

## Recollection

## Synergizing Digital and Physical Approaches: Experience Summary of the HIV PrEP Promotion Project

Shuyu Wang<sup>1</sup>; Wenting Kang<sup>2</sup>; Jingkun Hu<sup>1</sup>; Dapeng Zhang<sup>1</sup>; Jie Xu<sup>1</sup>; Houlin Tang<sup>1</sup>; Junjie Wang<sup>1</sup>; Fan Lyu<sup>1</sup>; Guang Zhang<sup>1,†</sup>

### ABSTRACT

China's human immunodeficiency virus / acquired immune deficiency syndrome (HIV/AIDS) prevention and control efforts have entered a new stage, necessitating the exploration of more effective intervention strategies. HIV pre-exposure prophylaxis (PrEP) is a proven method to prevent HIV infection, but its promotion in China faces challenges such as low public acceptance and inadequate service capacity. To further promote PrEP, the "HIV PrEP Model Exploration Project" was launched, exploring three PrEP service models: PrEP clinics, Digital services and physical testing, and PrEP self-service vending machines. The project achieved certain results, establishing a PrEP service network, training professional staff, and promoting the use of PrEP. In the future, it is necessary to further expand publicity channels, enhance public awareness and acceptance, optimize follow-up management, and promote the popularization of PrEP and HIV/AIDS prevention and control efforts.

As of December 31, 2023, China reported approximately 1.29 million individuals living with human immunodeficiency virus (HIV)/ acquired immune deficiency syndrome (AIDS), including 719,000 HIV-positive individuals and 570,000 AIDS patients, with 458,000 reported deaths (1). While HIV/AIDS prevalence in China remains low, prevention and control efforts have entered a new phase. A cost-effectiveness analysis funded by the National Natural Science Foundation revealed that regions with substantial financial investment and high antiretroviral therapy coverage are experiencing diminishing marginal returns from existing interventions, suggesting current strategies may be approaching their effectiveness threshold (2–3). This

necessitates the exploration of novel and more effective intervention strategies.

Pre-exposure prophylaxis (PrEP) has emerged as a proven HIV prevention method, demonstrating over 90% effectiveness when properly administered (4). PrEP has gained international recognition as a crucial HIV prevention tool, with World Health Organization (WHO) guidelines from 2016 recommending its use for high-risk populations, including men who have sex with men (MSM), female sex workers (FSW), seronegative partners among HIV serodiscordant couples (SNP), and transgender women (5). China's HIV/AIDS prevention and control frameworks have incorporated PrEP as a key preventive measure (6). Implementation of PrEP in China began in 2017 with Tianjin's pilot program, expanding to Beijing, Hunan, Yunnan, and Heilongjiang provinces from 2018 to 2019 (7). A significant milestone was reached in August 2020 when the China Food and Drug Administration approved Truvada as the country's first PrEP medication for HIV prevention in uninfected individuals. The subsequent publication of the *Chinese Expert Consensus on HIV Pre-Exposure Prophylaxis Medication* in November 2020 provided clinical guidance. However, PrEP implementation faces multiple challenges, including limited acceptance among target populations, incomplete policy frameworks and guidelines specific to the Chinese context, inadequate institutional capacity for PrEP service delivery, and high medication costs.

To address these challenges, the Chinese Association of STD & AIDS Prevention and Control and the National Center for AIDS/STD Control and Prevention jointly initiated the "HIV PrEP Model Exploration Project" across 24 cities from February 2022 to February 2023. The project aimed to develop and evaluate PrEP implementation models, establish effective service systems, create successful models for PrEP implementation, and generate evidence for updating and enhancing PrEP guidelines.

## IMPLEMENTATION PROCESS

### Launch Stage

In December 2021, nearly 400 participants from CDCs, non-government organizations (NGOs), and medical institutions across 24 cities attended a comprehensive project training conference. The conference focused on establishing proficiency in project mechanisms, technical guidelines, and data management procedures, while facilitating the development of locally tailored implementation strategies. By February 2022, three distinct PrEP implementation models were established and operational processes were finalized, allowing each city and municipality to select and adapt a model according to their specific circumstances.

### Model Exploration Stage

**PrEP Clinics:** Dedicated PrEP clinics were established to provide comprehensive services, including consultation, risk assessment, testing, medication dispensing, and follow-up care. The service delivery process encompasses six key components: 1) Scientific outreach: disseminating PrEP knowledge through multiple channels to enhance awareness and demand among target populations; 2) Consultation and referral: providing consultation services through CDC staff, community organizations, or medical institutions, with appropriate referral pathways; 3) Risk assessment: professional medical evaluation of HIV infection risk to determine PrEP eligibility; 4) Medical evaluation: comprehensive screening including HIV, sexually transmitted infections (STI), and liver and kidney function tests to exclude contraindications; 5) Medication initiation: following informed consent, qualified individuals receive prescriptions and obtain PrEP medication from clinic pharmacies; 6) Follow-up care: implementation of routine HIV testing and clinical monitoring to assess medication efficacy and safety, with protocol adjustments as needed.

**Digital services and physical testing:** This model integrates internet-based medical platforms to deliver comprehensive assessment and medication services. The implementation process encompasses: 1) Health education: dissemination of PrEP information through internet platforms and social media channels; 2) online consultation and risk assessment: Users receive professional consultation through digital platforms; 3) Laboratory testing: based on online physician assessment, individuals either visit medical facilities for

testing or utilize self-test kits; 4) digital prescription and delivery: Following prescription confirmation and payment through the online platform, medications are delivered directly to users; 5) telemedicine follow-up: Regular online monitoring with medication regimen adjustments as clinically indicated.

**PrEP Self-service Vending Machine:** This innovative approach utilizes automated dispensing systems for PrEP medication and HIV self-test kit distribution, primarily targeting experienced PrEP users. The service workflow consists of: 1) QR code-based user registration and information submission; 2) Integration with telemedicine platforms for consultation and risk assessment; 3) Online prescription services based on clinical evaluation results; 4) Automated dispensing of testing and medication packages with remote pharmacist support and follow-up care.

### Evaluation and Promotion Stage

Project evaluation incorporated multiple methodologies including on-site assessments, quantitative data analysis, expert panel reviews, and experience-sharing forums. In March 2023, comprehensive project reports were compiled, documenting objectives, implementation phases, outcomes, and key insights to identify best practices. These findings were subsequently disseminated through peer learning sessions, professional meetings, formal reports, and digital platforms.

## EXPERIENCE AND RESULTS

### Establishment of PrEP Service Network

The project successfully established 59 PrEP clinics across 24 cities, primarily integrated into existing antiviral treatment facilities. Eighteen cities implemented collaborative partnerships with internet medical platforms, including BlueCity, JD Health, and DDmedicine. To ensure service quality, the project conducted over 64 capacity-building activities, including meetings, training sessions, and supervisory visits, reaching approximately 2,100 healthcare professionals with comprehensive PrEP-related training.

### Growth in the Number of PrEP Users

Throughout the project period, HIV testing services were provided to 13,044 individuals. The total number of PrEP users reached 5,505, showing consistent growth over time (Figure 1). The cumulative

	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Total
Beijing	154	43	68	121	109	113	86	92	94	89	118	111	1,198
Nanchang	0	0	3	2	3	4	6	14	136	74	16	175	433
Kunming	104	13	28	17	39	25	18	21	20	17	16	26	344
Chongqing	13	1	3	1	6	8	2	6	29	76	81	63	289
Guizhou	16	12	30	20	21	8	0	21	39	46	15	30	258
Hangzhou	0	0	28	10	7	2	19	0	5	1	126	49	247
Chengdu	27	17	13	7	18	4	6	25	38	6	13	59	233
Zhengzhou	0	3	4	9	30	22	17	14	7	34	46	35	221
Changsha	5	2	7	7	14	16	12	17	13	50	41	36	220
Hefei	9	6	5	8	5	7	8	27	11	40	46	43	215
Tianjin	0	0	25	9	13	8	10	11	13	46	56	23	214
Changchun	0	0	0	11	16	10	13	39	18	5	7	91	210
Qingdao	4	6	5	6	15	10	32	33	29	25	18	25	208
Nanjing	32	5	5	2	30	28	8	17	13	16	12	38	206
Shenzhen	0	33	30	13	20	7	9	5	20	5	0	60	202
Guangzhou	4	0	2	26	54	32	15	24	2	5	14	23	201
Fuzhou	18	8	12	16	16	12	9	18	11	11	17	20	168
Nanning	0	1	24	21	12	12	11	13	6	5	8	14	127
Shanghai	0	0	0	0	0	66	8	8	8	6	6	20	122
Shijiazhuang	2	3	2	3	5	6	9	11	2	26	27	24	120
Xi'an	2	0	5	0	0	7	4	9	2	7	1	1	38
Wuhan	0	3	1	0	1	6	4	1	1	0	1	2	20
Harbin	0	0	0	0	0	0	0	0	0	0	6	4	10
Taiyuan	0	0	0	0	0	0	1	0	0	0	0	0	1
Total	390	156	300	309	434	413	307	426	517	590	691	972	5,505
	15	29	44	85	73	88	102	117	131	146	160	175	

FIGURE 1. Temporal and geographical distribution of PrEP users across 24 project cities and municipalities, 2022–2023. Abbreviation: PrEP=pre-exposure prophylaxis.

distribution analysis revealed sustained user growth particularly in Beijing Municipality and Kunming City, Yunnan Province, China (Figure 2). The demographic analysis showed that MSM comprised 97.7% (5,381/5,505) of users, followed by 78 SNP and 46 individuals reporting multiple sexual partnerships.

### Comparison of Three PrEP Implementation Models

**Analysis of advantages and disadvantages:** The PrEP clinic model offers distinct advantages in service delivery. First, specialized medical practitioners ensure high-quality care through direct clinical assessments, comprehensive testing, and supervised medication provision. Second, the outpatient service structure maintains complete medical records, facilitating systematic follow-up visits and robust data collection. However, this model presents certain limitations, including potential privacy concerns among clients visiting clinics and a relatively complex service process involving multiple steps such as registration, payment, and waiting times.

The digital services with physical testing model has successfully mitigated concerns regarding discrimination and privacy exposure. This approach offers flexible service timing that aligns with contemporary consumption patterns and enables broad geographical coverage with minimal professional staffing requirements. However, this model faces significant challenges in maintaining consistent follow-up care and comprehensive data collection.

The PrEP self-service vending machine model similarly addresses discrimination and privacy concerns while specifically catering to experienced PrEP users. The primary challenges include developing sophisticated hardware and software systems for automated dispensing machines and ensuring seamless integration with online medical platforms. This model shows potential for widespread adoption once PrEP becomes established as a routine HIV prevention method, similar to the current ubiquity of condom vending machines.

### Data Comparison

Based on their PrEP access patterns for initial and

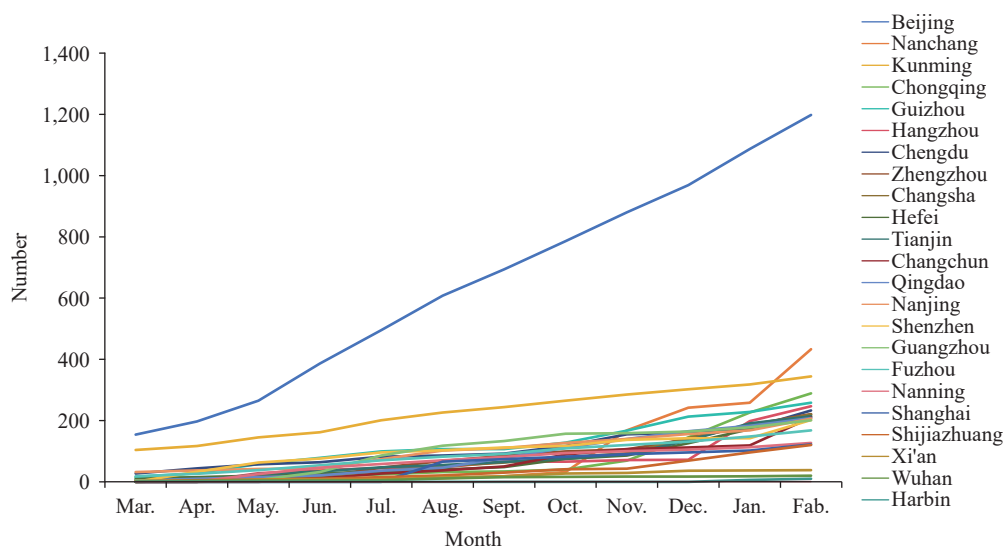


FIGURE 2. Cumulative PrEP initiation by city or municipality. Abbreviation: PrEP=pre-exposure prophylaxis.

subsequent visits, users were categorized into three distinct groups: those receiving services entirely offline, those transitioning from initial offline to subsequent online services, and those utilizing fully remote consultation and medication delivery. The offline-only group comprised 2,195 individuals, averaging 56 patients per clinic. The hybrid offline-to-online group included 1,754 users, while the fully remote service group consisted of 1,556 users.

Due to requirements for medical assessment and testing, most users (70.73%) initially accessed PrEP through clinics to ensure comprehensive medical evaluation. Subsequently, 60.13% of users transitioned to online services, potentially driven by privacy considerations or coronavirus disease 2019 (COVID-19)-related constraints.

### The Refinement of Best Practices

**Cooperation and expansion:** Through strategic partnerships with government agencies, NGOs, healthcare providers, and online medical platforms, we established a comprehensive service network that enhanced PrEP accessibility. This collaborative approach optimized resource allocation through clear role delineation: CDCs coordinated operations, provided technical guidance, and managed data collection; medical institutions conducted promotion activities, medical assessments, medication management, and follow-up care; and NGOs facilitated outreach, counseling, referrals, and retention services, effectively bridging the gap between clients and healthcare providers. This integrated approach not

only advanced organizational knowledge and strategy implementation but also fostered the development of innovative PrEP service delivery models.

**Optimization of the service process:** The service delivery framework encompasses six essential stages: promotion, consultation, assessment, testing, medication dispensing, and follow-up monitoring. While most stages can be conducted either online or offline, renal function testing remains exclusively hospital-based. Cities implemented locally adapted service processes while maintaining standardized training protocols to ensure consistent service quality. The online platform features a streamlined, user-friendly navigation process that prioritizes privacy protection. The offline clinic model, operating in partnership with social organizations, has achieved higher user trust levels through its community-based approach.

## PROBLEMS AND CHALLENGES

### Cognition and Acceptance Remained Low

The awareness and acceptance of PrEP among high-risk populations beyond MSM remains significantly limited. Survey results from participating project cities revealed that among individuals involved in sex work and drug use, only 37.0% had heard of PrEP, and merely 27.3% expressed willingness to use it — markedly lower than the corresponding rates of 86.3% and 96.4% among MSM populations.

Through user interviews regarding PrEP hesitancy,

two primary concerns emerged. First, participants expressed apprehension about medication efficacy and adverse effects, as illustrated by one respondent: “My only concern is the side effects, and for me, the side effects are noticeable, such as dizziness.” Second, users feared potential stigmatization associated with PrEP use, exemplified by another participant’s statement: “From what I understand, only those who frequently go to bars need such things. If I take this medication, others might think I’m ‘promiscuous’ and that scares me.” These barriers to PrEP adoption align with previous research findings, which have identified concerns about personal privacy disclosure, medication side effects, and social discrimination as key deterrents (8).

### Drug Accessibility and Prices

The consistent increase in PrEP users throughout the project demonstrates growing recognition of PrEP’s vital role in HIV prevention and heightened adoption willingness. This trend necessitates ensuring stable and accessible drug supply channels. Surveys across project sites identified medication and testing costs as the primary barriers to PrEP adoption, aligning with ZHANG’s findings (9). The limited availability of PrEP medications in China, with only Truvada currently approved, combined with regulatory constraints and pricing issues, has led some users to seek generic alternatives (10).

Qualitative data from MSM participants highlighted

these challenges: “Despite the current convenience of medication purchase through applications, many have discontinued their use. Some individuals, particularly those with lower educational levels, lack knowledge about medication access channels.” “Regarding costs, the current pricing structure remains prohibitive. At present rates, I find it financially burdensome.”

### Follow-up Management

Initial follow-up evaluations are required within the first month of PrEP initiation to assess HIV status and monitor for adverse reactions. Subsequent follow-up visits are recommended quarterly for HIV and STI screening (11). Analysis of daily PrEP users in Beijing revealed that while initial follow-up achieved 100% coverage, adherence to follow-up visits declined significantly over time. The overall follow-up rate was notably low at 19.47% (Table 1).

## OUTLOOK AND RECOMMENDATIONS

The implementation of PrEP in China remains in an exploratory phase, requiring strategic efforts to facilitate its integration into routine HIV prevention services. Three key areas demand immediate attention. First, awareness campaigns need to be expanded beyond MSM to reach other high-risk populations, particularly seronegative partners in HIV-discordant couples and female sex workers. Second, enhanced social support mechanisms and legal frameworks are

TABLE 1. Follow-up status of daily PrEP users in Beijing.

Months	Initiated PrEP count	Scheduled follow-ups	Actual follow-ups	Follow-up rate (%)*
March	59	–	–	–
April	16	59	59	100.00
May	19	16	16	100.00
June	98	19	19	100.00
July	75	157	32	20.38
August	88	91	45	49.45
September	124	107	49	45.79
October	138	281	42	14.95
November	146	229	36	15.72
December	245	253	31	12.25
January	164	526	30	5.70
February	144	393	56	14.25
Total	1,316	2,131	415	19.47

Note: “–” means the first month was not scheduled for follow-up.

Abbreviation: PrEP=pre-exposure prophylaxis.

\* The numerator is the number of actual follow-ups, and the denominator is the number of scheduled follow-ups.

essential, with specific focus on reducing financial barriers through insurance coverage or government procurement programs to make PrEP accessible to a broader spectrum of high-risk individuals. Third, medical services must incorporate comprehensive psychosocial support to address users' emotional needs and build trust, thereby improving long-term engagement and follow-up adherence. As these conditions evolve and systems mature, PrEP is positioned to become a crucial component of China's HIV prevention strategy for key populations.

**Conflicts of interest:** No conflicts of interest.

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# Corresponding author: Guang Zhang, [zhangguang2000@chinaaids.cn](mailto:zhangguang2000@chinaaids.cn).

<sup>1</sup> National Center for AIDS/STD Control and Prevention, Chinese Center for Disease Control and Prevention, Beijing, China; <sup>2</sup> Chinese Association of STD & AIDS Prevention and Control, Beijing, China.

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