

# Prevalence of HIV infection among foreign applicant to residency in Shanghai, China, 2005-2016

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## Research

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# Abstract

Background Shanghai is an international city which has high proportion of entry travelers from all over the world. The HIV(human immunodeficiency virus)infection status of this population can reflect the global trend of HIV prevalence. Thus, a retrospective epidemic investigation was conducted to clarify the prevalence and characteristics of HIV infection among entry travelers who apply to residency in Shanghai. Methods Totally 50830 entry travelers who applied to residency in Shanghai(2005-2016)were included. The HIV infection rate was confirmed based on the detection of HIV-1 antibody. Results Among all the recruited entry travelers, 245 persons were determined HIV positive with infection rate of 0.48%. The detection rate of HIV in male was significantly higher than that in female ( $\chi^2 = 62.584$ ,  $P < 0.0001$ ). Those aged 18-30 years, 31-40 years and >40years accounted for 34.3%, 39.6% and 26.1% of the infected population. There was no increase in trend of HIV prevalence rates among the sampling years (Cochran-Armitage  $Z=2.543$ ,  $P=0.111$ ). Proportions of individuals infected through homosexual transmission increased over the study period (Cochran-Armitage  $Z=5.41$ ,  $P<0.001$ ), while the proportion infected through heterosexual declined over time (Cochran-Armitage  $Z=3.38$ ,  $P =0.001$ ). Conclusion The rate and characteristics of HIV infection among foreign applicant to residency in Shanghai were clarified in the study. The results would have provided the necessary epidemiological data for monitoring the HIV epidemic among entry international travelers and to further contribute to the establishment of relevant policies and regulations for HIV control and prevention.

## Background

Since the AIDS epidemic peaked in 1993, it turned to be the leading cause of death among 25 to 44-year-old people, and it had become the eighth most common cause of death worldwide<sup>[1]</sup>. Although human immunodeficiency virus (HIV) infection and mortality rates have been declining because of the highly active antiretroviral therapy and effective prevention measures globally, about 35.3 million people are living with HIV worldwide, HIV infections are considered to be the global threat of present era<sup>[2,3]</sup>. China's State Council promulgated and implemented the "AIDS prevention and control regulations" in March 1st, 2006, to clear the work requirements and tasks of inspection and quarantine system. In May 30th, 2007, AQSIQ examined and approved the "port AIDS prevention and control measures", the port entry & exit personnel AIDS quarantine, monitoring, prevention and control and financial security has specific provisions and requirements. On April 24 of 2010, the executive meetings of the State Council adopted "the Decision of the State Council on Amending 'Detailed Rules for the Implementation of the Law of the People's Republic of China on Frontier Health Quarantine Inspection'", which clearly stipulated that the entry of foreign AIDS patients was no longer restricted. This regulation is consistent with most developed countries.

Shanghai is a major destination of international business and trade which has a large population of cross-border travelers consequently. Entry travelers and their activities often lead to the spread of infectious diseases in China and even on a global scale<sup>[4]</sup>. Moreover, such a large floating population could promote HIV cross-border transmission, leading to a higher HIV prevalence in the world.

Strengthening surveillance and attention to this group is crucial to the prevention of HIV/AIDS, particularly in the border areas where trade and tourists are flooding. In addition, the investigation of temporal changes in HIV infection and the associated risk factors could be important for the prevention of HIV in this bridge population. Although HIV infection among cross-border travelers has been reported in other major cities [2, 5], the HIV related epidemic characteristics of these population in Shanghai are still unclear. Therefore, in order to clarify the HIV epidemic characteristics among entry travelers, a large-scale retrospective study on HIV screening was conducted on cross-border travelers who entered China through Shanghai ports from 2005–2016 and a further analysis was performed. The objective of this research was to describe the epidemiological and characteristic of HIV infection among international entry travelers in Shanghai to help policy makers identify and address the specific needs for HIV prevention, control and treatment.

## Methods

### Study population and data collection

From January 2005 to December 2016, there were about 5 thousand entry travelers on average in Shanghai annually. Those foreign applicants who apply for a stay in China for one or more years need to finish health examinations in Shanghai International Travel Healthcare Center, which affiliated to Shanghai Entry-Exit Inspection and Quarantine Bureau, responsible for the health assessment and epidemiological surveillance of people entering and exiting Shanghai. Routine examinations included blood routine test, serum chemistries test and the detections of major infectious diseases. All applicants who completed the health examination in Shanghai International Travel Healthcare Center were forced to perform the HIV test. Before the entry, the applicant who had voluntarily declared HIV positive had to re-examined again to confirm the diagnosis. In the main, initial screening was carried out with an enzyme-linked immunoassay (ELISA) or an enzyme immunoassay (EIA). Samples which were screened to be reactive were repeated in duplicate with the same assay. If two of three test results were positive, the sample was transmitted to FDA-approved supplemental/confirmatory assays, HIV-1 Western Blot (Genetic Systems HIV-1 Western Blot, Bio-Rad Laboratories, Redmond, Washington, US) and/or an immunofluorescent antibody (IFA) test (Fluorognost HIV-1 IFA, Waldheim Pharmazeutika, GmbH, Vienna, Austria) would be done. The diagnosis of HIV was based on HIV assays approved by Chinese Food and Drug Administration (FDA). Detection methods and quality control are strictly referred to the same period "National AIDS detection technical specifications" and "National AIDS detection work management measures" [6]. A face-to-face interview was conducted in a private room to gather information on socio-demographic characteristics [age, gender, nationality, travel history, occupation, education, family situation and risk behaviors of transmission] for those with final diagnosis of HIV. The respondents who did not complete the survey were regarded as missing data and were not included in the statistical scope of the study.

All HIV patients' nations were classified as developed, developing and underdeveloped countries respectively. For the current 2016 fiscal year, low-income economies were defined as those with a GNI per capita, calculated using the World Bank Atlas method, of \$1,045 or less in 2014; middle-income economies were those with a GNI per capita of more than \$1,045 but less than \$12,736; high-income economies were those with a GNI per capita of \$12,736 or more; Lower-middle-income and upper-middle-income economies were separated at a GNI per capita of \$4,125<sup>[7]</sup>.

## Data Analysis

The statistical analysis was carried out using SPSS, version 22.0 software package (SPSS Inc., Chicago, IL, USA). Characteristics between the groups were compared using  $\chi^2$  tests. Cochran-Mantel-Haenszel was used to compare the differences of the total population while controlling for time factors. Time trends were calculated using Cochran-Armitage trend test. The results with P values < 0.05 were considered to be statistically significant.

## Results

### Characteristics of HIV positive travelers

From 2005 to 2016, a total of 50830 travelers who had entered in China through Shanghai port had finished HIV infection screening test in Shanghai International Travel Healthcare Center. The annual recruited populations (range 2640-5764) were not different significantly among the sampling years. According to ELISA and WB results, 245 individuals were detected to be infected with HIV, resulting in an infection rate of 0.48%. Among the 245 HIV-infected cross-border travelers entering at Shanghai border, 215 (87.8%) were male and 30 (12.2%) were female, with a male-to-female ratio of 7.17:1. The detection rate of HIV in male was significantly higher than that in female ( $\chi^2=62.584$ ,  $P<0.0001$ ). The age range of this population was 18-69 years old (median, 34.2 years). Those aged 18-30 years, 31-40 years and >40 years accounted for 34.3%, 39.6% and 26.1% of the infected population, respectively. Most of the positive cases were employed (53.88%) and had a second or higher degree (81.22%). Moreover, 54.70% of the positive cases were not married and 40.82% of them were from low-income countries.

Table 1 Demographic characteristic of positive cases

	Subjects	Proportion(%)
Total	245	100%
Gender		
male	215	87.76%
female	30	12.24%
Age		
18-30	84	34.3%
31-40	97	39.6%
>40	64	26.1%
Current employmentstatus		
Employed	132	53.88%
Unemployed	38	15.51%
Student	54	22.04%
Housewife/ husband	21	8.57%
Education		
Less than secondary	46	18.78%
Secondary or higher	199	81.22%
Marital status		
Never married	134	54.70%
Married orcohabitating	45	18.37%
Previouslymarried	66	26.94%
Host country		
high-income countries	56	22.86%
middle-income countries	89	36.33%
low-income countries	100	40.82%
Risk behaviors oftransmission		
Heterosexual	61	24.90%
Homosexual	142	57.96%
Blood/Plasma	8	3.27%
Injecting drugs	2	0.82%
Unknown/others	24	9.80%
Condom use		
never	45	18.37%
sometimes	92	37.55%
Almost always	90	36.73%
always	10	4.08%

## Infection rates over the years

Infection rates over the years were listed in Table 2. Although the annual detection rates were different, the results from trend analysis showed that there was no increase in trend of HIV prevalence rates among the sampling years (Cochran-Armitage  $Z=2.543$ ,  $P=0.111$ ). Trend analysis based on gender classification indicated that neither male ( $Z=1.944$ ,  $P=0.163$ ) nor women ( $Z=0.198$ ,  $P=0.656$ ) had increase trend of HIV positive rates .

**Table 2 HIV antibody positive rates among entry travelers 2005-2016**

Year	Male	Female	Total
2005	65(10/1532)	18(2/1108)	45(12/2640)
2006	54(10/1854)	8(1/1202)	36(11/3056)
2007	59(13/2198)	15(2/1374)	15(15/3572)
2008	58(15/2588)	39(6/1532)	51(21/4120)
2009	45(12/2665)	14(2/1445)	34(14/4120)
2010	80(15/1878)	12(2/1676)	48(17/3554)
2011	84(19/2254)	9(2/2136)	48(21/4390)
2012	85(20/2353)	10(2/2023)	50(22/4376)
2013	65(17/2604)	20(4/1969)	46(21/4573)
2014	99(29/2934)	5(1/2062)	60(30/4996)
2015	59(27/4541)	18(2/1128)	51(29/5669)
2016	77(28/3633)	19(4/2131)	56(32/5764)
Total	69(215/31034)	15(30/19796)	48(245/50830)

\* positive rate: number in 10000 persons (positive number / number of samples)

## The change of transmission route

Proportions of individuals infected through homosexual transmission increased over the study period (Cochran-Armitage  $Z=5.41$ ,  $P<0.001$ ), while the proportion infected through heterosexual declined over time (Cochran-Armitage  $Z=3.38$ ,  $P=0.001$ ). The proportion infected through injecting drug declined over time ( $Z=3.52$ ,  $P<0.001$ ). With the change in major HIV risk factors, the heterosexual spreading of HIV was gradually increasing to be the main transmission route, compared to syringe/needle sharing. (Figure 1.)

## Discussion

Epidemiological characteristics of infectious diseases have changed dramatically requiring necessitate health care workers to understand the status of these diseases, especially for AIDS and other pandemic disease [8-10]. Efforts and investments have been made globally to strengthen countries' HIV monitoring and evaluation (M&E) capacity [11]. Cross-border travelers with an HIV infection may cause local HIV transmission and are defined as a bridge population [12]. Shanghai has the largest cross-border population entering China from countries around the world. Cross-border travel is important for culture and commerce but also leads to the spread of infectious diseases. Therefore, it's important to analyze HIV prevalence and demographic characteristics in this population. This was the first study which displayed the HIV infection rate and their characteristics among entry travelers over such a long time span, with such a large-scale population in Shanghai.

From 2005 to 2016, there were 50830 international persons entering Shanghai who finished health examination in Shanghai International Healthcare Center. In this crossing border population, a total of 245 (0.48%) travelers were determined as HIV positive. Overall, we found that the HIV infection rate among entry travelers in Shanghai did not show an increasing tendency over these years, contributed by global HIV/AIDS prevention and control efforts, such as promoting condoms in Southeast Asian countries and implementing the Asian regional AIDS project, had received international attention and achieved good results.

After the HIV infected persons were found, the epidemic situations were reported to the CDC epidemic reporting system, and the related data were handed over to the local health department. In recent years, the Shanghai international travel healthcare center has strengthened the follow-up supervision of the entry of AIDS patients, and established foreign liaison files for foreign HIV infected persons. Health education for the HIV infected persons was carried out to provide information about disease diagnosis and treatment and conduct high risk behavior intervention. With the local disease control departments, medical institutions, foreign embassies and other information interoperability, joint cooperation, explore overseas HIV infection health counseling and treatment measures. AIDS patients who do not want to return to the country need to be treated by providing health consultation and designated medical institutions to receive paid medical treatment. Using the existing conditions, according to local conditions, the entry-exit personnel health examination site could be settled as a consulting base. We tried to make full use of newspapers, magazines, radio, television and other mass media to answer typical questions; to establish International Travel Health Advisory contact, by using of websites, cellphone app and other ways to answer questions raised by travelers on AIDS prevention and control work. With the local health administration, Family Planning Commission, Red Cross and other departments, through public welfare performances, on-site distribution brochures, free distribution of condoms and other means were undergoing.

In the last decade, we had seen a dramatic change in the demographic structure of the population of people living with HIV (PLWH) <sup>[13]</sup>. This study found that HIV infection of entry travelers in Shanghai also had certain demographic characteristics. From the perspective of age-specific HIV prevalence, the major age population of HIV infected travelers was 18–40 years (73.90%). Overall, an estimated of 5 million young people aged 15–24 were living with HIV in 2009 and accounted for 41% (about 890,000 cases) of new HIV infections globally <sup>[14]</sup>. HIV is disproportionately afflicting young people worldwide globally, especially in the developing countries. The similar trend persisting was founded in our study. According to the diagnostic tests, those with positive results was divided into three groups, (more than 40 years old, 31 to 40 years old, less than 30 years old), working men aged 31 to 40 had the highest incidence whereas working women had a very low incidence (near zero). The results are consistent with Wang's research, they found that travelers aged 21–30 and 31–40 were the most commonly infected individuals among entry travelers in Yunnan Province <sup>[2]</sup>.

In addition, HIV infection was more frequently detected among individuals with occupations such as businessman and entertainers. Furthermore, from a view of marriage, unmarried (single or other marital status) applicants had higher proportion of infection compared to those married group (54.70% vs 18.37%). In general, people with better education and better cognitive ability have healthier behaviors and lower HIV infection rate <sup>[15]</sup>. Nevertheless, our study found that most of the infected people were highly educated. The entry travelers are divided into high-income countries, middle-income countries, and low-income countries based on the host country <sup>[7]</sup>. Our data showed that most of the positive cases were from middle- and low-income countries.

From the view of transmission, our data implied that sexual contact was the major high risk behavior, especially in those men have sex with men (MSM). In the meantime, a study in the US reported the most common HIV transmission route had changed to homosexual contact in men, while injection drug users were ranked the third<sup>[16]</sup>. We also deemed that the major HIV infection route had been shifted from intravenous drug use to sexual contact in this study.

Monitoring of HIV infections in high-risk populations was particularly important for preventing the spread. This study found that those who did not use condom accounted for a large proportion in the positive cases. Inconsistent condom uses and several risk-taking behaviors were also reported among young people in United States (African-Americans aged 18–21) and Uganda<sup>[17]</sup>. Insufficient HIV-related knowledge and low self-awareness of risk might be associated with an increasing number of AIDS. Thus, promotion and acceptance of sex education, accurate and age-appropriate information on HIV appeared to be the needed in order to interrupt the spread of HIV.

## Strengths And Limitations

Since this was a record-based study, some of the applicant records might be incomplete. The face to face interviews were only conducted in the HIV population, the characteristics of HIV negative population could not be obtained. Therefore, the demographic characteristics of them could not be compared. Furthermore, the sample may not be representative of the total population of entry travelers in China. At present, most foreigners in China are short-term immigration, some of them go back and forth many times, the time of staying in China is less than one year each time, and the mobility is relatively large. China's law only applies to the foreign applicants who apply for residence in China to carry out AIDS monitoring, so there is no effective monitoring measures and methods for most of the short-term immigrants.

According to the relevant provisions, entry foreigners holding HIV antibody test negative proof of overseas public hospitals could be exempted from inspection. However, in the past years of work, many cases of these population, the HIV test were found positive. At the same time, the public security, inspection and quarantine, education, human resources and social security departments had found that some foreign health inspection materials provided by foreigners were incomplete or fraudulent. This part of the population was the potential spread of AIDS population, however, the supervision of them was more difficult.

This study was one of few studies based on the certain population that have been conducted in China. Although there were limitations and incomplete information, we still believed that this study could help us understand the dynamics of HIV transmission among international travelers to some extent. The findings of this study highlighted the information gap in this area and helped us fill in a small part of it.

## Conclusion

Our data from Shanghai International Travel Healthcare Center more than a decade, suggested a target for HIV/AIDS prevention and control efforts for international travelers. The rate and characteristics of HIV infection among foreign applicant to residency in Shanghai were clarified in the study. The results would have provided the necessary epidemiological data for monitoring the HIV epidemic among entry international travelers and to further contribute to the establishment of relevant policies and regulations for HIV control and prevention.

## **Declarations**

### **Ethics approval and consent to participate**

The design of this research was reviewed by Shanghai Entry-Exit Inspection and Quarantine Bureau and approved by Shanghai Medical Ethics Committee. All personally identifiable information for the study population was stripped and the individual research identification number was assigned before the data set was sent to investigators for analyses.

### **Consent for publication**

Written informed consent for publication was obtained from all participants.

### **Availability of data and material**

All data are fully available without restriction.

### **Conflicting interests**

All authors declare they have no conflict of interest.

### **Funding**

None

### **Authors' contributions**

QJ, XJ, ZPQ and ZR collaborated in the design of the study. QJ and XJ developed the survey instruments. QJ, ZPQ and ZR oversaw the data collection. QJ and ZR did the statistical analysis and also wrote the initial drafts. All authors reviewed and edited the report and all take responsibility for its integrity and the accuracy of the analysis.

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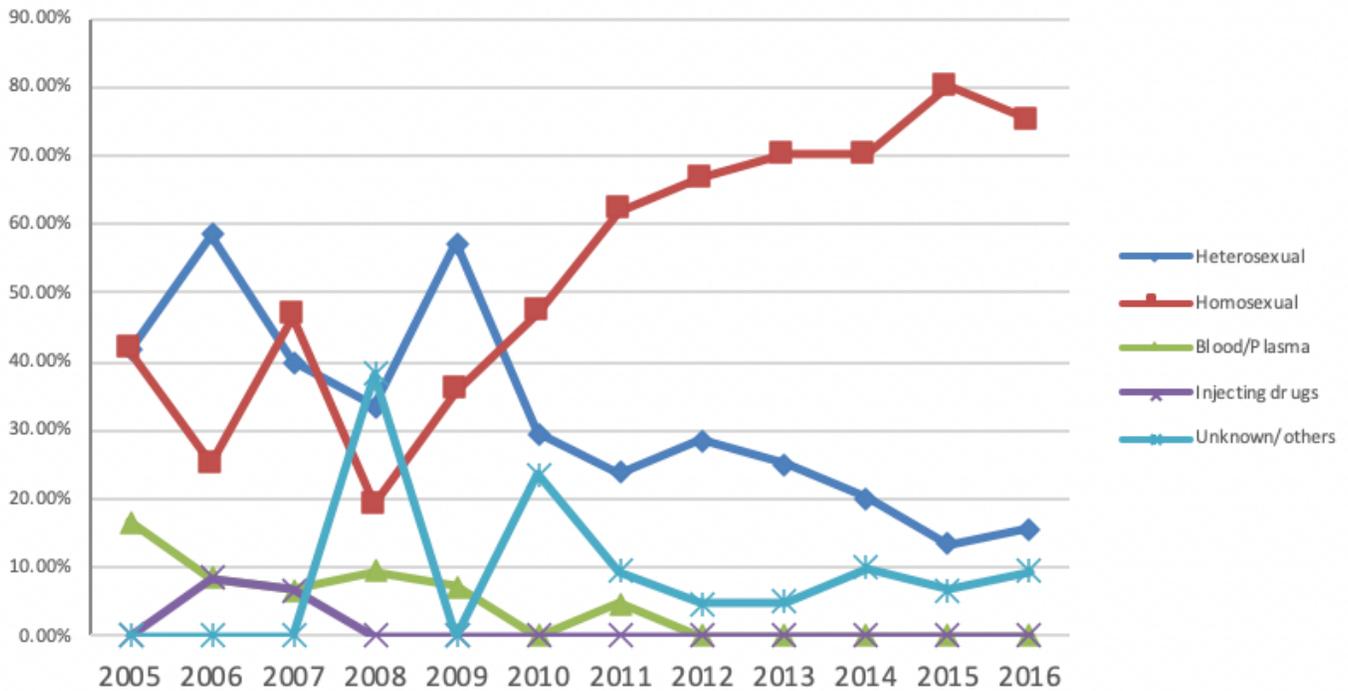
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## Figures



**Figure 1**

The change of transmission route over the years (Percentage of patients)