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Real-world data in late presentation of HIV infection in Suzhou, China: Results from four consecutive cross-sectional surveys, 2017–2020

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Objectives: This study aimed to examine the real prevalence of late presentation of HIV infection and to identify factors associated with late HIV presentation among patients with newly diagnosed HIV/AIDS in Suzhou, China.

Methods: Patients with newly diagnosed HIV/AIDS who registered in national AIDS surveillance system from 2017 to 2020 were included in this study. Late presentation (LP) of HIV infection was defined as HIV diagnosis with a CD4 count < 350 cells/ μ L or an AIDS-defining event. Multivariable logistic regression analyses were used to identify factors associated with LP.

Results: A total of 2,300 patients were enrolled. 1,325 were classified as late presenters, showing a high percentage of 57.6% (95% CI: 54.5–60.7%) and a rise ($P = 0.004$) over the four-year period. Patients with newly diagnosed HIV/AIDS who were older than 24 years of age (aOR = 1.549, $P = 0.001$ for 25–39 years; aOR = 2.389, $P < 0.001$ for 40 years and older), were Suzhou registered residents (aOR = 1.259, $P = 0.026$), and were from inpatient and outpatient (aOR = 1.935, $P < 0.001$) were more likely to be late presentation.

Conclusions: This study showed a high percentage and a rise of late presentation of HIV infection among patients with newly diagnosed HIV/AIDS in Suzhou, China, which is a challenge for future prevention and control of AIDS. Targeted measures should be urgently implemented to reduce late HIV diagnosis.

KEYWORDS

late presentation, associated factor, real-world data, China, HIV/AIDS

Introduction

Acquired immune deficiency syndrome (AIDS) is a chronic infectious disease caused by human immunodeficiency virus (HIV). By the end of 2020, there were about 37.7 million people living with HIV worldwide, and 1.5 million people became newly infected with HIV in 2020 (1). 27.5 million people were accessing antiretroviral therapy (ART) as of the end of 2020 (1). AIDS will continue to be a major public health focus for a long time to come. In response to it, the United Nations has proposed the goal of ending the AIDS epidemic by 2030, promising to achieve the “three 95%” by 2030, that is, 95% of people infected with HIV will be diagnosed, 95% of people who are diagnosed will have access to ART, and 95% of people who receive ART will have the virus suppressed (2). In this process, the first 95% is the foundation.

There is increasing evidence that early diagnosis and initiation of effective ART control the HIV-related morbidity and mortality (3, 4). The early use of ART reduces the size of the HIV reservoir and ensures that patients who start ART do so while preserving their immune function (5, 6). On the contrary, late presentation of HIV infection is associated with poor immune reconstitution, ART failure, and a higher mortality risk. Late presenters place a huge burden on the health system: they may have transmitted the virus to others because they are less likely to be aware of their infection and they require more medical resources than people diagnosed early (7).

The late presentation of HIV infection was defined by the European Late Presenter Consensus working group as a patient presenting for care with a CD4 count < 350 cells/ μ L or presenting with an established AIDS-defining event, regardless of the CD4 cell count (8). This definition aims at a coordinated care and unified management approach to AIDS in order to improve the standard of care for late HIV presenters. Another study proposed a definition of advanced patients as patients who present with a CD4 count < 200 cells/ μ L and/or have an AIDS-defining event within a month after HIV diagnosis, or patients with a first-reported CD4 count < 350 cells/ μ L or an AIDS-defining event within a month after diagnosis (9). A consensus definition of late presentation of HIV infection was proposed to ensure consistency and standard of care (10).

However, there is no such standard definition to describe the group of people living with HIV who present late with HIV infection in China. At present, Chinese Center for Disease Control and Prevention (China CDC) still uses the following definition to evaluate late presentation of HIV infection: persons who diagnosed with AIDS patients, or diagnosed with HIV infections and progressing to AIDS patients within the current year. AIDS patient is defined as a person presenting with a CD4 count < 200 cells/ μ L or presenting with an AIDS-defining event, regardless of the CD4 cell count. This definition of late HIV presentation has an obvious limitation that it can be influenced by ART. Moreover, the percentages of late presenters were underestimated because of the index assessment system. In China, a national study showed the percentage of patients with late HIV presentation ranged from 35.5 to 42.1% from 2010 to 2014 (11). In addition, 70.2% of newly diagnosed patients had late HIV presentation (according to the European consensus definition) in Guangxi Zhuang Autonomous Region from 2012 to 2016 (12). Another study showed that 40.1% of newly diagnosed patients were defined as having advanced HIV disease (AHD, was defined as an initial CD4 count < 200 cells/ μ L or an AIDS-defining event within a month after HIV diagnosis) in Guangdong Province from May 2018 to June 2019 (13).

Suzhou City, is an economically developed region with more than 13 million people, located in the southeastern part of China. Suzhou belongs to Jiangsu Province and is close to Shanghai. Toward the end of 2021, few finding about late HIV presentation had been reported. Herein, we conducted this four-year cross-sectional survey to examine the status of late presentation and identify factors associated with late HIV presentation among patients with newly diagnosed HIV/AIDS in Suzhou, China.

Materials and methods

Study population

All patients with newly diagnosed HIV/AIDS who registered in the AIDS surveillance system of China CDC between January 2017 and December 2020, whose addresses during diagnosis were located in Suzhou city, Jiangsu province, China, were included in this study. Eligible patients also needed to meet the following inclusion criteria: (1) had CD4+ T lymphocyte counts (CD4 counts) during diagnosis, (2) had CD4 counts detected within 3 months after diagnosis, (3) had CD4 counts detected before on antiretroviral therapy (ART). If there were multiple CD4 counts that meet the inclusion criteria, we chose the first into the study.

Study design

Four consecutive yearly cross-sectional observational study was conducted to examine the prevalence and trends in late presentation of HIV infection, and identify factors associated with late presentation among patients with newly diagnosed HIV/AIDS. Socio-demographic data (including gender, age, occupation, marital status, ethnicity, education level, and registered residence), HIV transmission route, reason for HIV testing, and CD4 count, were collected from the AIDS surveillance system of China CDC. CD4 count testing was conducted in the AIDS confirmatory laboratory of Suzhou Municipal Center for Disease Control and Prevention (Suzhou CDC). Subsequently, local CDC staff entered the CD4 count data of patients into the AIDS surveillance system.

Definition

In 2009, the European Late Presenter Consensus working group joined efforts to identify a common definition of what is mean by a 'late-presenting' patient. Two definitions were agreed upon, as follows. Late presentation: persons presenting for care with a CD4 count < 350 cells/ μ L or presenting with an AIDS-defining event, regardless of the CD4 cell count. Presentation with advanced HIV disease: presenting for care with a CD4 count < 200 cells/ μ L or presenting with an AIDS-defining event, regardless of the CD4 cell count (8). In our study, late presentation (LP) and non-LP were distinguished according to the consensus definition of late presentation. That was to say, a late presenter was defined as a patient with a CD4 count < 350 cells/ μ L or with an AIDS-defining event, regardless of the CD4 count.

Statistical analysis

Related data were downloaded from the AIDS surveillance system. Patients missing CD4 counts that met the inclusion criteria, were disqualified and not included into statistical analyses. According to the distributions of data, the quantitative variables were grouped and part of the qualitative variables were merged. Frequency analyses were used to show the distributions of socio-demographic

characteristics and other variables. Chi square tests were used to compare differences of late presentation between subgroups of characteristics. Chi square trend tests were used to compare differences of late presentation between years and observe trends over time. Factors associated with late presentation were first assessed using univariate logistic regression analysis. Variables with $P < 0.20$ were entered into multivariate regression analysis. Multivariable logistic regression analyses were conducted using forward LR method in order to determine the adjusted odds ratios (aORs). All analyses were conducted using SPSS software (version 19.0). $P < 0.05$ were considered statistically significant.

Results

Socio-demographic characteristics of study population

A total of 3,096 patients with newly diagnosed HIV/AIDS registered in the AIDS surveillance system of China CDC from 2017 to 2020, whose addresses were located in Suzhou during diagnosis. Among them, 2,300 eligible patients (513, 627, 583, and 577 in 2017, 2018, 2019, and 2020, respectively) were enrolled into the study. There were no statistically significant differences between their socio-demographic characteristics and those of patients who did not meet the inclusion criteria. Their socio-demographic characteristics are summarized in [Table 1](#). The average age of study population was 38.8 with a standard deviation of 14.7 (range: 2–84). Patients aged 24 years or younger during diagnosis constituted 15.0% (346), those aged 25–39 years constituted 45.7% (1,051), and those aged 40 years or older constituted 39.3% (903). Majority of patients were male (89.2%, 2,051) and ethnic Han (96.7%, 2,225). Approximately half (48.7%, 1,120) had an education level of junior high school or lower. About one-third (33.1%, 761) were Suzhou registered residents and two-third (66.9%, 1,539) were migrant population ([Table 1](#)).

HIV routes of transmission and reasons for HIV testing

Of the 2,300 patients, 61.3% (1,410) were MSM and 38.3% (880) were infected with HIV through heterosexual sex. Patients were tested for HIV for all different kinds of reasons, and then were found to be infected with HIV. Of those, 49.0% (1,127) were from medical institutions [inpatient, outpatient, pre-surgery, and STD (sexually transmitted disease) clinic], and 43.0% (988) from VCT (HIV voluntary counseling and testing) clinics and investigations ([Table 1](#)).

Late presentation of HIV infection

The overall median CD4 count was 317 cells/ μ L [inter-quartile range (IQR): 206–441]. Among 2,300 patients, 1,325 were classified as late presenters according to the definition, showing a high percentage of 57.6% (95% CI: 54.5–60.7%). Of those, higher percentages of patients with late presentation were found in those aged 40 years or older (68.1%), retirees (70.2%), farmers (70.8%), married (64.9%), heterosexuals (63.9%), those with education level of junior high

school or lower (61.5%), being registered residence of Suzhou (66.5%), and being from inpatient and outpatient (70.4%) ([Table 1](#)).

Trends in late presentation of HIV infection

Over the four-year period, a rise of late presentation of HIV infection was shown ($P = 0.004$), with 52.8% in 2017, 56.8% in 2018, 59.2% in 2019, and 61.2% in 2020, respectively. Increases of late presentation were noted in the patients who were male ($P = 0.003$), 25–39 years ($P = 0.049$), retirees ($P = 0.039$), married ($P = 0.001$), had an education level of junior high school or lower ($P = 0.046$), migrant population ($P = 0.007$), MSM ($P = 0.009$), and were from VCT clinics ($P = 0.026$) ([Table 2](#)).

Factors associated with late presentation of HIV infection

The potential factors associated with late presentation of HIV infection were analyzed with not late presenters as control. In the univariate analysis, late presentation was significantly associated with age, occupation, marital status, education level, registered residence, route of HIV transmission, and reason for HIV testing. In the multivariate analysis, the patients with newly diagnosed HIV/AIDS who were older than 24 years of age (aOR = 1.549, 95% CI: 1.209–1.985, $P = 0.001$ for 25–39 years; aOR = 2.389, 95% CI: 1.815–3.145, $P < 0.001$ for 40 years and older), were Suzhou registered residents (aOR = 1.259, 95% CI: 1.028–1.543, $P = 0.026$), and were from inpatient and outpatient (aOR = 1.935, 95% CI: 1.510–2.479, $P < 0.001$) were more likely to be late presentation ([Table 3](#)).

Discussion

Our study is among the first to examine trends in late presentation of HIV infection over a period of four consecutive years in Eastern China. A slight rise of late presentation of HIV infection for patients with newly diagnosed HIV/AIDS was found in Suzhou, from 2017 to 2020. It is different from most studies. In recent years, there had been decreasing trends among late presenters in Turkey (14), Kinshasa of DRC (15), and the East of England (16). In addition, trends in late presentation of HIV infection remained relatively stable in Australia (17), Panama (18), and Guangxi of China (12). Over the past dozen years, several HIV testing promotion measures and strategies have been widely used in medical institutions in China. For example, patients requiring surgery or transfusion have to receive HIV testing. Some inpatients, dental patients and endoscopy patients are also required to receive HIV testing. The expanded HIV testing strategy has resulted in a large number of late-stage HIV/AIDS being detected. This may be one reason for the rise of late presentation of HIV infection. Another possible explanation could be that HIV prevention and testing efforts in some population had been weakened or neglected, such as retirees, married, migrant population and people with low education.

In our study, high percentages of late presentation were shown over the time, with more than half each year. It is higher than that in some countries of Europe (14, 19–22), Australia

TABLE 1 Socio-demographic characteristics and late presentation among patients with newly diagnosed HIV/AIDS.

Characteristics	N (%)	LP Cases	Rate (%) (95% CI)	P-value
Gender				
Male	2,051 (89.2)	1,174	57.2 (54.0–60.5)	0.305
Female	249 (10.8)	151	60.6 (51.0–70.3)	
Age (years)				
≤24	346 (15.0)	145	41.9 (35.1–48.7)	< 0.001
25–39	1,051 (45.7)	565	53.8 (49.3–58.2)	
≥40	903 (39.3)	615	68.1 (62.7–73.5)	
Occupation				
Service personnel	768 (33.4)	387	50.4 (45.4–55.4)	< 0.001
Factory worker	529 (23.0)	307	58.0 (51.5–64.5)	
Homemaker or unemployment	392 (17.0)	248	63.3 (55.4–71.1)	
Retiree	114 (5.0)	80	70.2 (54.8–85.6)	
Farmer	219 (9.5)	155	70.8 (59.6–81.9)	
Others	278 (12.1)	148	53.2 (44.7–61.8)	
Marital status				
Single	1,005 (43.7)	497	49.5 (45.1–53.8)	< 0.001
Married	943 (41.0)	612	64.9 (59.8–70.0)	
Divorced or widowed	352 (15.3)	216	61.4 (53.2–69.5)	
Ethnicity				
Han	2,225 (96.7)	1,286	57.8 (54.6–61.0)	0.318
Ethnic minorities	75 (3.3)	39	52.0 (35.7–68.3)	
Education level				
Junior high school or lower	1,120 (48.7)	689	61.5 (56.9–66.1)	< 0.001
Senior high school	526 (22.9)	303	57.6 (51.1–64.1)	
College or higher	654 (28.4)	333	50.9 (45.4–56.4)	
Registered residence				
Suzhou	761 (33.1)	506	66.5 (60.7–72.3)	< 0.001
Others	1,539 (66.9)	819	53.2 (49.6–56.9)	
Route of transmission				
MSM	1,410 (61.3)	756	53.6 (49.8–57.4)	< 0.001
Heterosexual	880 (38.3)	562	63.9 (58.6–69.1)	
Others	10 (0.4)	7	70.0 (18.1–100.0)	
Reason for HIV testing				
VCT	625 (27.2)	314	50.2 (44.7–55.8)	< 0.001
Inpatient and outpatient	560 (24.3)	394	70.4 (63.4–77.3)	
Pre-surgery	287 (12.5)	176	61.3 (52.3–70.4)	
STD clinic	280 (12.2)	162	57.9 (48.9–66.8)	
Investigation	363 (15.8)	177	48.8 (41.6–55.9)	
Others	185 (8.0)	102	55.1 (44.4–65.8)	

LP, Late presentation; CI, Confidence interval; MSM, Men who have sex with men; VCT, HIV voluntary counseling and testing; STD, Sexually transmitted disease.

(17), and the United States (23), lower than that in Panama (18), South Africa (24, 25), Ethiopia (26), and Guangxi of China (12), and similar to that in Iran (27). It is important to

notice that higher percentages of late presentation were indicated among people over 40 years old, retirees, farmers, married, heterosexuals, and people registered in Suzhou in our study. Targeted

TABLE 2 Trends in late presentation of HIV infection among patients with newly diagnosed HIV/AIDS.

Characteristics	2017		2018		2019		2020		Trend test, P-value
	N	LP cases (Rate, %)	N	LP cases (Rate, %)	N	LP cases (Rate, %)	N	LP cases (Rate, %)	
Total	513	271 (52.8)	627	356 (56.8)	583	345 (59.2)	577	353 (61.2)	0.004
Gender									
Male	453	234 (51.7)	557	315 (56.6)	519	308 (59.3)	522	317 (60.7)	0.003
Female	60	37 (61.7)	70	41 (58.6)	64	37 (57.8)	55	36 (65.5)	0.732
Age (years)									
≤24	69	21 (30.4)	94	41 (43.6)	95	44 (46.3)	88	39 (44.3)	0.097
25-39	270	138 (51.1)	283	140 (49.5)	238	138 (58.0)	260	149 (57.3)	0.049
≥40	174	112 (64.4)	250	175 (70.0)	250	163 (65.2)	229	165 (72.1)	0.246
Occupation									
Service personnel	200	96 (48.0)	223	104 (46.6)	184	100 (54.3)	161	87 (54.0)	0.114
Factory worker	106	52 (49.1)	143	88 (61.5)	133	78 (58.6)	147	89 (60.5)	0.154
Homemaker or unemployment	84	51 (60.7)	118	77 (65.3)	91	60 (65.9)	99	60 (60.6)	0.947
Retiree	15	10 (66.7)	25	14 (56.0)	30	19 (63.3)	44	37 (84.1)	0.039
Farmer	47	34 (72.3)	53	39 (73.6)	77	53 (68.8)	42	29 (69.0)	0.596
Others	61	28 (45.9)	65	34 (52.3)	68	35 (51.5)	84	51 (60.7)	0.093
Marital status									
Single	228	105 (46.1)	262	122 (46.6)	249	127 (51.0)	266	143 (53.8)	0.050
Married	214	121 (56.5)	267	173 (64.8)	246	161 (65.4)	216	157 (72.7)	0.001
Divorced or widowed	71	45 (63.4)	98	61 (62.2)	88	57 (64.8)	95	53 (55.8)	0.365
Ethnicity									
Han	496	263 (53.0)	597	339 (56.8)	572	340 (59.4)	560	344 (61.4)	0.004
Ethnic minorities	17	8 (47.1)	30	17 (56.7)	11	5 (45.5)	17	9 (52.9)	0.925
Education level									
Junior high school or lower	230	129 (56.1)	285	174 (61.1)	306	193 (63.1)	299	193 (64.5)	0.046
Senior high school	128	64 (50.0)	153	93 (60.8)	115	68 (59.1)	130	78 (60.0)	0.159
College or higher	155	78 (50.3)	189	89 (47.1)	162	84 (51.9)	148	82 (55.4)	0.257
Registered residence									
Suzhou	174	112 (64.4)	197	130 (66.0)	209	134 (64.1)	181	130 (71.8)	0.203
Others	339	159 (46.9)	430	226 (52.6)	374	211 (56.4)	396	223 (56.3)	0.007
Route of transmission									
MSM	307	144 (46.9)	387	204 (52.7)	368	213 (57.9)	348	195 (56.0)	0.009
Heterosexual	203	125 (61.6)	238	152 (63.9)	213	130 (61.0)	226	155 (68.6)	0.206
Others	3	2 (66.7)	2	0 (0.00)	2	2 (100.00)	3	3 (100.00)	-
Reason for HIV testing									
VCT	143	63 (44.1)	183	88 (48.1)	140	74 (52.9)	159	89 (56.0)	0.026
Inpatient and outpatient	125	82 (65.6)	150	113 (75.3)	137	97 (70.8)	148	102 (68.9)	0.847
Pre-surgery	57	32 (56.1)	83	55 (66.3)	80	44 (55.0)	67	45 (67.2)	0.512
STD clinic	43	21 (48.8)	77	41 (53.2)	75	45 (60.0)	85	55 (64.7)	0.050
Investigation	90	45 (50.0)	89	41 (46.1)	108	56 (51.9)	76	35 (46.1)	0.854
Others	55	28 (50.9)	45	18 (40.0)	43	29 (67.4)	42	27 (64.3)	0.047

MSM, Men who have sex with men; VCT, HIV voluntary counseling and testing; STD, Sexually transmitted disease.

TABLE 3 Univariate and multivariate analysis of factors associated with late presentation of HIV infection.

Variable	LP (%)	Non-LP (%)	OR (95% CI)	P-value	aOR (95% CI)	P-value
Gender						
Male	1,174 (88.6)	877 (89.9)	1.000			
Female	151 (11.4)	98 (10.1)	1.151 (0.880–1.506)	0.305		
Age (years)						
≤24	145 (10.9)	201 (20.6)	1.000		1.000	
25–39	565 (42.6)	486 (49.8)	1.612 (1.261–2.060)	< 0.001	1.549 (1.209–1.985)	0.001
≥40	615 (46.4)	288 (29.5)	2.960 (2.293–3.821)	< 0.001	2.389 (1.815–3.145)	< 0.001
Occupation						
Service personnel	387 (29.2)	381 (39.1)	1.000			
Factory worker	307 (23.2)	222 (22.8)	1.361 (1.089–1.702)	0.007		
Homemaker or unemployment	248 (18.7)	144 (14.8)	1.696 (1.321–2.176)	< 0.001		
Retiree	80 (6.0)	34 (3.5)	2.316 (1.514–3.545)	< 0.001		
Farmer	155 (11.7)	64 (6.6)	2.384 (1.725–3.296)	< 0.001		
Others	148 (11.2)	130 (13.3)	1.121 (0.852–1.475)	0.416		
Marital status						
Single	497 (37.5)	508 (52.1)	1.000			
Married	612 (46.2)	331 (33.9)	1.890 (1.575–2.267)	< 0.001		
Divorced or widowed	216 (16.3)	136 (13.9)	1.623 (1.267–2.080)	< 0.001		
Ethnicity						
Han	1,286 (97.1)	939 (96.3)	1.000			
Ethnic minorities	39 (2.9)	36 (3.7)	0.791 (0.499–1.254)	0.319		
Education level						
Junior high school or lower	689 (52.0)	431 (44.2)	1.000			
Senior high school	303 (22.9)	223 (22.9)	0.850 (0.688–1.049)	0.130		
College or higher	333 (25.1)	321 (32.9)	0.649 (0.534–0.789)	< 0.001		
Registered residence						
Suzhou	506 (38.2)	255 (26.2)	1.744 (1.456–2.090)	< 0.001	1.259 (1.028–1.543)	0.026
Others	819 (61.8)	720 (73.8)	1.000		1.000	
Route of transmission						
MSM	756 (57.1)	654 (67.1)	1.000			
Heterosexual	562 (42.4)	318 (32.6)	1.529 (1.286–1.817)	< 0.001		
Others	7 (0.5)	3 (0.3)	2.019 (0.520–7.837)	0.310		
Reason for HIV testing						
VCT	314 (23.7)	311 (31.9)	1.000		1.000	
Inpatient and outpatient	394 (29.7)	166 (17.0)	2.351 (1.850–2.988)	< 0.001	1.935 (1.510–2.479)	< 0.001
Pre-surgery	176 (13.3)	111 (11.4)	1.570 (1.181–2.088)	0.002	1.174 (0.870–1.582)	0.294
STD clinic	162 (12.2)	118 (12.1)	1.360 (1.023–1.807)	0.034	1.324 (0.992–1.766)	0.057
Investigation	177 (13.4)	186 (19.1)	0.943 (0.728–1.221)	0.654	0.972 (0.748–1.264)	0.835
Others	102 (7.7)	83 (8.5)	1.217 (0.876–1.692)	0.242	1.042 (0.742–1.463)	0.813

LP, Late presentation; CI, Confidence interval; MSM, Men who have sex with men; VCT, HIV voluntary counseling and testing; STD, Sexually transmitted disease.

interventions addressed to specific subgroups in the population are needed.

Late presentation of HIV infection is associated with an increase in AIDS and AIDS-related deaths, particularly in the first year after diagnosis. Reducing late presentation of HIV infection is considered a public health priority and continues to be a great challenge (28). It is clear that late presentation is significantly associated with lack of recent testing. Therefore, earlier testing for HIV is considered the best measure. Given the priority of the Chinese government's response to HIV epidemic among men who have sex with men (MSM) (e.g., expanding HIV testing, Web-based HIV testing, increasing coverage of care and treatment), our observed percentage of late presentation among MSM was lower than that among heterosexuals (29). It indicates that current HIV testing strategies have not been effectively reaching certain segments of population that need to be tested or tested more frequently. HIV testing coverage needs to be expanded further. In order to achieve this goal, the US CDC and the US Preventive Services Task Force recommended that clinicians screen adolescents and adults aged 15 to 65 years for HIV infection (30).

Consistent with most studies (12, 14, 15, 20, 21, 27), age was significantly associated with late presentation of HIV infection in this study. Late presenters were more elderly. This might be due to several reasons. Because of the particularity of HIV infection, HIV symptoms in old people were misjudged as other illnesses, or the elderly were ignored and hard to receive targeted HIV prevention efforts, such as testing. In some areas of China, HIV testing has been incorporated into the physical examination of the elderly in basic public health services. It was reported that, during the year preceding the diagnosis, nearly half of the patients had sought medical advice owing to the presence of clinical indicators that should have led to HIV testing. Of those, 15% were classified as missed opportunities for earlier HIV diagnosis because testing was not performed (31). Besides, psychological factors, such as stigma, are more common in older people, which may also impede access to health services including HIV testing. Different from some studies (12, 18, 27), we did not observe any impact of gender.

In some studies (17, 32), there may be higher late presentation of HIV infection among migrant people compared with permanent residents. On the contrary, the patients with newly diagnosed HIV/AIDS who were Suzhou registered residents, were more likely to be late presentation in our study. The possible reason was the same as that of increasing late presentation. Due to more medical resources for registered residents, more patients with newly diagnosed HIV/AIDS were continuously passively found through surgery, hospitalization, outpatient service, endoscopy, and so on. The patients with newly diagnosed HIV/AIDS who were from hospital were more likely to be late presentation compared with those from VCT clinics and investigations, because of passive testing. Hence, WHO consolidated guidelines on HIV testing services recommended demand creation of HIV testing services. Demand creation was defined as activities intended to improve an individual's knowledge and attitude, motivation and intention, and eventually decision and behavior to seek HIV testing services (33).

Through this study, we obtained real data in late presentation of HIV infection and possible factors associated with late HIV presentation among patients with newly diagnosed HIV/AIDS in Suzhou, China, which are very important for future HIV prevention and control, especially in reducing AIDS-related deaths. However,

this study had several limitations. First, the details of the category of AIDS-defining event were unavailable among late presenters based on AIDS-defining event. Second, the patients of this study were from one city, thus leading to a selection bias. Still, the sample is representative because Suzhou has the largest number of patients in the province. Third, a limited number of variables were included in our study, as no additional questionnaire was conducted. Further study will focus on the knowledge of AIDS, attitude toward AIDS, the clinical symptoms and underlying diseases of patients.

Conclusions

This study showed a high percentage and a rise of late presentation of HIV infection among patients with newly diagnosed HIV/AIDS in Suzhou, China, from 2017 to 2020, which is a challenge for future prevention and control of AIDS. Targeted measures should be urgently implemented to reduce late HIV diagnosis.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

HH, XY, and ZX contributed to conception and design of the study. HH, XY, KZ, and ZD organized the database. HH and ZX performed the statistical analysis. QS, DW, WH, and RT conducted laboratory testing. HH wrote the first draft of the manuscript. XY, ZX, and QS wrote the sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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