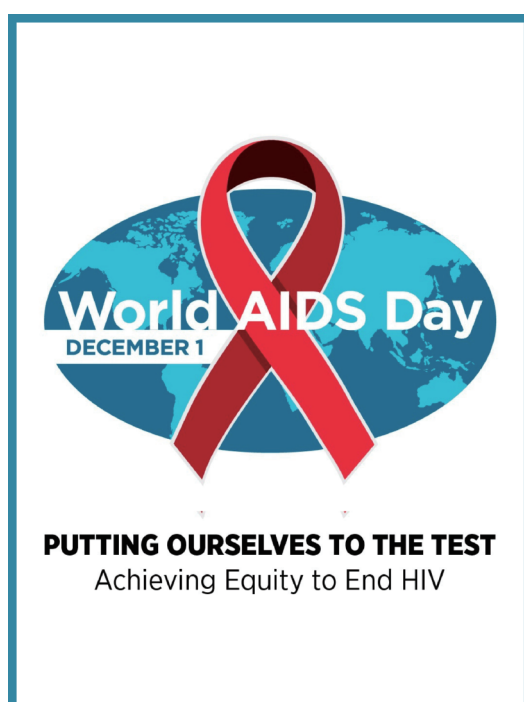


CHINA CDC WEEKLY



中国疾病预防控制中心周报



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ISSN 2096-7071



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Preplanned Studies

HIV-Related Knowledge, Attitude, and Practices Research Among College Students — Six Chinese Cities, 2021

Hui Liu^{1,2,*}; Qiyu Zhu^{1,*}; Lei Zhang³; Yujing Liu¹; Peng Xu¹; Maohe Yu⁴; Jixiang Fan⁵; Xiaohong Pan⁶; Xi Chen⁷; Huifang Xu⁸; Qinying He⁹; Mengjie Han^{1,#}

Summary

What is already known about this topic?

The number of newly diagnosed human immunodeficiency virus (HIV) cases among Chinese youth 15–24 years of age shows an upward trend between 2010 and 2019.

What is added by this report?

This survey is on a larger scale as compared to previous studies. It shows inadequate HIV knowledge — especially on HIV treatment, self-testing, and post-exposure prophylaxis — among college students. A significant gap exists between knowledge and behavior as indicated by the low condom use rate despite a high knowledge level.

What are the implications for public health practice?

Findings suggest priorities for future HIV education and awareness creation of existing services. A low condom use rate at sexual debut suggests that HIV prevention education should start early.

Globally, around 4,000 new human immunodeficiency virus (HIV) infections occur daily including among 1,100 youth aged 15–24 years (1). In China, newly diagnosed HIV cases among 15–24-year-olds — including young students — increased from 9,373 in 2010 to 15,790 in 2019 (2). To reduce new infections among students, a combination of prevention education and behavior as well as biomedical interventions were implemented. This implementation calls for a geographically larger-scale study to assess and identify gaps in students' HIV-related knowledge, attitudes, and practices (KAP). A survey of college students in 6 large cities was thus conducted in 2021, with a total of 54,052 respondents. In addition to finding knowledge gaps on HIV, especially on treatment, HIV self-testing (HIVST) and post-exposure prophylaxis (PEP), significant knowledge and behavior gaps in practicing safe sex were identified. These gaps, coupled with early sexual

initiation, suggest that comprehensive prevention education should start early.

The survey was conducted from September to December 2021 at 30 colleges and universities in 6 large cities (Tianjin Municipality, Changchun City, Hangzhou City, Changsha City, Guangzhou City, and Chengdu City) that rank high in newly identified student infections. Convenience sampling along with a minimum number of classes per grade and a minimum of 600 samples per school was used. A WeChat-based anonymous questionnaire was distributed and accessed by respondents via a quick response (QR) code scan. Each internet protocol (IP) address was set for one enrollment. This structured online questionnaire included both sociodemographic and KAP questions related to HIV. The KAP questions focus on basic HIV information, PEP, HIVST, and sexual experiences. Results were presented with descriptive statistics, including proportions and their 95% confidence intervals (CIs). R software (Version 4.1.3, R Foundation for Statistical Computing, Vienna, Austria) was used for data cleaning and analysis.

A total of 54,052 valid questionnaires were collected, of which 59.5% (32,178/54,052) were female and 55.9% (30,211/54,052) were freshmen. Regarding sexual orientation, 86.9% (46,985/54,052) reported being heterosexual, whereas 1.7% (930/54,052) and 5.7% (3,058/54,052) reported being homosexual or bisexual, respectively. In addition, 10.0% (5,384/54,052) of respondents reported having had sexual experience, and 0.05% (26/54,052) reported testing positive for HIV in the latest test (Table 1).

The survey consisted of 9 questions on basic HIV knowledge. Knowledge of condom use (Q7, Q8, Q9) was relatively high with an over 90% passing rate. Nearly everyone (94.2%; 50,896/54,052) knew that intentional HIV transmission was illegal (Q3). However, as many as 29.0% (15,694/54,052) of respondents did not know that HIV cannot be cured (Q1). Furthermore, 34.9% (18,865/54,052) were

TABLE 1. Sociodemographic characteristics of college students surveyed in 6 Chinese cities, 2021 (N=54,052).

Characteristic	n	Percentage (95% CI)
Sex		
Male	21,874	40.5 (40.1, 40.9)
Female	32,178	59.5 (59.1, 59.9)
Age (years)		
≤17	682	1.3 (1.2, 1.4)
18–	11,635	21.5 (21.2, 21.9)
19–	19,761	36.6 (36.2, 37.0)
20–	11,118	20.6 (20.2, 20.9)
≥21	10,856	20.1 (19.7, 20.4)
School level		
First-tier	29,252	54.1 (53.7, 54.5)
Second-tier	18,096	33.5 (33.1, 33.9)
Third-tier	2,111	3.9 (3.7, 4.1)
Vocational college	4,593	8.5 (8.3, 8.7)
City of residence		
Tianjin	7,603	14.1 (13.8, 14.4)
Changchun	8,762	16.2 (15.9, 16.5)
Hangzhou	11,715	21.7 (21.3, 22.0)
Changsha	15,136	28.0 (27.6, 28.4)
Guangzhou	7,209	13.3 (13.1, 13.6)
Chengdu	3,627	6.7 (6.5, 6.9)
Grade		
Freshman	30,211	55.9 (55.5, 56.3)
Sophomore	12,516	23.2 (22.8, 23.5)
Junior	7,502	13.9 (13.6, 14.2)
Senior	2,714	5.0 (4.8, 5.2)
Graduate and higher	1,109	2.1 (1.9, 2.2)
Sexual orientation		
Heterosexual	46,985	86.9 (86.6, 87.2)
Homosexual	930	1.7 (1.6, 1.8)
Bisexual	3,058	5.7 (5.5, 5.9)
Not sure	3,079	5.7 (5.5, 5.9)
Sexual experience		
Yes	5,384	10.0 (9.7, 10.2)
No	48,668	90.0 (89.8, 90.3)
Self-reported HIV testing result		
Positive	26	0.05 (0.03, 0.07)
Negative	854	1.6 (1.5, 1.7)
Unknown	226	0.4 (0.4, 0.5)
Not tested	52,946	98.0 (97.8, 98.1)

Abbreviation: CI=confidence interval; HIV=human immunodeficiency virus.

unaware that being infected with sexually transmitted diseases (STDs) increases the risk of HIV infection (Q5), and 33.2% (17,940/54,052) were unaware that male homosexual behavior is the main route of HIV transmission among young Chinese students (Q4). Only 64.7% of respondents reported having heard of PEP, but nearly all respondents (91.7%, 49,549/54,052) expressed willingness to take the drug after possible HIV exposure to prevent seroconversion. When asked the multiple-choice question on where to find PEP drugs, the answers were Centers for Disease Control and Prevention (82.3%, 28,773/34,958), hospitals (83.1%, 29,067/34,958), community-based organizations (20.5%, 7,176/34,958), and online purchases (13.6%, 4,746/34,958). Nearly all respondents knew that an HIV test should be taken after risky behaviors (97.5%, 52,697/54,052) to know their status, start treatment, and suppress HIV replication (97.8%, 52,859/54,052). Furthermore, 98.2% (53,082/54,052) indicated that HIV testing could give them peace of mind. However, 37.4% (20,204/54,052) of respondents worry about others' attitudes, and 19.7% (10,669/54,052) worry about a positive result. Still 57.9% (31,321/54,052) have not heard of HIV self-testing (HIVST) (Table 2).

Among those who reported sexual experience, 33.2% (1,790/5,384) first had sex at the age of 18, followed by 22.3% (1,203/5,384) at 17 or below, and 17.4% (937/5,384) at 20. Among the first sexual experiences, 2.2% (116/5,384) were forced sex, 9.1% (489/5,384) were sex between males, and 72.4% (3,896/5,384) were with correct condom use. Among them, 84.9% (4,573/5,384) had sex in the past 12 months, of which 94.2% (4,307/4,573) reported having a fixed partner. Of those with fixed partners, 71.4% (3,076/4,307) reported consistent condom use. However, 29.7% (1,359/4,573) reported casual sex, with 65.5% (890/1,359) reporting consistent condom use. In addition, 15.5% (708/4,573) reported sex with a commercial partner, during which 64.3% (455/708) reported consistent condom use. Furthermore, 2.4% (109/4,573) reported drug use before/during sex. Approximately 6.4% (292/4,573) reported male homosexual intercourse in the past 12 months, of whom 36.0% had a role of either exclusively receptive anal sex (36.0%, 105/292) or mixed receptive and insertive anal sex (34.2%, 100/292). Among them, 42.1% (123/292) reported having more than one homosexual partner in the past 12 months. Overall, only 47.6% (139/292) reported consistent condom use

during sex with another male (Table 3).

Among all respondents, 1,106 (2.0%, 1,106/54,052) reported ever having had an HIV test, with 67.5% (746/1,106) of them testing only once. Nearly half (48.0%, 531/1,106) had an HIV test in the past 6 months, and 32.6% (361/1,106) have had an HIVST. As for the major reasons for not using HIVST, 25.0% (186/745) did not know where to obtain HIVST kits and 18.3% (136/745) did not know how to conduct an HIVST.

DISCUSSION

The Implementation Plan for the Containment and Control of HIV/AIDS (2019–2022), jointly released by the National Health Commission and nine other ministries and commissions, defines the target HIV knowledge rate among college students at 95% (3). In this survey, some basic HIV knowledge questions scored as low as around 65% (Q4, Q5) and 71% (Q1). While the sample's high proportion of freshmen may negatively affect HIV knowledge results, HIV knowledge among college students as a whole falls short in both structure and comprehensiveness, as seen in the low-scored questions above. Over 90% of respondents are open to taking PEP to prevent HIV infection after unprotected sex, however, the 64.7% awareness rate and the lack of knowledge of where to find it impede access to PEP. HIVST, given its convenience and confidentiality (4), has been proven as a preferred testing method by college students (5). Additionally, HIVST kits can often be obtained from campus vending machines or online shops (6–7). However, over half of the respondents have not heard of HIVST, suggesting the need for its more prominent role in college prevention education and health services.

About 10% of respondents reported having had sexual experiences. The mean age for sexual debut was 18.39 years, which is consistent with the results of previous research (8). Among them, 22.3% reported first having sex at 17 or below and 33.2% reported having sex at the age of 18, mostly around a time before entering college or during the freshman year. Early sexual debut is associated with unintended pregnancy, more sexual partners, and unprotected sex (9). Future prevention education should therefore highlight preparedness before sexual debut. The correct condom use rate was low at first sex, and consistent condom use rates were low for sex in the past 12

TABLE 2. HIV/AIDS-related knowledge, attitudes of college students surveyed in 6 Chinese cities, 2021 (N=54,052).

Characteristic	n	Percentage (95% CI)
Basic HIV knowledge		
Q1. AIDS cannot be cured		
Yes	38,358	71.0 (70.6, 71.3)
No	15,694	29.0 (28.7, 29.4)
Q2. A healthy-looking person can have HIV		
Yes	47,046	87.0 (86.8, 87.3)
No	7,006	13.0 (12.7, 13.2)
Q3. It is illegal to transmit HIV intentionally		
Yes	50,896	94.2 (94.0, 94.4)
No	3,156	5.8 (5.6, 6.0)
Q4. HIV among young Chinese students is mainly through male homosexual behavior		
Yes	36,112	66.8 (66.4, 67.2)
No	17,940	33.2 (32.8, 33.6)
Q5. Infection with STDs could increase the risk of HIV infection		
Yes	35,187	65.1 (64.7, 65.5)
No	18,865	34.9 (34.5, 35.3)
Q6. Substance abuse could increase the risk of HIV infection		
Yes	46,003	85.1 (84.8, 85.4)
No	8,049	14.9 (14.6, 15.2)
Q7. Proper use of condoms during sex reduces the risk of HIV transmission		
Yes	51,128	94.6 (94.4, 94.8)
No	2,924	5.4 (5.2, 5.6)
Q8. It is necessary to use condoms even when having sex with acquaintances		
Yes	50,191	92.9 (92.6, 93.1)
No	3,861	7.1 (6.9, 7.4)
Q9. Condoms should be used even if the genital looks normal		
Yes	50,110	92.7 (92.5, 92.9)
No	3,942	7.3 (7.1, 7.5)
Knowledge and attitudes toward PEP		
Heard of PEP		
Yes	34,958	64.7 (64.3, 65.1)
No	19,094	35.3 (34.9, 35.7)
Knowledge on where to get PEP drugs (n=34,958)		
Centers for Disease Control and Prevention		
Yes	28,773	82.3 (81.9, 82.7)
No	6,185	17.7 (17.3, 18.1)
Hospitals		
Yes	29,067	83.1 (82.8, 83.5)
No	5,891	16.9 (16.5, 17.2)
Community-based organizations		
Yes	7,176	20.5 (20.1, 21.0)
No	27,782	79.5 (79.0, 79.9)

TABLE 2. (Continued)

Characteristic	n	Percentage (95% CI)
Purchase online		
Yes	4,746	13.6 (13.2, 13.9)
No	30,212	86.4 (86.1, 86.8)
Willing to use PEP after risky behavior		
Yes	49,549	91.7 (91.4, 91.9)
No	800	1.5 (1.4, 1.6)
Not sure	3,703	6.9 (6.6, 7.1)
Knowledge and attitudes toward HIV testing and counseling		
I should seek HIV testing and counseling after risky behavior		
Yes	52,697	97.5 (97.4, 97.6)
No	1,355	2.5 (2.4, 2.6)
Testing helps me know my status, start early treatment, and suppress HIV replication		
Yes	52,859	97.8 (97.7, 97.9)
No	1,193	2.2 (2.1, 2.3)
HIV testing gives me peace of mind		
Yes	53,082	98.2 (98.1, 98.3)
No	970	1.8 (1.69, 1.91)
Worry about others' attitude after HIV testing		
Yes	20,204	37.4 (37.0, 37.8)
No	33,848	62.6 (62.2, 63.0)
Worry about positive HIV testing results		
Yes	10,669	19.7 (19.4, 20.1)
No	43,383	80.3 (79.9, 80.6)
Heard of HIV self-testing		
Yes	22,731	42.1 (41.6, 42.5)
No	31,321	57.9 (57.5, 58.4)

Abbreviation: AIDS=acquired immunodeficiency syndrome; CI=confidence interval; HIV=human immunodeficiency virus; PEP=post-exposure prophylaxis; STDs=sexually transmitted diseases.

TABLE 3. Sex experience and HIV testing among college students in 6 Chinese cities, 2021 (N=5,384).

Characteristic	n	Percentage (95% CI)
First sex (n=5,384)		
Age at sexual debut (years)		
≤17	1,203	22.3 (21.2, 23.5)
18–	1,790	33.2 (32.0, 34.5)
19–	897	16.7 (15.7, 17.7)
20–	937	17.4 (16.4, 18.4)
≥21	557	10.3 (9.6, 11.2)
Forced sex at sexual debut		
Yes	116	2.2 (1.8, 2.6)
No	5,268	97.8 (97.4, 98.2)
Partner type at sexual debut		
Heterosexual	4,895	90.9 (90.1, 91.7)
Homosexual	489	9.1 (8.33, 9.9)

TABLE 3. (Continued)

Characteristic	n	Percentage (95% CI)
Condom use at sexual debut		
None	1,142	21.2 (20.1, 22.3)
Incorrect use	346	6.4 (5.79, 7.12)
Correct use	3,896	72.4 (71.1, 73.5)
Sex behavior (past 12 months; n=4,573)		
Sex with fixed partner (past 12 months)		
Yes	4,307	94.2 (93.5, 94.8)
No	266	5.8 (5.2, 6.5)
Condom use with fixed sex partner (past 12 months; n=4,307)		
None	288	6.7 (6.0, 7.5)
Not consistent use	943	21.9 (20.7, 23.2)
Consistent use	3,076	71.4 (70.0, 72.8)
Casual sex (past 12 months)		
Yes	1,359	29.7 (28.4, 31.1)
No	3,214	70.3 (68.9, 71.6)
Condom use with casual sex partner (past 12 months; n=1,359)		
None	204	15.0 (13.2, 17.0)
Not consistent use	265	19.5 (17.4, 21.7)
Consistent use	890	65.5 (62.9, 68.0)
Commercial sex (past 12 months)		
Yes	708	15.5 (14.5, 16.6)
No	3,865	84.5 (83.4, 85.5)
Condom use with commercial sex partner (past 12 months; n=708)		
None	152	21.5 (18.5, 24.7)
Not consistent use	101	14.3 (11.8, 17.1)
Consistent use	455	64.3 (60.6, 67.8)
Male homosexual behavior (past 12 months)		
Yes	292	6.4 (5.1, 7.1)
No	4,281	93.6 (92.9, 94.3)
Sex role (past 12 months; n=292)		
Receptive	105	36.0 (30.5, 41.8)
Insertive	87	29.8 (24.7, 35.5)
Receptive and insertive	100	34.2 (28.9, 40.0)
Homosexual sex partner number(past 12 months; n=292)		
1	169	57.9 (52.0, 63.6)
2–9	100	34.2 (28.9, 40.0)
10–	23	7.9 (5.2, 11.7)
Condom use with homosexual partner (past 12 months; n=292)		
None	89	30.5 (25.3, 36.2)
Not consistent use	64	21.9 (17.4, 27.2)
Consistent use	139	47.6 (41.8, 53.5)
Any drug use before/during sex (past 12 months)		
Yes	109	2.4 (1.97, 2.9)
No	4,464	97.6 (97.1, 98.0)

TABLE 3. (Continued)

Characteristic	n	Percentage (95% CI)
HIV testing and counseling practices (n=1,106)		
Number of HIV tests taken		
1	746	67.5 (64.6, 70.2)
2–	344	31.1 (28.4, 33.9)
10–	5	0.5 (0.2, 1.1)
20–	11	1.0 (0.5, 1.8)
The last HIV test was in the past		
6 months	531	48.0 (45.0, 51.0)
7–12 months	148	13.4 (11.5, 15.6)
1–2 years	177	16.0 (13.9, 18.3)
≥2 years	250	22.6 (20.2, 25.2)
Ever had HIV self-testing		
Yes	361	32.6 (29.9, 35.5)
No	745	67.4 (64.5, 70.1)
Reason for not doing HIV self-testing (n=745)		
Unaware of where to obtain HIV self-testing kits		
Yes	186	25.0 (21.9, 28.3)
No	213	28.6 (25.4, 32.0)
No answer	346	46.4 (42.8, 50.1)
Unsure about how to conduct HIV self-testing		
Yes	136	18.3 (15.6, 21.3)
No	263	35.3 (31.9, 38.9)
No answer	346	46.4 (42.8, 50.1)
Distrustful of the result of HIV self-testing		
Yes	55	7.4 (5.7, 9.6)
No	344	46.2 (42.6, 49.8)
No answer	346	46.4 (42.8, 50.1)
Unsure about what to do after HIV self-testing		
Yes	75	10.1 (8.1, 12.5)
No	324	43.5 (39.9, 47.1)
No answer	346	46.4 (42.8, 50.1)

Abbreviation: CI=confidence interval; HIV=human immunodeficiency virus.

months. In addition, 292 male respondents reported having sex with another male in the past 12 months, with a low rate of consistent condom use (47.6%). The risks of unprotected sex should thus be discussed in greater depth in prevention education, coupled with condom availability, including for men who have sex with men (MSM). In the present survey, 2.0% of respondents reported having had an HIV test. As voluntary HIV testing becomes a process of education and intervention, promoting HIV testing can add great value, especially for students with sexual experiences.

The HIV knowledge rate was compared with a previous study conducted in Henan Province (10). The

questions with low awareness rates were similar (Q1, Q4). Therefore, this survey can represent both the knowledge gaps of college students and where the gaps are.

This study has several limitations. First, the self-reported data may lead to underreporting of “not-encouraged behaviors” (i.e., unprotected sex). Second, considering the cross-sectional study design, recall bias may exist on past events. Third, as students from lower grades were over represented, further analysis is needed to factor in grade levels.

Overall, this survey provided empirical guidance on HIV education among students. First, as over half of

respondents with sexual experience reported their first sex at or before age 18 and condom use rate was low, prevention education should begin no later than middle school. Second, the curriculum should be specific about risky sexual behaviors, including unprotected sex between males. Third, college HIV prevention must integrate education with access to services, including those on HIVST and PEP.

Acknowledgments: Dr. Hao Yang, Ms. Wang Xinlun, and Mr. Jacob Wood.

Conflicts of interest: No conflicts of interest.

Funding: Provided by the Durex Public Welfare Foundation on college students' AIDS education.

doi: 10.46234/ccdcw2022.210

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Submitted: October 08, 2022; Accepted: November 21, 2022

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Preplanned Studies

Chinese American Caregivers' Attitudes Toward Tube Feeding for Persons with Dementia — USA, 2021–2022

Yaolin Pei¹; Xiang Qi¹; Zhen Cong²; Bei Wu^{1,†}

Summary

What is already known about this topic?

Little is known about Chinese American dementia caregivers' attitudes toward tube feeding.

What is added by this report?

To address this knowledge gap, the paper seeks to characterize participants' attitudes toward tube feeding based on a survey conducted among Chinese American dementia caregivers.

What are the implications for public health practice?

It is crucial to develop culturally tailored interventions to promote knowledge on tube feeding and advance care planning engagement in Chinese American communities.

Research has demonstrated a lack of evidence on the benefits and potential risks of tube feeding in individuals with advanced dementia (1). Consequently, national organizations increasingly advocate against the use of tube feeding in persons with advanced dementia (2). Few studies have examined Chinese American dementia caregivers' attitudes toward tube feeding. Based on the data collected from Chinese American dementia caregivers in New York City (NYC), it was found that knowledge about tube feeding and the expressed wishes of patients regarding tube feeding were associated with a higher likelihood of the 'hand feeding' selection among Chinese American dementia caregivers. The results suggest that it is crucial to develop culturally tailored interventions to promote knowledge on tube feeding and advance care planning engagement in Chinese American communities.

Data in the study were collected from 63 Chinese dementia caregivers living in NYC from November 2021 to June 2022. Using a purposive sampling approach, two bilingual social workers at CaringKind, a collaborating agency, referred 114 Chinese caregivers who had used their service. The research team at New York University (NYU) recruited 87 caregivers who were interested in the study. The caregivers'

sociodemographic characteristics and attitudes toward tube feeding were collected via an online survey or a telephone interview. For this study, participants whose care recipients had died (n=22) and two participants whose care recipients were using feeding tubes were excluded. The final sample included 63 Chinese dementia family caregivers whose care recipients were not using feeding tubes at the time of data collection. The study was approved by the NYU institutional review board. Table 1 presents the characteristics of participants.

In the study, participants' decision-making regarding tube feeding in the hypothesized scenario was measured by asking, "Imagine your care recipient is in a state where he/she has severe dementia. He/she has poor long-term and short-term memory and is unable to recognize his/her close relatives (e.g., spouse, children). He/she is also unable to communicate, is incoherent, confused and/or disorientated, and requires help in all activities of daily living, including feeding. On top of that, he/she has problems with feeding and swallowing and, as a result, has had several episodes of pneumonia (i.e., lung infection), requiring admission to a hospital. Would you choose tube feeding or hand feeding for your relative?" (0=tube feeding, 1=hand feeding, 2=unsure). Knowledge about tube feeding in individuals with advanced dementia was measured by a 3-item scale that was selected from an existing scale (3). The three items were "tube feeding is recommended for use when oral feeding difficulties arise," "patient survival improves when feeding tubes are used," and "tube feeding improves nutritional status." The three items were summed, resulting in a knowledge score ranging from 0 to 3 with higher scores indicating more knowledge. Cronbach's alpha for this scale was 0.66. The items for the importance of food at the end of life were selected from a previous study conducted in Singapore (4). Data were analyzed with STATA (Stata 15.1, Stata Corp, College Station, TX, USA). Descriptive statistics, correlation, and logistic regression were used to assess the attitudes toward tube feeding among Chinese American dementia caregivers.

Table 2 shows the frequency with which family caregivers decide to use tube feeding or hand feeding in the scenario of a patient with advanced dementia at the end of life. About 34.92% of participants chose tube feeding, 23.81% chose hand feeding, and 41.27% were unsure. Concerning the goal of care, 93.65% of participants preferred to relieve pain and discomfort as much as possible. Knowledge and discussion about tube feeding is shown in Table 2. The knowledge score was averaged at about 0.41 out of 3. About 15.87% of participants discussed tube feeding with providers.

The perception of the main purposes for tube feeding in individuals with advanced dementia is shown in Table 3. Prolonging life, not feeling hungry/thirsty, and preventing aspiration were identified as the most common purposes of tube feeding. The percentages for these common purposes were 80.95%, 65.08%, and 55.56%, respectively.

Supplementary Table S1 (available in <https://weekly.chinacdc.cn/>) presents the decision-making style of these caregivers and the perceived importance of different parties in decision-making on tube feeding. Within the family, 55.56% of caregivers thought that

caregivers or other family members were equally important in making decisions on tube feeding for the patients. About 53.97% of caregivers thought that the provider or the family should be equal with regard to making decisions on tube feeding for the patients. Doctors' opinions (39.68%) and patients' wishes (38.10%) were the two most important parties in decision-making on tube feeding.

Supplementary Table S2 (available in <https://weekly.chinacdc.cn/>) shows caregivers' perceptions concerning patients' wishes. About 69.84% of the caregivers stated that patients did not express in writing or in a previous discussion his/her wishes regarding tube feeding. About 46.03% stated they were confident that the patient would not have wanted a feeding tube if he/she could make his/her own medical decision, and 44.44% were unsure about this.

Supplementary Table S3 (available in <https://weekly.chinacdc.cn/>) shows caregivers' views toward food. About 82.54% of caregivers stated that "the provision of food at the end of life is a family obligation", followed by "Providing food at the end of life shows that the family has not given up" (77.78%), "Providing

TABLE 1. The sample characteristics of participants.

Variable	N	Percentage (%) or mean (M)
Age	58	65.86
Female	63	88.89%
High school or higher	63	76.19%
The relationship to the relative with dementia	63	
Spouse		39.68%
Child		38.10%
Other		22.22%
Foreign-born	63	96.83%
The years in the USA for the foreign-born	59	30.58

TABLE 2. Feeding options decision-making, the goal of care, and knowledge and discussion about tube feeding in the hypothesized scenario (N=63).

Variable	Percentage (%) or mean (M)
Hypothesized feeding options decision-making	
Tube feeding	34.92%
Hand feeding	23.81%
Unsure	41.27%
Goal of care	
Prefer to relieve pain and discomfort as much as possible	93.65%
Prefer to extend life as much as possible	6.35%
Tube feeding Knowledge (range: 0–3)	0.41
Providers have discussed tube feeding with caregivers	15.87%

TABLE 3. Purpose of tube feeding (N=63).

Main reason	Percentage (%)
Prolong Life	80.95
Moral obligation	38.10
Prevent aspiration	55.56
Not to feel hungry/thirsty	65.08
Be more comfortable	14.29
Health to be better	25.40
None	6.35

food at the end of life will help strengthen family bonds” (47.62%) and “Filial piety plays a role in determining if food should be administered at the end of life” (47.62%). It is noted that 49.21% stated that they disagreed with the statement, “Finances play a role in determining if food should be administered at the end of life.”

Correlation results showed that knowledge of tube feeding in individuals with advanced dementia ($r=0.33$, $P<0.01$) and knowing the expressed wishes of patients about their wishes regarding tube feeding ($r=0.25$, $P<0.05$) were related to the selection of hand feeding. The association of these two variables with the selection of hand feeding (1=hand feeding, 0=others) was examined in a logistic regression model controlling for age, gender, and education of participants (Supplementary Table S4, available in <https://weekly.chinacdc.cn/>). The results of logistic regression indicated that knowledge was significantly associated with the selection of hand feeding (OR 5.65, $P<0.01$), and knowing patients' wishes was marginally associated with the selection of hand feeding (OR 4.59, $P<0.1$).

DISCUSSION

This study provides new knowledge on Chinese American family caregivers' attitudes toward tube feeding for their relatives with dementia. The findings from the study showed that a considerable proportion of caregivers would choose tube feeding in the hypothesized scenario. Knowledge about tube feeding and knowing patients' expressed wishes regarding tube feeding were associated with a higher likelihood of preference towards hand feeding among Chinese American dementia caregivers.

It is important to note the finding that 34.92% of caregivers would choose tube feeding, and 41.27% were unsure about which one to choose in the hypothesized scenario. Previous studies conducted in Hong Kong SAR and Taiwan, China suggested that

more than 50% of Chinese with advanced dementia in nursing homes were tube-fed (5–6). The finding that knowledge was associated with the preference for hand feeding highlights the importance of improving decision-making with regard to feeding options among dementia caregivers (7). Knowing patients' expressed wishes regarding tube feeding was associated with a higher likelihood of preference toward hand feeding, which is consistent with previous studies that having an advance directive or an informal discussion is associated with a decrease in life-sustaining treatment (8–9). However, Chinese American caregivers had poor knowledge, and few caregivers knew patients' expressed wishes regarding tube feeding. The study also suggests that the cultural values of Chinese American dementia caregivers, such as family decision-making and filial piety, may play an important role in decision-making about tube feeding (10).

The study is subject to some limitations. The participants in the study were recruited from a community agency, and the sample size was small. The generalizability of the study's findings is not warranted. Also, given the cross-sectional design, the study was not able to establish causal relationships and capture the change of attitudes toward tube feeding in Chinese American dementia caregivers.

In conclusion, the findings suggest that knowledge of tube feeding and knowing patients' expressed wishes regarding tube feeding were associated with a higher likelihood of selecting hand feeding. The findings implies that it is important to develop culturally-tailored interventions to promote knowledge on tube feeding and advance care planning engagement in Chinese American communities.

Funding: Supported by Rory Meyers College of Nursing (New York University), School of Social work (University of Texas at Arlington), and the National Institutes of Health (Grant P50MD017356, and P30AG059304).

doi: 10.46234/ccdcw2022.211

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Submitted: September 16, 2022; Accepted: November 14, 2022

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SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE S1. Decision-making style and the perceived importance of different parties in decision-making on tube feeding (N=63).

Variable	Percentage (%)
With the family, who should make decisions on tube feeding	
Caregiver alone	9.52
Mostly caregiver	22.22
Mostly other family members	12.70
Caregiver or other family members equally	55.56
Who do you think should make decisions in tube feeding	
The provider alone or mostly the provider	14.29
The provider or the family equally	53.97
The family alone or mostly the family	31.74
Which party is the most important one in decision-making in tube feeding?	
Patients' wish	38.10
Doctors' opinion	39.68
Family/friend's opinion	6.35
The caregiver's judgment	15.87

SUPPLEMENTARY TABLE S2. Caregivers' perception concerning patients' wishes (N=63).

Variable	Percentage (%)
Has the patient ever expressed in writing or in a previous discussion his/her wishes regarding tube feeding?	
No	69.84
Yes	22.22
Unsure	7.94
Are you confident that the patient would have wanted a feeding tube if he/she is able to make his/her own medical decision?	
No	46.03
Yes	9.52
Unsure	44.44

SUPPLEMENTARY TABLE S3. The importance of food at the end of life (N=63).

Statement	Disagree (%)	Neither agree nor disagree (%)	Agree (%)
The provision of food at the end of life is a means of showing affection	22.58	22.58	54.84
The provision of food at the end of life is a family obligation	9.52	7.94	82.54
Providing food at the end of life will help strengthen family bonds	25.40	26.98	47.62
Providing food at the end of life will help reduce family conflict.	26.98	39.68	33.33
Providing food at the end of life shows that the family has not given up.	11.11	11.11	77.78
Filial piety plays a role in determining if food should be administered at the end of life.	30.16	20.22	47.62
Finances play a role in determining if food should be administered at the end of life.	49.21	17.46	33.33

SUPPLEMENTARY TABLE S4. The logistic regression model predicting the selection of hand feeding (N=58).

Variables	OR (SE)
Knowledge of tube feeding	5.65 (3.11)**
Knowing the expressed wishes of patients	4.59 (3.86)*
Age	1.00 (0.03)
Female	0.81 (0.93)
High school or higher	0.40 (0.33)
Pseudo R ²	0.23

* $P < 0.1$;** $P < 0.01$.

Outbreak Reports

Emergence of Autochthonous Melioidosis in Two Inland PLADs — China, 2021

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Guiyi Huang⁴; Jinrong He^{5,6}; Wei Li^{5,6}; Xiao Zheng^{5,6,#}

Summary

What is already known about this topic?

Melioidosis, a tropical infectious disease caused by *Burkholderia pseudomallei* (BP) infection, is endemic in the southern coastal provincial-level administrative divisions (PLADs) of China.

What is added by this report?

Three melioidosis cases, including two in young children and one in a 19-year-old female, were reported in Anhui and Jiangxi (two inland PLADs of China) respectively, in 2021. None of the patients had a travel history to a melioidosis-endemic area. All the BP isolates belonged to the same sequence type (ST51), which has been reported from elsewhere in Southeast Asia.

What are the implications for public health practice?

This is the first report of autochthonous melioidosis cases in inland Chinese PLADs. Surveillance and prevention and control work should be strengthened in this region.

On July 23, 2021, the Anhui CDC reported two cases of melioidosis in children (Patients A and B) from Huainan City, Anhui Province (Figure 1). The primary investigation indicated that the two patients were brothers and had no travel history. In late September, another indigenous case of melioidosis (Patient C) was confirmed in Fuzhou City of Jiangxi Province. Given that melioidosis was not known to be endemic in inland areas of China, such as Anhui and Jiangxi (1), the Institute of Communicable Disease Control and Prevention of China CDC (ICDC), Anhui CDC, and Jiangxi CDC initiated a joint investigation to identify the potential source of infection and any relationships between the patients.

INVESTIGATION AND RESULTS

Patient A, the first patient, was an 11-year-old boy

living with his grandparents in Huainan. On July 15, he experienced a sudden onset of fever. The next day, he received empirical therapy at a community hospital, but later, his illness worsened as he developed a high fever (41 °C) and chills. In the evening, the boy was sent to a local municipal hospital where computerized tomography revealed a pneumonic infection, and he was given intravenous antibiotics for treatment. On July 17, the boy fell into a coma, and he was transferred to a tertiary hospital in Hefei City, Anhui Province and admitted to the intensive care unit (ICU). On July 18, the boy's condition deteriorated, and he died of septic shock and multiple organ failure in the afternoon. On July 19, one bacterial strain was isolated on blood culture, and a rapid identification using the matrix-assisted laser desorption ionization-time of flight mass spectrometry technology (Bruker Biotyper MS system) revealed the pathogen to be *Burkholderia pseudomallei* (BP). The isolate was then subjected to biochemical assay (Vitek 2 system) and 16S rRNA sequencing and confirmed as BP by Anhui CDC.

Patient B (4-year-old) was Patient A's younger brother, and the two boys usually spent time together. On July 16 (the day after Patient A fell ill), Patient B became febrile (40 °C) and was sent to a tertiary hospital in Hefei and admitted to the ICU. As there was no clinical improvement after anticipated treatment, he was further transferred to a comprehensive teaching hospital in Shanghai Municipality 4 days later. His condition gradually improved, and he was discharged from the hospital on September 25. No isolate was cultured from Patient B, but DNA fragments of BP were identified in his blood sample by next-generation sequencing (NGS).

Patient C was a 19-year-old female college student from Fuzhou City in Jiangxi Province. She spent her entire summer vacation, from July 10 to September 7, in Shangrao City, Jiangxi Province, where she frequently paddled in a pond to pick lotus seedpods in her spare time. After returning home from Shangrao,



FIGURE 1. Geographic distribution of the three melioidosis cases in Anhui and Jiangxi Provinces, China, 2021.

Note: *Burkholderia pseudomallei*-endemic PLADs /regions (Hainan Province, Guangdong Province, Guangxi Zhuang Autonomous Region, Fujian Province, Hong Kong SAR, and Taiwan, China) in China are indicated with green shading. Abbreviation: PLAD=provincial-level administrative division; SAR=Special Administrative Region.

the patient developed a fever and chills and sought treatment at a municipal hospital in Fuzhou. Subsequently, a BP strain was isolated from her blood sample in the hospital laboratory, and the Jiangxi CDC confirmed the microbiological diagnosis on September 22.

To identify the etiology and epidemiological factors of the infections in Patients A and B, the ICDC and local CDC in Anhui Province conducted a field investigation. Through case searching, no further cases with signs and symptoms similar to those in Patients A and B were found in the community in which they lived. No family members (including grandparents and three cousins) or close contacts had a similar illness.

The epidemiological investigation indicated that the boys had no travel history and no history of contact with pets or animals, and all outdoor activities were performed within their residential community.

Considering the rarity of person-to-person spread of melioidosis (2), the coincidence of onset times and the similarity in their clinical manifestations, Patients A and B were suspected to have been exposed and infected at the same time. Thus, the subsequent investigation focused on the potential exposure source in the community in which they lived. According to local residents, the community is located in a lowland of suburban Huainan, and the yards are prone to flooding after rainfall. The grandparents of Patients A and B mentioned that the two boys lived with them because their parents worked and resided in another city. In addition, the boys' parents' home was in the same community (approximately 300 meters away from the grandparents' home), and sometimes they returned home to fetch items. The grandfather recalled that before the children's illnesses, there had been heavy rainfall lasting several days, leading to flooding

in their community, and during this time, the two boys had walked back and forth to their home several times. The physical examination records of the hospital indicated that both children had skin lesions on their feet and legs due to scratching after mosquito bites. Combining these circumstances, especially the high risk of exposure caused by rainfall and skin wounds (2), we inferred that Patients A and B were possibly infected through skin contact with contaminated water or soil while out in the floodwaters. In September, investigators collected environmental samples (30 soil samples and 10 water samples) around their apartment building and screened the samples for BP. However, no BP was detected by culture or polymerase chain reaction (PCR) assay (3). This result was not surprising because the environmental distribution of BP is often unstable and the isolation process is complicated and might be influenced by multiple factors. For Patient C, exposure to pond water during her vacation in Shangrao City was a potential risk factor as she had abrasions on her foot from scratching mosquito bites at that time.

Two clinical isolates obtained from Patients A and C were further confirmed (API 20 NE, real-time PCR, and specific antigen detection) and genetically analyzed by the ICDC. Multilocus sequence typing (MLST) (4) was used to identify the genomic relationship between them. Surprisingly, despite the remote distance (over 600 kilometers) between these two patients, the isolates had identical sequences, meaning they were the same type (ST51, allelic profile: 3,1,2,3,1,4,3). This indicated that these two isolates might share a common origin, and a more comprehensive investigation is needed to identify their source. Further online query of the global BP MLST database (<http://bpseudomallei.mlst.net/>) showed that the ST51 had previously been detected in Malaysia (70), Singapore (43), Thailand (13), and Hainan Island, China (2).

In response to the emergency events caused by melioidosis, local CDCs and health departments in Huainan and Fuzhou conducted epidemiological investigations, undertook environmental disinfection, and educated the local residents on how to prevent this disease. No new cases were reported.

DISCUSSION

Melioidosis is a potentially fatal disease caused by BP, a bacterium that inhabits soil and water in tropical areas and infects humans through inoculation, inhalation, or ingestion (2). Given the influence of

multiple inherent factors such as its soil-dwell niche, sensitivity to ultraviolet light and poor ability to be transmitted from person-to-person, BP is typically confined to a restricted geographic range (2–3,5). In particular, environmental strains and indigenous cases have been historically identified from only coastal endemic PLADs/regions in China, including Hainan Province, Guangdong Province, Guangxi Zhuang Autonomous Region, Fujian Province, Hong Kong Special Administrative Region, and Taiwan, China (1) (Figure 1). Outside these locations, all confirmed cases have been imported.

However, several studies have demonstrated that, even though rare, BP can spread over a long distance (6–7), as evidenced by its distribution across the global tropics. The transmission mode might be via soil, river water, animals or human activity or through air during an extreme weather event (6–8). In the two events of this report, although BP was not discovered from the environment, the epidemiological data suggested that all the infections were associated with environmental exposure and were probably autochthonous, implying that BP might have disseminated to and become endemic in Anhui and Jiangxi provinces. Indeed, with the rapid expansion of traffic and trade services in recent years, mass transportation of animals and plants may increase the risk of BP dispersion from endemic regions to other locations (2). Therefore, on the basis of the epidemiological investigation, the geographic closeness of Anhui and Jiangxi to endemic coastal PLADs in China and the sequence type matches between the clinical isolates and those from Hainan and Southeast Asia, we suggest that BP introduction from an original endemic area to the inland PLADs is a plausible explanation for its presence, although the exact origin remains to be determined.

The temporal and spatial closeness of such two events, and the identical ST between their isolates, might imply a more recent transmission of BP to Anhui and Jiangxi Provinces. However, we also could not exclude the possibility that the bacterium has been present there for a long time but unrecognized. There appears to be mounting evidence that BP can persist in temperate and more arid environments for tens of years, but melioidosis cases merely arise following extreme weather events in these regions.

In conclusion, the results of this investigation together with the large number of melioidosis cases in endemic PLADs, such as Hainan Province (1), hint at the possibility that the epidemiology of melioidosis might be changing and that the public health strategy

targeting melioidosis needs to be updated in the mainland of China. Therefore, we recommend that melioidosis be included on the national reportable disease list, health education be implemented to improve awareness of this disease, and sentinel and environmental surveillance work targeting this disease be performed. In the clinic, melioidosis should be considered as a differential diagnosis for febrile patients in southern China, and the diagnostic and treatment capability for the disease should be enhanced in medical centers.

Acknowledgments: The physicians and colleagues of the Anhui CDC, Huainan CDC, and Jiangxi CDC for participating in the investigation and melioidosis public health response. Lijie Zhang for help with editing the English.

Conflicts of interest: No conflicts of interest.

Funding: Supported by the National Science and Technology Major Project (2018ZX10714-002) and the National Natural Science Foundation of China (81573208).

doi: 10.46234/ccdcw2022.212

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Submitted: August 16, 2022; Accepted: November 21, 2022

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Methods and Applications

Assessment of POC CD4 Detecting Mode in District or County Labs — Jiangsu Province, China, 2021

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ABSTRACT

Objective: This study seeks to explore efficient and multiple-item detection modes in new-style HIV labs, as well as access the accuracy and reliability of CD4 cell count detected by point of care (POC) to analyze POC work feasibility in district or county labs.

Methods: POC devices adopted in grassroots-level labs and flow cytometers adopted in prefecture-level labs were used to analyze the same group of blood samples. The individual results were collected and compared for parametric tests in correlation and consistency.

Results: The Pearson correlation coefficients (r) between results detected by FACSPresto and that by FACSCalibur, FACSVia, FACSCantoII, and EPICSXL were 0.922, 0.938, 0.914, and 0.823, respectively; the average deviations were -25.64, 24.68, 3.05, and 70.97 cells/ μ L, respectively; the Pearson correlation coefficient (r) between results by Pima and FACSCalibur, FACSVia, FACSCantoII, and EPICSXL were 0.900, 0.950, 0.954, and 0.876, respectively; and the average deviations were -73.99, -40.78, -29.32, and -22.75 cells/ μ L, respectively.

Discussion: Strong positive correlations and good consistency were observed between the CD4 count tested by POC and flow cytometers. These findings provide theoretical support for new-style HIV labs and one-stop services, which can provide shorter testing duration and simpler testing processes, so that the most comprehensive testing results can be obtained in the shortest amount of time.

Accurate and reliable CD4 counts are the most specific indicator for monitoring the damage to the immune system of persons living with human immunodeficiency virus (PLWH); tracking them is thus crucial for human immunodeficiency virus (HIV) control and prevention. It is also a key indicator for

identifying the stage of HIV infection, estimating complications, and evaluating the efficacy of antiviral therapy (1). According to the clinical practice guidelines, absolute CD4 count should be tested one to four times per year for PLWH based on patient context (2). However, the time and frequency of detection are limited as flow cytometry techniques, which require more time, are the primary means of follow-up detection for PLWH in most areas of China (3–5). In comparison, some recent studies have shown point of care (POC) technology to positively affect timely treatment and assessment of therapeutic efficacy for HIV (6–7).

In the past 5 years, the proportion of late diagnosis was about 20%–25% among newly infected HIV patients (baseline CD4 <200/ μ L), while the average time from discovery to treatment of PLWH in Jiangsu was about 1 month (data not published). Early treatment plays an important role in immune reconstruction and therapeutic efficacy for PLWH (1,8). Therefore, exploring a new and efficient, multiple-item way for early detection using the POC technology will ideally provide PLWH with timely antiviral treatment, better treatment efficacy, and improve the diagnostic capacity of district or county labs. However, the evaluation of consistency and correlation of results for the same sample with different instruments in different laboratories has been rarely reported, making it difficult to justify the deployment of this new detection process.

This research thus evaluated correlation and consistency between POC detector results and flow cytometry method test results. This was achieved by comparing CD4 counts of newly infected HIV patients at the first follow-up determined by POC laboratory technologies in district or county labs and flow cytometry in prefecture-level labs, respectively.

METHODS

Materials and Methods

In this study, blood samples were collected in

duplicate ethylene diamine tetraacetic acid (EDTA) tubes from newly HIV-diagnosed patients (PLWH) in 13 cities of Jiangsu Province from January 1 to December 31, 2021. One tube of each blood sample was retained in the district and/or county CDCs for immediate detection, and the other tube was transported to corresponding prefecture-level labs for sample processing and subsequent flow cytometry detection.

This study used two POC devices [BDFACSPresto (Becton, Dickinson and Company, BD Biosciences, San Jose, California, USA) and Pima Analyser (Abbott Rapid Diagnostics Jena GmbH, Jena, Germany)] and four flow cytometers [FACSCalibur, FACSVia, and FACSCanto II (Becton, Dickinson and Company, BD Biosciences, San Jose, California, USA) as well as EPICSXL (Beckman Coulter, Inc. USA)] for CD4 counting. The POC devices were operated with reagents provided by their respective manufacturing companies, and the collection and analysis processes strictly followed the instructions provided. The flow cytometers used reagents registered with the National Medical Products Administration, and the instructions for device operation were strictly followed.

Overall, 903 blood samples were analyzed by FACSPresto — 374 duplicates of which were analyzed using FACSCalibur, 329 by FACSVia, 171 by FACSCantoII, and 29 by EPICSXL, respectively. A total of 955 blood samples were analyzed using Pima, of which 569 duplicates were detected using FACSCalibur, 240 by FACSVia, 130 by FACSCantoII, and 16 by EPICSXL. All the final data were submitted to provincial CDCs.

Statistical Analyses

Microsoft Excel 2016 (Microsoft Corporation, CA, USA), SPSS 26.0 (IBM, NY, USA), and GraphPad Prism 9.3 (GraphPad Software, CA, USA) were used to calculate the descriptive statistics and correlation measures between the 2 measurements taken by POC devices and flow cytometers. Measurement data (absolute CD4 count) was reported as median values. The differences between the two techniques were determined through the Wilcoxon signed-rank test. Pearson correlation was used for each pair of the results generated by different devices. All statistical tests were two-sided, and those with $P < 0.05$ were considered statistically significant. To determine the accuracy of each device, Bland–Altman analysis (deviation analysis) was done, and the Bland–Altman plots were produced to visualize bias and limits of agreement [LOA = mean

bias $\pm$ 1.96 standard deviation (SD) of the differences in the results obtained].

RESULTS

Performance Comparison

Strong positive correlations were observed between results by FACSPresto and 3 flow cytometers (FACSCalibur, FACSVia, and FACSCanto II) with Pearson correlation coefficients of (r) 0.922, 0.938, and 0.914. The Pearson correlation coefficient (r) between EPICSXL and FACSPresto was 0.823. The Pearson correlation coefficients (r) were all > 0.8 , showing a significant linear correlation ($P < 0.001$), as shown in Figure 1.

Positive correlations were also observed between Pima and 3 flow cytometers (FACSCalibur, FACSVia, and FACSCantoII). The Pearson correlation coefficients (r) were 0.900, 0.950 and 0.954, respectively. The Pearson correlation coefficient (r) between EPICSXL and Pima was 0.876. The Pearson correlation coefficients (r) were all > 0.8 , showing a significant linear correlation ($P < 0.001$), as shown in Figure 2.

Comparison of CD4 Count Results

The non-parametric test results showed that the CD4 cell count results for PLWH using FACSPresto and FACSCantoII tests were not statistically different (Table 1). However, the median FACSPresto test results were significantly lower than FACSCalibur results whilst higher than the FACSVia and EPICSXL test results ($P < 0.05$).

There was no statistically significant difference between the CD4 cell count test results using Pima and results from tests using EPICSXL on blood samples collected from PLWH. However, the median value of CD4 cell count using Pima was lower than the other three flow cytometers ($P < 0.05$). Details are in Table 2.

Consistency Analysis

Bland–Altman plots of the CD4 count results detected by FACSPresto and the 4 flow cytometers yielded mean relative deviations of -25.64 , 24.68 , 3.05 , and 70.97 cells/ μL , respectively (Figure 3). Among PLWH, approximately 94.65%, 95.14%, 94.15%, and 93.10% of participants in each group were within the mean $\pm$ 1.96 SD of the relative deviation, respectively.

The Bland–Altman plots of the CD4 count results

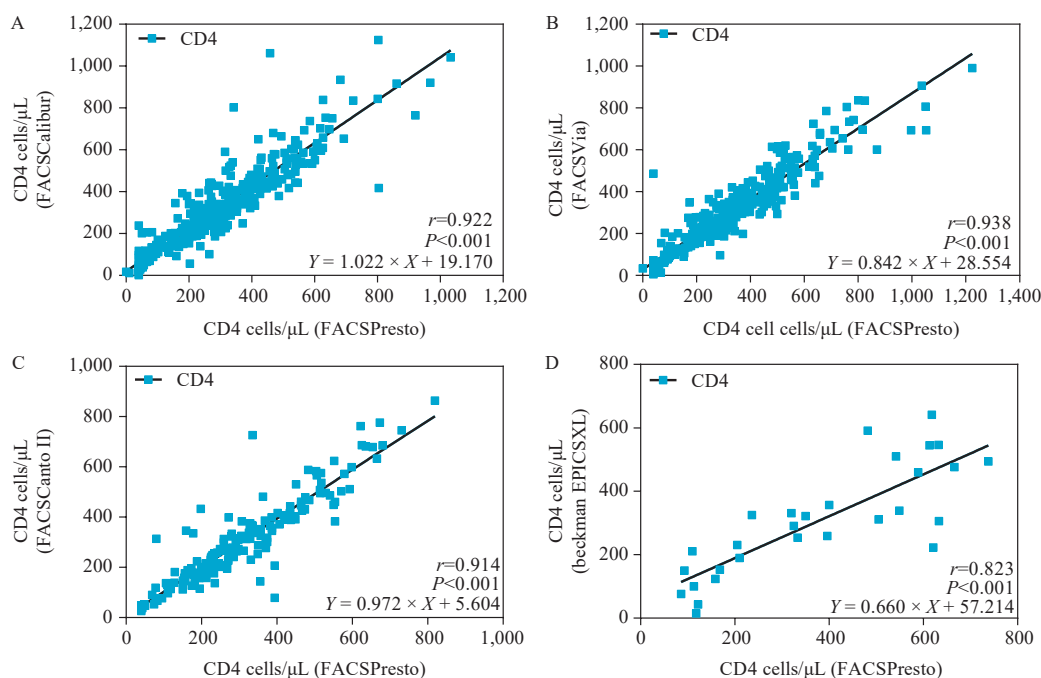


FIGURE 1. Correlation between the CD4 counts with FACSPresto and those with four types of flow cytometers. (A) Correlation between absolute CD4 cell counts (AbsCD4) in venous blood using FACSPresto and that using FACSCalibur. (B) Correlation between AbsCD4 in venous blood using FACSPresto and that using FACSVia. (C) Correlation between AbsCD4 in venous blood using the FACSPresto and that using FACSCanto II. (D) Correlation between AbsCD4 in venous blood using FACSPresto and that using EPICSXL. Abbreviation: AbsCD4=absolute CD4 cell counts.

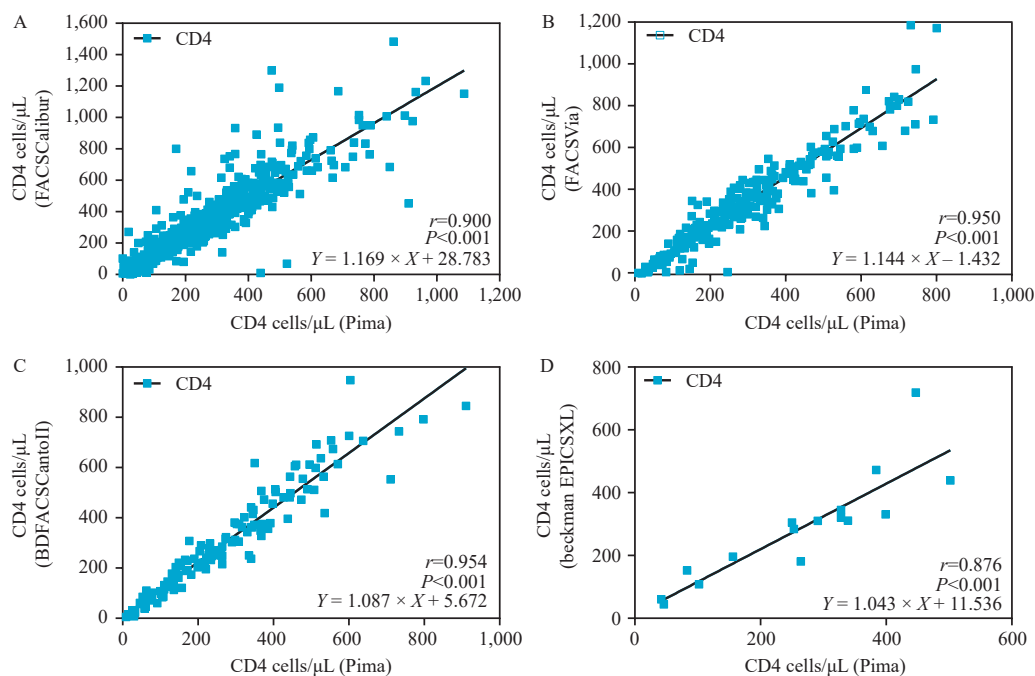


FIGURE 2. Correlation between the CD4 counts with Pima and those with four types of flow cytometers. (A) Correlation between AbsCD4 in venous blood using Pima and that using FACSCalibur. (B) Correlation between AbsCD4 in venous blood using Pima and that using FACSVia. (C) Correlation between AbsCD4 in venous blood using Pima and that using FACSCanto II. (D) Correlation between AbsCD4 in venous blood using Pima and that using EPICSXL. Abbreviation: AbsCD4=absolute CD4 cell counts.

TABLE 1. Comparison of CD4 count results detected by FACSPresto and other flow machines of the same samples (HIV/AIDS patients newly diagnosed with HIV) in Jiangsu 2021.

Comparison group	Flow cytometer	N	Median (cells/ μ L)	Z	P
Group 1	FACSCalibur	374	296	-6.393	<0.001*
	FACSPresto	374	277		
Group 2	FACSVia	329	294	-6.902	<0.001*
	FACSPresto	329	314		
Group 3	FACSCanto II	171	273	-1.765	0.078
	FACSPresto	171	279		
Group 4	EPICSXL	29	306	-2.844	0.004*
	FACSPresto	29	350		

*P value <0.05 is considered significant.

TABLE 2. Comparison of CD4 count results detected by Pima and other flow machines of the same samples (HIV/AIDS patients newly diagnosed with HIV) in Jiangsu 2021.

Comparison group	Flow cytometer	N	Median (cells/ μ L)	Z	P
Group 1	FACSCalibur	569	299	-17.249	<0.001*
	Pima	569	243		
Group 2	FACSVia	240	307	-8.821	<0.001*
	Pima	240	265		
Group 3	FACSCanto II	130	251	-5.239	<0.001*
	Pima	130	243		
Group 4	EPICSXL	16	308	-1.034	0.301
	Pima	16	278		

*P value <0.05 is considered significant.

detected by Pima and the four flow cytometers yielded mean relative deviations of -3.99, -40.78, -29.32, and -22.75 cells/ μ L, respectively (Figure 4). Among PLWH, approximately 95.96%, 95.00%, 95.38%, and 93.75% of participants in each group were within the mean $\pm$ 1.96 SD of the relative deviation, respectively.

DISCUSSION

Since flow cytometry is complicated to operate and expensive, it has a higher demand on minimum personnel and laboratory requirements (9). As a result, only prefecture-level labs can satisfy the laboratory test demands, which leads to a longer wait time for results from large batches of test samples and contributes to potential risks in sample transportation. The POC CD4 testing machine is a portable device that is easy to carry, simple to operate onsite, and adaptable to various environments — which helps realize a shorter detection time for single samples. It can ultimately help PLWH get their CD4 count test results faster and facilitate their timely initiation into or adjustment to

antiviral treatment regimens (9–10). In some countries, studies have shown that adopting POC CD4 detection instruments can meaningfully improve the timeliness of initiating antiviral therapies (6,11–12). Timeliness plays a vital role in the care and therapeutic evaluation of HIV patients; this is especially witnessed in mobile HIV testing services (HTS) delivery, which patients are often more willing to use (11). Therefore, using POC CD4 cell detectors, based on their accuracy and reliability, for PLWH in districts or counties without high-standard laboratories is a novel strategy in HIV prevention and control work that will help promote detection accessibility.

This research included 13 prefecture-level labs and 90 district or county labs. The findings indicated a good consistency and relevance between POC devices and flow cytometry test results with correlation coefficients >0.8. Moreover, the consistency was also close to the results reported in other research (11,13–14). This study did find variations in the CD4 cell counts test results for the same PLWH samples from different laboratories using POC devices and flow

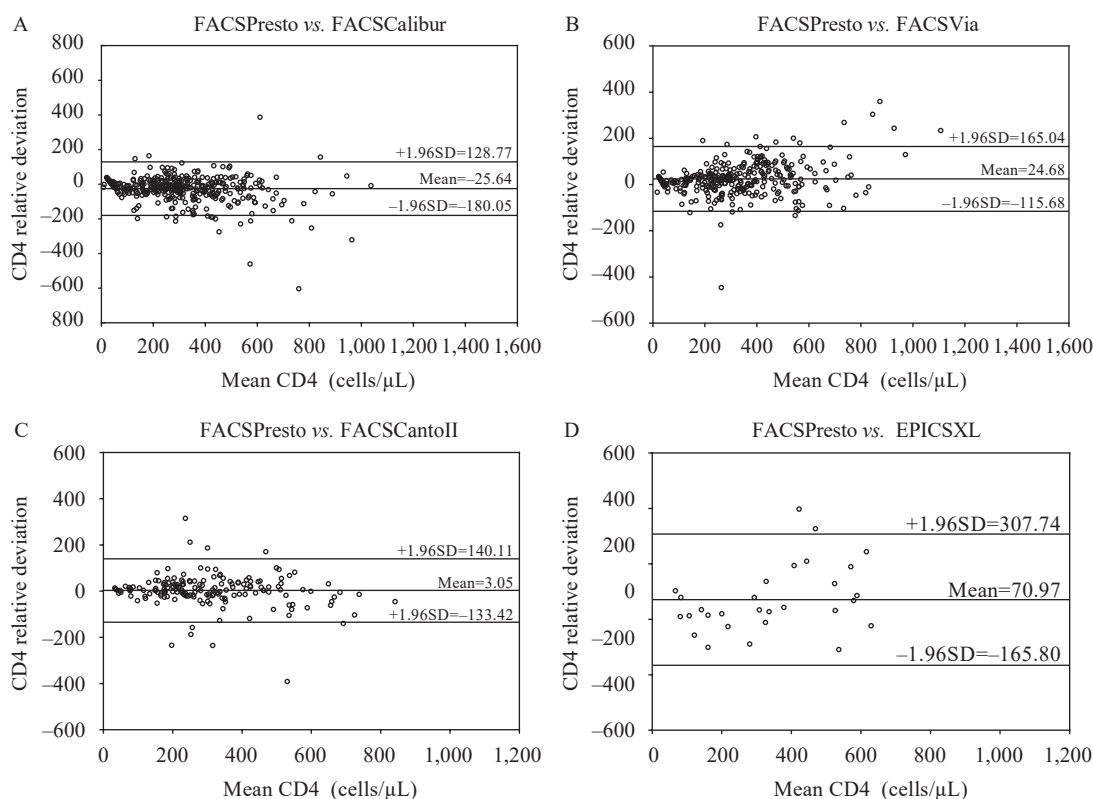


FIGURE 3. Bland-Altman analyses of relative deviations (FACSPresto to the four flow cytometers). (A) Deviation of AbsCD4 in venous blood using FACSPresto to that using FACSCalibur. (B) Deviation of AbsCD4 in venous blood using FACSPresto to that using FACSVia. (C) Deviation of AbsCD4 in venous blood using FACSPresto to that using FACSCanto II. (D) Deviation of AbsCD4 in venous blood using FACSPresto to that using EPICSXL.

Note: Mean CD4: Mean of CD4 counts detected by each comparison group. CD4 relative deviation: CD4 counts detected by FACSPresto minus the results detected by flow cytometers.

Abbreviation: AbsCD4=absolute CD4 cell counts.

cytometers. However, this observation is consistent with the findings of other studies (3,13–15) and may be related to differences in detection principles, laboratory conditions, and/or operators. This suggests that the same institutions with the same machines should be used for follow-up tests on the same patients to provide better stability in evaluating changes in CD4 by avoiding differences caused by devices and personnel, if possible. The correlation results of the 2 POC devices (FACSPresto and Pima) and 3 flow cytometers (FACSCalibur, FACSVia, and FACSCanto II) exceeded 0.9. This showed a good correlation between them: consistent with the findings of other research (3,13–15). However, the correlation coefficient in this study was slightly lower. This may be due to the fact that previous studies compared test results in the same laboratory using different machines, which reduced the error from influencing factors such as personnel and laboratory conditions. The correlation coefficient between the 2 POC detectors and EPICSXL was >0.8, which is lower than the other 3

models. This may be related to the small sample size, the testing machine's long service time, or the instrument's aging. The high consistency of the test results between the 2 POC detectors and the 4 flow cytometers was similar to the results of other research (3,13–15) in terms of deviation mean value and degree (especially the average deviation of the laboratory using FACSPresto in comparison to the one using FACSCanto II, which were within 5 cells/μL of each other).

PLWH with CD4⁺ T cell count less than normal values are the key population targeted in many practical public health interventions. Thus, this study made another analysis for low-CD4 populations (CD4 <200/μL). The nonparametric test results showed that CD4 counts detected by POC and flow cytometers were similar in results (Supplementary Tables S1 and S2, available in <https://weekly.chinacdc.cn/>). Furthermore, both FACSPresto and Pima showed a good correlation with the other flow cytometers (FACSCalibur, FACSVia, and FACSCanto II)

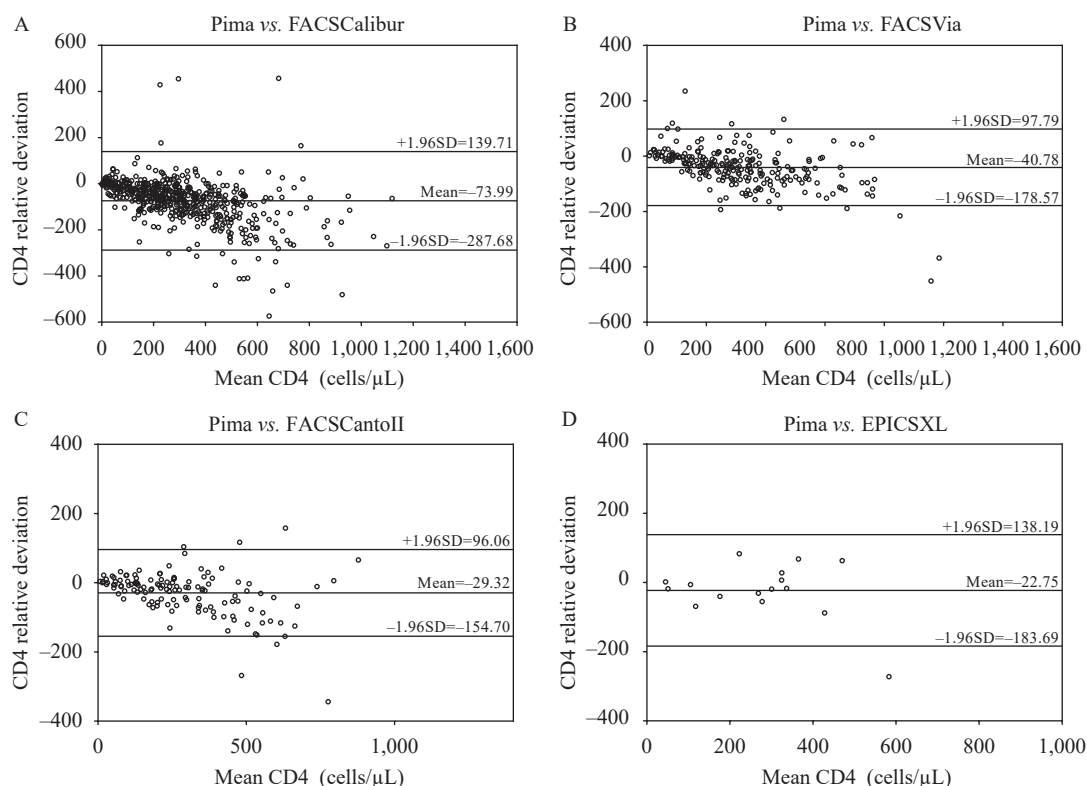


FIGURE 4. Bland-Altman analyses of relative deviation (Pima to the four flow cytometers). (A) Deviation of AbsCD4 in venous blood using Pima to that using FACSCalibur. (B) Deviation of AbsCD4 in venous blood using Pima to that using FACSVia. (C) Deviation of AbsCD4 in venous blood using Pima to that using FACSCanto II. (D) Deviation of AbsCD4 in venous blood using Pima to that using EPICSXL.

Note: Mean CD4=Mean of CD4 counts detected by each comparison group. CD4 relative deviation=CD4 counts detected by Pima minus the results detected by flow cytometers.

Abbreviation: AbsCD4=absolute CD4 cell counts.

($P < 0.001$). Compared with other samples, the Bland-Altman results showed a lower degree of dispersion tendency. Therefore, this study believes that the above devices have good stability and accuracy in detecting CD4 counts in populations with low CD4 cells (< 500 cells/μL).

This study was subject to some limitations. Due to variations in device models, case origin and distribution, and nuances in detection schemes between municipal laboratories, the number of tested samples between the two POC devices and flow cytometry instruments varied greatly between study groups. These variations were especially salient for those labs using EPICSXL, whose sample sizes were too small and thus limited the evaluation of the results. However, the overall results obtained from the POC equipment used in district or county labs were reliable and comparable to those obtained from large-scale flow cytometry.

Changes in CD4 count can effectively reflect the status and degree of a viral infection. Therefore

obtaining CD4 count test results early is essential to prompt treatment initiation and the early achievement of immune reconstitution effect in PLWH (1,8). Our findings show that POC CD4 machines in district or county labs could provide relatively accurate and reliable test results to facilitate treatment initiation. In addition, this assessment provides strong support for exploring modern, new-style AIDS laboratories, which could simplify CD4 count testing, shorten the wait time for results, and enable one-stop-shop service delivery.

Conflicts of interest: No conflicts of interest.

doi: 10.46234/ccdcw2022.213

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Submitted: July 28, 2022; Accepted: November 13, 2022

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SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE S1. Comparison of CD4 count of HIV/AIDS patients newly diagnosed between FACSPresto and four types of flow cytometry in Jiangsu 2021.

Comparison group	Flow cytometer	N	Median (cells/ μ L)	Z	P
Group 1	FACSCalibur	307	252	-5.052	<0.001*
	FACSPresto	307	240		
Group 2	FACSVia	259	250	-5.861	<0.001*
	FACSPresto	259	266		
Group 3	FACSCanto II	143	239	-2.781	0.005*
	FACSPresto	143	2,245		
Group 4	EPICS XL	17	211	-1.349	0.177
	FACSPresto	17	205		

*P value <0.05 is considered significant.

Abbreviation: HIV=human immunodeficiency virus; AIDS=acquired immune deficiency syndrome.

SUPPLEMENTARY TABLE S2. Comparison of CD4 count of HIV/AIDS patients newly diagnosed between Pima and four types of flow cytometry in Jiangsu 2021.

Comparison group	Flow cytometer	N	Median (cells/ μ L)	Z	P
Group 1	FACSCalibur	438	248	-14.240	<0.001*
	Pima	438	195		
Group 2	FACSVia	191	265	-7.111	<0.001*
	Pima	191	227		
Group 3	FACSCanto II	104	220	-3.885	<0.001*
	Pima	104	203		
Group 4	EPICSXL	14	294	-1.099	0.272
	Pima	14	258		

*P value <0.05 is considered significant.

Abbreviation: HIV=human immunodeficiency virus; AIDS=acquired immune deficiency syndrome.

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The inauguration of *China CDC Weekly* is in part supported by Project for Enhancing International Impact of China STM Journals Category D (PIIJ2-D-04-(2018)) of China Association for Science and Technology (CAST).



Vol. 4 No. 47 Nov. 25, 2022

Responsible Authority

National Health Commission of the People's Republic of China

Sponsor

Chinese Center for Disease Control and Prevention

Editing and Publishing

China CDC Weekly Editorial Office
No.155 Changbai Road, Changping District, Beijing, China
Tel: 86-10-63150501, 63150701
Email: weekly@chinacdc.cn

CSSN

ISSN 2096-7071
CN 10-1629/R1