]. We surveyed prescriber characteristics, including age, sex, race/ethnicity, location of practice, qualification/licensure, length of practicing independently, and specialty area. Key content domains included: 1) experience prescribing PrEP, 2) the primary population for which the respondent has previously prescribed PrEP (if at all) (including MSM, PWID, and heterosexual individuals behaviorally vulnerable to HIV, including sero-different couples seeking conception), 3) how often in the course of routine care does the respondent typically ask his/her patients about partners' HIV serostatus, and 4) general level of comfort in counseling patients on safer conception options. We also developed clinical scenarios to examine practitioner preferences in prescribing PrEP as a “best first step” for sero-different couples trying to conceive, MSM, and PWID. The survey included case vignettes followed by specific clinical options that asked practitioners to identify the first clinically recommended step for groups at high risk for HIV ([Fig 1](#)).

Analysis

We calculated descriptive statistics including means and standard deviations (SDs) for continuous variables and counts with proportions for categorical variables. We employed multivariable logistic regression analysis for binary and collapsed ordinal outcomes (experience prescribing PrEP and practitioner responses indicating PrEP as the “best first step” to vignette questions; for the latter, we dichotomized participant responses into “considered PrEP” or “did not consider PrEP”), using a backward elimination process, and included all covariates that altered the association between physician groups and outcome by more than 10%. Control variables included age, sex, ethnicity/race, CME course location, qualification/licensure, number of years practicing independently, and specialty area. We examined interaction between physician specialty and covariates such as age, sex, and preferences prescribing across risk categories. We excluded respondents with missing outcome variables for each study objective

The following case vignettes are followed by specific clinical options, none of which can be considered either correct or incorrect. Please choose one option as the best first step in your opinion.

1. A 30-year-old male who is HIV-negative and has sex with men with an unremarkable PMH is sexually active with his HIV-positive husband. The (+) partner is on cART but having challenges reaching an undetectable HIV viral load. What do you recommend as a first step?
 - Use condoms
 - Recommend initiating PrEP for HIV-negative partner
 - Use both condoms and initiate PrEP for HIV-negative partner
 - Other (please specify):

2. A 30-year old female who is HIV-negative with an unremarkable PMH is hoping to conceive with her HIV-positive partner. The (+) partner is on cART with an undetectable HIV viral load. What do you recommend as a first step?
 - Do not conceive
 - Recommend initiating PrEP for HIV-negative woman
 - Refer couple for Assisted Reproductive Technology services
 - Other (please specify):

3. A 30-year old male who is HIV-negative with a history of injection drug use reports sharing needles with injection partners of unknown sero-status. What do you recommend as a first step?
 - Refer to harm reduction program only, such as safe needle exchange
 - Refer to substance abuse treatment and harm reduction program such as safe needle exchange if exists
 - Recommend initiating PrEP
 - Other (please specify):

Fig 1. Vignettes identifying practitioner “best first step” for groups vulnerable to HIV. This figure depicts the case vignettes on the survey instrument.

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(experience prescribing PrEP by practitioner specialty and practitioner opinions on offering PrEP as a “best first step” in different risk scenarios), representing less than 1% and 3% of the total sample, respectively. We used SAS® 9.4 for statistical analyses. The raw anonymous data file and statistical output for the analyses can be found in the [S2](#) and [S3](#) Files).

Results

Demographic characteristics

Of the 954 participants across the five CME courses, 728 responded (response rate, 76%). Of those who responded, 652 were independent prescribers (MD/DOs, NPs, PAs). We excluded

pharmacists from the study because they did not independently prescribe or dispense PrEP for this population when the survey was distributed. Of our narrowed cohort of 652 independent prescribers, 519 (80%) responded to the survey. Of our final sample of 519, 362 (70%) were physicians, 45 (9%) PAs, and 112 (21%) NPs. Response rates for physicians, PAs, and NPs were 77%, 82%, and 90% respectively. Respondents' average age was 49 years (SD +/- 12.05) with the majority identifying as female (57%) and white (58%). Length of time in practice varied, though the majority having practiced independently for more than 10 years (59%). Our sample included 38% of prescribers specializing in infectious disease, 27% in family medicine, 26% in internal medicine, and 9% in other specialties (Table 1).

Table 1. Demographic and prescribing characteristics.

CHARACTERISTIC	N/Mean	SD or %
CME Course Location	519	100%
<i>New York City, NY</i>	200	39%
<i>San Francisco, CA</i>	77	15%
<i>Los Angeles, CA</i>	71	14%
<i>District of Columbia, DC</i>	63	12%
<i>Chicago, Illinois</i>	108	21%
Age (Missing: 21)	49	+/- 12
Identified sex (Missing: 5)		
<i>Male</i>	222	43%
<i>Female</i>	292	57%
Ethnicity/Race (Missing: 11)		
<i>Hispanic/Latino</i>	42	8%
<i>White</i>	293	58%
<i>Black or African American</i>	52	10%
<i>Asian</i>	94	18%
<i>Native Hawaiian or Pacific Islander</i>	1	0.20%
<i>Other^a</i>	26	5%
Qualification/license		
<i>MD/DO</i>	362	70%
<i>PA</i>	45	9%
<i>NP</i>	112	21%
Time in practice (Missing: 7)		
<i>In training</i>	38	7%
<i>< 5 years</i>	86	17%
<i>5–10 years</i>	82	16%
<i>11–20 years</i>	130	25%
<i>21+ years</i>	176	34%
Specialty (Missing: 3)		
<i>Infectious disease</i>	197	38%
<i>Internal medicine</i>	133	26%
<i>Family medicine</i>	141	27%
<i>Other^b</i>	45	9%
Experience prescribing PrEP (Missing: 4)	276	54%
<i>Infectious disease</i>	103	37%
<i>Internal medicine</i>	82	30%
<i>Family medicine</i>	70	25%
<i>Other</i>	21	8%

(Continued)

Table 1. (Continued)

CHARACTERISTIC	N/Mean	SD or %
Prescribed population (<i>Missing: 2; N = 274</i>)		
MSM	232	85%
PWID	12	4%
Heterosexual (<i>not trying to conceive</i>)	67	24%
Anticipated conception exposure	44	16%
Comfort in counseling people living with HIV on safer conception (<i>Missing: 11</i>)		
Strongly agree/agree	333	65%
Neutral	104	20%
Strongly disagree/disagree	71	14%
Case vignette #1: MSM, best first step (<i>Missing: 17</i>)		
Use condoms	53	11%
Initiate PrEP	27	5%
Condoms and PrEP	410	82%
Other	12	2%
Case vignette #2: Conception, best first step ^c (<i>Missing: 17</i>)		
Do not conceive	4	1%
Initiate PrEP	285	56%
Refer to assisted reproduction	182	36%
PrEP or assisted reproduction	21	4%
cART alone, undetectable viral load	6	1%
Other	4	4%
Case vignette #3: PWID, best first step (<i>Missing: 17</i>)		
Refer to harm reduction program only	48	10%
Refer to harm reduction and substance use treatment programs	275	55%
Initiate PrEP	117	23%
Treatment programs + PrEP	59	12%
Other	3	0.5

^a Other: Including mixed race (chose 2 or more categories).

^b Other: 18 respondents specified pediatrics, 9 OBGYN, and 18 did not specify.

^c When we designed the clinical vignettes, the CDC recommended either PrEP or other safer conception methods irrespective of partner virologic suppression for HIV sero-different couples seeking conception [22].

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PrEP prescribing patterns

Of the 519 respondents, 515 answered the question about experience prescribing PrEP; of these, 54% (276/515) had prescribed PrEP. In unadjusted logistic regression analyses, there were no significant proportional differences between practitioner specialty areas and the proportion who report ever prescribing PrEP. After adjusting for salient control variables, however, internal medicine practitioners were 1.6 times more likely than infectious disease practitioners to have prescribed PrEP, albeit with borderline significance (95% CI: 0.99–2.60, $p = .0524$) (main confounder was age). Each additional year of age reduced the odds of prescribing PrEP by 4% (aOR: 0.96, 95% CI: 0.93–0.98, $p = 0.0014$). Those still in training were 0.30 times as likely as those with 20 or more years of experience to have prescribed PrEP (95% CI: 0.11–0.84, $p = 0.0214$), and women were 0.57 times as likely as men to have prescribed PrEP (95% CI: 0.39–0.84, $p = 0.0044$) (Fig 2).

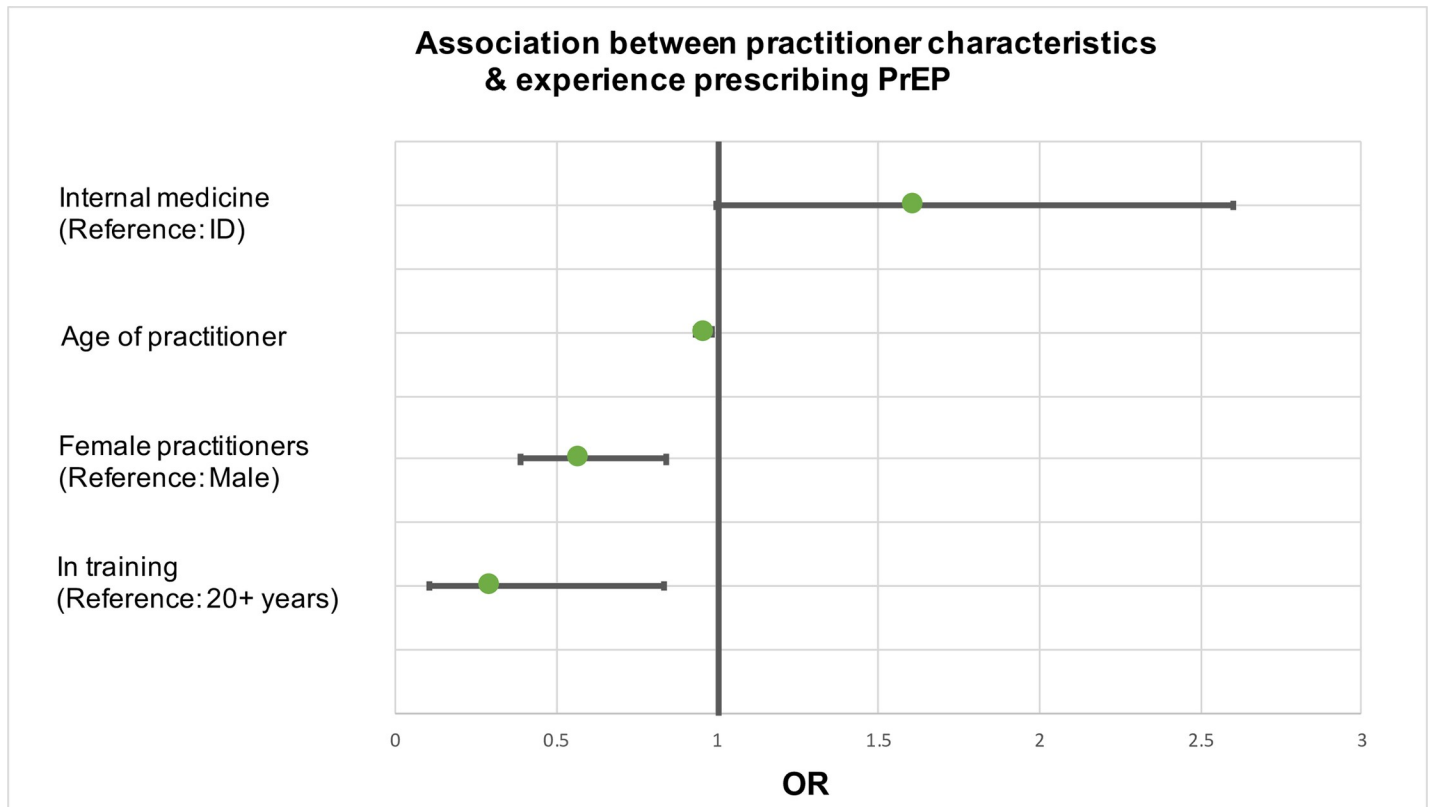


Fig 2. Multivariable logistic regression analysis on the association of practitioner characteristics and experience prescribing PrEP. This figure details the variables significantly impacting practitioner experience prescribing PrEP. ID = infectious disease.

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Willingness to prescribe PrEP as a “best first step” to different groups vulnerable to HIV

In our regression models when willingness to prescribe PrEP for the purpose of safer conception was the outcome variable, practitioners who viewed PrEP as the best first clinical step for MSM were less likely to have also considered PrEP as the first recommendation for safer conception purposes, albeit not significantly less likely (aOR: 0.750, 95% CI: 0.4–1.4, $p = 0.356$). On the other hand, practitioners who viewed PrEP as the first clinical step for PWID were twice as likely to have also considered PrEP as the best first step for safer conception, and vice-versa (95% CI: 1.4–3.2, $p < .001$) (Fig 3). Our tests of interactions were not statistically significant, and after adjusting for control variables, the model did not change.

In our regression models when willingness to prescribe PrEP for PWID was the outcome variable, practitioners who viewed PrEP as the first recommended step for MSM were nearly six times as likely to also consider PrEP as the best first step for PWID, and vice-versa (95% CI: 2.28–13.56, $p = .0002$). Our tests of interaction were not significant. When adjusting for important covariates in the model, our main results did not change. However, when specialty area was added, internal medicine practitioners were 1.94 times as likely (95% CI: 1.19–3.16, $p = 0.0074$) and family medicine practitioners two times as likely (95% CI: 1.26–3.33, $p = 0.0037$) as infectious disease specialists to view PrEP as the best first clinical step for PWID (Fig 3).

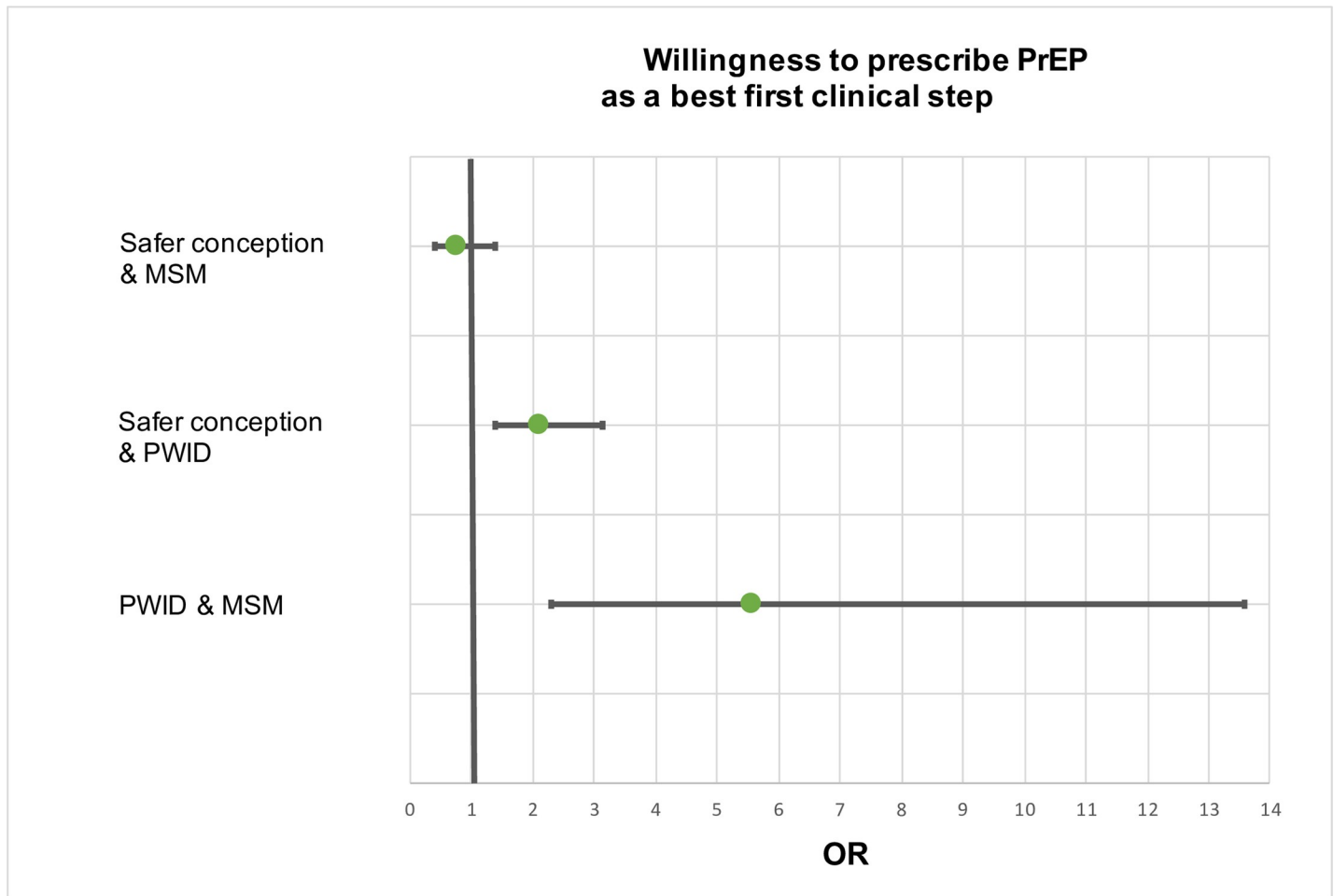


Fig 3. Multivariable logistic regression analysis on willingness to prescribe PrEP as a best first clinical step across groups vulnerable to HIV. This figure encompasses regression models comparing willingness to prescribe PrEP as a best first step in different risk scenarios—i.e. safer conception and MSM, safer conception and PWID, and PWID and MSM. MSM = Men who have sex with men; PWID = people who inject drugs.

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Discussion

The US Preventive Services Task Force has endorsed the value of PrEP for HIV prevention and recommended offering the medication to MSM, PWID, and heterosexually active men and women behaviorally vulnerable to HIV [2]. With less than 10% of individuals vulnerable to HIV taking the preventive medication in the US [2, 4, 5], our study characterizes a group of HIV-motivated clinicians that could play an important role in expanding PrEP availability in the US.

One important finding of this work is that among this highly motivated group of practitioners who were attending a continuing medical education course focused specifically on HIV, only 54% reported ever prescribing PrEP. Although this proportion is substantially higher than that reported in surveys of other practitioners, it may demonstrate that even among the most motivated clinicians, who are clearly focused on HIV care and seeking up-to-date information about HIV, only approximately half could be actively implementing current PrEP guidance. This finding could also reflect patients' own decision making around PrEP or practitioner lack of opportunity to offer PrEP. However, for PrEP to have a substantial impact on HIV incidence in the US, this proportion likely needs to increase. The low current rate of PrEP

prescribed by motivated clinicians suggests that they would be a high-value practitioner group to target for increased PrEP prescribing and tailored patient messaging.

Our finding that internal medicine practitioners were nearly twice as likely as infectious disease specialists to have experience prescribing PrEP supports the general consensus that primary care and family physicians play a crucial role in conducting HIV risk assessments and offering PrEP within their clinical purviews [6, 8, 9, 11]. Infectious disease specialists are also less inclined to encounter individuals without HIV compared to primary/family care practitioners. However, we know from recent literature that routine HIV risk assessments by clinicians is a barrier to implementing PrEP [11], which could further impact identifying and engaging with priority populations vulnerable to HIV. A study published in 2019 further reinforced barriers related to confusion or disagreement over the clinical purview for PrEP, with patients being “bounced back and forth between primary care and HIV clinics” [23]. Other barriers noted included knowledge gaps and practitioner attitudes, or stigma associated with PrEP prescribing.

Moreover, our findings suggest that practitioners might be more willing to prescribe PrEP as a best first clinical step for PWID than previously indicated [11, 14–16]. Practitioner specialty also mattered for the PWID case vignette, as internal and family medicine practitioners were twice as likely as infectious disease practitioners to view PrEP as an important first step for PWID. This result might suggest that infectious disease practitioners vary from other practitioners in prioritizing other preventive interventions before PrEP such as safe needle exchange programs or substance use treatment. Although our results indicating an inverse relationship between practitioner willingness to prescribe PrEP as the best first clinical step for MSM and for sero-different heterosexual couples seeking conception were statistically insignificant, this relationship should be further examined in future research [14, 24].

More work is needed to evaluate preventive interventions that engage priority groups vulnerable to HIV and potential barriers in identifying risk across populations and clinical specialties. Tailored messaging across different populations could pose an opportunity to better communicate with patients and reach individuals who could most benefit from PrEP [11, 17, 25].

Limitations

Although the practitioners in our sample had a vested interest in HIV, this cohort likely represents the leaders driving PrEP availability across the country. Understanding their prescribing patterns and differentiation in prescribing across groups vulnerable to HIV could be important in expanding the use of PrEP. Although the missing responses to the outcome and control variables could have biased the results, no visible pattern existed in regard to the characteristics of omission, which comprised of less than 3% of the total sample. In addition, the vignettes and their response options were not parallel and therefore cannot be used to directly infer differences in PrEP prioritization by risk category. Finally, there may be important structural factors that could limit prescribing PrEP that are not examined in this study, including, but not limited to, patient financial barriers as a result of insurance restrictions and out of pocket costs.

Conclusion

Heterosexual individuals and PWID make up more than a quarter of new HIV diagnoses each year in the US [26]. With a US policy goal to eradicate HIV by 2030, practitioners are central to ensuring the delivery of PrEP across care settings. Our findings indicate that even among a subset of HIV-focused practitioners, PrEP prescribing is not routine. Additionally, general

internal medicine practitioners were more likely to prescribe PrEP than HIV specialists, and practitioner willingness to prescribe PrEP varied across different risk scenarios. Our sample of motivated prescribers could be an optimal group to target to address any uncertainties in PrEP prescribing across risk groups and to effectively reach individuals that could most benefit from PrEP.

Supporting information

S1 File. Research survey conducted at IAS-USA Continuing Medical Education (CME) practitioner course. This file comprises of the survey distributed at IAS-USA CME courses in five locations across the US (San Francisco, CA, Los Angeles, CA, New York, NY, Washington, DC, and Chicago, IL).

(DOCX)

S2 File. Raw anonymous data file. This csv file comprises of participant responses to the survey that is provided in the [S1 File](#).

(CSV)

S3 File. Statistical output. This file encompasses the relevant statistical output for the multi-variable logistic regression analyses presented in the Results section.

(DOCX)

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Writing – review & editing: Ashley A. Leech, Cindy L. Christiansen, Benjamin P. Linas, Donna M. Jacobsen, Isabel Morin, Mari-Lynn Drainoni.

References

1. US Department of Health and Human Services. What is 'Ending the HIV Epidemic: A Plan for America'? [Internet]. [HIV.gov](https://www.hiv.gov/ending-hiv-epidemic). 2019 [cited 2019 Aug 7]. Available from: <https://www.hiv.gov/ending-hiv-epidemic>

2. Owens DK, Davidson KW, Krist AH, Barry MJ, Cabana M, Caughey AB, et al. Preexposure Prophylaxis for the Prevention of HIV Infection: US Preventive Services Task Force Recommendation Statement. *JAMA*. 2019 Jun 11; 321(22):2203–13. <https://doi.org/10.1001/jama.2019.6390> PMID: 31184747
3. Saag MS, Benson CA, Gandhi RT, Hoy JF, Landovitz RJ, Mugavero MJ, et al. Antiretroviral Drugs for Treatment and Prevention of HIV Infection in Adults: 2018 Recommendations of the International Antiviral Society—USA Panel. *JAMA*. 2018 Jul 24; 320(4):379–96. <https://doi.org/10.1001/jama.2018.8431> PMID: 30043070
4. Smith DK, Van Handel M, Wolitski RJ, Stryker JE, Hall HI, Prejean J, et al. Vital Signs: Estimated Percentages and Numbers of Adults with Indications for Preexposure Prophylaxis to Prevent HIV Acquisition—United States, 2015. *MMWR Morb Mortal Wkly Rep*. 2015 Nov 27; 64(46):1291–5. <https://doi.org/10.15585/mmwr.mm6446a4> PMID: 26606148
5. Sullivan PS, Giler RM, Mouhanna F, Pembleton ES, Guest JL, Jones J, et al. Trends in the use of oral emtricitabine/tenofovir disoproxil fumarate for pre-exposure prophylaxis against HIV infection, United States, 2012–2017. *Ann Epidemiol*. 2018; 28(12):833–40. <https://doi.org/10.1016/j.annepidem.2018.06.009> PMID: 30037634
6. Krakower D, Ware N, Mitty JA, Maloney K, Mayer KH. HIV Providers' Perceived Barriers and Facilitators to Implementing Pre-exposure Prophylaxis in Care Settings: A Qualitative Study. *AIDS Behav*. 2014 Sep 1; 18(9):1712–21. <https://doi.org/10.1007/s10461-014-0839-3> PMID: 24965676
7. Lee SS, Petersen E. Overcoming 'purview paradox' to make way for the effective implementation of PrEP in preventing HIV transmission. *Int J Infect Dis*. 2018 Dec; 77:105–6. <https://doi.org/10.1016/j.ijid.2018.10.018> PMID: 30389618
8. Hoffman S, Guidry JA, Collier KL, Mantell JE, Boccher-Lattimore D, Kaighobadi F, et al. A Clinical Home for Preexposure Prophylaxis: Diverse Health Care Providers' Perspectives on the "Purview Paradox." *J Int Assoc Provid AIDS Care JIAPAC*. 2016 Jan 1; 15(1):59–65. <https://doi.org/10.1177/2325957415600798> PMID: 26293904
9. Blumenthal J, Jain S, Krakower D, Sun X, Young J, Mayer K, et al. Knowledge is Power! Increased Provider Knowledge Scores Regarding Pre-exposure Prophylaxis (PrEP) are Associated with Higher Rates of PrEP Prescription and Future Intent to Prescribe PrEP. *AIDS Behav*. 2015 May; 19(5):802–10. <https://doi.org/10.1007/s10461-015-0996-z> PMID: 25616837
10. Petroll AE, Walsh JL, Owczarzak JL, McAuliffe TL, Bogart LM, Kelly JA. PrEP Awareness, Familiarity, Comfort, and Prescribing Experience among US Primary Care Providers and HIV Specialists. *AIDS Behav*. 2017 May; 21(5):1256–67. <https://doi.org/10.1007/s10461-016-1625-1> PMID: 27885552
11. Krakower DS, Mayer KH. The Role of Healthcare Providers in the Roll-Out of PrEP. *Curr Opin HIV AIDS*. 2016 Jan; 11(1):41–8. <https://doi.org/10.1097/COH.0000000000000206> PMID: 26417953
12. Ojile N, Sweet D, Kallail KJ. A Preliminary Study of the Attitudes and Barriers of Family Physicians to Prescribing HIV Preexposure Prophylaxis. *Kans J Med*. 2017 May; 10(2):40–2. PMID: 29472966
13. Seidman D, Carlson K, Weber S, Witt J, Kelly PJ. United States family planning providers' knowledge of and attitudes towards preexposure prophylaxis for HIV prevention: a national survey. *Contraception*. 2016 May 1; 93(5):463–9. <https://doi.org/10.1016/j.contraception.2015.12.018> PMID: 26772906
14. Adams LM, Balderson BH. HIV Providers' Likelihood to Prescribe Pre-exposure Prophylaxis (PrEP) for HIV Prevention Differs By Patient Type: A Short Report. *AIDS Care*. 2016 Sep; 28(9):1154–8. <https://doi.org/10.1080/09540121.2016.1153595> PMID: 26915281
15. Bazzi AR, Biancarelli DL, Childs E, Drainoni M-L, Edeza A, Salhaney P, et al. Limited Knowledge and Mixed Interest in Pre-Exposure Prophylaxis for HIV Prevention Among People Who Inject Drugs. *AIDS Patient Care STDs*. 2018 Oct 11; 32(12):529–37. <https://doi.org/10.1089/apc.2018.0126> PMID: 30311777
16. Krakower DS, Beekmann SE, Polgreen PM, Mayer KH. Diffusion of Newer HIV Prevention Innovations: Variable Practices of Frontline Infectious Diseases Physicians. *Clin Infect Dis*. 2016 Jan 1; 62(1):99–105. <https://doi.org/10.1093/cid/civ736> PMID: 26385993
17. Lanier Y, Castellanos T, Barrow RY, Jordan WC, Caine V, Sutton MY. Brief Sexual Histories and Routine HIV/STD Testing by Medical Providers. *AIDS Patient Care STDs*. 2014 Mar; 28(3):113–20. <https://doi.org/10.1089/apc.2013.0328> PMID: 24564387
18. Karim SSA, Gray GE, Martinson N. Preexposure Prophylaxis for HIV Prevention. *N Engl J Med*. 2012 Aug 2; 367(5):462–5. <https://doi.org/10.1056/NEJMcld1207706> PMID: 22784042
19. Mullins TLK, Lally M, Zimet G, Kahn JA, the Adolescent Medicine Trials Network for HIV/AIDS Interventions. Clinician Attitudes Toward CDC Interim Pre-Exposure Prophylaxis (PrEP) Guidance and Operationalizing PrEP for Adolescents. *AIDS Patient Care STDs*. 2015 Apr; 29(4):193–203. <https://doi.org/10.1089/apc.2014.0273> PMID: 25692683
20. Scherer ML, Douglas NC, Churnet BH, Grossman LC, Kline M, Yin MT, et al. Survey of HIV care providers on management of HIV serodiscordant couples—assessment of attitudes, knowledge, and practices.

- AIDS Care. 2014 Nov 2; 26(11):1435–9. <https://doi.org/10.1080/09540121.2014.920950> PMID: 24878166
21. White JM, Mimiaga MJ, Krakower DS, Mayer KH. Evolution of Massachusetts Physician Attitudes, Knowledge, and Experience Regarding the Use of Antiretrovirals for HIV Prevention. *AIDS Patient Care STDs*. 2012 Jul; 26(7):395–405. <https://doi.org/10.1089/apc.2012.0030> PMID: 22694239
 22. Department of Health and Human Services, Centers for Medicare & Medicaid Services, Centers for Disease Control and Prevention. US Public Health Service: Preexposure Prophylaxis for the Prevention of HIV Infection in the United States—2017 Update from 2014 guidelines [Internet]. 2017. Available from: <https://www.cdc.gov/hiv/pdf/risk/prep/cdc-hiv-prep-guidelines-2017.pdf>
 23. Skolnik AA, Bokhour BG, Gifford AL, Wilson BM, Epps PV. Roadblocks to PrEP: What Medical Records Reveal About Access to HIV Pre-exposure Prophylaxis. *J Gen Intern Med*. 2019 Nov 8;1–7.
 24. Amrhein V, Greenland S, McShane B. Scientists rise up against statistical significance. *Nature*. 2019 Mar; 567(7748):305–7. <https://doi.org/10.1038/d41586-019-00857-9> PMID: 30894741
 25. Stankevitz K, Schwartz K, Hoke T, Li Y, Lanham M, Mahaka I, et al. Reaching at-risk women for PrEP delivery: What can we learn from clinical trials in sub-Saharan Africa? Madiba S, editor. *PLOS ONE*. 2019 Jun 21; 14(6):e0218556. <https://doi.org/10.1371/journal.pone.0218556> PMID: 31226165
 26. US Government, March 13 P last updated; 2019. U.S. HIV Statistics [Internet]. HIV.gov. 2019 [cited 2019 Aug 26]. Available from: <https://www.hiv.gov/hiv-basics/overview/data-and-trends/statistics>