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Vital Surveillances

Trends in Bidirectional Screening and Treatment Outcomes for Tuberculosis/HIV Comorbidity — China, 2020–2024

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ABSTRACT

Introduction: The comorbidity of tuberculosis (TB) and human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) represents a persistent global public health challenge. This study examines the epidemiological trends of TB/HIV comorbidity in China during 2020–2024, extending previous analyses from the 2015–2019 period.

Methods: We collected annual TB/HIV comorbidity surveillance data from 32 provincial-level administrative divisions (PLADs) in China, encompassing bidirectional screening protocols, treatment initiation rates, and clinical outcomes. TB screening among people living with HIV (PLHIV) incorporated systematic symptom assessment and chest X-ray or sputum examination. HIV testing for TB patients employed standard serological methodologies. We performed statistical analyses and generated spatial distribution maps using R 4.2.1.

Results: During 2020–2024, 5,970,062 PLHIV were registered nationwide, with TB examination coverage increasing significantly from 90.2% (957,844/1,061,665) to 94.3% (1,246,274/1,321,458) ($P<0.01$). The overall TB detection rate among PLHIV was 0.5% (27,991/5,506,876). Among 2,843,159 registered TB patients, HIV testing coverage rose from 67.1% (419,332/625,395) to 68.7% (375,488/546,386) ($P<0.01$), yielding an overall HIV positivity rate of 1.1% (22,030/1,937,418). We identified 31,783 TB/HIV comorbid patients, of whom 70.9% (21,139/29,836) received concurrent antiretroviral therapy (ART) and anti-TB treatment. Treatment success rates declined significantly from 88.6% (9,521/10,751) in 2020 to 82.9% (3,743/4,513) in 2024 ($P<0.01$), while mortality rate increased from 4.8% (515/10,751) to 8.8% (398/4,513) ($P<0.01$).

Conclusions: Although bidirectional screening coverage has improved, substantial regional disparities persist alongside concerning trends of declining treatment success rates and increasing mortality. Enhanced implementation of efficient diagnostic technologies, optimized treatment protocols, and comprehensive stigma reduction initiatives are essential to improve survival outcomes for TB/HIV comorbid patients.

TB and human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) continue to pose significant threats to global public health. The dual burden of TB/HIV comorbidity creates a synergistic effect that substantially amplifies disease severity and mortality. HIV/AIDS compromises cellular immunity, dramatically increasing the likelihood that latent TB infection will progress to active disease by 19-fold, while TB simultaneously accelerates HIV replication and diminishes the effectiveness of ART. In 2023, an estimated 6.1% of global TB cases and 12.9% of TB-related deaths were attributed to HIV comorbidity. As the third-highest TB-burdened country globally, China confronts substantial challelnges in managing TB/HIV comorbidity, with notable regional disparities in screening coverage and treatment outcomes. This study provides updated epidemiological trends of TB/HIV comorbidity in China during 2020–2024, extending previous comprehensive analyses conducted from 2015–2019.

METHODS

We collected annual TB/HIV comorbidity surveillance reports from all 32 PLADs in China, encompassing comprehensive data on bidirectional screening protocols, treatment initiation rates, and clinical outcomes. For people living with HIV (PLHIV), TB screening protocols included systematic symptom assessment (evaluating cough, sputum production, and hemoptysis) combined with chest

radiography and sputum mycobacterial examination when clinically indicated. HIV testing among TB patients was performed using standardized serological assays following national guidelines.

We prepared all datasets in Microsoft Excel and conducted statistical analyses using R (version 4.2.1, R Foundation for Statistical Computing, Vienna, Austria, https://www.r-project.org/). To evaluate temporal trends in screening and treatment proportions, we applied the Cochran-Armitage test for trend analysis, setting statistical significance at α =0.05. We generated provincial-level spatial distribution maps using the sf and tmap packages in R, incorporating China's official administrative boundaries as approved under map review number GS(2020)0650 (National Platform for Common GeoSpatial Information Services, https://cloudcenter.tianditu.gov.cn/administrativeDivision).

RESULTS

During 2020–2024, a total of 5,970,062 PLHIV were registered (including newly diagnosed and follow-up cases), with numbers increasing from 1,061,665 to 1,321,458, representing an annual growth rate of 5.6% (Table 1). The proportion undergoing symptom screening demonstrated significant improvement, rising from 95.4% to 98.3% (Z=150.14, P<0.01). Similarly, the proportion receiving TB examination increased substantially from 90.2% to 94.3% (Z=136.43, P<0.01). However, the overall TB detection rate was 0.5%, showing a declining trend from 0.7% to 0.5% (Z=–16.34, P<0.01).

Substantial regional variation was observed in TB screening practices, with rates ranging from 45.2% (Tibet) to 98.7%. Six provinces (Hainan, Guangdong, Guangxi, Jilin, Guizhou, Tibet) fell below the 90% screening threshold (Figure 1A). TB prevalence among PLHIV also varied considerably across regions, ranging from 0.1% (Tianjin) to 1.0% (Guizhou), with Tibet excluded from analysis due to extreme outlier values (11.2%) (Figure 1B).

During 2020–2024, 2,843,159 TB patients were registered, representing a 3.3% annual decrease from 625,395 to 546,386 (Table 1). The proportion receiving HIV testing increased from 67.1% to 68.7% (Z=7.83, P<0.01). Known HIV-positive cases accounted for 0.6% of registered TB patients, increasing from 0.6% to 0.7% (Z=6.24, P<0.01).

Among newly tested patients, the HIV positivity rate was 0.3%, rising from 0.26% to 0.28% (Z=2.71, P=0.01). The overall HIV prevalence among TB patients increased from 1.1% to 1.3% (Z=6.35, P<0.01).

HIV testing rates among PLADs ranged from 18.8% to 98.4%, with a median of 62.5% (IQR: 36.2%, 84.7%), and the lowest rates observed in northern and western regions (Figure 1C). HIV prevalence among TB patients varied from 0.1% to 2.7%, with a median of 0.8% (IQR: 0.5%, 1.1%). The highest prevalence rates were recorded in Sichuan (2.7%), Guangxi (2.7%), and Jilin (2.1%) (Figure 1D).

During 2020–2024, a total of 31,783 TB/HIV comorbid patients were registered, with numbers increasing from 6,410 to 8,742 (Table 1). Of these patients, 91.7% received either ART or anti-TB treatment. The overall proportion receiving concurrent anti-TB and ART declined significantly from 82.5% in 2020 to 56.8% in 2024 (Z=–39.13, P<0.01). Treatment success rates for the prior-year cohort demonstrated a concerning downward trend, decreasing from 88.6% in 2020 to 82.9% in 2024 (Z=–9.43, P<0.01). Conversely, mortality rates increased substantially from 4.8% to 8.8% over the same period (Z=10.19, P<0.01).

Regional variations in treatment outcomes were substantial. The proportion of patients receiving concurrent treatment ranged from 14.4% to 95.4% across PLADs, with a median of 75.7% (IQR: 61.7%, 83.0%) (Figure 1E). Similarly, anti-TB treatment success rates varied considerably, ranging from 58.3% to 92.5%, with seven PLADs achieving success rates below 80% (Figure 1F).

DISCUSSION

During 2020–2024, tuberculosis diagnosis among people living with HIV declined from 0.7% to 0.5%, with an overall detection rate of 0.5% — lower than the 0.9% rate observed in 2015–2019. This downward trend aligns with China's sustained decline in tuberculosis incidence across the general population. Although the overall HIV prevalence among tuberculosis patients (1.1%) remains below the global level (6.8%), it has demonstrated an upward trajectory over the past five years. The persistent substantial burden of TB/HIV comorbid patients indicates that China remains a high-burden country for TB/HIV

TABLE 1. Bidirectional screening and treatment for TB/HIV comorbidity in China, 2020−2024 [*n* (%)].

Year	2020	2021	2022	2023	2024	Total
TB screening among PLHIV						
PLHIV	1,061,665	1,156,204	1,187,549	1,243,186	1,321,458	5,970,062
Symptom screening	1,012,713 (95.4)	1,118,173 (96.7)	1,159,403 (97.6)	1,219,011 (98.1)	1,299,330 (98.3)	5,808,630 (97.3)
TB examination	957,844 (90.2)	1,052,723 (91.1)	1,088,922 (91.7)	1,161,113 (93.4)	1,246,274 (94.3)	5,506,876 (92.2)
TB cases diagnosed	6,972 (0.7)	4,416 (0.4)	4,993 (0.5)	5,862 (0.5)	5,748 (0.5)	27,991 (0.5)
HIV testing among TB patients						
TB cases notified	625,395	585,640	512,926	572,812	546,386	2,843,159
Known HIV-positive cases	3,719 (0.6)	3,143 (0.5)	2,834 (0.6)	3,260 (0.6)	3,735 (0.7)	16,691 (0.6)
HIV testing performed	419,332 (67.1)	404,638 (69.1)	335,509 (65.4)	385,760 (67.3)	375,488 (68.7)	1,920,727 (67.6)
Newly tested HIV-positive	1,097 (0.3)	1,013 (0.3)	1,081 (0.3)	1,101 (0.3)	1,047 (0.3)	5,339 (0.3)
Total HIV-positive	4,816 (1.1)	4,156 (1.0)	3,915 (1.2)	4,361 (1.1)	4,782 (1.3)	22,030 (1.1)
Treatment initiation for TB/HIV comorbidity						
TB/HIV comorbid cases	6,410	5,304	4,980	6,347	6,795	29,836
Anti-TB treatment	5,892 (91.9)	4,921 (92.8)	4,194 (84.2)	5,517 (86.9)	4,726 (69.6)	25,250 (84.6)
ART	5,680 (88.6)	4,711 (88.8)	4,006 (80.4)	4,881 (76.9)	5,767 (84.9)	25,045 (83.9)
Concurrent anti-TB & ART	5,287 (82.5)	4,488 (84.6)	3,390 (68.1)	4,113 (64.8)	3,861 (56.8)	21,139 (70.9)
Either anti-TB treatment or ART	6,285 (98.1)	5,144 (97.0)	4,810 (96.6)	6,285 (99.0)	6,632 (97.6)	29,156 (97.7)
Anti-TB treatment outcome for prior-year cohort						
Cases notified	10,751	5,784	3,068	3,997	4,513	28,113
Treatment success	9,521 (88.6)	4,996 (86.4)	2,709 (88.3)	3,386 (84.7)	3,743 (82.9)	24,355 (86.6)
Death	515 (4.8)	411 (7.1)	193 (6.3)	341 (8.5)	398 (8.8)	1,858 (6.6)
Treatment failure	646 (6.0)	377 (6.5)	151 (4.9)	58 (1.5)	77 (1.7)	1,309 (4.7)
Other	69 (0.6)	0 (0)	15 (0.5)	212 (5.3)	295 (6.5)	591 (2.1)

comorbidity, necessitating continued strengthening of bidirectional screening efforts.

During this period, China achieved steady improvements in TB/HIV bidirectional screening compared with the 2015–2019 period, with tuberculosis screening among people living with HIV increasing to 94.3%, and HIV testing among tuberculosis patients reaching 68.7%. However, significant regional disparities persist, particularly in western and central provincial-level administrative divisions (e.g., Xizang's tuberculosis screening among people living with HIV at 45.2%). Limited healthcare resources, geographic accessibility challenges, and stigma represent major barriers to TB/HIV bidirectional case-finding. Chest radiography remains the primary tool for tuberculosis screening, but limited interpretive capacity at grassroots levels poses a significant constraint. Substantial evidence supports the use of computer-aided detection (CAD) to replace human readers for tuberculosis screening, addressing diagnostic bottlenecks in resource-limited settings and enhancing case detection. For mycobacterial testing, molecular diagnostics (e.g., Xpert MTB/RIF) and lateral flow lipoarabinomannan (LF-LAM) assays demonstrate superior sensitivity compared to traditional sputum smear microscopy, particularly among people living with HIV, and are suitable for decentralized implementation. C-reactive protein (CRP) testing provides specific diagnostic value among treatment-naive people living with HIV, offering a viable alternative in areas lacking bacteriological testing capabilities. Targeted investments in medical resources, diagnostic equipment, and reagents should be prioritized in remote regions. Provinces with screening rates below 90% (e.g., Guangxi, Guizhou, Xizang) can prioritize implementing computer-aided detection and
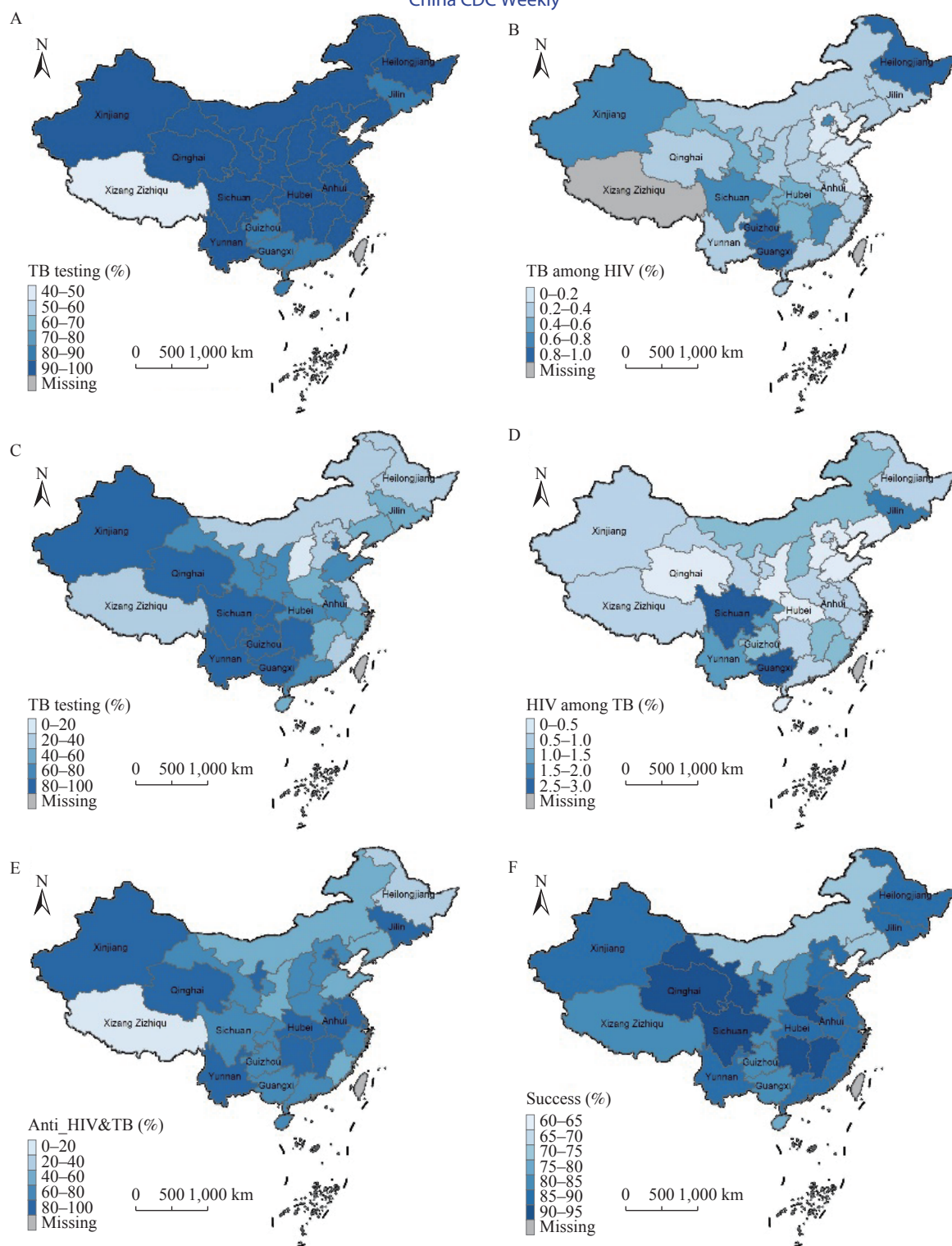
FIGURE 1. Regional Disparities in Bidirectional Screening and Treatment for TB/HIV Comorbidity in China, 2020–2024. (A) Proportion of tuberculosis examination among people living with HIV; (B) Tuberculosis prevalence among people living with HIV. Data from Tibet excluded from analysis due to extreme values; (C) Proportion of HIV testing among tuberculosis patients; (D) Prevalence of HIV/AIDS among tuberculosis patients; (E) Proportion of concurrent antiretroviral therapy and anti-TB treatment among notified TB/HIV patients; (F) Proportion of anti-TB treatment success among TB/HIV comorbid patients.

Abbreviation: TB=Tuberculosis; HIV/AIDS=human immunodeficiency virus/acquired immunodeficiency syndrome; PLADs=provincial-level administrative divisions; PLHIV=people living with HIV; ART=antiretroviral therapy; CAD=computer-aided detection; LF-LAM=lateral flow lipoarabinomannan; CRP=C-reactive protein.

Map approval number: GS 京（2025）1851 号.

lateral flow lipoarabinomannan assays.

Over the past five years, the proportion of TB patients undergoing HIV testing reached 67.6%, representing an improvement from the 55% observed in 2015–2019, yet remaining below the global benchmark of 80% for HIV testing among diagnosed TB patients in 2023. The World Health Organization (WHO) advocates "provider-initiated HIV testing" for all TB patients and promotes test acceptability through anti-discrimination policies. The suboptimal coverage likely stems from both limited equipment availability and HIV-related stigma. As emphasized in WHO guidelines, health services should adhere to medical ethics, avoid stigma, ensure non-discrimination, and uphold the right to health. To address stigma-related barriers, concrete multi-faceted interventions are needed, including: implementing structured community education programs to increase awareness; training healthcare workers in non-discriminatory communication practices; supporting peer education initiatives led by successfully treated TB/HIV patients; and integrating anti-stigma messaging into broader TB/HIV health promotion campaigns. Provinces with testing rates below 60% (e.g., parts of western China) require targeted service model optimization: integrating HIV testing into initial TB consultation workflows to minimize patient burden, and adopting rapid testing technologies to reduce operational barriers.

This period also witnessed a decline in anti-TB treatment success rates alongside increased mortality, suggesting a correlation with suboptimal coverage of concurrent ART and anti-TB treatment. Previous studies indicate that more than half of TB/HIV-related deaths occur within 3 months of TB diagnosis, with early treatment interruptions and adverse drug effects serving as key factors contributing to treatment failure and mortality. Early initiation of both ART and anti-TB treatment represents a critical intervention for achieving favorable outcomes in TB/HIV patients, as ART suppresses HIV replication and maintains CD4+ T cell levels. The WHO has recommended initiating ART within 2 weeks of TB treatment initiation for PLHIV, regardless of CD4 count, while strengthening adverse event monitoring to improve treatment success and reduce mortality risks.

Several limitations characterize this study. First, data reliance on routine reporting may undercount unregistered cases. Second, the data collection method for treatment enrollment shifted from aggregated reporting to individual case-based tracking since 2023. This methodological change likely contributed to the observed decline in concurrent treatment proportions (from over 80% before 2022 to below 70% since 2023). Nevertheless, the persistent downward trend since 2023 suggests underlying systemic challenges. Critically, the lack of integrated TB/HIV electronic medical records limits real-time data sharing between programs, hindering coordinated care delivery. Future analyses using consistent methodology are essential to confirm the true trajectory.

In summary, while China has achieved progress in bidirectional TB/HIV screening, significant regional disparities persist alongside declining treatment success rates and rising mortality rate. We recommend prioritizing enhanced inter-facility collaboration, scaling up efficient diagnostic technologies, optimizing treatment workflows, and reducing disease stigma through health education and community interventions to ultimately improve survival outcomes for TB/HIV comorbid patients.

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A Volunteer-Based Social Network Strategy to Promote HIV Testing Among MSM Aged 50 and Above — Tianjin Municipality, China, 2021–2024

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Summary

What is already known about this topic?

HIV prevalence among men who have sex with men (MSM) aged 50 and above has been increasing. This population has a low testing rate and insufficient knowledge of human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) prevention. At present, limited strategies are available for improving the testing coverage among elderly MSM.

What is added by this report?

By comparing with the traditional testing strategy, our study found that Volunteer-Based Social Network HIV Testing Services (VBSNS) could significantly improve the testing coverage and newly reported HIV-positive cases of elderly MSM in the remote suburbs of Tianjin Municipality.

What are the implications for public health practice?

Our study confirmed the feasibility of VBSNS among the elderly MSM population in suburban areas and provides a reference model for improving testing coverage in remote areas.

ABSTRACT

Introduction: To evaluate the efficiency and effectiveness of Volunteer-Based Social Network human immunodeficiency virus (HIV) Testing Services (VBSNS).

Methods: Collaborating with a local non-governmental organization, we recruited eligible elderly men who have sex with men (MSM) between 2021 and 2024. Participants were assigned to either the traditional Community-Based HIV Testing Services (CBHTS) group or the VBSNS group. We conducted questionnaire surveys, HIV and syphilis antibody rapid testing.

Results: We recruited 144 volunteers, each of whom facilitated HIV testing for 9.13 participants on average. VBSNS accounted for 47.9% of all HIV tests and covered 66.6% of suburban areas. It also accounted for 67.2% of all newly reported cases, compared to only 32.8% for CBHTS. A higher proportion of testers who were under age 60, single, married, or cohabiting, with an education level of below junior college participated in VBSNS. Conversely, a smaller proportion of VBSNS participants reported identifying as homosexual, practiced HIV prevention measures beyond condom use, and had received HIV testing.

Conclusions: VBSNS effectively increased HIV testing uptake and new case identification among MSM in remote areas, successfully reaching a high-risk population. This model provides a valuable alternative for settings where traditional methods such as on-site testing and counseling are inaccessible.

According to estimates by the Joint United Nations Programme on human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) (UNAIDS), the number of people aged 50 and above living with HIV has risen significantly over the last 10 years (*1*). In China, a similar upward trend has been observed, with newly diagnosed HIV cases among those aged 50 and above increasing from 32,850 in 2015 to 51,856 in 2022 (*2*). Of these cases, 11.04% were attributed to male-to-male sexual contact, a proportion that has been consistently increasing (*3*). Tianjin, the second-largest city in Northern China, serves as a key regional center for inter-provincial trade. The city's HIV epidemic is largely driven by transmission among men who have sex with men (MSM). In Tianjin, MSM aged 50 and above had the highest prevalence of any age group: 7.29% (*4*). However, only 38.18% have ever been tested for HIV (*5*). Key barriers to testing include limited awareness,

fears of confidentiality breaches, and limited accessibility of testing services (6). This low testing coverage poses several significant challenges. First, individuals in this age group who are diagnosed with HIV often present at a late stage. This late diagnosis, compounded by age-related declines in immune function, significantly increases the risk of HIV-related mortality. Second, many MSM over 50 were in heterosexual marriages, elevating the risk of HIV transmission to their female spouses (7). Since 2021, Tianjin Center for Disease Control and Prevention (CDC) has cooperated with a local non-governmental organization (NGO), the Tianjin Shen Lan Public Health Consulting Service Center (hereinafter, "Shen Lan NGO"), to implement an on-site HIV testing and counseling program targeted at the MSM community. Shen Lan NGO recruits MSM through online and offline methods and provides free HIV testing and counseling services. Nevertheless, the Community-Based HIV Testing Services (CBHTS) remain concentrated in central urban districts, with limited availability in suburban areas.

From January 2021 to December 2024, Tianjin CDC has applied the Volunteer-Based Social Network Strategy for HIV Testing Services (VBSNS) to assess its impact on HIV testing rates in MSM aged 50 and above, compared to standard CBHTS. The social network strategy (SNS) recommended by the World Health Organization (WHO) for HIV testing trains individuals living with HIV or from high-risk populations to encourage their peers to seek voluntary testing (8). Multiple studies have demonstrated the effectiveness of this strategy (9–10). Its primary strength consists in the volunteers' use of pre-existing social networks and community trust to increase HIV testing uptake among MSM.

Volunteers were recruited through WeChat Moments posts shared by the Shen Lan NGO staff, which allowed MSM individuals to register. The inclusion criteria for volunteers were as follows: aged 18 years or older; had condomless anal sex in the past six months; had a history of new psychoactive substance (NPS) use; and had an HIV-negative result in the most recent HIV test. The training curriculum covered HIV prevention strategies, interpersonal counseling skills, instructions on the use of HIV self-testing kits, and guidelines on maintaining confidentiality. After the training, volunteers who successfully passed the assessments participated in HIV testing outreach and promotional activities. They identified potential participants within their own social networks, such as friends, relatives, or sexual partners, through both online and offline channels. The inclusion criteria for participants were as follows: biological male sex and aged 50 years or above; engagement in anal intercourse with at least one male partner in the past six months; willingness to provide informed consent, complete the study questionnaire, and undergo blood collection for HIV testing; and capacity for independent decision-making and no clinical diagnosis of a mental health disorder. For participants who consented to testing, volunteers provided assistance in conducting HIV self-testing at offsite locations chosen for their convenience, such as public parks, entertainment venues, or private vehicles. Rapid testing for both HIV and syphilis was administered using the HIV 1+2 Antibody Test Kit and the Treponema pallidum (TP) Antibody Test Kit (Zhongxin Keju Biological Pharmaceutical Co., China). Participants were not permitted to undergo repeat testing within a three-month period. Following the HIV test, volunteers administered a digital survey to collect demographic and sexual behavior information. Upon survey completion, an automatic text alert was sent to full-time staff at the Shen Lan NGO, who then reviewed the submission. The process was only finalized after staff verification. Positive screening results were confirmed by Western blot (HIV Blot 2.2, MP Diagnostics, Singapore). Participants with confirmed HIV-positive results were cross-referenced by Tianjin CDC staff via the regional HIV management system. Participants not found in the system were categorized as newly reported cases and were promptly initiated on antiretroviral therapy (ART) (Figure 1).

The Shen Lan NGO also established a long-term motivative system for volunteers. This system incorporated various incentives, including performance-based rewards tied to the number of participants recruited and the new HIV-positive cases identified, as well as non-financial recognition. The latter included the regular selection and awarding of "Outstanding Volunteer" certificates, opportunities for skill enhancement and professional growth, and the establishment of a volunteer community to foster a sense of belonging.

During the data statistical analysis, we only used the number of individuals, instead of the total number of tests. All statistical analyses, including two-sided tests with a significance level of $P<0.05$, were performed using R 4.3.3 software [an open-source software project supported by the R Foundation for Statistical
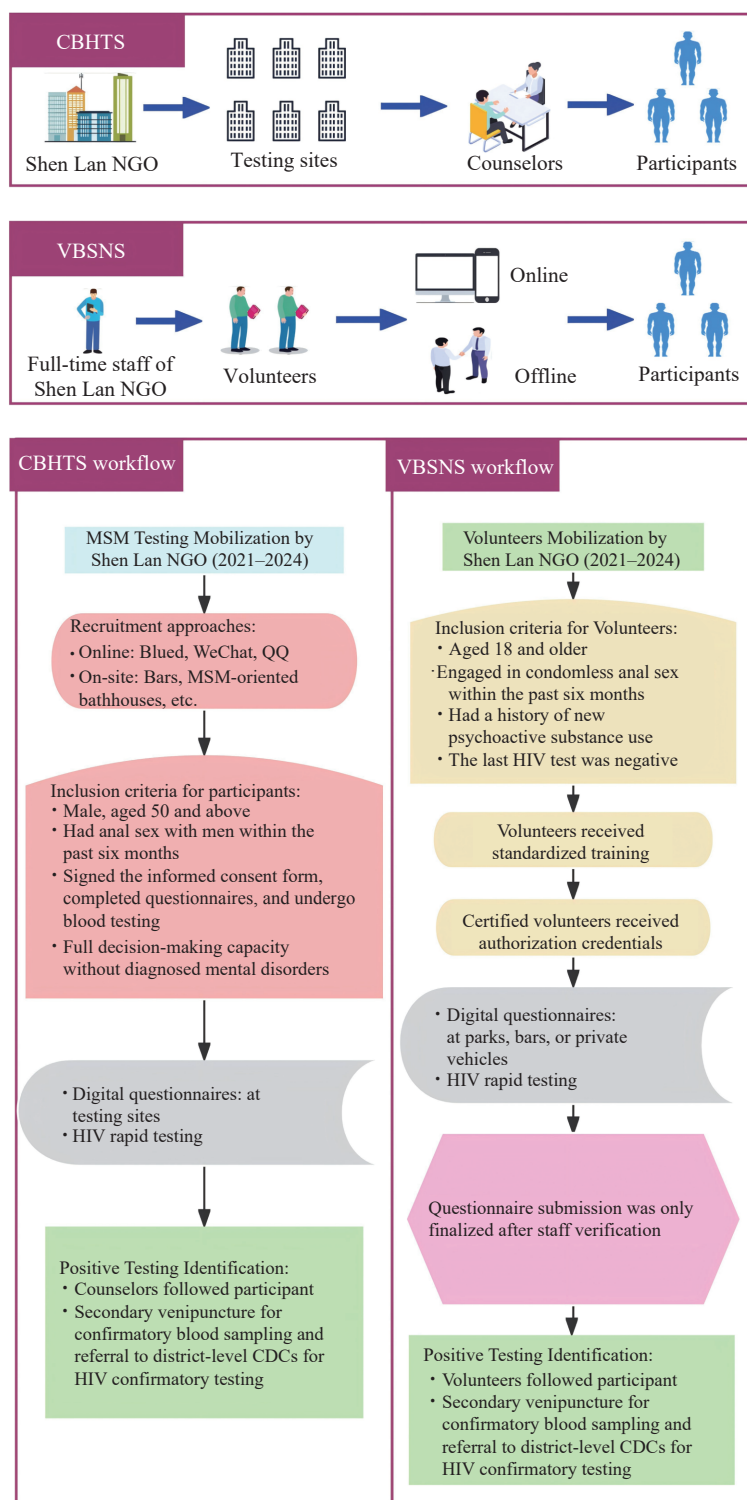
FIGURE 1. Overview of HIV testing services via CBHTS and VBSNS.
Abbreviation: HIV=human immunodeficiency virus; CBHTS=community-based HIV testing services; VBSNS=volunteer-based social network HIV testing services.

Computing (Vienna, Austria)]. We generated a visual representation of VBSNS testing results from 2021 to 2024 using Gephi software (version 0.10; https://gephi.org/).

In terms of sociodemographic characteristics, most participants tested through VBSNS were under the age of 60, identified as single, married, or cohabiting, and had a college education or less. Regarding behavioral

characteristics (for participants with multiple testing, only their most recent questionnaire record was used), the majority identified as homosexual, had HIV prevention methods beyond condom use, and had never been tested for HIV (Figure 2).

For 2021, 2022, 2023, and 2024, VBSNS recruited 64, 53, 72, and 55 volunteers, respectively. Of these, 65 volunteers participated in multiple years, resulting in a total of 144 unique volunteers. On average, each volunteer facilitated testing for 9.1 participants. Each volunteer was assigned a distinct identification number from 001 to 144. Those who conducted 50 or more tests in a given year included volunteers 017, 034, and 107 in 2021; 011, 034, and 107 in 2022; 011, 034, and 091 in 2023; and 011, 034, 055, and 071 in 2024 (Figures 3). A total of 1,316 individuals were tested through VBSNS. The annual number of tests among MSM aged 50 and above was 213, 191, 340, and 572, respectively. In comparison, CBHTS reached 1,430 individuals during the same period, with annual test counts of 313, 124, 357, and 636, respectively. VBSNS accounted for 47.9% of all local tests and conducted 900 tests in suburban areas, representing 66.6% of the total tests conducted in those areas. Among the 10 distant suburban districts, only three reported fewer tests through VBSNS than through CBHTS (Figure 4).

Between 2021 and 2024, 78 newly reported HIV-positive cases were identified through VBSNS, resulting in an HIV-positive rate of 5.9% (78/1,316). The annual positivity rate was 7.2% in 2021, 3.0% in 2022, 3.1% in 2023, and 2.5% in 2024. In comparison, CBHTS identified 38 new cases, yielding a positivity rate of 2.7% (38/1,430); the annual rate was 2.6%, 1.7%, 2.2%, and 1.3%, respectively. VBSNS accounted for 67.2% of all newly reported cases, compared to 32.8% for CBHTS, with annual rates of 69.1%, 66.7%, 55.6%, and 63.6%.

DISCUSSION

The results regarding testing efficiency underscore the significant role of VBSNS in enhancing access to HIV services, especially in under-resourced suburban areas. Notably, VBSNS accounted for 47.9% of the area's total tests. Its effectiveness was particularly pronounced in remote suburban regions, where it accounted for 66.6% of all tests, markedly exceeding the reach of CBHTS. These findings highlight VBSNS's advantage in reaching and mobilizing key

Characteristics	VBSNS	CBHTS	OR (95% CI)	P
Age (years)				
50–59	1,135 (86.3)	1,058 (74.0)	2.2 (1.8–2.7)	<0.001
≥60	181 (13.8)	372 (26.0)	1	
Marital status				
Married or cohabiting	893 (67.9)	900 (62.9)	0.9 (0.8–1.2)	0.61
Divorced or widowed	203 (15.4)	320 (22.4)	0.6 (0.5–0.8)	<0.001
Single	220 (16.7)	210 (14.7)	1	
Degree of education				
Junior high school and below	528 (40.1)	496 (34.7)	1.5 (1.2–1.8)	<0.001
High school	483 (36.7)	509 (35.6)	1.3 (1.1–1.6)	<0.05
College or above	305 (23.2)	425 (29.7)	1	
City areas				
Suburban areas	900 (68.4)	452 (34.6)	4.1 (3.5–4.8)	<0.001
Central urban	416 (31.6)	856 (65.4)	1	
Recruitment approaches				
Online	1,045 (79.4)	571 (39.9)	5.8 (4.9–6.9)	<0.001
On-site	271 (20.6)	859 (60.1)	1	
Homosexual orientation				
No	379 (28.8)	185 (12.9)	2.7 (2.2–3.3)	<0.001
Yes	936 (71.2)	1,245 (87.1)	1	
Used condoms consistently for the last three months				
Yes	524 (39.8)	328 (23.5)	2.2 (1.9–2.5)	<0.001
No	792 (60.2)	1,070 (76.5)	1	
Used condoms for the last anal sex				
No	499 (37.9)	577 (41.3)	0.9 (0.7–1.0)	0.07
Yes	817 (62.1)	821 (58.7)	1	
Had HIV prevention methods beyond condom use				
No	1,086 (82.5)	611 (42.7)	6.3 (5.3–7.6)	<0.001
Yes	230 (17.5)	819 (57.3)	1	
Had previously received HIV testing				
No	397 (30.2)	69 (5.2)	7.9 (6.0–10.3)	<0.001
Yes	919 (69.8)	1,254 (94.8)	1	

Odds Ratio (OR) and 95% CI
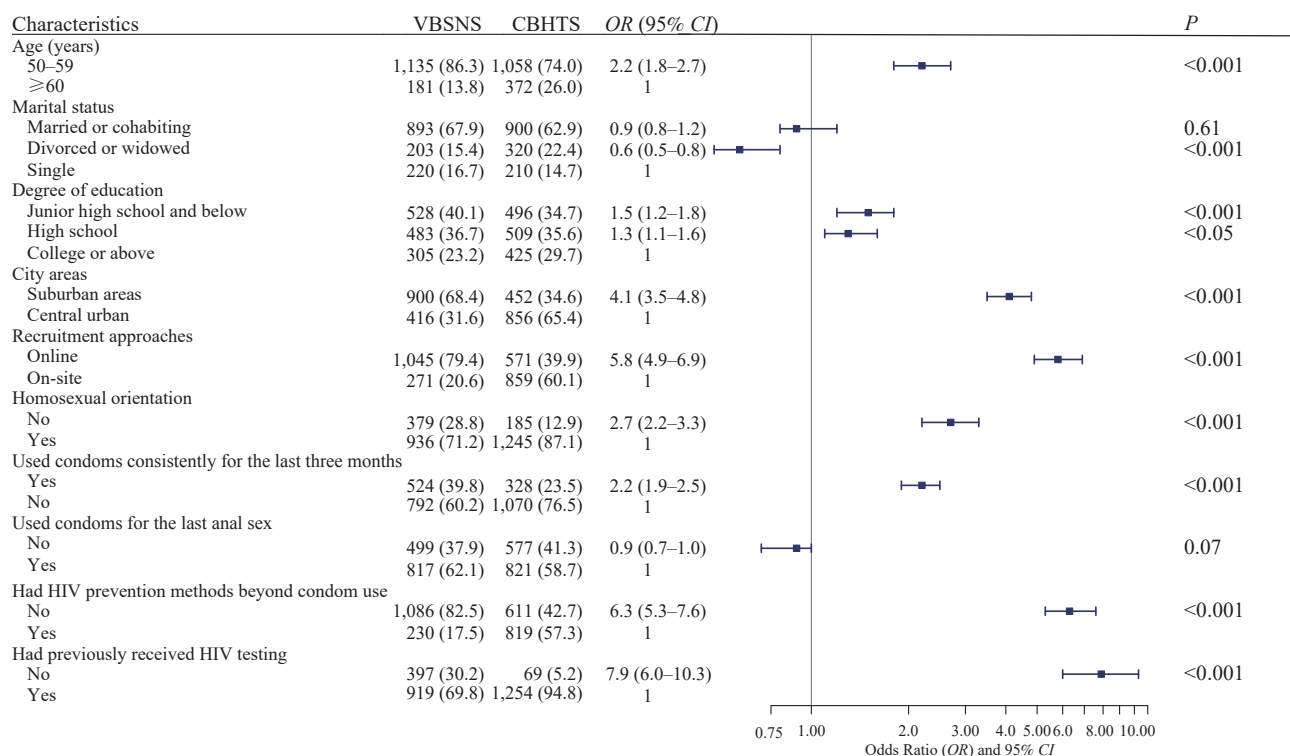0.75 1.00 2.0 3.00 4.00 5.00 6.0 8.00 10.00

FIGURE 2. Sociodemographic and behavioral characteristics of participants in CBHTS and VBSNS.
Abbreviation: CBHTS=community-based HIV testing services; VBSNS=volunteer-based social network HIV testing services.
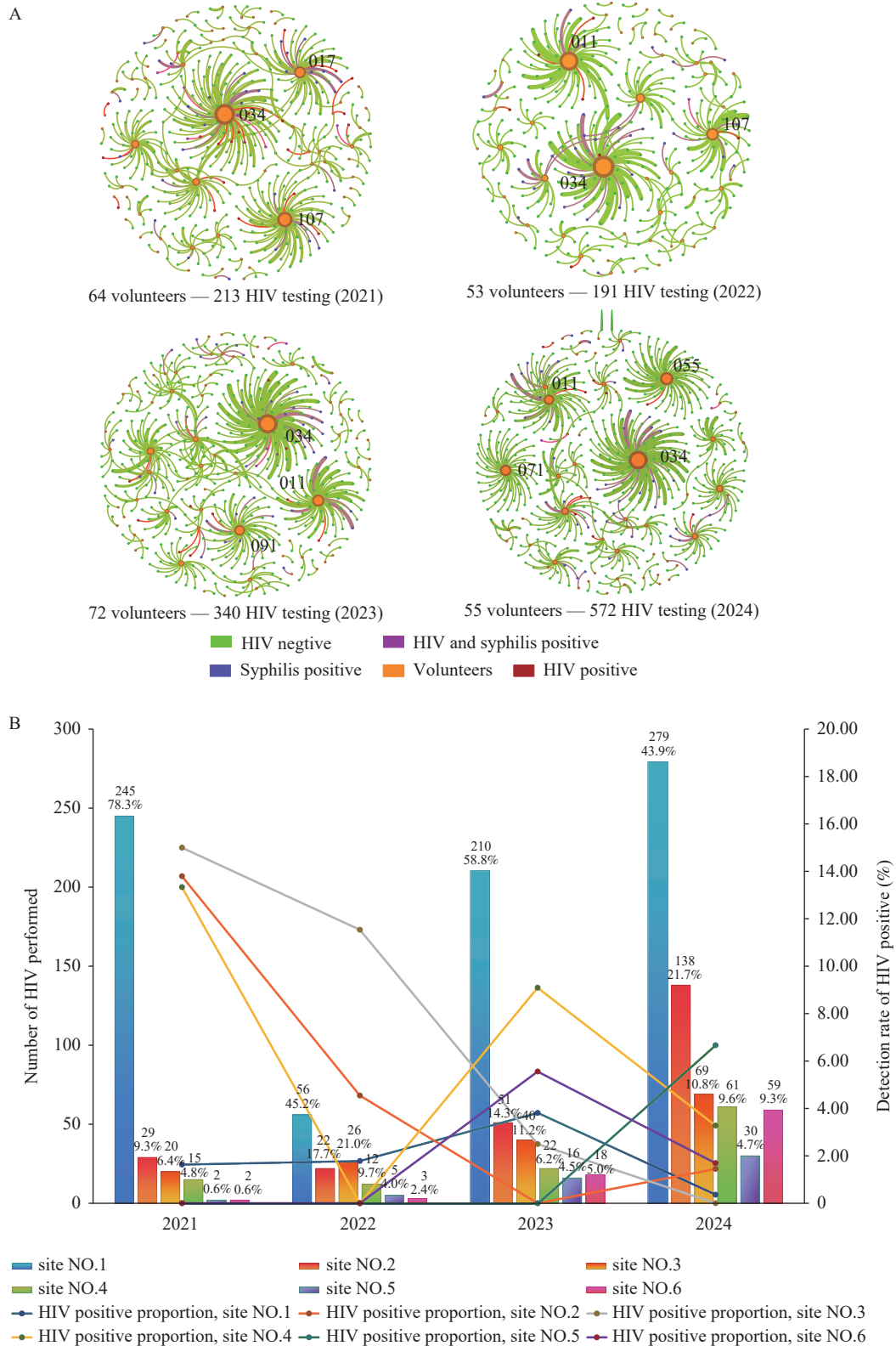* P<0.05; ** P<0.01.

FIGURE 3. Visualization of VBSNS and CBHTS testing between 2021 and 2024. (A) VBSNS: The orange circular with a number represents volunteers who have tested more than 50 people this year, and the thickness of the line is positively correlated with testing frequency. (B) CBHTS: Numbers above the column represent the testing frequency of participants in the testing sites, and percentage numbers indicate the proportion of the testing site's testing volume in the total testing sites. Abbreviation: CBHTS=community-based HIV testing services; VBSNS=volunteer-based social network HIV testing services.
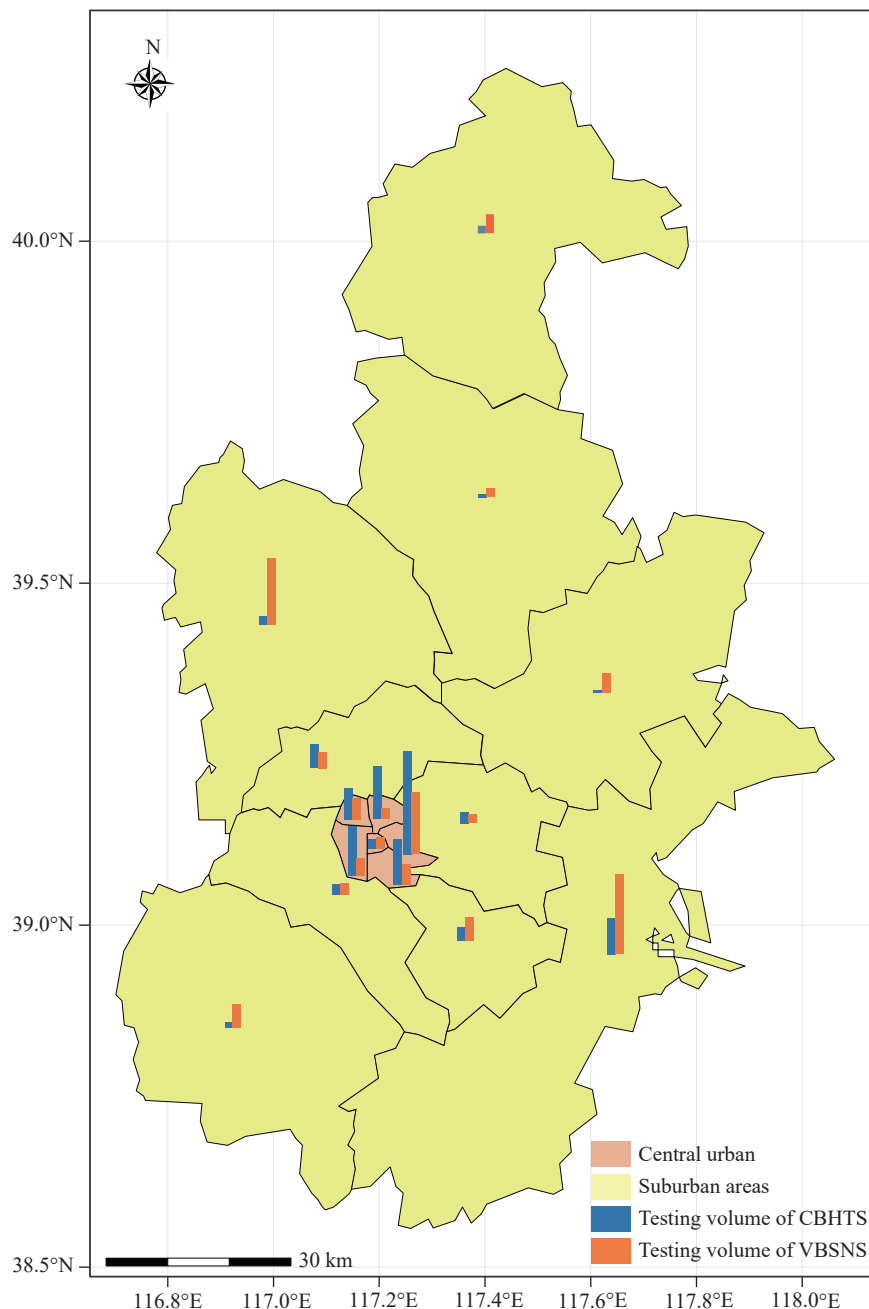
FIGURE 4. Map of HIV testing volume in VBSNS and CBHTS.
Abbreviation: CBHTS=community-based HIV testing services; VBSNS=volunteer-based social network HIV testing services; HIV=human immunodeficiency virus.

populations, particularly MSM aged 50 and above.

An analysis of volunteer efficiency under VBSNS reveals that each volunteer conducted an average of 9.2 tests, which exceeds the average of 2.9 tests per volunteer reported in a self-testing kit distribution strategy in Zhuhai and surpasses the 6.7 participants per recruiter documented in U.S.-based social network strategy studies (*11–12*). A major factor contributing to this outcome is the role of volunteers as "peer motivators," whose integration within the target community enhances both their reliability and trustworthiness. Additionally, the study identified a group of exceptionally effective "core volunteers" (e.g., 011, 017, 034), each of whom tested more than 50 participants annually. These high-performers played a central role in the success of VBSNS. Therefore, the long-term incentive system for volunteers has proven effective and will be maintained.

In terms of detection effectiveness, a key finding from this study is that VBSNS successfully reached high-risk populations for HIV that are typically difficult for traditional services to cover. VBSNS also identified a significantly higher proportion of newly reported HIV-positive MSM, accounting for 67.2% of all local cases during the study period. The positivity rate for VBSNS was 5.9%, considerably higher than the 2.7% observed for CBHTS. The testing rate among VBSNS participants (69.8%) was comparable to averages for MSM in major Chinese cities such as Shanghai and Qingdao (*13*) but lower than the 93.1% rate seen in developed countries such as the United States (*14*). This gap highlights the considerable challenges China faces in expanding testing coverage among elderly MSM, while simultaneously underscoring the potential of alternative strategies such as VBSNS to narrow this gap.

This study has several limitations. First, we identified three districts where testing volumes were lower under VBSNS than under CBHTS. This uneven distribution suggests that the performance of VBSNS may be influenced by local sociocultural factors and the reach of volunteer networks. Future work should conduct focus group discussions or individual interviews to explore the specific challenges faced by volunteers in these areas. Second, when volunteers with low engagement levels dropped out of the program, their social contacts were lost to follow-up testing. Future interventions should strengthen support and training for such volunteers and establish a structured handover system to facilitate the integration of replacements.

Despite its limitations, VBSNS effectively engaged high-risk MSM aged 50 and above, thereby increasing both testing uptake and case identification in remote areas. This model provides a valuable alternative for regions where traditional on-site testing and counseling services are not feasible.

Ethical statement: Approval by the Ethics Committee of the Tianjin Center for Disease Control and Prevention (Approval No: TJCDC-R-2023-020).

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Preplanned Studies

HIV Prevention Cascade and PrEP/PEP Implementation Gaps Among High-Risk University Students — Sichuan Province, China, 2022–2023

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Summary

What is already known about this topic?

Chinese university students face elevated human immunodeficiency virus (HIV) risks, yet pre-exposure prophylaxis (PrEP) and post-exposure prophylaxis (PEP) uptake remain low despite proven efficacy.

What is added by this report?

Among 645 high-risk students, 12.87% utilized PrEP and 13.02% utilized PEP. High HIV knowledge strongly predicted awareness [PrEP: adjusted odds ratio (aOR)=5.62; PEP: aOR=3.42], yet among students who understood the services, 70% did not access them. This finding indicates that structural barriers, rather than knowledge deficits, represent the primary constraint limiting cascade effectiveness.

What are the implications for public health practice?

Educational interventions alone are insufficient to improve service uptake; comprehensive strategies that simultaneously address both knowledge deficits and systemic barriers are essential for expanding PrEP and PEP access.

ABSTRACT

Introduction: To analyze human immunodeficiency virus (HIV) prevention cascade performance and identify implementation barriers for pre-exposure prophylaxis (PrEP) and post-exposure prophylaxis (PEP) among high-risk university students in Sichuan Province, China.

Methods: A cross-sectional survey of 29,017 students across universities in Sichuan Province (November 2022–September 2023) identified 645 high-risk students. Prevention cascades were assessed using a four-stage framework spanning from awareness through service utilization. Multivariable logistic regression models identified predictors of cascade progression.

Results: Among 645 high-risk students (2.22% of surveyed population; mean age 20.36±2.47 years; 66.20% male), only 34.57% achieved high HIV knowledge scores. PEP demonstrated higher awareness than PrEP (83.72% *vs.* 68.37%), whereas PrEP showed superior understanding conversion (59.41% *vs.* 52.22%). Utilization rates were comparable (12.87% *vs.* 13.02%). High HIV knowledge strongly predicted awareness [PrEP: adjusted odds ratio (aOR)=5.62; PEP: aOR=3.42] and PrEP utilization (aOR=1.76). Men who have sex with men (MSM) behavior predicted utilization for both services (PrEP: aOR=2.10; PEP: aOR=1.78). Among students who understood the services, two-thirds did not access them.

Conclusions: High HIV knowledge represents the primary modifiable predictor of cascade progression, yet structural barriers prevent two-thirds of informed students from accessing services. Educational interventions alone are insufficient; comprehensive strategies that simultaneously address both knowledge deficits and systemic barriers are essential for improving service uptake.

Human immunodeficiency virus (HIV) incidence among Chinese university students has risen substantially in recent years, with sexual transmission emerging as the predominant route of infection, particularly through male homosexual contact (*1*). The crude reported rate of HIV/acquired immune deficiency syndrome (AIDS) among out-of-school youth aged 15–24 years in China escalated from 5.25/100,000 in 2010 to 13.75/100,000 in 2020, with epidemic hotspots concentrated in Southwest China, including Sichuan Province (*2*). Biomedical prevention tools — particularly pre-exposure prophylaxis (PrEP) and post-exposure prophylaxis (PEP) — have demonstrated high efficacy in preventing HIV

acquisition, with PrEP reducing sexual transmission risk by up to 99% when taken as prescribed (3–5). However, since China began promoting PrEP and PEP services through demonstration projects in 2019, substantial implementation gaps have persisted despite the proven effectiveness of these interventions (6).

Current evidence from China reveals concerning deficits in prevention uptake among key populations. University students represent a distinct at-risk group with unique behavioral and social characteristics that influence their engagement with HIV prevention services. Understanding where and why students disengage from the prevention cascade is essential for designing effective campus-based programs. Yet, no studies have systematically characterized prevention cascade performance or identified specific barriers to service uptake in this population.

The prevention cascade framework (7–8) provides a systematic approach to identifying specific bottlenecks — from initial awareness through service utilization — that constrain intervention impact. This study addresses these critical knowledge gaps by analyzing prevention cascade performance and distribution patterns for both PrEP and PEP services, identifying modifiable predictors of cascade progression, and quantifying implementation barriers that limit service access among high-risk university students in Sichuan Province.

A cross-sectional survey was conducted across 5 universities in Sichuan Province, China, November 2022–September 2023: Chengdu Technological University, Chengdu Medical College, Chengdu Polytechnic, Sichuan Tourism University, and Southwest Petroleum University. Full-time undergraduate and graduate students were recruited through convenience sampling via peer educator networks, dormitory outreach, and classroom presentations. All participants provided written informed consent prior to enrollment.

High-risk sexual behavior was defined by concurrent fulfillment of two criteria: 1) unprotected sexual intercourse in the preceding 6 months (inconsistent or absent condom use); and 2) at least one behavioral risk factor — either men who have sex with men (MSM) behavior (biological males reporting any male sexual partners, with or without female partners) or multiple sexual partnerships (2 or more partners in the preceding 6 months, regardless of gender or sexual orientation).

Trained student volunteers from each university's Youth Red Ribbon team administered anonymous questionnaires via secure electronic platforms. The instrument incorporated validated components from China's National HIV Behavioral Surveillance System, assessing: 1) demographics (age, gender, academic year); 2) sexual behaviors (sexual experience, partner types and numbers, condom use frequency); 3) HIV/AIDS knowledge using a validated 8-item scale (score range 0–8, with scores ≥ 7 classified as high knowledge); 4) subjective HIV infection risk perception (binary yes/no); and 5) prevention service engagement for PrEP and PEP. Prevention service engagement was assessed using a four-stage cascade framework from population risk exposure through service utilization. For each service, participants were classified into one of four mutually exclusive stages: Stage 1 (unaware) — no awareness of the service; Stage 2 (aware) — aware of the service but lacking understanding of its use; Stage 3 (understand) — understand the service but have not used it; Stage 4 (utilization) — have used the service.

Descriptive statistics were calculated as frequencies with percentages or means with standard deviations. Prevention cascade performance was assessed across four mutually exclusive stages for both PrEP and PEP services, with between-service comparisons performed using χ^2 tests. Multivariable logistic regression models identified predictors of PrEP and PEP awareness and utilization. To assess model reliability, we confirmed adequate sample size post-hoc [events-per-variable ratios ranged from 16.6 to 108 across all models, exceeding the recommended minimum of 10 (9)] and evaluated multicollinearity among predictors (all variance inflation factor values ranged from 1.01 to 1.50, well below the threshold of 3.0). Statistical significance was set at $P<0.05$. All analyses were performed using R version 4.4.2 (R Foundation for Statistical Computing, Vienna, Austria).

Among 29,017 students surveyed across five universities — Chengdu Technological University (4,327 students, 14.91%), Chengdu Medical College (4,351, 14.99%), Chengdu Polytechnic (9,630, 33.19%), Sichuan Tourism University (6,146, 21.18%), and Southwest Petroleum University (4,563, 15.73%) — 3,576 (12.32%) reported sexual experience, 1,640 (5.65%) reported unprotected sexual behavior, and 645 (2.22%) met high-risk criteria. Among these 645 high-risk students, 206 (31.94%) reported MSM behavior and 521 (80.78%) had multiple sexual partners (≥ 2). Analysis of risk behavior patterns revealed that 439 (68.06%) had multiple partners only, 124 (19.22%) had MSM behavior only,

and 82 (12.71%) exhibited both risk behaviors. Only 223 (34.57%) demonstrated high HIV knowledge levels (≥7 points) (Table 1).

Prevention cascade analysis revealed distinct engagement patterns between PrEP and PEP services among the 645 high-risk students (Figure 1 and Table 2). Cumulative cascade metrics demonstrated that PrEP achieved 68.37% (n=441) awareness, 40.62% (n=262) understanding, and 12.87% (n=83) utilization. In comparison, PEP achieved higher rates across all stages: 83.72% (n=540) awareness, 43.72% (n=282) understanding, and 13.02% (n=84) utilization. Stepwise conversion analysis revealed differential performance across cascade stages. PEP demonstrated significantly higher population-to-awareness conversion than PrEP (83.72% vs. 68.37%, χ^2=40.87, P<0.05). However, among aware participants, PrEP showed significantly better understanding conversion than PEP (59.41% vs. 52.22%, χ^2=4.79, P=0.029). The understanding-to-use conversion rates showed no significant difference between services (31.68% vs. 29.79%, χ^2=0.15, P=0.700), resulting in comparable final utilization rates (12.87% vs. 13.02%, χ^2=0.00, P=1.000). Implementation gap analysis revealed substantial service underutilization: among participants who achieved understanding, 68.32% (179/262) for PrEP and 70.21% (198/282) for PEP did not access services, with no significant difference between the two interventions (χ^2=0.15, P=0.700).

High HIV knowledge (≥7 points) emerged as the strongest predictor of awareness outcomes, with students demonstrating substantially increased odds of both PrEP awareness [adjusted odds ratio (aOR) 5.62, 95% confidence interval (CI): 3.90, 8.19, P<0.05] and PEP awareness (aOR=3.42, 95% CI: 2.40, 4.90, P<0.05). High HIV knowledge also significantly predicted PrEP utilization (aOR=1.76, 95% CI: 1.07, 2.87, P<0.05). MSM behavior demonstrated significant associations with service utilization, predicting both PrEP use (aOR=2.10, 95% CI: 1.19, 3.77, P<0.05) and PEP use (aOR=1.78, 95% CI: 1.01, 3.20, P<0.05), though not with awareness outcomes. Upper-year students exhibited significantly lower odds of PrEP awareness relative to lower-year students (aOR=0.59, 95% CI: 0.41, 0.85, P<0.05). Perceived HIV risk demonstrated an inverse association with PrEP awareness (aOR=0.66, 95% CI: 0.45, 0.97, P<0.05). Gender showed no significant association with any cascade outcome (Table 3).

TABLE 1. Baseline characteristics of high-risk students in universities in Sichuan Province, China, 2022–2023.

Characteristic	n (%) or Mean±SD
Demographics	
Age, years	20.36±2.47
Gender	
Male	427 (66.20)
Female	218 (33.80)
Academic year	
Lower year (1st–2nd)	364 (56.43)
Upper year (3rd+ and graduate)	281 (43.57)
Risk Behaviors	
MSM	206 (31.94)
Multiple sexual partners (≥2)	521 (80.78)
Risk behavior patterns	
Multiple partners only	439 (68.10)
MSM behavior only	124 (19.20)
Both MSM and multiple partners	82 (12.70)
HIV Knowledge and Risk Perception	
HIV knowledge score (0–8 scale)	5.39±2.02
High HIV knowledge level (≥7 points)	223 (34.57)
Perceived HIV infection risk	210 (32.56)

Abbreviation: HIV=human immunodeficiency virus; MSM=men who have sex with men.

DISCUSSION

This study represents the first systematic analysis of the HIV prevention cascade among high-risk university students in Sichuan Province, which bears the heaviest HIV burden among Chinese provinces. Our findings reveal two critical gaps: only 34.57% of high-risk students demonstrated adequate HIV-related knowledge, yet among those who understood how to access PrEP and PEP services (40.62% and 43.72%, respectively), approximately 70% failed to utilize them despite engaging in unprotected sexual intercourse. This substantial implementation gap indicates that structural barriers, rather than knowledge deficits alone, constitute the primary constraint limiting prevention cascade effectiveness. The finding is particularly concerning for PEP, which represents the final emergency prevention option following potential HIV exposure. Notably, while service-specific awareness rates were relatively high (68.37% for PrEP and 83.72% for PEP), comprehensive HIV knowledge remained inadequate (only 34.57% achieved ≥7/8 correct answers). This discrepancy suggests that students may recognize these prevention tools without
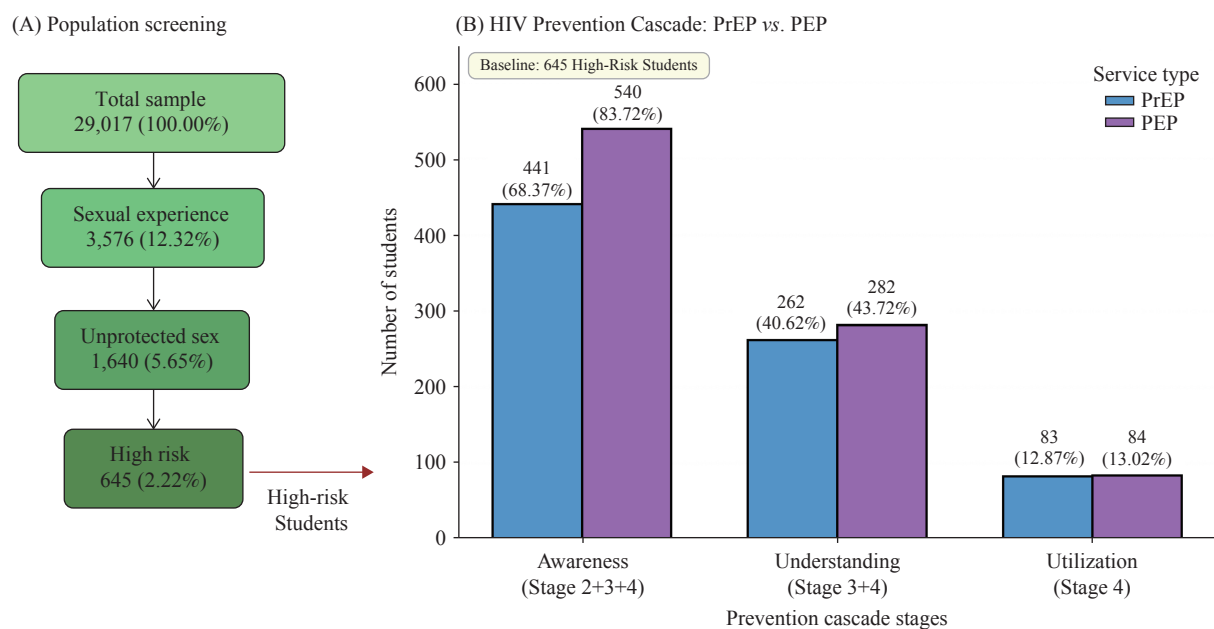
FIGURE 1. Study Population and HIV Prevention Cascade Among University Students in Sichuan Province, China. (A) Population screening flowchart illustrating the identification of 645 high-risk students from 29,017 participants. (B) Prevention cascade comparing pre-exposure prophylaxis (PrEP) and post-exposure prophylaxis (PEP) across three cumulative stages: Awareness, Understanding, and Utilization.

TABLE 2. Prevention cascade performance and statistical comparisons for PrEP and PEP services among high-risk university students (N=645).

Category	PrEP n (%)	PEP n (%)	x^2	P
Four-stage distribution				
Stage 1: Unaware	204 (31.63)	105 (16.28)		
Stage 2: Aware only	179 (27.75)	258 (40.00)		
Stage 3: Understand only	179 (27.75)	198 (30.70)		
Stage 4: Utilization	83 (12.87)	84 (13.02)		
Cumulative cascade				
Awareness (Stage 2+3+4)	441 (68.37)	540 (83.72)	40.87	<0.001
Understanding (Stage 3+4)	262 (40.62)	282 (43.72)	1.15	0.284
Utilization (Stage 4)	83 (12.87)	84 (13.02)	<0.01	1.000
Stepwise Conversion Rates [% (n/N)]				
Population → Awareness	68.37 (441/645)	83.72 (540/645)	40.87	<0.001
Awareness → Understanding	59.41 (262/441)	52.22 (282/540)	4.79	0.029
Understanding → Utilization	31.68 (83/262)	29.79 (84/282)	0.15	0.700
Implementation Gap				
Not using among understanding	68.32 (179/262)	70.21 (198/282)	0.15	0.700

Abbreviation: PrEP=pre-exposure prophylaxis; PEP=post-exposure prophylaxis.

fully comprehending HIV transmission risks or their own vulnerability, underscoring the critical need to integrate PrEP/PEP promotion with comprehensive HIV/AIDS education that emphasizes personal risk assessment.

Recent studies among Chinese university students corroborate this pattern, documenting PrEP awareness rates of 61%–88% alongside utilization rates consistently below 8% (10–11). The 70% implementation gap among students who understand these services represents a critical failure point in the prevention cascade, demonstrating that structural

TABLE 3. Multivariable logistic regression analysis of factors associated with PrEP and PEP awareness and utilization among high-risk university students (*N*=645).

Variable	PrEP awareness aOR (95% CI)	PrEP utilization aOR (95% CI)	PEP awareness aOR (95% CI)	PEP utilization aOR (95% CI)
Demographics				
Male *vs*. female	1.27 (0.82, 1.98)	1.04 (0.55, 2.01)	0.83 (0.55, 1.25)	0.98 (0.52, 1.84)
Upper *vs*. lower academic year	0.59 (0.41, 0.85)**	0.62 (0.37, 1.01)	0.83 (0.59, 1.15)	0.74 (0.46, 1.20)
Knowledge and Risk Perception				
High *vs*. low HIV knowledge	5.62 (3.90, 8.19)***	1.76 (1.07, 2.87)*	3.42 (2.40, 4.90)***	1.44 (0.88, 2.35)
Perceived HIV risk (yes *vs*. no)	0.66 (0.45, 0.97)*	1.10 (0.66, 1.83)	0.79 (0.55, 1.13)	1.36 (0.83, 2.22)
Risk behavior				
MSM behavior (yes *vs*. no)	1.34 (0.86, 2.08)	2.10 (1.19, 3.77)*	1.48 (0.98, 2.25)	1.78 (1.01, 3.20)*

Note: Model fit statistics: AIC range 487.20–837.27; Nagelkerke pseudo-R^2 range 0.033–0.246.
Abbreviation: aOR=adjusted odds ratio; CI=confidence interval; PrEP=pre-exposure prophylaxis; PEP=post-exposure prophylaxis; MSM=men who have sex with men.
* $P<0.05$; ** $P<0.01$; *** $P<0.001$.

barriers outweigh individual knowledge in determining service access. Systematic reviews have identified several primary barrier categories: high medication costs, confidentiality concerns coupled with fear of HIV status disclosure, multilevel stigma, limited geographic accessibility, and insufficient provider capabilities (*12–14*). Students who understand PrEP and PEP but fail to utilize them following unprotected sexual intercourse may lack an accurate perception of their own HIV risk, resulting in a diminished perceived need for these services. Consequently, education addressing personal risk awareness is as essential as instruction on service access procedures. The differential effect of knowledge on utilization — statistically significant for PrEP but not for PEP — likely reflects fundamental differences in decision-making processes between these interventions. PrEP requires proactive planning and sustained behavioral commitment, whereas PEP responds to discrete exposure events and may be driven primarily by immediate clinical guidance rather than pre-existing knowledge (*4–5*).

This study has several limitations that warrant consideration. The convenience sampling approach across five universities within a single province constrains the generalizability of findings to broader student populations. The cross-sectional design prevents establishment of causal relationships between identified factors and cascade outcomes. Additionally, unexpected findings — such as the inverse association between academic year and PrEP awareness — require validation through multi-site longitudinal investigations to determine whether these patterns reflect genuine temporal trends or sampling artifacts.

Analysis of HIV prevention cascades among high-risk university students reveals substantial implementation gaps that extend beyond individual knowledge deficits. Structural barriers — including financial costs, multilevel stigma, and geographic accessibility constraints documented in prior research — constitute the primary obstacles limiting service uptake. Effective cascade optimization requires integrated multi-level strategies that simultaneously address individual knowledge gaps through comprehensive education, interpersonal stigma through peer-led interventions, and systemic barriers through policy reforms ensuring both affordability and accessibility of prevention services.

Conflicts of interest: No conflicts of interest.

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Notifiable Infectious Diseases Reports

Reported Cases and Deaths of National Notifiable Infectious Diseases — China, September 2025*

Diseases	Cases	Deaths
Plague	0	0
Cholera	1	0
COVID-19	66,915	4
SARS-CoV	0	0
Acquired immune deficiency syndrome[†]	4,571	1,675
Hepatitis	125,571	324
Hepatitis A	1,228	0
Hepatitis B	105,931	41
Hepatitis C	14,991	282
Hepatitis D	27	0
Hepatitis E	2,798	0
Other hepatitis	596	1
Poliomyelitis	0	0
Human infection with noval influenza virus	2	0
Measles	55	0
Epidemic hemorrhagic fever	102	0
Rabies	26	29
Japanese encephalitis	66	3
Dengue	2,321	0
Monkey pox[§]	84	0
Anthrax	68	1
Dysentery	3,064	0
Tuberculosis	56,168	262
Typhoid fever and paratyphoid fever	619	0
Meningococcal meningitis	10	0
Pertussis	1,028	0
Diphtheria	0	0
Neonatal tetanus	0	0
Scarlet fever	1,925	0
Brucellosis	4,835	0
Gonorrhea	10,540	1
Syphilis	53,818	5
Leptospirosis	176	2
Schistosomiasis	4	0
Malaria	352	0
Influenza	157,988	0
Mumps	9,068	0

Continued

Diseases	Cases	Deaths
Rubella	45	0
Acute hemorrhagic conjunctivitis	2,082	0
Leprosy	17	0
Typhus	195	0
Kala azar	27	0
Echinococcosis	357	2
Filariasis	0	0
Hand, foot and mouth disease	159,828	0
Infectious diarrhea¶	124,055	0
Total	785,983	2,308

* According to the National Bureau of Disease Control and Prevention.

† The number of deaths of Acquired immune deficiency syndrome (AIDS) is the number of all-cause deaths reported in the month by cumulative reported AIDS patients.

§ Since September 20, 2023, Monkey pox was included in the management of Class B infectious diseases.

¶ Infectious diarrhea excludes cholera, dysentery, typhoid fever and paratyphoid fever.

The number of cases and cause-specific deaths refer to data recorded in National Notifiable Disease Reporting System in China, which includes both clinically-diagnosed cases and laboratory-confirmed cases. Only reported cases of the 31 provincial-level administrative divisions in the Chinese mainland are included in the table, whereas data of Hong Kong Special Administrative Region, Macau Special Administrative Region, and Taiwan, China are not included. Monthly statistics are calculated without annual verification, which were usually conducted in February of the next year for de-duplication and verification of reported cases in annual statistics. Therefore, 12-month cases could not be added together directly to calculate the cumulative cases because the individual information might be verified via National Notifiable Disease Reporting System according to information verification or field investigations by local CDCs.

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