Received: 10 February 2021 | Revised: 21 March 2021 | Accepted: 27 March 2021

DOI: 10.1002/jcla.23794

RESEARCH ARTICLE

WILEY

Performance of HIV detection in Zhejiang province in China: The Pareto principle at work

Jiafeng Zhang | **Xiaobei Ding** | **Xin Zhou** | **Wanjun Chen** | **Jiaming Yao** | **Zhihong Guo** | **Lin Chen** | **Yan Xia** | **Qin Fan**

Department of HIV/AIDS & STD Control and Prevention, Zhejiang Provincial Center for Disease Control and Prevention, Hangzhou, China

Correspondence
Zhihong Guo, Department of HIV/AIDS & STD Control and Prevention, Zhejiang Provincial Center for Disease Control and Prevention, No.3399, Binsheng Road, 310051 Hangzhou, China.
Email: zhhguo@cdc.zj.cn

Abstract

Background: Timely detection of HIV infection is critical for curbing the AIDS epidemic, and building an extensive and effective HIV laboratory network is of great importance. Therefore, improving quality management of the laboratory network and optimizing detection strategies are desirable research issues.

Methods: We assessed the applicability of the Pareto principle to HIV detection performance. We conducted a retrospective review of basic information and numbers of screening tests among an HIV laboratory network (1,452 laboratories) in Zhejiang province in 2014 and statistically analyzed HIV testing data for different population categories.

Results: Approximately, 80% of the cumulative HIV screening tests and positive screening tests originated from 17.3% (251/1,452) and 11.7% (170/1,452) of the laboratories in the whole province, respectively, and similar patterns were observed at the prefectural level. We found that the top five population screening categories (25%, 5/20) had the highest contribution (approximately 80%) to not only the number of screening tests (77.2%) but also the numbers of positive (76.4%) and confirmed positive tests (81.5%).

Conclusions: The Pareto principle provides a method for identifying noteworthy laboratories to deliver prior quality supervision and developing highly efficient screening strategies that best suit local needs.

KEYWORDS
HIV, laboratory network, Pareto principle

1 | INTRODUCTION

As a major infectious challenge, recently, HIV/AIDS has gained increasing attention in China. Annual amount of HIV testing increased to 200 million person-times in 2018, accounting for 17.6% of the whole population and the number of newly identified cases increased to 148,589.[1] Timely and accessible detection of HIV infection is critical to curb the epidemic because of the long symptom-free incubation period and the benefits of enrolling patients in therapy and providing follow-up as early as possible.[2–4] Thus, an extensive and effective HIV laboratory network is of great importance. Through government support at all levels, China has

constructed a well-coordinated HIV laboratory network together with national and provincial quality assessment (QA) systems to obtain a high quality of testing.[5] In 2009, China had 8,273 local screening laboratories, 254 confirmatory laboratories, 35 provincial confirmatory central laboratories, and 1 National AIDS Reference Laboratory.[5] Zhejiang, which is a southeastern coastal province of China, has established a representative HIV laboratory network that plays a crucial role in HIV/AIDS case-finding. By the end of 2014, 578 HIV screening laboratories, 862 testing sites, and 12 confirmatory laboratories were located in Zhejiang. Studies aimed at improving the efficiency of continuous quality management in the laboratory network are warranted to ensure the good track record of this network.

The Pareto principle (also known as the 80/20 rule, the law of the vital few, or the principle of factor sparsity) states that for many events, approximately 80% of the effects come from 20% of the causes.[6–10] The Pareto principle has been reported to be applicable to drug-therapy safety issues,[10] electronic health records,[11] preanalytical quality in clinical biochemistry testing,[8] deaths from coronary heart disease,[12] optimation in surgical training,[7] distribution of tick species on neotropical vertebrates,[13] virus shedding in birds,[9] and simulating a transmission network of COVID-19,[14] and other fields. The Pareto principle provides a useful method for identifying the most relevant and important components in a complex whole, which leads to improved management efficiency with clear and focused targets. However, to the best of our knowledge, the Pareto principle has not been applied for HIV detection to date.

We found that the Pareto principle was applicable to assessment of the HIV detection performance. Under guidance of the Pareto principle, we gained insight into the running of the HIV laboratory network and the performance of screening tests in subjects from different categories. These findings will provide practical support for improvement of laboratory management and the HIV testing strategy.

2 | MATERIALS AND METHODS

By the end of 2013, the Chinese HIV Laboratory Information Management System (CLIMS) had been developed and put into use. This system is a web-based database system that is managed by the National Center for AIDS/STD Control and Prevention (NCAIDS), Chinese Center for Disease Control and Prevention. The CLIMS includes laboratory information and laboratory testing modules.

2.1 | Data sources

Data related to running the HIV laboratory network in Zhejiang province in 2014 were retrieved from the CLIMS. The basic information and numbers of screening tests for the 1,452 laboratories were used for the subsequent analysis. The statistical forms of HIV testing in subjects from different categories in Zhejiang province in 2014 were extracted from the Chinese HIV/AIDS Comprehensive Response Information Management System (CRIMS)[15] and applied for performance analysis using different categories. The downloaded data only involved the numbers of HIV antibody tests. No personal information was included in the database and subsequent analysis.

2.2 | Statistical analysis

The numbers of laboratories at different levels and the institutional types were calculated. The numbers of HIV screening tests and HIV-positive screening tests for each laboratory were sorted from high to low to apply the Pareto principle. The numbers of HIV screening tests, HIV-positive screening tests, and confirmed positive tests performed for each population category according to the HIV testing strategy were also sorted from high to low. The proportions of laboratories (or categories) and the proportions based on the number of screening tests were calculated according to the Pareto principle. All statistical analyses were performed with Statistical Product and Service Solutions (SPSS) v19.0 (IBM, Armonk, NY, USA). The graph was drawn with GraphPad Prism version 5.01 for Windows (GraphPad Software, San Diego, CA, USA). Each laboratory was georeferenced and linked to a digital map of Zhejiang according to its location using Geographic Information System (GIS) technologies. The geographical distribution of laboratories was drawn by ArcGIS software (version 10.1).

3 | RESULTS

3.1 | HIV laboratory network in Zhejiang

By the end of 2014, 12 HIV confirmatory laboratories (including a provincial confirmatory central laboratory), 578 HIV screening laboratories, and 862 testing sites were operating in Zhejiang province. These laboratories were located in 96 (6.6%) centers for disease control and prevention (CDCs), 1,227 (84.5%) hospitals, 14 (5.4%) blood collection and supply institutions (BCSIs), 79 (1.0%) maternal and childcare institutions (MCCIs) and 36 (2.5%) other healthcare facilities (Table 1).

With the exception of the provincial confirmatory central laboratory, the other 11 HIV confirmatory laboratories were distributed in 11 prefectures (Figure 1). All of the HIV confirmatory laboratories were founded in provincial or prefectural CDCs. HIV screening laboratories (39.8%, 578/1,452) and testing sites (59.4%, 862/1,452) constituted the majority of the network, of which hospitals dominated. To improve the accessibility of HIV testing, a large number of testing sites was established in township hospitals or community health service centers.

TABLE 1 The distribution of HIV laboratories in Zhejiang province in 2014

	Ranks			Institutions				
Prefectures	Confirmatory labs	Screening labs	Testing sites	CDCs	Hospitals	MCCIs	BCSIs	Others
Hangzhou	2	109	156	14	229	10	1	13
Ningbo	1	84	22	12	81	8	1	5
Wenzhou	1	54	155	12	184	12	2	0
Jiaxing	1	46	66	7	99	6	1	0
Huzhou	1	31	40	4	61	3	1	3
Shaoxing	1	63	81	7	131	5	1	1
Jinhua	1	58	78	10	112	8	3	4
Quzhou	1	32	84	6	98	6	1	6
Zhoushan	1	15	32	5	40	2	1	0
Taizhou	1	49	86	10	112	10	1	3
Lishui	1	37	62	9	80	9	1	1
Total	12	578	862	96	1,227	79	14	36

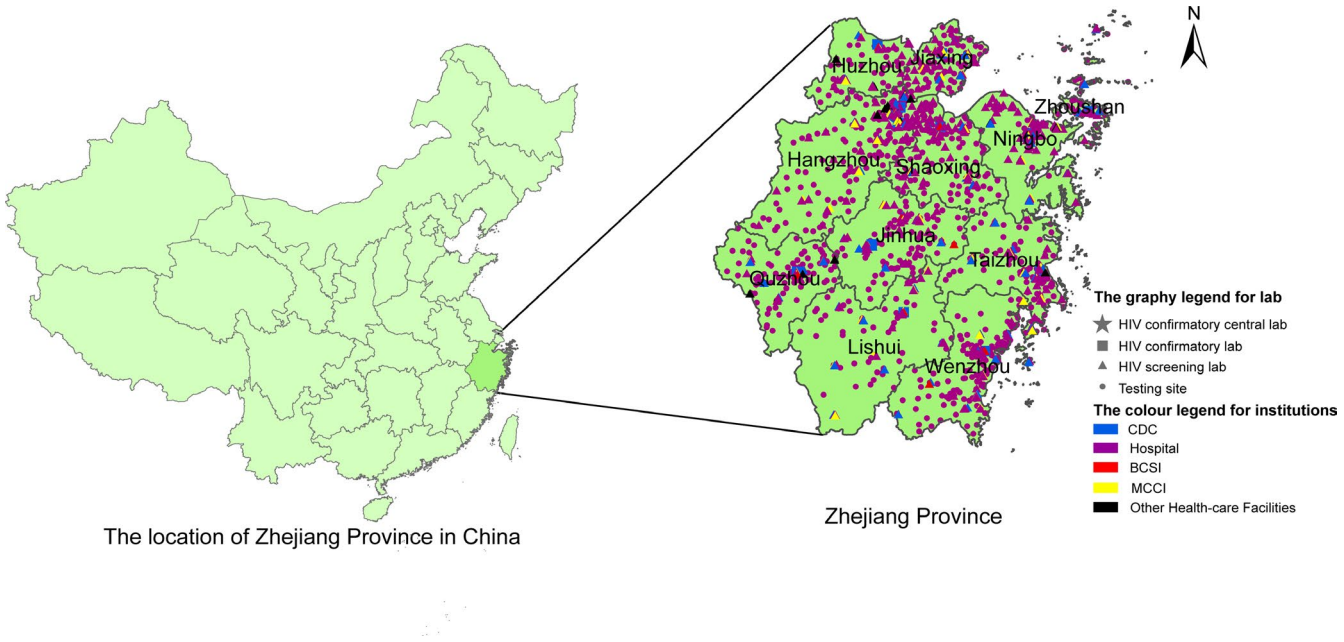

FIGURE 1 HIV laboratory network in Zhejiang province. Zhejiang province is highlighted on the map of China (left). The provincial confirmatory central laboratory, confirmatory laboratories, screening laboratories, and testing sites are labeled with a solid five-pointed star (★), solid squares (■), solid upward-pointing triangles (▲), and solid circles (●), respectively. Different institutional types are labelled with different colors as follows: CDCs (blue), hospitals (purple), BCSIs (red), MCCIs (yellow), and others (black)

The number of laboratories varied in each prefecture. Two prefectures (Hangzhou and Wenzhou) had more than 200 laboratories. Hangzhou, which is the capital of Zhejiang province, set up a total of 267 laboratories and had the largest number of laboratories of all 11 prefectures. A total of 63.6% (7/11) of prefectures had between 100 and 150 established HIV laboratories. In contrast, two prefectures (Huzhou and Zhoushan) had less than 100 laboratories. Zhoushan, which is China's largest archipelago and the only prefecture-level city consisting solely of islands, built 48 laboratories, which was the lowest number.

3.2 | HIV antibody screening test

In 2014, more than nine million cumulative HIV screening tests were performed at all laboratories, and the reactive samples were confirmed at confirmatory laboratories. A total of 80.0% of the cumulative HIV screening tests came from 17.3% (251/1,452) of the laboratories in the whole province (Table 2). In other words, 290 laboratories (20.0%, 290/1,452) contributed most of the cumulative HIV screening tests at the provincial level, accounting for 84.0% of the total (7,623,063/9,078,154). Generally,

TABLE 2 Results of HIV antibody screening tests in the laboratory network

	Tests in the network		Reactive specimens	
Prefectures	Proportion of labs	Proportion of testing volume	Proportion of labs	Proportion of reactive specimens
Hangzhou	13.9% (37/267)	80.7% (1,773,017/2,197,845)	7.9% (21/267)	80.1% (2,048/2,557)
Ningbo	30.8% (33/107)	80.6% (929,328/1,153,423)	21.5% (23/107)	80.3% (1,161/1,446)
Wenzhou	16.7% (35/210)	80.4% (1,008,397/1,254,570)	9.0% (19/210)	81.0% (1,378/1,701)
Jiaxing	20.4% (23/113)	79.8% (571,764/716,897)	14.2% (16/113)	80.2% (449/560)
Huzhou	20.8% (15/72)	81.9% (394,486/481,889)	18.1% (13/72)	79.6% (253/318)
Shaoxing	14.5% (21/145)	80.1% (515,286/643,628)	10.3% (15/145)	80.7% (415/514)
Jinhua	21.2% (29/137)	80.1% (838,690/1,046,446)	17.5% (24/137)	80.0% (950/1,187)
Quzhou	17.1% (20/117)	81.0% (283,018/349,577)	13.7% (16/117)	81.3% (165/203)
Zhoushan	18.8% (9/48)	82.0% (109,852/133,992)	18.8% (9/48)	82.4% (70/85)
Taizhou	20.6% (28/136)	80.4% (632,721/786,485)	16.9% (23/136)	81.5% (650/798)
Lishui	21.0% (21/100)	80.4% (252,041/313,402)	15.0% (15/100)	80.4% (201/250)
Total	17.3% (251/1,452)	80.0% (7,260,940/9,078,154)	11.7% (170/1,452)	80.1% (7,702/9,619)

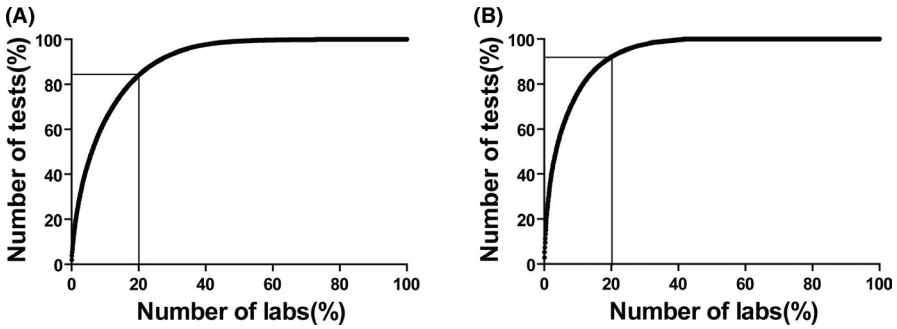

FIGURE 2 Cumulative distribution of the numbers of HIV screening tests and positive screening tests. Each dot represents a laboratory. The laboratories are plotted as the cumulative percentages of the numbers of laboratories on the horizontal axis and the cumulative percentages of numbers of screening tests (A) or positive screening tests (B) on the vertical axis

approximately 20% of the laboratories served approximately 80% of the HIV screening tests at the prefectural level (Figure 2, Table 2).

3.3 | HIV-positive antibody screening results

In 2014, 9,619 samples were reported as HIV-positive based on antibody screening by the laboratory network in Zhejiang. A total of 80.1% of the cumulative HIV-positive screening tests came from 11.7% (170/1,452) of the laboratories in the whole province (Table 2). In other words, most of the HIV-positive screening tests (91.8%, 8,827/9,619) originated from 20.0% (290/1,452) of the laboratories in the province (Figure 2), and similar patterns were observed at the prefectural level (Table 2). Further statistical analysis at the prefectural level showed that approximately 20% (15.0%–20.6%) of the laboratories contributed approximately 80% (79.0%–91.4%) of the positive screening tests, which was also consistent with the Pareto principle (Table 2). Because the confirmatory test data were reported by HIV confirmatory laboratories in the CLIMS, the HIV specimen seropositivity at the first contact laboratory could not be assessed.

3.4 | HIV screening of subjects from different categories

We implemented an HIV testing strategy targeting different populations that were roughly divided into the following 20 categories: preoperational patients, blood and blood product recipients, sexually transmitted disease (STD) clinic attendees, other patients, pre-marital testing attendees, pregnant women, voluntary counselling and testing (VCT) attendees, spouses or sex partners of HIV-positive individuals, children of positive women, people with occupational exposure, employees in entertainment fields, paid blood donors, unpaid blood donors, entry-exit personnel, recruits, detainees in detoxification and reeducation centers, detainees in female reeducation centers, other detainees, specific survey subjects and others. A total of 8 9,22,989 HIV screening tests were performed in 2014 in Zhejiang according to the statistical report forms of the CRIMS, of which 4,212 were confirmed to be HIV antibody-positive, resulting in a positive rate of 0.047%. Given that Zhejiang had a permanent population of 55 million, the total screened percentage of the general public was greater than 16%. However, a great difference existed in the number of screening tests and the screening efficiency in different categories. For instance, 3.5 million preoperational HIV tests (the highest number)

were performed in Zhejiang, of which 1,058 were confirmed as HIV antibody-positive, resulting in a positive rate of 0.030%. In contrast, 80 children of HIV-positive women (the lowest number) were tested for HIV and produced a high positive rate of 3.750% (3/80). The highest positive rate was 6.871% (85/1,237) for spouses or sex partners of HIV-positive individuals, followed by 3.750% for children of positive women and 0.997% for people seeking VCT.

We found that the top five categories (25%, 5/20) made the major contribution (approximately 80%) to not only in the number of screening tests but also the number of positive screening and confirmatory tests. Specifically, the top five categories contributed 77.2% (6,890,210/8,922,989) of the total screening tests, 76.4% (5,570/7,287) of the positive screening tests, and 81.5% (3,433/4,212) of the HIV-positive confirmatory tests in the whole province in 2014 (Figure 3, Table 3). At the prefectural level, the top five categories contributed 70.5%–86.8% of the HIV screening tests, 62.5%–85.3% of the positive screening tests, and 65.2%–87.7% of the confirmed positive tests (Table 3), which generally conformed to the Pareto principle.

4 | DISCUSSION

In this study, we performed a systematic and in-depth analysis of HIV detection in a whole province with the aim of assessing applicability of the Pareto principle for management optimization. Our results will contribute to the effective management of HIV detection, which will help guide resources to their best destinations. Although the results in this study draw from data in a specific area, the analysis methods are generic and will contribute to in-depth understanding of HIV detection performance in a wide range of locations.

The United Nations Joint Programme on HIV/AIDS (UNAIDS) sets a 90-90-90 target for 2020 to help end the AIDS epidemic.[16] The first 90 target is that 90% of all people living with HIV should know their status. Obviously, the launch of the laboratory testing strategy provides great support for the 90-90-90 target. Zhejiang, which is one of the most economically developed areas in China, is under increasing pressure from the AIDS epidemic but still has a low HIV prevalence. Construction of a network of HIV laboratories extending throughout the whole province began in 1995. At present, Zhejiang benefits from a laboratory network that provides broad coverage for blood safety, epidemiologic surveillance in vulnerable populations, preoperational examination and VCT in general populations and medical services with a profound social impact, such as premarital examination and diagnosis during pregnancy and the perinatal period. However, only 12 HIV confirmatory laboratories were founded and were concentrated in CDCs, which increased the difficulty of meeting the need for a timely AIDS diagnosis. In the future, we should strengthen optimization of the network, especially by substantially increasing the number of HIV confirmatory laboratories, which will greatly improve the accessibility of HIV confirmatory testing.

The Pareto principle is of great importance in quality improvement[6–8,10,11] because it addresses that a small number of laboratories contribute the notable achievements in HIV detection. Quality supervision (eg, on-site inspection) is necessary to maintain good operation of the laboratory network.[4] However, the laboratory network is already large (1,452 laboratories), supervisors cannot feasibly perform specialized inspections for each member due to limited resources. Therefore, we can identify high-impact laboratories for quality improvement interventions following the Pareto principle, which will maximize the role of quality supervision and guidance. However, because the functions of less productive laboratories are always found at consistent sites, routine quality assurance can be implemented through proficiency testing (PT) or external quality assessment (EQA).[17] Additionally, productive laboratories can be effectively selected as candidate confirmatory laboratories, demonstration laboratories, regional key laboratories or others to develop multi-level authorization management strategies according to the Pareto principle. Finally, we will develop a sustainable and efficient management model through reasonable hierarchies and targeted differentiation.

To curb the AIDS epidemic, the Chinese government issued the 'Four Free and One Care' policy in 2003,[2] which included free VCT. VCT, which was originally recommended by the American Centers for Disease Control and Prevention in 1993,[18] has gained

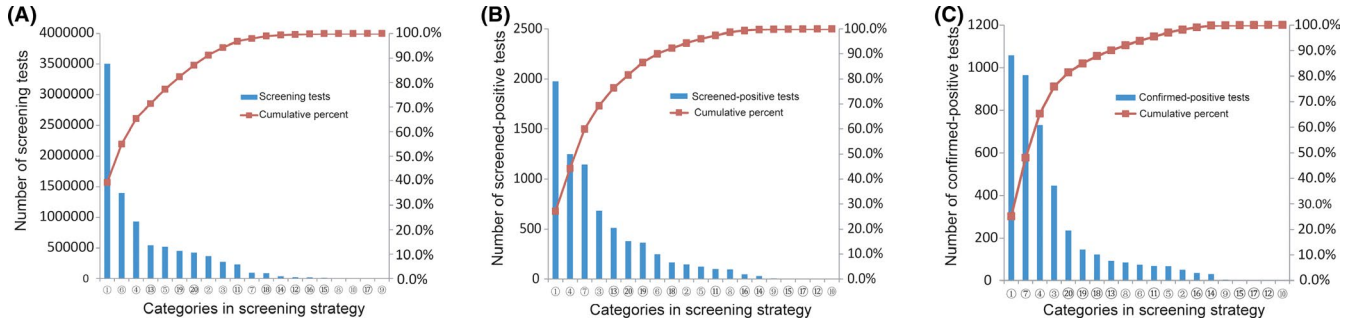

FIGURE 3 Distribution of the numbers of HIV screening tests, positive screening tests, and confirmed positive tests in different categories. The right side coordinates display the cumulative percentages of the numbers of HIV screening tests (A), positive screening tests (B), and confirmed positive tests (C). The digital codes (the same as in Table 3) on the horizontal axes represent specific categories in the screening strategy

TABLE 3 HIV screening in subjects from different categories in Zhejiang province

	Numbers of tests		Numbers of positive screening tests		Numbers of confirmed positive tests	
Prefectures	Categories[a]	Proportion of tests	Categories	Proportion of positive tests	Categories	Proportion of positive tests
Hangzhou	①⑥④⑬⑤	83.1% (1,611,658/1,938,758)	①④⑦③⑬	82.6% (1,546/1,871)	①⑦④③⑳	87.7% (957/1,091)
Ningbo	①⑥④⑪⑳	81.0% (894,949/1,104,812)	①⑦④③⑳	82.6% (799/967)	⑦①④③⑳	82.1% (468/570)
Wenzhou	①④⑥⑳⑬	86.8% (1,010,325/1,164,440)	④①⑦⑲⑬	85.3% (1,079/1,265)	④⑦①③⑳	87.0% (587/675)
Jiaxing	①⑲⑥⑤⑬	82.0% (705,381/860,623)	①④③⑦⑲	83.2% (326/392)	①⑦④③⑲	81.8% (225/275)
Huzhou	①⑥⑳④⑲	80.0% (428,381/535,453)	①④⑬⑦③	77.4% (226/292)	①③⑦④⑳	85.5% (141/165)
Shaoxing	①⑥⑳②⑬	76.7% (522,001/680,963)	①③②⑬⑦	72.7% (328/454)	①⑦③④⑳	68.3% (155/227)
Jinhua	①⑥⑲②④	78.9% (889,826/1,127,217)	①⑦④③⑬	77.7% (690/888)	⑦①④③⑲	82.1% (437/532)
Quzhou	①⑥⑤④⑬	76.3% (245,255/321,444)	①⑤⑬③④	62.5% (90/144)	①③⑦⑱④	65.2% (60/92)
Zhoushan	①⑥④⑬⑲	70.5% (108,922/154,554)	①⑦④⑲⑭	63.2% (48/76)	①⑦④⑭⑱	65.6% (40/61)
Taizhou	①⑥④⑤⑬	84.0% (642,086/764,809)	①⑦④⑳⑬	78.1% (550/704)	①⑦④③⑪	78.5% (306/390)
Lishui	①⑥④⑤⑳	83.9% (226,582/269,916)	①④⑥⑦③	77.4% (181/234)	④①⑦⑤③	80.6% (108/134)
Total	①⑥④⑬⑤	77.2% (6,890,210/8,922,989)	①④⑦③⑬	76.4% (5,570/7,287)	①⑦④③⑳	81.5% (3433/4212)

[a]① Preoperational patients; ② Blood and blood product recipients; ③ Sexually transmitted disease (STD) clinic attendees; ④ Other patients; ⑤ Pre-marital testing attendees; ⑥ Pregnant women; ⑦ VCT attendees; ⑧ Spouses or sex partners of HIV-positive individuals; ⑨ Children of positive women; ⑩ People with occupational exposure; ⑪ Employees in entertainment fields; ⑫ Paid blood donors; ⑬ Unpaid blood donors; ⑭ Entry-exit personnel; ⑮ Recruits; ⑯ Detainees in detoxification and reeducation centers; ⑰ Detainees in female reeducation centers; ⑱ Other detainees; ⑲ Specific survey subjects; ⑳ Others. The code was sorted according to the corresponding numbers of tests from high to low. Only the top five categories are shown in the table.

increasing attention in China. The targeted population who had experienced a risk of HIV infection had a high seropositivity of 0.997% in our study. Likewise, spouses or sex partners of HIV-infected individuals, who were exposed and at definite risk of HIV infection, had the highest seropositivity of 6.87%. Obviously, HIV testing of high-risk populations should be further strengthened in the future. To make VCT accessible, it should be provided in existing community health services,[19] followed by standardization and implementation of high-quality VCT services. Notably, HIV/AIDS had spread from high-risk to general populations in Zhejiang.[20] Targeting general populations by providing preoperational HIV testing free of charge in Zhejiang found the highest number of HIV-infected individuals. Provider-initiated testing and counselling (PITC)[21] was introduced and implemented at general hospitals and STD clinics in China in 2006. Significant effects of PITC programs were seen for patients who received testing at STD clinics or other testing services in China.[22] Moreover, STD clinic attendees and other patients were listed in the top five populations when sorted by the numbers of confirmed positive tests in our study (Table 3). Therefore, PITC should be routinized in all HIV-related divisions in medical settings to increase early HIV diagnoses.[22,23] Obviously, the numbers of screening tests and seropositivity were heterogeneous in subjects from different categories. However, these findings have implications for strategy developers, who can focus their resources and efforts on targeted groups to achieve high input-output efficiency[6,7,10] in containing the spread of HIV/AIDS. Further effort should be expended on expanding the screening coverage of vulnerable populations to achieve the first 90 target at an early date.

Notably, the findings in this study only focus on the distribution of HIV testing, whereas an effectiveness evaluation of HIV/AIDS detection should be multi-dimensional and comprehensive. Additional aspects (eg, accessibility, convenience, and input cost) need to be taken into consideration prior to practical application. Moreover, the data in this study were drawn from electronic statistical forms from a single year, and the results might differ somewhat in different years or in different areas. As a result of disagreement in the statistical calibre and the reporting requirements of the different systems, the CLIMS and CRIMS data differ somewhat. However, the data from the two systems agree in terms of the conclusion and support the fitness of the Pareto principle. Feasibly, the Pareto principle will work in different years and different areas and can serve as a general guideline for the practice of HIV testing management or other related fields. By leveraging the Pareto principle, we can identify high-impact targets for quality improvement interventions and in doing so bring strategy and efficiency to achieve the first 90 target to help end the AIDS epidemic.

ACKNOWLEDGEMENTS

The authors are especially grateful to Prof. Ping Zhong for thoughtful comments on this study.

CONFLICT OF INTEREST

The authors declared no conflicts.

DATA AVAILABILITY STATEMENT

All original data throughout our manuscript are available upon reasonable request.

ORCID

Jiafeng Zhang https://orcid.org/0000-0003-4288-5516

REFERENCES

1. UNAIDS. Country progress report 2019- China. https://www.UNAIDS.org/sites/default/files/country/documents/CHN_2019_countryreport.pdf. Accessed March 20, 2021.
2. Wu Z, Sun X, Sullivan SG, et al. Public health. HIV testing in China. *Science*. 2006;312(5779):1475-1476.
3. Diaz HM, Perez MT, Lubian AL, et al. HIV detection in Cuba: role and results of the National Laboratory Network. *MEDICC Rev*. 2011;13(2):9-13.
4. Abimiku AG. Building laboratory infrastructure to support scale-up of HIV/AIDS treatment, care, and prevention: in-country experience. *Am J Clin Pathol*. 2009;131(6):875-886.
5. Jiang Y, Qiu M, Zhang G, et al. Quality assurance in the HIV/AIDS laboratory network of China. *Int J Epidemiol*. 2010;39(Suppl 2):ii72-ii78.
6. Harvey HB, Sotardi ST. The Pareto principle. *J Am Coll Radiol*. 2018;15(6):931.
7. Kramp KH, van Det MJ, Veeger NJ, et al. The Pareto analysis for establishing content criteria in surgical training. *J Surg Edu*. 2016;73(5):892-901.
8. Kulkarni S, Ramesh R, Srinivasan AR, et al. Evaluation of preanalytical quality indicators by six sigma and Pareto`s principle. *Indian J Clin Biochem*. 2018;33(1):102-107.
9. Jankowski MD, Williams CJ, Fair JM, et al. Birds shed RNA-viruses according to the pareto principle. *PLoS One*. 2013;8(8):e72611.
10. Muller F, Dormann H, Pfistermeister B, et al. Application of the Pareto principle to identify and address drug-therapy safety issues. *Eur J Clin Pharmacol*. 2014;70(6):727-736.
11. Wright A, Bates DW. Distribution of problems, medications and lab results in electronic health records: the Pareto principle at work. *App Clin Inform*. 2010;1(1):32-37.
12. Li C, Cobb L, Vesper H, et al. Global surveillance of trans-fatty acids. *Prev Chronic Dis*. 2019;16:e147.
13. Esser HJ, Foley JE, Bongers F, et al. Host body size and the diversity of tick assemblages on Neotropical vertebrates. *Int J Parasitol Parasites Wildl*. 2016;5(3):295-304.
14. Gürsakal N, Batmaz B, Aktuna G. Drawing transmission graphs for COVID-19 in the perspective of network science. *Epidemiol Infect*. 2020;148:e269.
15. Mao Y, Wu Z, Poundstone K, et al. Development of a unified web-based national HIV/AIDS information system in China. *Int J Epidemiol*. 2010;39(Supplement 2):ii79-ii89.
16. Gangakhedkar RR. Ending AIDS: the 90–90-90 strategy. *Med J Armed Forces India*. 2017;73(1):3-4.
17. Louis FJ, Anselme R, Ndongmo C, et al. Evaluation of an external quality assessment program for HIV testing in Haiti, 2006–2011. *Am J Clin Pathol*. 2013;140(6):867-871.
18. Centers for Disease Control and Prevention. Recommendations for HIV testing services for inpatients and outpatients in acute-care hospital settings. *Morb Mortal Weekly Rep*. 1993;42(8):157-158.
19. Van de Perre P. HIV voluntary counselling and testing in community health services. *Lancet*. 2000;356(9224):86-87.
20. Xu Y, Pan X, Yang J, et al. HIV/AIDS epidemic in Zhejiang province, 1985–2009. *Dis Surveill*. 2010;25(11):877-890.
21. WHO. Guidance on Provider-initiated HIV testing and counselling in health facilities. 2007.
22. Jin X, Xiong R, Mao Y. HIV/AIDS cases detection in medical institutions from 2008 to 2013 in China]. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2015;36(4):323-326.
23. Cheng W, Tang W, Han Z, et al. Late presentation of HIV infection: prevalence, trends, and the role of HIV testing strategies in Guangzhou, China, 2008–2013. *Biomed Res Int*. 2016;2016:1631878.

How to cite this article: Zhang J, Ding X, Zhou X, et al. Performance of HIV detection in Zhejiang province in China: The Pareto principle at work. *J Clin Lab Anal*. 2021;35:e23794. https://doi.org/10.1002/jcla.23794