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ORIGINAL PAPER

Predicting Pharmacist Dispensing Practices and Comfort Related to Pre-exposure Prophylaxis for HIV Prevention (PrEP)

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Abstract

To identify factors associated with pharmacist dispensing practice and comfort counseling patients about pre-exposure prophylaxis for HIV prevention (PrEP). Cross-sectional 2016 census of Indiana managing pharmacists measured PrEP awareness, comfort dispensing and counseling patients. Modified Poisson models with robust error variance estimated relative risks and confidence intervals. 15.8% of 284 pharmacists had dispensed PrEP and 11.6% had consulted about it. Dispensing and comfort counseling were associated with confidence in knowledge about PrEP medication adherence and adverse effects of PrEP medication; awareness about PrEP before the survey, number of full time pharmacists in their pharmacy, and increases in new HIV cases from 2015 to 2016 in communities served. Comfort counseling about PrEP was associated with the belief that pharmacists can be an important resource for HIV and HCV treatment.

Keywords PrEP · HIV prevention · Pharmacy practice · Pharmacist

Resumen

Identificar los factores asociados con la práctica de dispensación de farmacéuticos y aconsejar a los pacientes sobre la profilaxis previa a la exposición para la prevención del VIH (PrEP). El censo transversal de 2016 de los farmacéuticos de Indiana midió el conocimiento de PrEP, la dispensación de la comodidad y el asesoramiento a los pacientes. Los modelos de Poisson modificados con una varianza de error robusta estimaron los riesgos relativos y los intervalos de confianza. El 15.8% de los 284 farmacéuticos habían dispensado PrEP y el 11.6% había consultado al respecto. El asesoramiento sobre la dispensación y la comodidad se asociaron con la confianza en el conocimiento sobre la adherencia a la medicación con PrEP y los efectos adversos de la medicación con PrEP; conocimiento sobre PrEP antes de la encuesta, número de farmacéuticos a tiempo completo en su farmacia, y aumentos en nuevos casos de VIH desde 2015 hasta 2016 en las comunidades atendidas. El asesoramiento de comodidad sobre la PrEP se asoció con la creencia de que los farmacéuticos pueden ser un recurso importante para el tratamiento del VIH y el VHC.

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Introduction

Pre-exposure prophylaxis (or PrEP) is an evidence-based intervention with an effectiveness rate greater than 90% for preventing HIV transmission [1–3]. However, populations that need it often do not or cannot access it. Barriers are multifaceted, involving individual awareness of PrEP [4–6], cost [46] and clinical awareness and comfort prescribing it [7–9]. Increasing access to PrEP involves, among other things, building community awareness about PrEP, including engagement of additional partners in the medical relationship.

Pharmacists are part of this medical relationship and can play an important role in individual PrEP awareness because they can identify potential need for PrEP and consult about its indications and management during the entire patient decision process: from first consideration through dispensing and medications management. This consultative role is appropriate for pharmacists, as has been shown in several recent studies of health consultation through community pharmacies [50–54]. These findings reflect the recent evolution of pharmacy practice when contrasted with earlier meta-analyses reporting conflicting results about whether consumers saw pharmacists as providers of health advice [48] or only as drug experts [49].

Earlier studies notwithstanding, pharmacist facilitation of PrEP access reflects current scope of U.S. pharmacy practice [11, 12] because pharmacists today engage in myriad practices related to medications and healthcare consultation [13–16]. Many pharmacies also offer health-related interventions to prevent chronic disease [17–19]. Our 2016 study in Indiana found that over 90% of community managing pharmacists believed that pharmacists are important resources for the prevention and treatment of HIV and hepatitis C [20, 21]. Further, our prior studies and that of Amesty et al. found interest among community pharmacists for an expanded role with HIV prevention [22–24]. Thus, the evolving pharmacist consulting role could provide an added layer of consultation opportunity from a trusted provider [10], and may increase PrEP readiness and access for populations considering PrEP.

PrEP awareness and clinical practice studies tend to focus on physicians [7–9, 46, 47], HIV-specialists [8, 25], or other providers such as substance abuse treatment providers [26]. Carter et al's study broadened the literature to include advanced practice nurses [27]. To our knowledge, there are four recent studies exploring various aspects of PrEP knowledge, intent, and current practice among pharmacists. Shaeer et al's 2014 study among Florida community and hospital pharmacists found that 22% reported having dispensed PrEP yet 63% were unaware of the 2014 CDC guidelines recommending it, 68% believed PrEP use would lead to risky behaviors, and 65% believed it would lead to increased rates of sexually transmitted infections (STIs). The relationship between these beliefs and PrEP dispensing or comfort counseling patients about PrEP was not explored [13]. Further, community and hospital pharmacists were aggregated in the Florida sample, and this may have skewed findings about knowledge and pharmacy practice given the settings differences, as suggested by two European studies [29, 30]. We cannot, however, confirm that hospital pharmacists have a different knowledge base about PrEP than community pharmacists. To our knowledge, no U.S. studies have been conducted to identify whether any differences exist between pharmacists in these two settings.

Unni et al's 2016 study of Utah PrEP knowledge and attitudes among community pharmacists found that pharmacist intent to counsel about PrEP was associated with their beliefs about their PrEP-related knowledge and consultation capacities, and with the social influence of other pharmacists [31]. Matyanga et al's 2014 study among community and hospital pharmacists in Harare, Zimbabwe found that while 94% of pharmacists were willing to stock PrEP medication (Truvada®), only 58% were knowledgeable about it; and negative perceptions about PrEP were based on attitudes about its cost, accessibility and concerns about promiscuity among those who use it [28]. Finally, Yoong et al's 2016 small survey of 48 Canadian HIV care pharmacists found that 75% believed PrEP would benefit their pharmacy customers; yet they also observed that PrEP familiarity was not associated with pharmacist support for it. Notably, Yoong et al. found that 42% of the sample had been asked about PrEP by patients in the last year [32].

These PrEP studies among pharmacists suggest that PrEP awareness and knowledge may have an impact on support for PrEP or intent to counsel about it; however, pharmacists may also hold beliefs about the deleterious impact of PrEP use. These studies did not seek to understand pharmacy level factors (such as type of pharmacy or number of FTEs), or community level factors such as HIV incidence; though Yoong et al., did measure whether pharmacists were asked about PrEP from the community. The next step, then, is to explore the relationship between individual, structural and community factors and their influence on pharmacy PrEP practice.

Studying community pharmacies is of interest here because these pharmacists are well positioned to identify populations needing PrEP and help normalize discussion about it. This is important for HIV prevention because 20% of the those living with HIV in the U.S. are unaware of it; a rate that increases to 59% for men who have sex with men and populations of color [33, 34].

This study sought to identify factors associated with PrEP dispensing and comfort with PrEP counseling among community pharmacists in Indiana to inform the design

of evidence-based pharmacy-practice PrEP interventions. While PrEP geographic and epidemiologic studies are few [39, 40], and systematic pharmacy studies have yet to be conducted, we hypothesized that pharmacist comfort and dispensing would be higher among pharmacists practicing in communities with higher rates of HIV. We also hypothesized that PrEP dispensing would be predicted by pharmacist comfort counseling patients about it. Finally, based on our pharmacy study on naloxone stocking and dispensing [35] where we found that chain pharmacies with larger pharmacy staff stocked naloxone, we hypothesized that pharmacists working at chain pharmacies and pharmacies with more than 1 full time (FTE) pharmacist (a higher number of FTEs) would be more likely to report having dispensed PrEP. The theory is that pharmacies with greater institutional capacity may be early adopters of pharmacy practice change requiring staff resources.

Understanding both PrEP dispensing and comfort consulting about it is important because PrEP consultation often occurs at the time of dispensing and involves several kinds of conversations such as discussions about additional behavioral risk reduction (sharing syringes, using condoms), as well as medication adherence and adverse effects. Studying pharmacy practice in a Midwestern state such as Indiana provides a view of an environment where conversations about PrEP may not be happening at the community level or within the patient-clinician relationship.

Methods

We conducted a cross-sectional census of all managing pharmacists in Indiana's 850 community pharmacies from July to September 2016. To identify the study population, we matched licensed managing pharmacists (Indiana Board of Pharmacy, Feb 2016) with retail pharmacies (Hayes Directories, Inc. Dec 2015). As described elsewhere [35, 36], the study utilized an online survey platform with mailed paper invitations containing a $5.00 pre-incentive. Surveying managing pharmacists reduced respondent bias by ensuring that a specific individual within each pharmacy was identified. The study was deemed exempt by Indiana University Institutional Review Board.

PrEP survey questions were informed in part by Shaeer's survey of Florida pharmacists [13], and measured pharmacist characteristics including demographics, education (formal and continuing), years in pharmacy practice, pharmacy characteristics (pharmacy type, staffing and location) pharmacist practices related to PrEP awareness, patient counseling and dispensing, and pharmacist attitudes about PrEP counseling and the impact of PrEP use. Pharmacy location was coded as metropolitan/nonmetropolitan designation based on 2013 USDA rural–urban commuting area codes [37]. PrEP awareness was measured by asking: *Prior to this survey, were you aware of PrEP (pre-exposure prophylaxis) for HIV prevention?* with response options: Yes/No/not at all/I was aware of pre-exposure prophylaxis for HIV, but not the term "PrEP." Pharmacists were also asked to identify topics about which they felt they had *sufficient knowledge to counsel patients with a PrEP prescription.* Selections included medication adverse effects, medication adherence, behavior modification ("*such as condom use")*, and summary of PrEP clinical trials.

We measured pharmacy practice by asking about PrEP counseling and dispensing in their current pharmacy. With each item, respondents could indicate whether they engaged in the practices, and whether other pharmacists did so at the pharmacy. Attitudes and beliefs about PrEP were measured by asking pharmacists to identify barriers to PrEP counseling and dispensing from a list of 10 barriers including separate items related to personal and customer discomfort, and beliefs about PrEP use: (1) *A patient taking PrEP would eventually develop resistance to the medications*, (2) *Use of PrEP would reinforce risky behaviors (e.g. multiple sexual or injection partners, unprotected sex, sharing injection equipment,* etc*),* and (3) *Widespread use of PrEP would contribute to increased rates of HIV and other sexually transmitted diseases).*

Comfort counseling patients about PrEP was measured by a 5-point Likert-type agreement selection in response to this statement: *I am comfortable counseling patients/customers about pre-exposure prophylaxis (PrEP) prescriptions and HIV risk reduction.* Pharmacists were also asked to identify situations in which they would be comfortable dispensing PrEP including dispensing *to anyone with a medical need and a prescription* and seven other specific sub-categories.

Survey data were matched with the most recent county-level data describing potential community level indicators of need for pharmacy interventions about PrEP. This included: (1) new HIV diagnoses (HIV incidence) for 2015 and 2016, (2) HIV prevalence for 2015 and 2016, (3) the ratio of primary care providers to county population, (4) county medical underservice designation [38] and (5) whether the pharmacist had been asked about PrEP, antiretroviral treatment for HIV and HIV testing in the last 2 years by customers, other pharmacists or medical providers *(doctors or nurses)*. Due to cell size, these last measures were dummy coded ('Asked by Anyone'/'Not Asked by Anyone') for each of the items (PrEP, PEP (post exposure prophylaxis for HIV prevention), ARV and HIV testing). This decision was made because there were too few positive responses for these individual questions in each category of the outcome variables for analysis as separate components. A measure representing change in HIV incident cases and prevalent cases from 2015 to 2016 was also computed.

Outcomes of interest included PrEP dispensing and pharmacist comfort counseling patients about PrEP. Based on the Unni study [32] we hypothesized that pharmacists would be more comfortable with PrEP counseling had they been asked about it in the past 2 years.

Variables were initially described and then compared using Chi square goodness of fit testing for categorical variables and t-tests for continuous variables between outcome groups for PrEP dispensing and counseling comfort. Variables with associations statistically significant at the $p \leq 0.05$ level were included in multivariable prediction. Number of full time employees was marginally insignificant with having dispensed PrEP Participants with missing observations for awareness of PrEP ($n = 14$) or comfort counseling patients ($n = 16$) were excluded from the analyses and models. As the outcomes were common, violating the rare outcome assumption, odds ratios from logistic regression are not accurate estimates of risk ratios. Risk ratios and confidence intervals were directly estimated with modified Poisson models with robust error variance [41]. Multicollinearity was assessed by examining condition indexes and variance proportions. Condition indexes greater than 15 were used to indicate collinearity. Once the presence of collinearity was indicated, variance proportions greater than 0.50 were used to identify specific collinear variables. Variables deemed collinear were removed from the models [42]. For the both the dispensing model and the comfort counseling models the variables removed were new HIV cases in the county in 2015, new HIV cases in the county in 2016, HIV prevalence in the county in 2015, HIV prevalence in the county in 2016, and the difference in HIV prevalence from 2015 to 2016. The variable included was the difference in new HIV cases from 2015 to 2016. The variable that Pharmacists can be an important resource for HIV and HCV prevention was also removed from the comfort counseling model (Strongly Agree) in favor of the variable Pharmacists can be an important resource for HIV and HCV treatment (Strongly Agree). P-values were not adjusted for multiple testing.

Results

Complete responses from 284 managing pharmacists were included in the analysis for a response rate of 33.4% (see Table 1). The sample reflected Indiana's population of community pharmacies in terms of type for all but Independent pharmacies. As of December 2015, 14.8% of pharmacies were independent as compared with 3.9% of responding pharmacies [55]. Responding pharmacies did, however, reflect Indiana's rurality distribution, as 78.5% of responding pharmacies were located in a metropolitan area whereas 72.4% of the population lives in metropolitan areas [37]. To our knowledge, there are no measures of demographics for Indiana managing pharmacists. A comparison with the most recent available pharmacist demographic data included all Indiana pharmacists, irrespective of pharmacy role or setting. Demographically, responding pharmacists reflected the overall Indiana population of pharmacists, as 50.4% were female (compared with 58% of all Indiana pharmacists), and 91.3% were white (compared with 89.9% overall) [56]. Responding pharmacies were located in over 70% of Indiana's 92 counties [20].

Less than 10% of pharmacists had continuing education (CE) about PrEP in the past 2 years. While 56.0% knew about PrEP prior to the survey, 52.1% felt they did not have sufficient knowledge about PrEP medication adherence, behavior modification, the medication's adverse effects, and PrEP clinical trials. Of those reporting CE for PrEP, only 8.7% reported lack of confidence in knowledge of PrEP components, compared with 55.9% of those with no CE for PrEP ($p \leq 0.001$). Few (15.8%) pharmacists reported having dispensed PrEP at their current pharmacy, 11.6% reported having consulted about it, and 54.3% were comfortable counseling patients about PrEP.

Most pharmacists (85.6%) were comfortable dispensing PrEP to anyone with a medical need and a prescription. Bivariate comparisons revealed that pharmacists who were comfortable dispensing PrEP had significantly fewer years of pharmacy practice than those who were not (Mean = 16.5 years vs. Mean = 20.9 years, $p = 0.03$). Comfort dispensing PrEP was also significantly associated with having a PharmD degree (63.0% vs. 43.9%, $p = 0.02$), reporting they or another pharmacist have dispensed PrEP (17.7% vs. 4.9%, $p = 0.04$), and the belief that there are no potential barriers to dispensing PrEP (42.0% vs. 22.0%, $p = 0.02$), see Table 2.

As shown in Table 2, dispensing PrEP was significantly associated with PrEP awareness (82.2% vs. 51.0%, $p < 0.001$) continuing education about PrEP (17.8% vs. 6.3%, $p = 0.02$) and HIV management (35.6% vs. 21.3%, $p = 0.04$). Dispensing was also associated with pharmacist confidence in three PrEP knowledge aspects: PrEP medication adverse effects (48.9% vs. 30.5%, $p = 0.02$), medication adherence (66.7% vs. 36.8%, $p < 0.001$), and behavior modification (48.9% vs. 32.6%, $p = 0.04$). PrEP dispensing was also associated with comfort dispensing PrEP to anyone with a medical need or prescription and having consulted with a customer about PrEP (95.6% vs. 83.7%, $p = 0.04$).

PrEP dispensing was marginally not significantly associated the number of full time pharmacists (Mean = 2.6 vs. Mean = 2.2, $p = 0.053$). Some community indicators were also associated with PrEP dispensing, including metropolitan location (93.3% vs. 75.7%, $p < 0.01$), and having been asked about PrEP (28.9% vs. 9.6%, $p < 0.001$) and also HIV antiretroviral treatment in the past 2 years (51.1% vs. 26.4%, $p < 0.001$). Finally, PrEP dispensing was also associated with

Table 1 PrEP knowledge, beliefs, consultation, and dispensing among Indiana community pharmacists 2016 (n = 284)

Pharmacist characteristics	n	Percentage
Gender		
Male	141	49.6%
Female	143	50.4%
Age (in years)	Mean = 42.4 (SE: 0.7, r:25–73)	
Years in pharmacy practice	Mean = 17.1 (SE: 0.7, r: 1–51)	
PharmD degree	171	60.2%
HIV certified pharmacist	6	2.1%
Continuing education in the past 2 years		
HIV management	67	23.6%
PrEP (Pre-exposure prophylaxis for HIV prevention)	23	8.0%
Pharmacy characteristics		
Staffing		
Full time pharmacists at location	Mean = 2.2 (SE: 0.1, r: 1–10)	
Part time pharmacists at location	Mean = 6.1 (SE: 0.3, r:1–11)	
Pharmacy type		
Chain	160	56.3%
Food store	64	22.5%
Mass merchandiser	49	17.3%
Independent	11	3.9%
Pharmacy located in a metropolitan area	223	78.5%
Pharmacy sells HIV testing kits	162	57.0%
Pharmacist PrEP knowledge and knowledge confidence		
Aware of PrEP prior to the survey	159	56.0%
Confident in knowledge about PrEP aspects		
Medication adherence	118	41.5%
Behavior modification "such as condom use"	100	35.2%
Medication adverse effects	95	33.5%
Summary of PrEP clinical trials	7	2.5%
Does not have sufficient knowledge about any of these topics, but supports counseling for patients with PrEP prescriptions	148	52.1%
Pharmacist practice		
You or other pharmacists at this pharmacy consulted with a customer about PrEP	33	11.6%
You or other pharmacists at this pharmacy have dispensed PrEP	45	15.8%
Pharmacist comfort, beliefs and attitudes		
Comfortable dispensing to anyone who has a medical need and a prescription	243	85.6%
Comfortable counseling patients about PrEP	153	53.9%
Pharmacists can be an important resource for HIV and HCV treatment (Strongly Agree)	176	62.0%
Pharmacists can be an important resource for HIV and HCV prevention (Strongly Agree)	164	57.7%
Potential Barriers to PrEP dispensing		
None	111	39.1%
Customer discomfort talking with pharmacists about PrEP	111	39.1%
Use of PrEP would reinforce risky sexual or injection behaviors	53	18.7%
Only HIV-specialty pharmacists should counsel patients about PrEP	43	15.1%
Personal discomfort counseling a patient about sexual activity in general	28	9.9%
Widespread use of PrEP would contribute to increased rates of HIV and other STIs	26	9.2%
Personal discomfort counseling a patient about gay sexual activity	24	8.5%
A patient taking PrEP would eventually develop resistance to the medications	23	8.1%

Table 1 (continued)

Pharmacist characteristics	n	Percentage
Personal disagreement with dispensing PrEP because "I don't agree with the lifestyle choices that this drug enables"	10	3.5%
It will attract the wrong customers to this pharmacy	4	1.4%
Cost	3	1.1%
Community characteristics		
Have been asked in the past 2 years about		
Using an HIV testing kit by customers, medical providers or other pharmacists	91	32.0%
HIV antiretroviral treatment by customers, medical providers or other pharmacists	86	30.3%
HIV testing by customers, medical providers or other pharmacists	73	25.7%
PEP (Post exposure prophylaxis) by customers, medical providers or other pharmacists	51	18.0%
PrEP by customers, medical providers or other pharmacists	36	12.7%
HIV disease		
New cases of HIV in the county 2015	Mean = 40 (SE: 3.9, r:4.0–187.0)	
New cases of HIV in the county for 2016	Mean = 44.5 (SE: 4.4, r:4.0–208.0)	
Difference in HIV incidence from 2015 to 2016 in the county	Mean = 4.4 (SE: 0.5, r: -10.0-21.0)	
People living with HIV in the county 2015	Mean = 1003.5 (SE: 102.2, r: 7.0–4816.0)	
People living with HIV in the county 2016	Mean = 1039.8 (SE: 105.8, r: 6.0–4986.0)	
Difference in HIV prevalence from 2015 to 2016 in the county	Mean = 36.3 (SE: 3.6, r: -14.0-170.0)	
County Medical underservice designation (0–100, HRSA. 0 = completely underserved)	Mean = 59.4 (SE: 1.5, r: 0.0-100.0)	
Number of people per primary care physician (county health rankings), 2017	Mean = 1766.6 (SE: 85.5, r: 0.0–14249)	

practicing in a county with a significantly higher change in new HIV cases from 2015 to 2016 (Mean = 8.3 vs. Mean = 3.7 cases, $p < 0.01$) and a significantly lower primary care physician ratio for their county (Mean = 1382.5 vs. Mean = 1838.9, $p < 0.0001$).

As with dispensing PrEP, comfort counseling patients about PrEP was also associated with awareness of PrEP (65.4% vs. 44.2%, $p < 0.001$), continuing education for PrEP (14.4% vs. 0.8%, $p < 0.0001$) and for HIV management (33.3% vs. 12.4%, $p < 0.0001$). It was also associated with confidence in the following PrEP knowledge aspects: medication adverse effects (50.3% vs. 14.0%, $p < 0.0001$), medication adherence (63.4% vs. 16.3%, $p < 0.0001$), and behavior modification (53.6% vs. 14.0%, $p < 0.0001$). Significant associations were also found with the belief that no barriers exist to PrEP dispensing (45.1% vs. 32.6%, $p = 0.03$), and with pharmacist reported personal discomfort counseling about sexual activity (6.5% vs. 14.0%, $p = 0.04$), counseling about gay sexual activity (3.9% vs. 14.0%, $p < 0.01$), and "personal disagreement with the lifestyle choices," (1.3% vs. 6.2%, $p = 0.048$).

As shown in Table 3, comfort counseling patients about PrEP was neither associated with dispensing PrEP (19.6% vs. 11.6%, $p = 0.07$) nor with comfort dispensing PrEP to anyone with a medical need or prescription (88.2% vs. 83.7%, $p = 0.27$); yet was associated with having consulted with a customer about PrEP (16.3% vs. 6.2%, $p < 0.01$). Size of pharmacy appeared to matter, as pharmacists working at pharmacies with larger numbers of full time pharmacists were comfortable consulting about PrEP (Mean = 2.4 vs. Mean = 2.1, $p = 0.047$). Pharmacist comfort counseling patients about PrEP was also associated with being asked in the past 2 years about PrEP (18.3% vs. 6.2%, $p < 0.01$), about post-exposure prophylaxis (26.1% vs. 8.5%, $p < 0.001$), and about HIV antiretroviral treatment (41.2% vs. 17.8%, $p < 0.0001$). The increase in the number of new HIV infections in the county from 2015 to 2016 was associated with comfort counseling patients about PrEP (Mean = 5.6 vs. Mean = 3.1, $p = 0.01$). Unlike PrEP dispensing, comfort counseling patients was not associated with primary care physician ratio (Mean = 1816.7 vs. 1710.8, $p = 0.53$).

Modified Poisson models were attempted for both PrEP dispensing and comfort with PrEP counseling (Table 4). Significant variables in the modified Poisson model for PrEP dispensing included awareness of PrEP prior to the survey (RR = 2.15; 95% CI 1.01, 4.60), more full time pharmacists (RR = 1.20; 95% CI 1.05, 1.37), and confidence in medication adherence (RR = 2.78; 95% CI 1.36, 5.70). Significant variables in the modified Poisson model for comfort with PrEP counseling included confidence in knowledge of PrEP medication adherence (RR = 1.72; 95% CI 1.23, 2.41), personal discomfort counseling about gay sexual activity (RR = 0.48; 95% CI 0.24 0.93), the belief that only specialty pharmacists should counsel patients about PrEP (RR = 0.49; 95% CI 0.26, 0.91) and being asked in the past 2 years about

Table 2 Characteristics associated with pharmacist PrEP dispensing and comfort dispensing, Indiana 2016 (n = 284)

	Comfortable dispensing PrEP to anyone who has a medical need and a prescription					You or other pharmacists at this pharmacy have dispensed PrEP				
	Yes (n = 243)		No (n = 41)		*P*	Yes (n = 45)		No (n = 239)		*P*
	n	(%)	n	(%)		n	(%)	n	(%)	
	Mean	SE	Mean	SE		Mean	SE	Mean	SE	
Pharmacist characteristics										
Gender, Male	118	(48.6)	23	(56.1)	0.37	23	(51.1)	118	(49.4)	0.83
PharmD Degree	153	(63.0)	18	(43.9)	0.02	26	(57.8)	145	(60.7)	0.72
Age (years)	41.9	0.7	45.6	1.9	0.06	41.6	1.7	42.6	0.8	0.61
Years in pharmacy practice	16.5	0.8	20.9	2.0	0.03	16.4	1.7	17.2	0.8	0.65
Continuing education in the past 2 years										
HIV management	57	(23.5)	10	(24.4)	0.90	16	(35.6)	51	(21.3)	0.04
PrEP (Pre-exposure prophylaxis for HIV prevention)	23	(9.5)	0	0	0.06*	8	(17.8)	15	(6.3)	0.02*
Pharmacy characteristics										
Type of pharmacy					0.94					0.43
Chain	137	(56.4)	23	(56.1)		30	(66.7)	130	(54.4)	
Food store	54	(22.2)	10	(24.4)		8	(17.8)	56	(23.4)	
Mass merchandiser	43	(17.7)	6	(14.6)		5	(11.1)	44	(18.4)	
Independent	9	(3.7)	2	(4.9)		2	(4.4)	9	(3.8)	
Chain Pharmacy, Yes	137	(56.4)	23	(56.1)	0.97	30	(66.7)	130	(54.4)	0.13
Pharmacy located in a metropolitan area	188	(77.4)	35	(85.4)	0.25	42	(93.3)	181	(75.7)	< 0.01
Pharmacist knowledge and knowledge confidence										
Aware of PrEP prior to the survey	137	(56.4)	22	(53.7)	0.75	37	(82.2)	122	(51.0)	< 0.001
Confident in knowledge about PrEP aspects										
Medication adherence	104	(42.8)	14	(34.1)	0.30	30	(66.7)	88	(36.8)	< 0.001
Behavior modification, such as condom use	86	(35.4)	14	(34.1)	0.88	22	(48.9)	78	(32.6)	0.04
Medication adverse effects	84	(34.6)	11	(26.8)	0.33	22	(48.9)	73	(30.5)	0.02
Pharmacist practice										
You or other pharmacists at this pharmacy have consulted about PrEP	30	(12.3)	3	(7.3)	0.44*	17	(37.8)	16	(6.7)	< 0.0001
You or other pharmacists at this pharmacy have dispensed PrEP	43	(17.7)	2	(4.9)	0.04					
Pharmacist comfort, beliefs and attitudes										
Comfortable dispensing to anyone who has a medical need and a prescription.						43	(95.6)	200	(83.7)	0.04
Potential Barriers to PrEP dispensing										
None	102	(42.0)	9	(22.0)	0.02	19	(42.2)	92	(38.5)	0.64
Only HIV-specialty pharmacists should counsel patients about PrEP	30	(12.3)	13	(31.7)	<.01	2	(4.4)	41	(17.2)	0.03
Use of PrEP would reinforce risky sexual or injection behaviors	40	(16.5)	13	(31.7)	0.02	2	(4.4)	51	(21.3)	0.01

Table 2 (continued)

	Comfortable dispensing PrEP to anyone who has a medical need and a prescription					You or other pharmacists at this pharmacy have dispensed PrEP				
	Yes (n = 243)		No (n = 41)		*P*	Yes (n = 45)		No (n = 239)		*P*
	n	(%)	n	(%)		n	(%)	n	(%)	
	Mean	SE	Mean	SE		Mean	SE	Mean	SE	
Widespread use of PrEP would contribute to increased rates of HIV and other STIs	18	(7.4)	8	(19.5)	0.03*	2	(4.4)	24	(10.0)	0.40*
Community characteristics										
Have been asked in the past 2 years about										
PrEP	34	(14.0)	2	(4.9)	0.10	13	(28.9)	23	(9.6)	< 0.001
HIV antiretroviral treatment	78	(32.1)	8	(19.5)	0.10	23	(51.1)	63	(26.4)	< 0.001
HIV disease										
New cases of HIV in the county, 2015	40.9	4.3	35.2	9.2	0.61	74.5	12.7	33.6	3.9	< 0.01**
New cases of HIV in the county, 2016	45.4	4.8	38.7	10.3	0.59	82.8	14.1	37.2	4.3	< 0.01**
Difference in new HIV cases, 2016–2015	4.6	0.6	3.5	1.2	0.46	8.3	1.6	3.7	0.5	< 0.01**
Number of people per primary care physician (county health rankings), 2017	1799.2	98.6	1573.3	95.6	0.10**	1382.5	51.9	1838.9	100.5	< 0.0001**
Number of full time pharmacists	2.3	0.1	2.1	0.1	0.48	2.6	0.2	2.2	0.1	0.053**

*Fisher's exact test

**Satterthwaite test for unequal variances

Table 3 Characteristics associated with pharmacist comfort counseling patients about PrEP, Indiana 2016 (n = 284)

	Pharmacist comfort counseling patients about PrEP				
	Yes (n = 153)		No (n = 129)		*P*
	n	(%)	n	(%)	
	Mean	SE	Mean	SE	
Pharmacist characteristics					
Gender, Male	81	(52.9)	60	(46.5)	0.28
PharmD Degree	98	(64.1)	72	(55.8)	0.16
Age (years)	41.8	0.9	43.1	1.1	0.35
Years in pharmacy practice	16.6	0.9	17.8	1.1	0.42
Pharmacy characteristics					
Type of pharmacy					0.61
Chain	87	(56.9)	72	(55.8)	
Food store	33	(21.6)	31	(24.0)	
Mass merchandiser	25	(16.3)	23	(17.8)	
Independent	8	(5.2)	3	(2.3)	
Chain pharmacy, yes	87	(56.9)	72	(55.8)	0.86
Pharmacy located in a metropolitan area	122	(79.7)	99	(76.7)	0.54
Pharmacist knowledge and knowledge confidence					
Aware of PrEP prior to the survey	100	(65.4)	57	(44.2)	< 0.001
PrEP continuing education (past 2 years)	22	(14.4)	1	(0.8)	< 0.0001
HIV Management Continuing Education (past 2 years)	51	(33.3)	16	(12.4)	< 0.0001
Confident in knowledge about PrEP aspects					
Medication adherence	97	(63.4)	21	(16.3)	< 0.0001
Behavior modification, such as condom use	82	(53.6)	18	(14.0)	< 0.0001
Medication adverse effects	77	(50.3)	18	(14.0)	< 0.0001
Pharmacy practice					
You or other pharmacists at this pharmacy consulted with a customer about PrEP	25	(16.3)	8	(6.2)	< 0.01
You or other pharmacists at this pharmacy have dispensed PrEP	30	(19.6)	15	(11.6)	0.07
Pharmacist comfort, beliefs and attitudes					
Comfortable dispensing to anyone who has a medical need and a prescription	135	(88.2)	108	(83.7)	0.27
Pharmacists can be an important resource for HIV and HCV treatment (Strongly Agree)	115	(75.2)	61	(47.3)	< 0.0001
Pharmacists can be an important resource for HIV and HCV prevention (Strongly Agree)	112	(73.2)	52	(40.3)	< 0.0001
Potential barriers to PrEP dispensing					
None	69	(45.1)	42	(32.6)	0.03
PrEP use reinforces HIV risk behaviors	27	(17.6)	26	(20.2)	0.59
Only HIV-specialty pharmacists should counsel patients about PrEP	8	(5.2)	35	(27.1)	< 0.0001
Personal discomfort counseling a patient about sexual activity in general	10	(6.5)	18	(14.0)	0.04
Widespread use of PrEP would contribute to increased rates of HIV and other STIs	15	(9.8)	11	(8.5)	0.71
Personal discomfort counseling a patient about gay sexual activity	6	(3.9)	18	(14.0)	< 0.01
Personal disagreement with dispensing PrEP because "I don't agree with the lifestyle choices that this drug enables"	2	(1.3)	8	(6.2)	0.048*
Community characteristics					
Asked in the past 2 years about					
PrEP	28	(18.3)	8	(6.2)	< 0.01
Post-exposure prophylaxis ("PEP") for the prevention of HIV infection	40	(26.1)	11	(8.5)	< 0.001
HIV antiretroviral treatment	63	(41.2)	23	(17.8)	< 0.0001
HIV disease					
New cases of HIV in the county, 2015	49.5	5.9	29.1	4.9	< 0.01
New cases of HIV in the county, 2016	55.0	6.6	32.1	5.5	< 0.01
Difference in New HIV Cases, 2016–2015	5.6	0.7	3.1	0.7	0.01
Number of people per primary care physician (county health rankings), 2017	1816.7	127.4	1710.8	112.7	0.53**
Number of full time pharmacists	2.4	0.1	2.1	0.1	0.047**

*Fisher's exact test

**Satterthwaite test for unequal variances

HIV antiretroviral treatment (RR = 1.27; 95% CI 1.03, 1.57, Table 4.

As shown in Table 4, PrEP dispensing and comfort counseling were both significantly associated with pharmacist confidence in knowledge about PrEP medication adherence. Dispensing was also associated with pharmacist confidence in knowledge about adverse effects of PrEP medication, awareness about PrEP before the survey, and number of full

Table 4 Predictors of pharmacist PrEP dispensing and comfort counseling patients about PrEP, Indiana 2016 (N = 284)

Variable	PrEP dispensing				Comfort counseling about PrEP			
	Parameter estimate	Risk ratio	95% CI		Parameter Estimate	Risk ratio	95% CI	
Knowledge and knowledge confidence								
Aware of PrEP prior to the survey	0.767	2.15	1.01	4.60	−0.060	0.94	0.74	1.20
Confident in knowledge about PrEP aspects								
Medication adherence	1.024	2.78	1.36	5.70	0.543	1.72	1.23	2.41
Medication adverse effects	−0.271	0.76	0.43	1.36	0.023	1.02	0.81	1.30
Behavior modification, such as condom use	−0.510	0.60	0.32	1.12	0.098	1.10	0.87	1.41
Pharmacist practice								
You or other pharmacists have consulted a patient/customer about PrEP					−0.116	0.89	0.68	1.16
Pharmacy and pharmacist characteristics								
Number of full time pharmacists	0.183	1.20	1.05	1.37	0.033	1.03	0.96	1.11
Pharmacy located in a metropolitan area	0.520	1.68	0.47	6.05				
HIV certified pharmacist	0.351	1.42	0.74	2.73				
Continuing education in the past 2 years								
HIV management	−0.106	0.90	0.48	1.67	0.098	1.10	0.91	1.34
PrEP (Pre-exposure prophylaxis for HIV prevention)	−0.183	0.83	0.39	1.79	0.171	1.19	0.92	1.53
Pharmacist comfort, beliefs, and attitudes								
Pharmacists can be an important resource for HIV and HCV treatment (Strongly Agree)	0.041	1.04	0.58	1.89	0.297	1.35	1.03	1.75
Comfortable dispensing PrEP to anyone who has a medical need and a prescription	0.820	2.27	0.58	8.95				
Potential barriers to PrEP dispensing								
None					−0.025	0.98	0.81	1.17
Only HIV-specialty pharmacists should counsel patients about PrEP	−0.560	0.57	0.14	2.41	−0.715	0.49	0.26	0.91
Personal discomfort counseling a patient about sexual activity in general					0.184	1.20	0.75	1.93
Use of PrEP would reinforce risky sexual or injection behaviors	−1.482	0.23	0.05	1.01				
Personal discomfort counseling a patient about gay sexual activity					−0.738	0.48	0.24	0.93
Personal disagreement with dispensing PrEP because I don't agree with the lifestyle choices that this drug enables					−0.839	0.43	0.18	1.02
Community characteristics								
Have been asked in the past 2 years about								
PrEP by customers, medical providers or other pharmacists	0.081	1.08	0.54	2.17	−0.071	0.93	0.72	1.20
PEP (Post exposure prophylaxis) by customers, medical providers or other pharmacists	0.179	1.20	0.61	2.35	0.013	1.01	0.79	1.30
HIV antiretroviral treatment by customers, medical providers or other pharmacists	0.335	1.40	0.80	2.43	0.241	1.27	1.03	1.57
Difference in new HIV cases from 2015 to 2016 in the county	0.022	1.02	0.998	1.05	0.003	1.00	0.99	1.01
Number of people per primary care physician (county health rankings), 2017	−0.0004	1.00	0.999	1.00				

time pharmacists in their pharmacy. Separate models testing if dispensing was predicted by comfort counseling about PrEP or if comfort counseling was predicted by dispensing were non-significant (data not reported). Comfort counseling about PrEP was also significantly associated with the belief that pharmacists can be an important resource for HIV and HCV treatment and whether the pharmacist was asked about HIV antiretroviral treatment in the past 2 years.

Discussion

This study was the first to identify factors associated with pharmacist dispensing of PrEP and pharmacist comfort counseling patients about PrEP. In the multivariable models, with all likely predictor variables included together, awareness of PrEP prior to the survey and confidence in one's knowledge about PrEP medication adherence were associated with greater odds of dispensing PrEP. The latter was also associated with greater odds of being comfortable counseling about PrEP. The impact of continuing education (CE), however, is not clear because it was associated with both outcomes in bivariate analyses yet fell out in the final model. This suggests that awareness and confidence (as described) are more important variables in the best-fitting model, but do not allow us to infer that CE is the means by which those were obtained. This is particularly the case because only 23 pharmacists obtained CE, and therefore the majority of pharmacists reporting awareness and/or confidence did not obtain it through CE. Thus, we can reasonably conclude that we should consider ways to increase interest in PrEP related CE, because awareness and knowledge are important, but few pharmacists had engaged in CE. That awareness is associated with dispensing behavior reflects Blumenthal et al's finding among health care providers that knowledge is associated with intent to prescribe PrEP; though this finding was among providers attending two HIV related meetings in New York and California [45].

We also found that pharmacist belief that they are important resources for HIV and HCV treatment predicted comfort counseling about PrEP. This reflects Unni et al's observed association of moral norms with intent to counsel about PrEP [31]. What this may suggest is that training programs for counseling in this area likely should emphasize the importance of the pharmacist role in providing patient counseling as a way to increase likelihood that they will be comfortable doing it.

Notably, pharmacist beliefs that PrEP would reinforce risky sexual or injection behaviors and that widespread use of PrEP would contribute to increase rates of HIV and other STIs was associated with not being comfortable consulting patients about PrEP. These beliefs did not remain in the final model, which suggests that these views do not determine pharmacist comfort engaging in counseling about PrEP.

On the surface, our findings did not match Yoong's observation that PrEP dispensing and counseling comfort were associated with being asked about PrEP in the past 2 years [32]. Instead, we found only that being asked about HIV antiretroviral treatment (ARV) predicted pharmacist comfort counseling patients about PrEP. It is possible that Yoong's finding is true only for HIV-specialty pharmacists who, at face-value, seem more likely to be asked about PrEP than community managing pharmacists in aggregate. It is also possible that the types of questions asked to HIV-specialty pharmacists are more specific than questions asked to community pharmacists. While PrEP is a specific pharmaceutical intervention, ARV medication is better-known. In this sense, it is possible that our finding and Yoong's are not especially dissimilar given the disparate study populations.

Low levels of reported PrEP dispensing may reflect PrEP access in Indiana generally, though to our knowledge, studies have yet to be published about PrEP prescribing in Indiana. That fewer pharmacists reported consulting about PrEP than dispensing was not surprising, given that customers receiving medications at pharmacies do not necessarily elect to discuss their prescriptions with a pharmacist.

The study is the first to associate proxy epidemiological indicators of PrEP need with PrEP dispensing and comfort counseling patients about PrEP. Notably, we found that in bivariate analyses HIV incidence, prevalence and change in both over a 2 year period were associated with PrEP dispensing. This is not surprising, in that communities with higher levels of disease may have a more educated population about the need for mitigating the impact of exposure to HIV. This finding supports the continued use of epidemiologic data in pharmacy PrEP studies, with the caveat that perhaps longer trend data (5 or 10 years) might be more helpful.

An interesting finding was that comfort counseling patients about PrEP was predicted by two beliefs that, at face value, may not reflect such: pharmacist reported discomfort counseling patients about gay sexual activity and the belief that only HIV-specialty pharmacists should counsel patients about PrEP. The Shaeer study found awareness and support for PrEP alongside held beliefs about the impact of PrEP use such as that PrEP would increase STIs in the community. Qualitative studies among pharmacists to make sense of our findings would be beneficial. Perhaps studies among greater numbers of pharmacists across states would also clarify the findings given differences among communities.

Finally, while pharmacy type was not associated with PrEP dispensing, the number of pharmacists at a location was. The number of pharmacists practicing at a location speaks more closely to pharmacy capacity than does the type of pharmacy, and this may be the indicator to use when developing interventions for pharmacy practice change. That

type of pharmacy was not found to associate with PrEP dispensing is not all that surprising because pharmacy selection is often a function of patient decision, pharmacy benefits and/or physician referral.

This study has several limitations. First, the response rate was 33.4% which suggests the possibility of non-response bias. That said, findings might not have been impacted by more rigorous recruitment procedures, such as additional and personalized follow up with managing pharmacists [43]. Further, the sample reflected pharmacists in Indiana in terms of pharmacy type, community rurality and pharmacist gender.

Second, we surveyed pharmacy managers to have a consistent sampling unit representing each pharmacy, as the managing pharmacist is a unique role at each pharmacy. While perhaps such sampling does not focus on all pharmacists, which would include those with likely interest in PrEP consultation and dispensing, the census method generates less bias than self-selection into the study or referral due to specific clinical practice interests. Further, understanding pharmacist practice and beliefs in general is important because patients and customers who enter pharmacies are presented with pharmacists and staff at random when seeking consultation or prescription services. Our studies must continue to understand pharmacists as a population to fully design interventions that will respond to the need for PrEP consultation and support.

Third, responses were self-reported and may have been influenced by social desirability bias, though the extent of this is unknown. The use of anonymous online surveying mitigates some of this as compared with in-person interviewing [44]. Finally, modeling is based on theoretical assumptions about the relationship of variables and variables used such as variables representing community need. Future studies can help validate which measures of community need for PrEP.

In conclusion, this study identifies factors associated with pharmacist comfort counseling about PrEP and dispensing PrEP. This is an important step toward identifying structural opportunities to expand access to PrEP in communities throughout the country; especially those with higher HIV morbidity. Additional studies will need to examine factors associated with comfort discussing PrEP with pharmacists with focus on communities at greatest risk for HIV acquisition and transmission.

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Compliance with Ethical Standards

Conflict of interest The authors have no conflicts of interest to disclose.

Research Involving Human Participants This study was deemed exempt by the Indiana University IRB. Informed consent was obtained from all individuals participating in the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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