



Published in final edited form as:

*J Am Coll Clin Pharm.* 2024 November ; 7(11): 1107–1113. doi:10.1002/jac5.2043.

## Assessing pharmacy students' HIV pre-exposure prophylaxis (PrEP) prescribing knowledge, PrEP attitudes, and HIV-related stigma

Celeste Noelle Bustria, BS<sup>1</sup>, Finan Yohannes<sup>1</sup>, Jennifer Cocohoba, PharmD MAS<sup>1</sup>, Lee Nguyen, PharmD<sup>2</sup>, Nimish Patel, PharmD PhD<sup>3</sup>, Parya Saberi, PharmD MAS<sup>1</sup>

<sup>1</sup>San Francisco School of Pharmacy, University of California, San Francisco, California, USA

<sup>2</sup>Irvine Susan & Henry Samueli College of Health Sciences, University of California, Irvine, California, USA

<sup>3</sup>San Diego Skaggs School of Pharmacy and Pharmaceutical Sciences, University of California, San Diego, California, USA

### Abstract

**Introduction:** Human immunodeficiency virus (HIV) pre-exposure prophylaxis (PrEP) significantly reduces the risk of acquiring HIV. To increase PrEP prescribing, it is crucial to evaluate the preparedness of future pharmacists who will play a pivotal role in providing PrEP education, counseling, and prescribing.

**Objective:** We assessed PrEP-prescribing knowledge, attitudes, and HIV-related stigma of pharmacy students.

**Methods:** We conducted a cross-sectional web-based survey of student pharmacists in their final two years of education and training at the three University of California pharmacy schools. Survey questions assessed students' awareness of PrEP, familiarity with prescribing guidelines and Senate Bill 159 (SB159), PrEP knowledge, HIV-related stigma, and attitudes about PrEP. The sample was characterized using descriptive statistics, and non-parametric tests were used to examine associations between dependent variables and independent variables. A p-value <0.05 was deemed statistically significant.

**Results:** A total of 110 students participated in the survey. The greatest familiarity with guidelines was observed in male (77.4%) ( $p = 0.047$ ) and gay-identifying (100%) ( $p = 0.039$ ) students compared with other genders and sexual identities, respectively. Non-advanced pharmacy

---

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](#) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

**Correspondence** Parya Saberi, 550 16th street, UCSF Box 0886 San Francisco, CA 94143, USA. [parya.saberi@ucsf.edu](mailto:parya.saberi@ucsf.edu).

#### SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

#### CONFLICT OF INTEREST STATEMENT

Jennifer Cocohoba has received an investigator-initiated grant from Viiv Healthcare. Lee Nguyen received personal fees from WCG Institutional Biosafety Committee and received a grant from Merck & Co. Nimish Patel has received investigator-initiated grant support from Gilead Sciences and served on advisory boards for ViiV Healthcare. All other authors declare no conflicts of interest.

practice experience (APPE) students (70.3%) displayed significantly more familiarity with SB159 than APPE students (65.2%) ( $p = 0.006$ ). Non-APPE students displayed higher HIV-related stigma compared with APPE students (13.8 vs. 9.4,  $p = 0.0015$ ). Significant differences in PrEP knowledge ( $p = 0.0105$ ), HIV-related stigma ( $p = 0.0003$ ), and PrEP attitudes ( $p = 0.0098$ ) were observed between the schools. African American students had a significantly higher mean PrEP attitudes score (mean = 51.0, standard deviation [SD] = 3.6) compared with other racial categories ( $p = 0.0329$ ).

**Conclusion:** Elevated HIV-related stigma, in the presence of high levels of PrEP knowledge, highlights the need to focus on destigmatizing HIV prevention services and increasing anti-stigma training, which is imperative in preparing student pharmacists to prescribe PrEP.

## Keywords

education; HIV; pharmacist; pre-exposure prophylaxis; social stigma; student

## 1 | INTRODUCTION

Combating the human immunodeficiency virus (HIV) epidemic is a national priority. A key strategy for reducing HIV transmission is the use of HIV pre-exposure prophylaxis (PrEP). Reports from the Centers for Disease Control and Prevention (CDC) indicate a 99% reduction in HIV transmission through consistent use of PrEP.<sup>1</sup> Despite the clear benefits of PrEP, only 36% of eligible individuals are prescribed it, and there are clear disparities among persons receiving it. Lower PrEP coverage is observed among females (15%) compared with males (40%), and among Black (13%) and Hispanic/Latino (24%) individuals compared with White individuals (94%).<sup>2</sup> These findings emphasize the importance of programs and policies to accelerate PrEP prescribing, particularly for disproportionately affected communities. Some barriers to PrEP prescribing include clinician knowledge about PrEP, comfort with discussions related to PrEP and sexual history, attitudes toward PrEP, and HIV-related social stigma.<sup>3</sup> In October 2019, California passed Senate Bill 159 (SB159), which authorized California pharmacists to independently prescribe HIV PrEP and post-exposure prophylaxis (PEP) medications.<sup>4</sup> A cross-sectional survey found that among 919 California pharmacists and pharmacy students, only 11% and 13% reported observing pharmacists at their workplace prescribe PrEP and PEP under SB159, respectively.<sup>5</sup> A review of existing PrEP research in the United States suggests that student pharmacists have greater PrEP knowledge and higher intentions to counsel compared with actively working pharmacists, possibly due to more comprehensive training on PrEP.<sup>6</sup> In another study assessing health care students' comprehension, awareness, and willingness to prescribe PrEP, student pharmacists had greater PrEP knowledge and familiarity with prescribing guidelines than medical students and greater awareness than nursing students. Despite demonstrating higher knowledge, pharmacy students were less comfortable and willing to execute PrEP-related clinical activities than medical students.<sup>7</sup>

Pharmacists knowledgeable in HIV treatment and prevention can help improve health equity. A previous study on pharmacy students at the University of Buffalo found significant associations between confidence in PrEP counseling and PrEP knowledge, attitudes toward PrEP, and familiarity with prescribing guidelines.<sup>8</sup> These findings highlight the importance

of further PrEP research among student pharmacists. Because California was the first state to pass legislation allowing pharmacists to independently prescribe PrEP and PEP, it is imperative to assess whether California Doctor of Pharmacy (Pharm.D.) programs are preparing students for these future positions. Additionally, the passing of SB339 in February 2024 serves as a testament to the constant drive toward expanding PrEP access and addressing disparities in HIV prevention.<sup>9</sup> This updated Senate bill increases the time limits that a pharmacist is authorized to prescribe from a 60-day to a 90-day course of PrEP. If pharmacists can fulfill accurate documentation and communication with the patient's primary care providers (PCPs), and if they can ensure a patient's PrEP laboratory testing and follow-up care is consistent with CDC guidelines, pharmacists can continue to prescribe beyond a 90-day course of PrEP. This bill also requires insurers to cover PrEP prescribed by pharmacists including laboratory testing costs and the pharmacist's services. These improvements offer greater opportunities for pharmacists to increase PrEP access. With these Senate bills, there is a need to better understand the future outlooks of current student pharmacists who will be asked to engage in HIV prevention efforts.

Our study aimed to explore the familiarity of student pharmacists with PrEP prescribing at the levels of CDC guidelines and SB159, as well as HIV-related stigma, PrEP attitudes, social expectations for PrEP prescribing, comfort in prescribing PrEP, and HIV knowledge. Additionally, we explored the differences between the three University of California pharmacy schools and student demographics for the abovementioned variables.

## 2 | METHODS

### 2.1 | Study participants

We conducted a cross-sectional web-based survey (Qualtrics, Silver Lake Management and the Canada Pension Plan Investment Board (CPPIB), Seattle, WA) that included students from the three University of California pharmacy schools (the University of California, San Francisco [UCSF] School of Pharmacy, the University of California, San Diego [UCSD] Skaggs School of Pharmacy and Pharmaceutical Sciences, and the University of California, Irvine [UCI] School of Pharmacy and Pharmaceutical Sciences) that were in the final two years of their respective programs.

The UCSD and UCI schools are four-year programs, while UCSF is a three-year program. Students across all three schools learn HIV pharmacotherapy during their penultimate year of instruction, and they may engage in HIV patient care activities during their final year. At UCSD, students received 6 hours of didactic HIV education and an additional 2 hours on PrEP. This education is delivered annually during the students' third year (P3). At UCSF, students received 5 hours of didactic HIV education in their second year (P2) and an additional 4 hours of patient skill activities on PrEP counseling and HIV drug interactions. At UCI, students received 6 hours of didactic HIV pharmacotherapy in their P3. None of the University of California pharmacy schools offer elective courses on HIV. These educational hours were delivered at all institutions before survey distribution.

The survey was created in Qualtrics and responses were exported to Excel 16.84 (Microsoft, Redmond, WA). For three weeks starting in March 2024, the survey links were distributed

through email, and two email reminders were sent to students. Research team members who serve as faculty at these universities facilitated recruitment at their respective institutions. Survey completion was voluntary, and no incentives were provided. Because the survey was anonymous, students were not required to provide signed informed consent. The study was approved by the UCSF Institutional Review Board.

## 2.2 | Measures

Students' demographic information (age, gender, race, sexual identity) and year of pharmacy school (Advanced Pharmacy Practice Experience [APPE] year or non-APPE year) were collected. Questions from prior studies were adapted to create portions of the survey that assessed students' awareness of PrEP,<sup>7</sup> familiarity with prescribing guidelines,<sup>7</sup> familiarity with SB159,<sup>7</sup> knowledge of PrEP clinical care,<sup>10</sup> HIV-related stigma,<sup>11</sup> societal expectations to prescribe PrEP,<sup>12</sup> personal attitudes about PrEP,<sup>10</sup> comfort prescribing PrEP,<sup>10</sup> and their likelihood to prescribe PrEP in the future. For all survey questions, students had the option to indicate "Prefer not to answer" or "Not sure/Don't know" which were scored as 0 in the scoring described below.

The *PrEP Awareness* section included five questions. Students' baseline PrEP Awareness<sup>7</sup> was determined by a "yes," "no," or "not sure/don't know" response to the question "Prior to this survey, were you aware of the concept of HIV PrEP (pre-exposure prophylaxis), which is prescribing regularly scheduled oral or injectable HIV medications to persons with a negative HIV test to help them from getting HIV?" Awareness was further determined by having students estimate the number of hours of education and experiential training they received about HIV prevention or PrEP prescribing and counseling in their Pharm.D. programs. Students also indicated if they had or will have an HIV-focused APPE.

*Familiarity with PrEP prescribing* was assessed with one item asking students to rate their familiarity with CDC guidelines on a scale from (1) not at all familiar to (5) extremely familiar. *Familiarity with Senate Bills* was measured with two items evaluating knowledge of the PrEP clinical activities and requirements expected of pharmacists outlined by SB159. Students' answers were scored on a scale from (0) incorrect to (1) correct.<sup>7</sup>

Adapted from a previous study,<sup>10</sup> *PrEP Knowledge* was measured using ten questions that evaluated students' comprehension of PrEP and prescribing practices. The students were tested on selection criteria for PrEP candidates, available PrEP formulations, dosing, drug-drug interactions, and laboratory monitoring. Students' answers were scored on a scale from (0) incorrect to (1) correct. Partial credit was awarded for questions with multiple components. Students' responses were totaled to provide the sum of PrEP knowledge score per individual. Scores ranged from 0 to 10, with higher scores indicating higher PrEP knowledge.

The remaining sections of the survey were constructed based on the Theory of Planned Behavior (TPB),<sup>13</sup> which states that human behavior is affected by behavioral, normative, and control beliefs. *Behavioral beliefs* are the beliefs an individual has about negative or positive experiences associated with the action in question. *Normative beliefs* reflect social pressures to perform an action (i.e., the extent to which an individual or group encourages

or discourages a behavior). *Control beliefs* are beliefs about which external factors may promote or prevent an individual's ability to engage in the action (e.g., confidence in pursuing a task). According to the TPB, these beliefs influence human intentions and guide human behavior. Students' behavioral beliefs were reflected by their responses to questions related to *HIV stigma*<sup>11</sup> and *PrEP Attitudes*.<sup>10</sup> The *Social Expectations*<sup>12</sup> to Prescribe PrEP questions corresponded to the students' normative beliefs. The *Comfort Prescribing PrEP*<sup>10</sup> questions corresponded to students' control beliefs.

For HIV-related social stigma, the students were presented with six statements about people with HIV (PWH) and were asked to indicate their agreement with each one using a 7-point scale from (1) completely disagree to (7) completely agree.<sup>11</sup> Students' responses were summed to provide an HIV stigma score per individual. Scores ranged from 6 to 42 and higher scores represented higher HIV-related stigma. Students' PrEP attitudes were evaluated using eight questions in which they were presented with a list of different perspectives about PrEP, and they rated their level of agreement with each one using a 7-point scale from (1) completely disagree to (7) completely agree.<sup>10</sup> Six questions were reverse-coded as outlined in the original study. Participant responses were totaled to provide an individual PrEP attitude score. Scores had a total possible range of 8 to 56, with higher scores indicating more positive attitudes regarding PrEP prescribing.

Students indicated if they believed certain social expectations applied to them, such as the assumption that people will approve or disapprove of them independently prescribing PrEP, using a 7-point scale from (1) completely disagree to (7) completely agree.<sup>12</sup> These four questions were modified from a previous survey. Responses were summed to provide an overall social expectation score per individual. Scores ranged from 4 to 28, with higher scores indicating more significant pressure from social expectations to prescribe PrEP.

Students indicated their level of comfort prescribing PrEP and performing PrEP-related clinical activities using a 5-point scale ranging from (1) not at all comfortable to (5) extremely comfortable.<sup>10</sup> For these nine questions, students' responses were summed to provide a comfort prescribing score per individual. Scores ranged from 9 to 45, with higher scores indicating more comfort in prescribing PrEP.

*Future Outlooks* of PrEP and PEP prescribing activities were evaluated with one item asking: "In the next 5 years, what is the likelihood that you would practice in a setting that furnishes PrEP and PEP?" Students answered on a scale from (1) not at all likely to (5) extremely likely.

## 2.3 | Data analysis

The sample was characterized using descriptive statistics (means, standard deviations [SDs], medians, and interquartile ranges [IQRs]) using Excel. Because data were not expected to be normally distributed, non-parametric tests were conducted using STATA 15.0 (College Station, TX) to examine associations between dependent variables (i.e., HIV stigma, PrEP attitudes, social expectations, and comfort prescribing) and independent variables (i.e., age, race, gender, and school). The Kruskal–Wallis test was used to compare associations between continuous dependent variables (e.g., HIV-related stigma, PrEP attitudes, social

expectations, comfort prescribing PrEP, and PrEP knowledge) with categorical independent variables of two or more categories (e.g., school, race, gender, and sexual orientation). Spearman's rank correlation test was used to measure the strength and direction of association between continuous dependent variables and continuous independent variables (e.g., age). Fisher's exact test was used to measure associations between familiarity with guidelines and SB 159 and demographics. A p-value <0.05 was deemed statistically significant.

### 3 | RESULTS

At the time of this survey, the P3 and P4 class sizes of UCI were 50 and 40, respectively. The P3 and P4 class sizes of UCSD were 71 and 59, respectively. The P2 and P3 class sizes of UCSF were 113 and 120, respectively. One hundred and ten (24.3%) students participated in the survey. The distribution of participants per institution was 44 (40%) from UCI, 35 (31.8%) from UCSD, and 31 (28.2%) from UCSF. The survey took a mean of 43.3 minutes to complete (IQR = 11.7 minutes). Table 1 includes the demographics of the participating students.

Among these students, 24 (21.8%) were enrolled in their final year of pharmacy school (APPE year), while 86 (78.2%) were not. The majority of the students self-identified as Asian (68%), women (65.5%), and heterosexual (79.5%). The mean age of students was 25.6 years (SD = 2.3). Nearly 89.0% were aware of the concept of PrEP before the survey (Table 2). The mean number of lecture and experiential hours related to HIV prevention or treatment that students reported receiving was 6.1 hours (SD = 3.7) and 12 hours (SD = 22.6), respectively. Students also reported spending a mean of 4.3 hours (SD = 9.2) in lecture sessions and 2.3 hours (SD = 6.3) in hands-on training related to PrEP prescribing and counseling.

Approximately 69.1% (67/97) of students were at least moderately familiar with PrEP-prescribing guidelines and 70.8% (68/96) correctly identified the actions and requirements of a pharmacist independently prescribing PrEP under SB159 (Supporting Information, Table 1). The mean PrEP knowledge score was 6.9 (SD = 2.0). The greatest number of incorrect or partially correct responses pertained to identifying correct PrEP regimens, PrEP monitoring laboratory tests, and drug-drug interactions with PrEP. The mean score for HIV stigma was 12.7 (SD = 5.7) while the mean score for attitudes toward PrEP was 46.2 (SD = 6.6), and the mean score for social expectations to prescribe PrEP was 15.0 (SD = 4.3) (Supporting Information, Table 2). Approximately 60.8% (48/79) answered that they were at least moderately likely to furnish PrEP in their future practice (Supporting Information, Table 3).

No statistically significant associations were found for social expectations or comfort in prescribing PrEP between the schools, APPE versus non-APPE students, age, racial categories, gender identities, or sexual orientations. However, there were statistically significant differences in familiarity with PrEP-prescribing guidelines and SB159 by gender identity, sexual orientation, and year of instruction. Regarding gender, 77.4% of male students were at least moderately familiar with CDC PrEP guidelines versus 68.3% of



female students ( $p = 0.047$ ). All students who identified as gay (100.0%) were at least moderately familiar with the guidelines as compared with their heterosexual (74.4%), lesbian (25.0%), and bisexual (33.3%) peers ( $p = 0.039$ ). African American students across all schools had significantly higher PrEP attitudes (mean = 51.0, SD = 3.9) compared with Asian (mean = 46.7, SD = 5.1), and White students (mean = 46.4, SD = 12.5) ( $p = 0.0329$ ).

Non-APPE students (70.3%) displayed significantly more familiarity with SB159 than APPE students (65.2%,  $p = 0.006$ ). Students in their non-APPE year had a significantly higher mean HIV-related stigma score compared with students in their APPE year, with a mean score of 13.8 versus 9.8, respectively ( $p = 0.0015$ ).

Statistically significant differences in PrEP knowledge were observed between the pharmacy schools (mean knowledge scores UCI 7.4 vs. UCSD 5.8 vs. UCSF 7.2 L,  $p = 0.0105$ ) (Table 3). Differences in HIV-related stigma were observed between the pharmacy programs (mean stigma scores UCI 14.7 vs. UCSD 12.2 vs. UCSF 9.4 for each school,  $p = 0.0003$ ). Differences in attitudes toward prescribing PrEP between the schools were also statistically significant ( $p = 0.0098$ ). The PrEP attitudes score was lowest for UCI (mean = 44.3, SD = 7.2) compared with UCSD (mean = 46.4, SD = 6.0) and UCSF (mean = 49.7, SD = 4.5).

## 4 | DISCUSSION

The goal of our study was to examine different domains related to PrEP awareness, familiarity, attitudes, social expectations, comfort, and stigma among the three University of California pharmacy schools. In summary, students identifying as male or gay across all schools were most familiar with PrEP-prescribing guidelines compared with students who identified with different genders or sexual orientations. Students who identified as African American across all schools had the most positive PrEP attitudes compared with students of other races. Non-APPE year students at all schools exhibited greater familiarity with SB159 compared with APPE students, but they also indicated higher levels of HIV-related stigma compared with APPE students. Similar levels of social expectations and comfort in prescribing PrEP were observed across the three schools, years of instruction, age, racial categories, gender identities, and sexual orientations. However, the UCI students demonstrated the greatest PrEP knowledge yet had the highest HIV-related stigma and lowest attitudes toward prescribing PrEP, while UCSF students demonstrated similarly high knowledge but the lowest HIV-related stigma and the most positive attitudes toward PrEP.

Among the three schools, we noted increasing HIV-related stigma with decreasing PrEP attitudes. Differences in HIV stigma across the schools are likely multifactorial and may partially be explained by the differences in HIV prevalence across the three sites (HIV prevalence in 2021 was 15 631 in San Francisco County, 13 524 in San Diego County, and 7229 in Orange County).<sup>14</sup> In alignment with these differences, we observed the lowest scores in HIV stigma among UCSF students, followed by UCSD and UCI. Although HIV-related stigma is influenced by multiple internal and external factors, these findings suggest that negative beliefs, prejudice, disapproval of PWH, or unfamiliarity with PWH may influence student pharmacists to also have negative perspectives toward PrEP and its benefits which can, in turn, impact their willingness to prescribe PrEP in the future. Similar

to our findings, a study<sup>15</sup> across four U.S. pharmacy schools found no associations between PrEP knowledge and confidence in prescribing. In this study, implicit racism was found to be associated with lower prescribing confidence. The study's recognition of implicit bias as a barrier to PrEP care aligns with our findings that HIV-related stigma was associated with lower PrEP attitudes. Despite the presence of SB159 and knowledgeable pharmacists, there is a need to address HIV-related stigma among health care professionals to overcome deep-seated biases that cannot be surmounted by knowledge alone. The observed differences in PrEP knowledge, HIV-related stigma, and attitudes between schools are consistent with two prior studies<sup>7,8</sup> which highlight varying levels of PrEP knowledge and confidence among student groups.

The mismatch between PrEP knowledge and beliefs towards PrEP prescribing was also exhibited in non-APPE and APPE students across all schools. Although non-APPE students demonstrated higher familiarity with SB159 because their didactic training was more recent, they had greater HIV-related stigma, and less positive PrEP attitudes. It is possible that the general lack of clinical or patient care experiences in non-APPE students explains having more negative beliefs and attitudes about HIV and PrEP. This aligns with the results from a national survey of pharmacy and medical students across the United States<sup>16</sup> that found students who had more training demonstrated higher PrEP knowledge relative to students in their first year of training.

Our study found that students who identified as male were more familiar with guidelines, which is similar to another prior study<sup>7</sup> that found males reported higher confidence in PrEP counseling. It is unknown why male participants reported greater familiarity with PrEP-prescribing guidelines. Based on past research, there is a potential gender gap with overconfidence in knowledge that may explain this difference.<sup>17</sup> Despite the statistically significant results in PrEP attitudes among students who identified as Black/African American, we cannot draw any concrete conclusions due to the small sample size.

There are some limitations to our study. The study was conducted with a relatively small sample of students in California. While we specifically selected the three geographically diverse University of California pharmacy schools to achieve internal validity, a potential limitation of our findings is the lack of generalizability to all pharmacy schools in California or the United States. Future research will be needed to verify our study findings across schools of pharmacy nationwide. Additionally, the presence of a majority Asian demographic (68%) may limit the interpretation of our findings. The study's cross-sectional design prevents us from establishing temporal relationships or causal connections between variables. Longitudinal follow-up can better identify needed educational interventions to address potential gaps in the pharmacy school curriculum. Moreover, self-reported data may introduce potential biases including social desirability and recall biases. Finally, because our study did not offer incentives, we reduced the number of questions to increase the chances of participation. As such, we focused on PrEP and not on PEP.

In a study examining PrEP knowledge, PrEP attitudes, and comfort in prescribing PrEP, some intervention targets for increasing PrEP prescribing among PCPs were noted to include motivation, education, and skills to prescribe PrEP.<sup>10</sup> Our study, similarly, sees the value of



increasing PrEP-prescribing capacities among pharmacists in California; however, without addressing stigma, high levels of PrEP knowledge may not necessarily translate to increased PrEP prescribing. Future longitudinal research on addressing HIV-related social stigma in pharmacy students can shed light on potential educational interventions that can improve PrEP attitudes and confidence to prescribe PrEP. Ultimately, integrating lessons that shape behavioral beliefs may be critical in how the HIV PrEP curriculum of California pharmacy schools equips students to prescribe PrEP. Therefore, we believe pharmacy schools should more strongly emphasize coursework related to stigma and bias as targets to promote PrEP prescribing among future California pharmacists.

The 2023 update to the American College of Clinical Pharmacy Pharmacotherapy Didactic Curriculum Toolkit is a guide for developing and mitigating curricula at schools of pharmacy.<sup>18</sup> The updated Toolkit assigns HIV infection, including PrEP and PEP, as a tier 2 topic (foundational education and post-graduate training) which underscores the need for more in-depth education during and after pharmacy graduate training. Additionally, in Feb 2024, SB339<sup>9</sup> was passed to address some of the barriers imposed by SB159 (e.g., the PrEP prescription limit and the need for pharmacists to refer patients to PCPs). Despite this progress, our study's findings suggest that there may still be existing barriers to PrEP access, particularly as related to HIV social stigma. This highlights the need for pharmacy schools to evaluate and enhance their curricula on HIV and HIV prevention in order to develop future pharmacists who are willing to be actively engaged in ending the HIV epidemic.<sup>19</sup>

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

## REFERENCES

1. Effective HIV Prevention Strategies | HIV Risk and Prevention Estimates | HIV Risk and Prevention | HIV/AIDS | CDC. 2022 [cited 2024 May 2]. Available from: <https://www.cdc.gov/hiv/risk/estimates/preventionstrategies.html>
2. Expanding PrEP Coverage in the United States to Achieve EHE Goals | 2023 | Dear Colleague Letters | NCHHSTP | CDC 2023 [cited 2024 May 2]. Available from: [https://www.cdc.gov/nchhstp/dear\\_colleague/2023/dcl-101723-prep-coverage.html](https://www.cdc.gov/nchhstp/dear_colleague/2023/dcl-101723-prep-coverage.html)
3. Pleuhs B, Quinn KG, Walsh JL, Petroll AE, John SA. Health care provider barriers to HIV pre-exposure prophylaxis in the United States: a systematic review. *AIDS Patient Care STDS*. 2020;34(3):111–123. 10.1089/apc.2019.0189 [PubMed: 32109141]
4. 1747 fe.pdf. [cited 2024 May 6]. Available from: [https://www.pharmacy.ca.gov/laws\\_regs/1747\\_fe.pdf](https://www.pharmacy.ca.gov/laws_regs/1747_fe.pdf)
5. Hunter LA, Packel LJ, Chittle P, Beltran RM, Rafie S, de Martini L, et al. Opportunities to increase access to HIV prevention: evaluating the implementation of pharmacist-initiated pre-exposure prophylaxis in California. *Open Forum Infect Dis*. 2023;10(11):ofad549. 10.1093/ofid/ofad549

6. Zhao A, Dangerfield DT 2nd, Nunn A, Patel R, Farley JE, Ugoji CC, et al. Pharmacy-based interventions to increase use of HIV preexposure prophylaxis in the United States: a scoping review. *AIDS Behav.* 2022;26(5):1377–1392. 10.1007/s10461-021-03494-4 [PubMed: 34669062]
7. Przybyla S, Fillo J, Kamper-DeMarco K, Bleasdale J, Parks K, Klasko-Foster L, et al. HIV pre-exposure prophylaxis (PrEP) knowledge, familiarity, and attitudes among United States healthcare professional students: a cross-sectional study. *Prev Med Rep.* 2021;22: 101334. 10.1016/j.pmedr.2021.101334
8. Przybyla SM, Parks K, Bleasdale J, Sawyer J, Morse D. Awareness, knowledge, and attitudes towards human immunodeficiency virus (HIV) pre-exposure prophylaxis (PrEP) among pharmacy students. *Curr Pharm Teach Learn.* 2019;11(4):352–360. 10.1016/j.cptl.2019.01.011 [PubMed: 31040011]
9. California SB339 | 2023–2024 | Regular Session. LegiScan. [cited 2024 May 6]. Available from: <https://legiscan.com/CA/text/SB339/id/2832417>
10. Walsh JL, Petroll AE. Factors related to pre-exposure prophylaxis prescription by U.S. Primary Care Physicians. *Am J Prev Med.* 2017;52(6): e165–e172. 10.1016/j.amepre.2017.01.025 [PubMed: 28363410]
11. Stringer KL, Turan B, McCormick L, Durojaiye M, Nyblade L, Kempf MC, et al. HIV-related stigma among healthcare providers in the deep south. *AIDS Behav.* 2016;20(1):115–125. 10.1007/s10461-015-1256-y [PubMed: 26650383]
12. Macalino GE, Sachdev DD, Rich JD, Becker C, Tan LJ, Beletsky L, et al. A national physician survey on prescribing syringes as an HIV prevention measure. *Subst Abuse Treat Prev Policy.* 2009;4:13. 10.1186/1747-597X-4-13 [PubMed: 19505336]
13. Ajzen I. The theory of planned behaviour: reactions and reflections. *Psychol Health.* 2011;26(9):1113–1127. 10.1080/08870446.2011.613995 [PubMed: 21929476]
14. Understanding HIV where you live. Available at: <https://aidsvu.org/> (Accessed September 12, 2024) n.d.
15. Bunting SR, Feinstein BA, Bertram C, Hazra A, Sheth NK, Garber SS. Effects of knowledge and implicit biases on pharmacy students' decision-making regarding pre-exposure prophylaxis for HIV prevention: a vignette-based experimental study. *Curr Pharm Teach Learn.* 2023;15(2):139–148. 10.1016/j.cptl.2023.02.019 [PubMed: 36898891]
16. Bunting SR, Feinstein BA, Hazra A, Sheth NK, Garber SS. Knowledge of HIV and HIV pre-exposure prophylaxis among medical and pharmacy students: a national, multi-site, cross-sectional study. *Prev Med Rep.* 2021;24:101590. 10.1016/j.pmedr.2021.101590
17. Exley C, Kessler J. The Gender Gap in Self-Promotion. Cambridge, MA: National Bureau of Economic Research; 2019 [cited 2024 Sep 10]. p. w26345 Report No.: w26345. Available from: <https://www.nber.org/papers/w26345.pdf>
18. Kolanczyk DM, Merlo JR, Bradley B, Flannery AH, Gibson CM, McBane S, et al. 2023 update to the American College of Clinical Pharmacy Pharmacotherapy Didactic Curriculum Toolkit. *J Am Coll Clin Pharm.* 2024;7(3):255–269. [PubMed: 39463489]
19. Ending the HIV epidemic in the US (EHE) (no date) Ending the HIV Epidemic in the US (EHE). Available at: <https://www.cdc.gov/ehe/index.html> (Accessed September 12, 2024) n.d.

**TABLE 1**Characteristics of pharmacy students ( $N = 110$ ).

Doctor of pharmacy program, $n$ (%)	
University of California, Irvine	44 (40.0)
University of California, San Diego	35 (31.8)
University of California, San Francisco	31 (28.2)
Year of instruction, $n$ (%)	
Advanced Pharmacy Practice Experience Student	24 (21.8)
Non-Advanced Pharmacy Practice Experience Student	86 (78.2)
Age in years, mean (SD)	25.6 (2.3)
Race <sup>a</sup> , $n$ (%)	
Asian	75 (65.8)
Black or African American	3 (2.6)
White	18 (15.8)
Prefer to self-describe	14 (12.3)
Prefer not to answer	4 (3.5)
Gender identity, $n$ (%)	
Man	35 (31.8)
Woman	72 (65.5)
Non-binary	1 (0.9)
Prefer not to answer	2 (1.8)
Sexual orientation <sup>a</sup> , $n$ (%)	
Gay	5 (4.5)
Lesbian	5 (4.5)
Straight (not gay, lesbian, etc.)	89 (79.5)
Bisexual	8 (7.1)
Prefer to self-describe	3 (2.7)
Prefer not to answer	2 (1.8)

Abbreviation: SD, standard deviation.

<sup>a</sup> Respondents were allowed to choose multiple options; therefore, the total  $N$  is higher than the sample size.

**TABLE 2**PrEP awareness among pharmacy students (*N* = 100).**PrEP awareness, *n* (%)**

Before this survey, were you aware of the concept of HIV PrEP, which is prescribing regularly scheduled oral or injectable HIV medications to persons with a negative HIV test to help prevent them from getting HIV?

Yes	89 (89.0)
No	9 (9.0)
Not sure/Don't know	2 (2.0)

**Hours of education & training, mean (SD)**

Approximately, how many hours of education (lecture, required readings, videos) did you receive on HIV prevention or treatment throughout your Pharm.D. program thus far (including didactics, IPPEs, and APPEs)?

Estimated lecture hours	6.1 (3.7)
Estimated experiential hours	12.0 (22.6)

Approximately, how many hours of education (lectures, required readings, videos) did you receive on PrEP prescribing and counseling throughout your Pharm.D. program thus far?

Estimated lecture hours	4.3 (9.2)
Estimated experiential hours	2.3 (6.3)

**HIV-focused APPE experience, *N* (%)**

Have you had an HIV-focused APPE experience?

Yes	4 (4.0)
No	74 (74.0)
No, but I will have one in the future	9 (9.0)
Not sure/don't know	13 (13.0)

Abbreviations: APPE, advanced pharmacy practice experience; HIV, human immunodeficiency virus; IPPE, introductory pharmacy practice experience; OSCE, objective structured clinical exam; PrEP, pre-exposure prophylaxis; Pharm.D., doctor of pharmacy; SD, standard deviation.

**TABLE 3**  
Comparison between the three pharmacy schools regarding behavioral beliefs, normative beliefs, control beliefs, and familiarity with PrEP.

		UCI	UCSD	UCSF	Total
Behavioral beliefs, mean (SD) <sup>a</sup>	HIV stigma ( <i>n</i> = 83) PrEP attitudes ( <i>n</i> = 97)	14.7 (5.3) 44.3 (7.2)	12.2 (5.6) 46.4 (6.0)	9.4 (5.2) 49.7 (4.5)	12.7 (5.7) 46.2 (6.6)
Normative beliefs, mean (SD) <sup>b</sup>	Social expectations to prescribe PrEP ( <i>n</i> = 82)	14.7 (4.5)	15.7 (4.4)	15.5 (3.8)	15.0 (4.3)
Control beliefs, mean (SD) <sup>c</sup>	Comfort prescribing PrEP ( <i>n</i> = 79)	35.2 (6.3)	30 (9.2)	31.2 (10.9)	32.9 (8.7)
Familiarity, <i>n</i> (%)	At least moderately familiar with CDC guidelines ( <i>n</i> = 97)	34 (35.1%)	20 (20.6%)	13 (13.4%)	97 (69.1%)
	Correctly identified SB 159 <sup>d</sup> clinical activities ( <i>n</i> = 96)	34 (35.4%)	16 (16.7%)	18 (18.8%)	96 (70.8%)
Knowledge, mean (SD) <sup>d</sup>	Correctly identified SB 159 <sup>d</sup> requirement PrEP knowledge ( <i>n</i> = 87)	17 (17.7%) 7.4 (1.3)	20 (20.8%) 5.8 (2.5)	15 (15.6%) 7.2 (1.9)	96 (54.2%) 6.9 (2.0)

Abbreviations: PrEP, pre-exposure prophylaxis; SD, standard deviation; UCI, University of California, Irvine; UCSD, University of California, San Diego Skaggs School of Pharmacy and Pharmaceutical Sciences; UCSF, University of California, San Francisco.

<sup>a</sup>Stigma: scores range from 6 to 42; Attitudes: scores range from 8 to 56.

<sup>b</sup>Social expectations: scores range from 4 to 28.

<sup>c</sup>Comfort: scores range from 9 to 45.

<sup>d</sup>PrEP-Knowledge: scores range from 0 to 10.