

Supplementary file

Table 1 Summary of key functions of the mini-app prototype

Key functions	Intervention objectives	Intervention strategies			
		Information	Motivation	Behavioral Skills	Mental Health
Mini-classroom	Build knowledge and navigation skills around local HIV care system, enhance interest and motivation to use PrEP, and increase self-efficacy in HIV/STI prevention strategies; Improve mental health management skills.	Educational materials in multimedia forms, including text, videos, and graphics.	Real stories of PrEP users; Positive meanings of using PrEP and HIV/STI testing.	List local PrEP and other HIV/STI care providers and contact information; Tips for safe sex, condom use, and PrEP initiation, adherence, and management.	Links to local support groups and mental health care resources. Self-management for mental health. Coping with stigma and discrimination against LGBTQ community.
Online counseling	Enable MSM to describe their feelings or concerns related to HIV, sexual health or this intervention study, and help them make healthy decisions.	Answer questions about HIV, STI, PrEP, and/or other health topics, and provide additional information if needed.	Tailored health advice regarding PrEP use.	Referral to the HIV/PrEP clinic at the study hospital, or other healthcare providers based on individual needs.	Listen to their needs, and refer to local support groups or mental health care resources, if necessary.
Home-based HIV/syphilis test ordering	Establish individual habit of routine testing for HIV and syphilis.	Information about how to complete the home-based test kit.	Provides a cue to action and removes barrier of in-person testing and stigma.	An HIV/syphilis home-based test kit ordering system.	
User profile center	Allow participants to monitor their HIV/syphilis testing behaviors.			A profile page to manage orders of HIV/syphilis test kits and keep a record of test results.	

Table 2 Main topics in the in-depth interview guide in Phase 1

Topic	Description	Sample probes
HIV/STI knowledge & experience	Understanding or knowledge of HIV/STI, HIV/STI testing experience, experience with the local HIV/STI prevention & care system.	What do you know about HIV/STI? What do you think about the local HIV prevention and care system? What do you know about PEP and your experience with it, if any?
PrEP knowledge and attitudes	Understanding of PrEP, and attitudes, including acceptability and willingness of using PrEP to prevent HIV, pre- and post- PrEP attitudes for PrEP-experienced individuals.	What do you know about Pre-Exposure Prophylaxis (PrEP)? Have you ever heard any people you know are taking PrEP? How do you think PrEP have or could have an impact on your sexual health?
PrEP experience (for current & intermittent users only)	Narrative of PrEP using experience	What do you think about your PrEP using experience? (probe for motivations to start PrEP, experience with PrEP refilling, cost, side effects, adherence/discontinuation, others' attitudes and/or support)
Barriers to PrEP use/continued use	Perceived barriers to access, use, and manage PrEP care, and suggestions for PrEP-scale in China	Have you ever considered using PrEP? (If Yes) How would you think that will help you? (If not) would you please tell me about your concerns?
Biomedical prevention strategies	Experience or perceptions of using biomedical strategies to prevent diseases.	What do you think about taking medicines for preventive purpose, like using PrEP to prevent HIV?
Health beliefs and stress due to COVID-19	Experience of the COVID-19 pandemic and how it has influenced health beliefs, views on preventive medicine, and mental health	What do you think about the COVID-19 pandemic has changed your thoughts of health, if any? How have you been since the outbreak of COVID-19?
Mini-app usability test	Feedback on the mini-app design, contents and ease of use.	How was your overall experience with the mini app? How did you think the app meet your needs/expectations?
	Suggestions on app refinement based on the current structure.	If you were able to redesign this feature, what changes would you make? What other contents could be added to make the app more useful or engaging to you?

Note: for people who have never heard of PrEP before, a standard brief description of PrEP will be given before asking further questions: *The HIV prevention pill (known as 'PrEP') is a pill taken to prevent HIV. It is safe and more than 90% effective when taken every day. People who decide to use the oral HIV prevention pill need to return to their doctor every 3 months for HIV/STI testing, bloodwork, and a new prescription for the next 3 months*".¹

Table 3 Phase 2 pilot RCT study measures and timepoints of data collection

		Week					
		Day 1	2	4	6	8	12
Primary outcomes							
PrEP use intention	A single bipolar scale with 7-point rating (-3 to 3)	X		X		X	X
PrEP stages of change	5 stages informed by the Transtheoretical Model of Behavioral Change (pre-contemplation, contemplation, preparation, action, & maintenance)	X		X		X	X
PrEP initiation	Yes/No (study record)			X		X	X
Secondary outcomes							
PrEP knowledge	5-item True/False quiz ²	X		X		X	X
Test behavior	Frequency of at-home HIV/syphilis tests (≥ 0)			X		X	X
Willingness to pay	Percentage of monthly income to pay for PrEP	X		X		X	X
Self-report PrEP adherence***	Daily PrEP: missed doses in past 7 days (0 to 7) PrEP on-demand: occurrence of missing any dose in a single sex event and number of sex events without any PrEP coverage in the past month			X		X	X
PrEP self-efficacy	8-item scale with 5-point rating (1 to 5) ²	X		X		X	X
PrEP stigma	5-item scale with 5-point rating (1 to 5) ²	X		X		X	X
PrEP attitudes	5-item scale with 5-point rating (0 to 5) ²	X		X		X	X
Predictor variables							
Intervention exposure	Yes/No	X					
Mini-app Engagement*	Self-reported frequency of app use		X	X	X	X	X
	Perceived app usefulness		X	X	X	X	X
Covariates							
Demographics & socio-economic indicators	Age, education, gender, sexual orientation, relationship status, private or shared bedroom, employment, income	X				X	
Drug use	Ever used recreational drugs (Yes/No)	X					
	Drug use in the past 4 weeks	X		X		X	X
Alcohol use	Ever consumed alcohol (Yes/No)	X					
	Average weekly alcohol consumption, past 30 days	X		X		X	X
Tobacco use	Ever consumed tobacco products (Yes/No)	X					
	Average weekly tobacco consumption, past 30 days	X		X		X	X
Prior HIV test history	Self-report HIV test history before the study (Yes/No)	X					
HIV knowledge	2-item HIV quiz	X		X		X	X
HIV risk perception	2 questions of perceived risk of HIV infection	X		X		X	X
HIV-related anxiety	3-item scale with 5-point rating ³	X		X		X	X
Perceived stress	4-item Cohen Perceived Stress Scale ³ (overall stress)	X		X		X	X
HIV-social support	10-item scale with bipolar scale (-2 to 2) ⁴	X		X		X	X
Condomless sex	Occurrence of condomless sex in the past 4 weeks	X		X		X	X
Number of sex partners	Self-reported number of sex partners, past 4 weeks	X		X		X	X

*Only performed in participants in the intervention arm;

** Only performed in a subgroup of participants;

***Only performed in participants who have started using PrEP.

Table 4 Main topics in the in-depth interview guides in Phase 2

Topic	Description	Sample probes
HIV/STI knowledge & experience	Understanding or knowledge of HIV/STI, HIV/STI testing experience, experience with the local HIV/STI prevention & care system.	What do you know about HIV/STI? What do you think about the local HIV prevention and care system? What do you know about PEP and your experience with it, if any?
Health beliefs and stress due to COVID-19	Experience of the COVID-19 pandemic and how it has influenced health beliefs and mental health	What do you think about the COVID-19 pandemic has changed your thoughts of health, if any? How have you been since the outbreak of COVID-19?
PrEP knowledge and attitudes	Understanding of PrEP, and attitudes, including acceptability and willingness of using PrEP to prevent HIV	How has your participation in this study changed your thoughts on PrEP? In general, what do you think about taking medicines for health purposes? How about take medicines to prevent HIV?
PrEP experience (for participants who started PrEP)	Narrative of PrEP using experience in this study, including perceived barriers to access, use, and manage PrEP care	What you think are the main reasons that motivate you to initiate PrEP? What is your experience of getting and refilling PrEP through this study?
PrEP intention (for participants who haven't started PrEP)	Perceived barriers or concerns of starting PrEP Readiness to start PrEP	Would you please tell me about your concerns or things that you think are barring you from accessing PrEP? How likely are you going to start PrEP in next week, next month or in near future?
Mini-app using experience	Feedback on the mini-app design, contents and ease of use, technical problems encountered.	How was your overall experience with the mini app? How did you think the app meet your needs/expectations?
	Using experience on each of the main functions: HIV/syphilis testing, the Knowledge Center, & online counseling	How would you describe your experience of using this feature? How did you think by reading these articles have changed your health beliefs or behaviors? Overall, how useful do you think this online counseling is for supporting your health, PrEP use or HIV/STI prevention?
	Long-term sustainability	How could you see yourself using this app in the future? Would you recommend this app to your friends?

References:

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