Acceptability, Appropriateness, and Preliminary Effects of the PrEP Diffusion Training for Lay HIV Workers: Increased PrEP Knowledge, Decreased Stigma, and Diffusion of Innovation

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Abstract

Background Training lay health workers is a critical strategy for HIV pre-exposure prophylaxis (PrEP) implementation, but little is known about effective approaches to conducting and evaluating such trainings. We evaluated the effect of the PrEP Diffusion Training, a one-day participatory training informed by the Diffusion of Innovation theory, on knowledge, PrEP stigma, implementation behavior, and diffusion of PrEP innovation among lay HIV workers in China.

Methods Nine PrEP Diffusion Trainings were delivered to 220 lay HIV workers. We conducted multi-time-point surveys to assess acceptability, appropriateness, and preliminary effects of the training on participants' knowledge, PrEP stigma, determinants of implementation behavior, and diffusion of PrEP information. We used an observation-based checklist to evaluate implementation fidelity.

Results All trainings were delivered with high fidelity to the standardized manual, with little variability across sites. Acceptability and appropriateness of training were high. PrEP knowledge score significantly increased by 65% from pre-training to post-training, and remained high one month after the training. We observed a significant decrease in PrEP stigma and a positive influence on determinants of implementation behaviors. All participants surveyed one-month after the training reported having shared PrEP information in their social networks, and 43% reported integrating PrEP education into their routine HIV prevention work on a regular basis.

Conclusions The PrEP Diffusion Training is a practical and effective strategy to build lay HIV workers' capacity to participate in PrEP implementation. Longer-term follow up post training would be ideal to further assess actual PrEP uptake and sustained effects of intervention on PrEP implementation.

Background

Lay health workers, individuals who did not receive formal healthcare education but are trained to perform health-related services such as outreach, counseling, and education, have played an important role in the HIV response since the start of the epidemic. The World Health Organization advocates for the rational redistribution of tasks from higher-trained medical providers to lay health workers as a health workforce expansion strategy to rapidly increase access to HIV and other health services [1]. Globally, there is ample evidence supporting acceptability and effectiveness of non-specialists delivering testing, counseling and treatment services [2–5]. In the HIV realm, lay health workers have often been members of communities most affected by HIV such as gay, bisexual, and other men who have sex with men (GBM), and people who inject drugs [6, 7]. In addition, given lay health workers' connection to their communities, public health intervention purveyors often select them as champions [8] to advocate for the adoption of novel practices among their community members [7, 9].

Studies investigating PrEP implementation models have found benefits to lay HIV workers delivering components of PrEP care. For example, while medical providers report insufficient knowledge, skills, and time to take a culturally-competent sexual history for GBM [2, 10–13], lay HIV workers are well-positioned

and have more time to take on this work. Training lay HIV workers is therefore a critical implementation strategy for PrEP [14]; evaluating such trainings is necessary to generate evidence on effective and efficient approaches to build capacity of lay HIV workers to support PrEP implementation. Previous published studies of PrEP capacity building efforts have reported on training of internal medicine residents [15, 16], primary care providers [17], family planning providers [18], and the whole HIV care team [19, 20]. To our knowledge, there is no published data on approaches to and evaluation of trainings that specifically target lay HIV workers to facilitate PrEP implementation. To address this research gap and to prepare for upcoming PrEP implementation in China we developed a standardized training package, entitled the PrEP Diffusion Training, informed by the Diffusion of Innovation (DOI) theory [21]. This study aimed (1) to assess key aspects of training implementation – acceptability and appropriateness of the training, and fidelity of trainings delivered by facilitators; and (2) to evaluate effects of the training on lay health workers' knowledge, PrEP stigma, determinants of implementation behavior, and diffusion of PrEP implementation.

In China, as in many other countries around the world [22], PrEP has yet to be integrated into the health system. However, there is national endorsement of PrEP as an effective HIV prevention strategy [23], ongoing real-world use of PrEP [24], and implementation science projects to introduce and sustain PrEP delivery for GBM [25], suggesting PrEP implementation is already underway. In contexts such as this, in which PrEP has yet to be scaled up and integrated into health services, DOI theory [21], can provide valuable insights to understand PrEP adoption and inform interventions to accelerate the process. DOI seeks to understand how and at what rate an innovation spreads among members of a social system over a period of time [21, 26]. The focus on lay HIV workers is particularly appropriate in China because HIV-related services have been supported or delivered through a large cadre of lay HIV workers employed at community-based organizations (CBOs) since the early 2000s [27, 28]. Such lay HIV workers, many of them who are GBM themselves, remain the primary source of HIV prevention services for GBM in China, a group hardest-hit by the epidemic with an estimated incidence over 5.5 per 100 person years [29, 30].

Methods

Study design

This study was conducted from April to July 2019. We used multi-time-point cross-sectional surveys to assess training implementation and preliminary effects. Data were collected from training participants at three time points: (a) an online survey before the start of the training (T1); (b) an online survey immediately after the training (T2); and (c) a follow-up online survey approximately one month after the training (T3). The study design was informed by Training Evaluation Framework and Tools [14], a framework for outcome-level evaluation of health worker training.

In addition, we used a fidelity checklist administered by an independent rater to assess whether training implementers delivered the intervention with fidelity. We followed previous literature to operationalize

fidelity as: (1) adherence (the degree to which trainer delivers the training content as specified in the manual); and (2) competency (trainers' skillfulness in the delivery of the training) [31–35].

Recruitment and participants

Lay HIV workers were eligible to participate in the training if they were (1) aged 18 years or older; and (2) currently providing HIV prevention services to GBM clients. To identify potential champions who would be more likely to disseminate PrEP information after training, we targeted recruitment to key opinion leaders in HIV prevention and active members of the GBM community identified through an ongoing Good Participatory Practices (GPP) program in each city [36].

Potential participants received an invitation to attend a one-day PrEP training. For those who registered, local research staff informed them of the opportunity to participate in the evaluation study by sending them a link to the online consent form. Participation in the evaluation was voluntary and confidential; it was explained that declining would have no negative impact on participation in the training or their work.

Study procedures

Data collection instruments were developed in English and translated by bilingual research staff into Chinese. The translated instruments were reviewed by a group of lay HIV workers, CBO leaders and local researchers to ensure accuracy and readability.

Consented participants created a unique identifier, used to link their responses across the three data collection time points. Participant compensation ranged from \$3.5 to \$11.50, dependent on survey completion across the three timepoints. The Institutional Review Board of Fudan University (Shanghai, China) approved the protocol and all procedures (IRB#2019-04-0736).

Intervention development

The intervention's overarching goal was to create a cohort of PrEP champions. We designed the training to enhance lay HIV workers' knowledge, self-efficacy, and skills in educating GBM clients about PrEP and to decrease PrEP-related stigma. We hypothesized that this would lead to an increase in their intention to integrate PrEP education and counseling into routine work and diffuse PrEP information through their personal networks. Informed by diffusion of innovations theory [21], our training emphasizes the critical role social influence plays in diffusing and adopting innovations, purposively targeting recruitment among individuals who were not only lay HIV workers but also key opinion leaders in the community. The training curriculum is also developed based on theoretical frameworks including the information-motivation-behavioral skills model [37], and social learning theory [38]. Details on intervention development and training modules are included in Additional file S1.

Study measures

Participant measures

PrEP awareness (T1). Participants were asked whether they had heard of PrEP. For participants who indicated awareness of PrEP, we asked whether they knew any PrEP users.

PrEP knowledge (T1, T2, T3). We developed seven multiple choice questions to assess participants' knowledge of PrEP. Total PrEP knowledge score is calculated by summing the number of correct responses and dividing by the total number of items with higher PrEP score indicating greater PrEP knowledge.

PrEP stigma (T1, T2, T3). We assessed anticipated stigma towards PrEP among participants using measures developed by Calabrese et al. [39]. Response options range from "1 = Strongly disagree" to "4 = Strongly agree".

Training acceptability and appropriateness (T2). We assessed two implementation outcomes (acceptability and appropriateness) using two subscales from the Acceptability, Feasibility, Appropriateness Scale (AFAS) [40–43] that we have previously used to measure training implementation among HIV workers in China [13]. Consistent with definitions proposed by Proctor et al. [44] and Lyon et al. [45], we define acceptability as the perception among participants that the training is "agreeable, palatable, or satisfactory"; and appropriateness as the "perceived fit, relevance, or compatibility" with participants' work mission. Each construct is measured by a 5-item subscale. Response options range from "1 = Not at all", to "5 = Extremely".

Determinants of Implementation Behavior Questionnaire (DIBQ) (T1, T2, T3). The DIBQ was developed based on constructs in the Theoretical Domain Framework, an implementation science framework of theory-based, modifiable constructs that has been shown useful in explaining health workers' implementation behavior [46–48]. We adapted the DIBQ to assess whether the training had any effect on factors that might influence health workers' behavior related to PrEP implementation. Our scale comprises 9 domains: knowledge, skills, role, self-efficacy, social-political context, organization, positive emotions, negative emotions, and intentions, with response options ranging from "1 = Strongly disagree", to "7 = Strongly agree".

Diffusion of innovation (T3). One month after training, lay HIV workers were asked about frequencies of conducting PrEP-related activities in the last month. Four types of PrEP-related behavior were measured: (1) talking about PrEP with people they know; (2) sharing PrEP information on social media; (3) integrating PrEP education into their daily work; and (4) organizing community events about PrEP. Response options range from "1 = Never" to "5 = Always". Participants were considered conducting these activities "on a regular basis" if their response is "4 = Often" or "5 = Always".

Demographics (T1). Participants were asked about their birth year, education, gender, sexual orientation, primary work duty, client population, and how long they have been working in the field of HIV prevention. If a participant did not respond to T1 survey but agreed to answer T2 or T3 survey, s/he would be asked to complete demographic questions at T2 or T3.

Observation measures

Fidelity checklist. The checklist, consisting of two sections, was completed by an independent observer. Section A includes adherence and competency measures that were specific to each training session, and required ratings on a 7-point agreement scale (1 = strongly disagree, 7 = strongly agree). Section B, adapted from I-TECH Trainer Competencies Checklist [49], aims to evaluate trainer's overall skills. The 25 items of Section B were rated on a 3-point scale ("1 = Trainer shows strength in this area", "3 = Trainer needs additional support in this area") [Additional file S2].

Statistical analysis

We performed descriptive analyses for demographics and outcome variables to characterize the sample. We generated descriptive statistics for the training acceptability and appropriateness subscales to understand training implementation. We also conducted descriptive analysis for measures in the fidelity checklist to examine trainers' adherence and competence in delivering the standardized trainings.

To assess changes in PrEP knowledge between T1 and T2 time points, we performed McNemar's test to examine changes of correct responses to individual PrEP knowledge items. We compared mean PrEP knowledge scores between T1 and T2 using paired t-test. To examine whether PrEP knowledge was retained one month after the training, we compared PrEP knowledge items between T2 and T3, and between T1 and T3 by repeating McNemar's tests for individual items and paired t-tests for PrEP knowledge scores.

To measure changes in PrEP stigma and DIBQ scores between T1 and T2, we used paired t-test to compare mean scores of PrEP stigma scales, and conducted Wilcoxon signed-rank tests to compare mean scores of DIBQ domains.

We restricted comparative analyses of PrEP knowledge, stigma, and DIBQ to participants who were aware of PrEP at T1 and completed surveys at three time points (n = 157). There was no significant difference in demographics and baseline PrEP knowledge score between this sample (n = 157) and those who were not included (n = 55). We evaluated statistical assumptions before performing tests. The level of significance was set at p-value < 0.05. Data analyses were conducted using SPSS version 26.[50]

Results

Sample characteristics

Of the 220 HIV workers who received our training, 191 (87%) responded to T1 survey, 200 (91%) responded to T2 survey, and 180 (82%) responded to T3 survey. A total of 212 (96%) people completed at least one survey, and 165 (75%) completed all three.

Table 1 displays demographic information of participants who completed at least one survey (n = 212). Among 191 participants who responded to the T1 survey, almost all (96%) had heard of PrEP prior to the training. Among the 183 PrEP-aware participants, nearly half (46%) reported knowing at least one PrEP user and ten (6%) were using PrEP themselves prior to the training.

Table 1
Sample characteristics (n = 212).

Variable	n / M	% / SD
Participants attended		
Full training	193	91.0%
50% of training	7	3.3%
Missing data	12	5.7%
Where did you attend the training		
Beijing	101	47.6%
Shanghai	41	19.3%
Changsha	19	9.0%
Guangzhou	51	24.1%
Age (n = 204, range: 18 to 63)	30.4	9.3
Gender identity		
Male	181	85.4%
Transgender	4	1.9%
Female	16	7.5%
Other	3	1.4%
Missing data	8	3.8%
Sexual orientation		
Gay	152	71.7%
Bisexual	34	16.0%
Heterosexual	14	6.6%
Other	3	1.4%
Missing data	8	3.8%
Education		
Below college	34	16.0%
College	129	60.8%
Above college	41	19.3%

Variable	n / M	% / SD
Missing data	8	3.8%
Work duty		
HIV counseling and testing	119	56.1%
Outreach	63	29.7%
Management	44	20.8%
Medical care	19	9.0%
Other	51	24.1%
Career length		
2 years or less	144	67.9%
2–5 years	36	17.0%
5–10 years	11	5.2%
10 or more years	13	6.1%
Missing data	8	3.8%
M: mean; SD: standard deviation. This table displays demographic information of participants who completed at least one survey (n = 212).		

Training implementation: high fidelity, acceptability and appropriateness

All nine trainings were delivered with high fidelity, with little variability across sites. Specifically, ratings of overall competence were high on the 3-point scale (mean [M] = 1.14, standard deviation [SD] = 0.08) and adherence to each training session was rated high on the 7-point scale (M = 5.95, SD = 0.44). Participants rated the training as highly acceptable (M = 4.68, SD = 0.56) and appropriate (M = 4.47, SD = 0.61) [Table 2].

Table 2
Acceptability and appropriateness of the training (n = 200).

Subscale	M	SD
Acceptability (Cronbach's $\alpha = 0.94$)	4.68	0.56
• To what extent are you satisfied with the training you received?	4.68	0.62
• How professional did you find the trainers?	4.68	0.65
• How well organized and executed do you believe the training program to be?	4.66	0.64
• How satisfied are you with the content of the training covered?	4.72	0.58
• How satisfied are you with the exercises contained within the training?	4.64	0.62
Appropriateness (Cronbach's $\alpha = 0.91$)	4.47	0.61
• How compatible are the information and practices with your work mission or service provision mandate?	4.51	0.63
• How relevant are the information and practices to your client population?	4.57	0.69
• How well do the information and practices fit with your current approach to work?	4.36	0.77
• How compatible are the information and practices with your workflow timing (e.g., when and for how long you see clients)?	4.41	0.74
• How well do the information and practices from the training fit with your overall approach to service delivery in the setting in which you provide care?	4.49	0.74
M: mean; SD: standard deviation. Collected at T2 post-training survey. Likert responses ranged from 1 to 5, with higher scores indicating greater positive endorsement (1 Not at all, 2 Slightly, 3 Moderately, 4 Very, 5 Extremely).		

Training effects: increased knowledge, retained one month after the training

Table 3 shows correct response rate to each PrEP knowledge item and mean knowledge score at three time points. Compared to baseline, PrEP knowledge significantly increased after the training from a mean of 3.78 ± 1.28 at baseline to 6.25 ± 1.00 after the training ($t = 22.10$, $p < 0.0001$). While we observed a slight decline in PrEP knowledge score one month after the training (T2: $M = 6.25$, $SD = 1.00$ vs. T3: $M = 5.65$, $SD = 1.12$), a paired t-test comparing T1 and T3 PrEP knowledge scores showed statistical significance ($t = 15.15$, $p < 0.0001$), suggesting that PrEP knowledge was well retained one month after the training.

Table 3
PrEP knowledge (n = 157).

	Pre-training (T1)		Post-training (T2)*		1 M follow-up (T3)	
Correct response to individual questions	n	(%)	n	(%)	n	(%)
How effective is PrEP?	96	61.1%	144	91.7%	140	89.2%
About how many people are using PrEP worldwide?	51	32.5%	121	77.1%	91	58.0%
Out of 100 PrEP users, about how many would you expect to experience common side effects such as headache, nausea or weight loss?	78	49.7%	153	97.5%	138	87.9%
How often should someone see a healthcare provider to monitor medication side effects, lab bloodwork, and STIs once they are using PrEP?	84	53.5%	144	91.7%	124	79.0%
For PrEP users, which parts of their bodies should be tested for gonorrhea and chlamydia regularly?	104	66.2%	141	89.8%	135	86.0%
One should not drink alcohol while on PrEP use. True or false?	33	21.0%	147	93.6%	141	89.8%
Does TDF/FTC have approval by the China FDA to be used as PrEP in China	27	17.2%	121	77.1%	104	66.2%
PrEP knowledge score	M	SD	M	SD	M	SD
	3.78	1.28	6.25	1.00	5.65	1.12
M: mean; SD: standard deviation. Analyses restricted to participants who had heard of PrEP prior to T1 and completed all three surveys. *We used McNemar's test to compare each item's correct response rate at T2 versus T1. All increases were significant at $p < 0.0001$, results not shown in the table.						

Training effects: reduced PrEP stigma

We observed a significant decrease in both subscales of the PrEP stigma scale after the training (Table 4): PrEP user stereotypes subscale score decreased from a baseline mean of 2.06 ± 0.65 to 1.92 ± 0.64 after the training ($t = -2.87$, $p < 0.0001$); disapproval by others subscale score decreased from a mean of 2.18 ± 0.72 at baseline to 2.00 ± 0.67 after the training ($t = -3.125$, $p < 0.002$). The significant decrease in stigma was retained one month later (results not shown).

Table 4
Anticipated PrEP stigma (n = 157).

	Pre-training (T1)		Post-training (T2)		Paired t-test	
	M	SD	M	SD	t	p value
PrEP-user stereotypes subscale	2.06	0.65	1.92	0.64	-2.87	0.005
People would assume I slept around if they knew I took PrEP.	2.11	0.84	1.9	0.76		
People would think I am a bad person if they know I took PrEP.	2.03	0.82	1.87	0.74		
People would assume I am gay if they knew I took PrEP.	2.25	0.83	2.15	0.81		
People would assume that I was HIV-positive if they knew I took PrEP.	2.04	0.86	1.82	0.76		
I would feel ashamed to tell other people that I was taking PrEP.	1.89	0.72	1.85	0.75		
PrEP disapproval by others subscale	2.18	0.72	2.00	0.67	-3.125	0.002
My sexual partner(s) would approve of me taking PrEP. *	2.09	0.87	1.93	0.76		
My family would approve of me taking PrEP. *	2.41	0.85	2.19	0.82		
My friend would approve of me taking PrEP. *	2.03	0.75	1.89	0.71		
M: mean; SD: standard deviation. All item Likert responses ranged from 1–4, with higher scores indicating greater agreement to the statements (1 Strongly disagree, 2 Disagree, 3 Agree, 4 Strongly agree). * Indicating that responses to this item were reverse coded.						

Training effects: determinants of implementation behavior (measured by DIBQ)

We saw significant increases in mean scores in eight out of nine DIBQ domains after the training (Table 5). Respondents reported higher perceived knowledge, skills, self-efficacy, positive emotions, and intentions regarding PrEP implementation after the training. They also indicated more positive perceptions of their own role in providing PrEP communication, social-political context, and organization-level factors regarding PrEP implementation. There was no significant difference in mean scores of negative emotions domain before and after the training.

Table 5
Determinants of Implementation Behavior Questionnaire (DIBQ) (n = 157).

	Pre-training (T1)		Post- training (T2)		Wilcoxon signed-rank test	
	M	SD	M	SD	Z	p value
Knowledge	5.13	1.22	6.34	0.68	-9.18	< 0.0001
I know basic information about PrEP.	5.17	1.33	6.37	0.75		
I know how to communicate basic information about PrEP with MSM.	5.09	1.38	6.31	0.78		
Skills	4.56	1.45	6.20	0.77	-9.65	< 0.0001
I have been trained to talk about PrEP with MSM.	4.42	1.91	6.22	0.98		
I have the skills to discuss PrEP with MSM.	4.83	1.48	6.06	0.94		
I have practiced ways to respond to MSM questions about PrEP.	4.43	1.70	6.31	0.78		
Role	6.11	0.82	6.28	0.79	-2.87	0.004
Providing PrEP-related information to MSM is a part of my work as an HIV prevention worker.	6.16	1.00	6.28	0.89		
As an HIV prevention worker, it is my job to initiate discussion about PrEP with MSM.	5.99	1.03	6.25	0.90		
It is my responsibility as an HIV prevention worker to educate MSM about PrEP.	6.17	0.86	6.30	0.88		
Self-efficacy	5.62	0.98	6.21	0.74	-7.58	< 0.0001
I am confident that I can talk accurately about PrEP with MSM.	5.30	1.36	6.06	0.87		
I am confident that I can present PrEP as one of many HIV prevention options to MSM.	5.92	1.04	6.32	0.79		
I am confident that I can add a clear introduction about PrEP into HIV testing or outreach services I already provide.	5.63	1.23	6.24	0.82		
Social-political context	5.60	1.09	5.86	1.03	-2.86	0.004
Investing in PrEP would be a reasonable use of healthcare resources for the government.	5.61	1.28	5.86	1.28		

	Pre-training (T1)		Post-training (T2)		Wilcoxon signed-rank test	
I think the government should pay for PrEP-related costs.	5.59	1.44	5.85	1.35		
Organization	5.65	1.23	6.01	0.96	-3.73	< 0.0001
Discussing PrEP with clients is acceptable within my workplace.	5.62	1.50	5.97	1.28		
The management of the organization I work in is supportive of providing PrEP education to MSM.	5.67	1.38	6.05	1.12		
Positive emotions	5.72	1.04	6.22	0.75	-6.21	< 0.0001
When I talk about PrEP with MSM, I feel natural.	5.96	1.07	6.29	0.79		
When I talk about PrEP with MSM, I feel confident.	5.48	1.24	6.15	0.85		
Negative emotions	2.53	1.34	2.50	1.50	-0.55	0.582
When I talk about PrEP with MSM, I feel nervous.	2.60	1.49	2.77	1.82		
When I talk about PrEP with MSM, I feel awkward.	2.45	1.47	2.24	1.57		
Intentions	5.18	0.93	5.43	0.99	-3.47	0.001
In the next month, I will talk about PrEP with people I know.	5.79	1.23	6.08	1.06		
In the next month, I will share information about PrEP on my social media.	5.27	1.41	5.63	1.34		
In the next month, I will integrate PrEP education into services I provide at work.	5.85	0.99	6.02	1.08		
In the next month, I will organize community events about PrEP.	4.85	1.39	5.29	1.34		
In the next month, I will start to take PrEP.	4.14	1.81	4.14	1.90		
M: mean; SD: standard deviation. All item Likert responses ranged from 1–7, with higher scores indicating greater positive endorsement (1 Strongly disagree, 2 Disagree, 3 Somewhat disagree, 4 Neither agree nor disagree, 5 Somewhat agree, 6 Agree, 7 Strongly agree).						

Training effects: diffusion of innovation for PrEP

A high proportion of training participants communicated PrEP information through their personal and professional networks. Among 180 T3 respondents, all reported having talked about PrEP with other individuals they knew after the training; more than 90% shared PrEP information through social media;

and 76% had organized community events about PrEP. Almost all (96%) participants had ever integrated PrEP education into their routine HIV prevention work, and 43% reported doing so on a regular basis.

Discussion

The design of our evaluation is rigorous and has addressed several methodological issues identified in previous literature about evaluation of trainings and capacity building interventions [14, 51]. First, we moved beyond traditional pre and post-test evaluation design and instead used a multi-time-point data collection approach. By collecting follow-up data one month after the training, we were able to capture knowledge retention and possible training effects on the diffusion of PrEP implementation. Second, we addressed the potential risk of bias associated with self-reported measures by assessing actual knowledge using a standardized questionnaire. Third, we relied on the Training Evaluation Framework and Tools, an outcome-focused training evaluation framework for health workers [14], and measured training effects in multiple dimensions, including individual level knowledge and stigma, determinants of HIV workers' implementation behaviors, and diffusion of innovation. Finally, implementers' fidelity to a training intervention is important to intervention success but often overlooked in evaluation studies. Thus, the use of observation-based measures to assess implementation fidelity was a strength.

Our results show that prior to the training, participants had a high awareness of PrEP, high perceived knowledge, but low actual knowledge of PrEP. We observed a statistically significant increase in perceived and actual knowledge of PrEP, well retained one month after the training. The gap between perceived and actual knowledge of PrEP highlights the need to provide scientifically accurate knowledge to various stakeholders who will be involved in PrEP implementation in China. Our findings demonstrated that the PrEP Diffusion Training was highly acceptable and appropriate, and was delivered by trained lay HIV workers with fidelity. This suggests the potential usefulness of the training in improving PrEP knowledge and facilitating PrEP implementation in China. Future adaptation of this training for multiple types of audience (e.g. medical providers, public health professionals), and larger scale testing of the intervention may be warranted.

PrEP stigma has been identified as a major barrier to PrEP uptake and adherence globally [39, 52, 53]. Our previous studies among potential PrEP users identified the need for gain-framed messaging when promoting PrEP to avoid such stigma [24, 54]. Our training therefore adopted a sex-positive approach to empower lay HIV workers to accurately communicate potential benefits of PrEP and avoid stigmatizing approaches (such as promoting PrEP as a strategy for people with "very high risk" of HIV) [24, 53, 54] as a stigma-mitigation strategy. As China is on the cusp of PrEP implementation, it is critical to devise strategies to integrate PrEP into health services without introducing PrEP stigma against potential users. Our evaluation confirmed the preliminary effects of this training in reducing PrEP stigma among participants and offers a viable approach to mitigate potential PrEP stigma while introducing PrEP to stakeholders.

Drawing on the key DOI concept “homophily” [21], our training has a strong emphasis on peer networks, an important strategy suggested by Rogers for speeding up the diffusion of preventive innovations [55]. DOI theory suggests that communications about innovations is usually more effective among homophilous groups [21, 26, 55], i.e. groups in which the change agent’s characteristics is similar to the ones of the intended audience [21, 26]. Studies have shown that homophilous HIV workers have been effective in sharing innovations with clients/peers in a culturally-sensitive manner [6, 7, 56]. In our study we purposively recruited HIV workers who were influencers in their local GBM community and relied on a lay health worker-led approach, encouraging participants (88% gay or bisexual) to leverage their professional and personal networks to diffuse PrEP information. Our results show that not only were participants able to spread PrEP information through their networks, remarkably more than 75% of participants reported having organized community events about PrEP within a month after the training, and 43% reported integrating PrEP education into their routine HIV prevention work with GBM clients.

Given the central role of lay HIV workers in PrEP implementation, it is critical to understand their implementation behaviors related to PrEP. Unlike previous evaluation of PrEP trainings that primarily focused on investigating whether the trainings had any effects on trainees’ knowledge [15, 18, 20], confidence of [18–20] and comfort level in discussing PrEP with clients [16], we systematically assessed determinants of implementation behavior through a valid and reliable questionnaire (DIBQ) [47, 48]. We observed a positive influence of the training on almost all DIBQ domains, suggesting the training’s potential in mobilizing and motivating lay HIV workers to participate in upcoming PrEP implementation in China.

Limitations

Our study has several limitations. First, our baseline assessment did not measure whether or not participants had already engaged in diffusion of PrEP information prior to the training. However, based on our work with CBOs through our GPP program over the last four years, we believe very few participants were conducting such activities given PrEP is not part of the routine HIV prevention service in China yet. Second, we conducted the follow-up survey one month after the training. As a result, we were not able to evaluate longer-term effects of the training, such as whether participants were able to retain accurate PrEP knowledge in a longer time frame. Finally, our evaluation was not able to assess whether the training had any impact on client-level or facility-level outcomes (e.g. actual PrEP uptake among clients) as PrEP has still not received regulatory approval and therefore PrEP use is still informal.

Conclusions

Training lay health workers is a critical strategy for PrEP implementation, but little is known about effective approaches to conducting and evaluating such trainings. To our knowledge, this is the first evaluation of a PrEP training that specifically targets lay HIV workers. This study, using data collected from observations and multi-time-point surveys, demonstrated that the PrEP Diffusion Training was acceptable, appropriate, and was delivered by lay HIV workers with fidelity. Findings from our study also

suggest preliminary effectiveness of the training in enhancing PrEP knowledge and implementation behaviors, reducing PrEP stigma, and facilitating diffusion of PrEP implementation among lay HIV workers in China.

Abbreviations

AFAS

Acceptability, Feasibility, Appropriateness Scale

CBO

Community-Based Organization

DIBQ

Determinants of Implementation Behavior Questionnaire

DOI

Diffusion of Innovation

GBM

Gay, Bisexual, and other Men who have sex with men

GPP

Good Participatory Practices

HIV

Human Immunodeficiency Virus

PrEP

Pre-Exposure Prophylaxis

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Board of Fudan University in Shanghai, China (approval number: IRB#2019-04-0736). Participation was anonymous and no personal identification data were collected. Consent to participate was collected through an online e-consent form. This e-consent form details study information, potential risks and benefits, and contact information of the research team. Participants provided consent by an active click on the “I agree” button in the form.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

KM conceived the study, developed the protocol and data collection tools, provided overall guidance to the study, and revised the manuscript. YW conceived the study, developed the protocol and data collection tools, developed and piloted the PrEP Diffusion Training curriculum, analyzed the data, and drafted the manuscript. GY developed and piloted the PrEP Diffusion Training curriculum, and reviewed the manuscript. All authors have read and approved the final manuscript.

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