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An Analysis of Risk Factors for HIV Infection among Chinese Blood Donors

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Abstract

Background—Information regarding the risk factors for HIV infection among Chinese donors is important for understanding the trend of HIV transmission routes and for developing effective donor behavioral screening policies.

Methods—In 2009–2011, 77 HIV positive and 649 HIV negative consented donors who screened non-reactive for HBV, HCV, Syphilis, and ALT in four REDS-II Chinese regions received and completed a questionnaire by mail regarding their recent and past medical procedures, drug use, and sexual behaviors as well as the reason for making a donation. Exploratory and confirmatory factor analyses grouped questions into three risk factors. Multivariable logistic regression analysis examined the relationship between dichotomized factor scores (> median for higher risks vs. <=median for lower risks) and HIV status adjusting for center, age, gender, and education.

Results—More males (81% vs. 64%), donors with < high school education (38.2% vs. 15.5%), and divorced/separated/widowed donors (14% vs. 4%) were in the HIV positive than negative group. The three risk factors were: Test-seeking tendency, medical-related risks, and behavioral risks. In multivariable logistic regression analysis, greater test-seeking tendency and behavioral risks were associated with HIV infection, adjusted ORs being 2.2 (1.2–4.1) and 3.8 (1.8–7.9) respectively; but medical risks were not, OR: 1.2 (0.6–2.2). In comparison to less high school education, high school and above education was significantly associated with lower risks for HIV infection, ORs being 0.35 (CI: 0.17–0.70) and 0.17 (CI: 0.09–0.33), respectively.

Conclusions—Test-seeking tendency and high-risk sexual behaviors are important predictors of HIV infection in Chinese blood donors, suggesting that the Health History Inquiry used in donor selection process needs improvement to defer high-risk donors more effectively.

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Keywords

risk factors for HIV infection; Chinese Blood donors; behavioral risks; medical risks; test-seeking and HIV infection

In 2008, China became one of the 62 countries in the world where national blood supplies came from 100% or almost 100% non-remunerated voluntary donors [1,2]. This was a dramatic increase from 5.5% unpaid donations in 1998[3]. Meanwhile, all blood donations are mandatorily screened for anti-HIV-1/2, HBV, anti-HCV, and anti-Syphilis using serological assays[1]. Such landmark changes, as a consequence of the implementation of National Blood Law in 1998 and execution of new policies, regulations, and standards for donor selection have greatly improved the safety of blood supply and reduced the number of transfusion transmitted HIV infections in China[4]. In the period of 1985–2005, about 1/3 of reported HIV infections in China were attributed to former commercial blood donation; yet in 2009, only 5.5%, or about 2,640, newly detected HIV infections were related to blood products[5], and many of them were cases infected years ago. The fears of HIV infection through transfusion aroused by the outbreaks among commercial blood donors in late 1980's and early 1990's are almost history. However, strict surveillance of HIV infections in blood donors is still crucial to maintain and further enhance the safety of blood supply, especially in the context of the changing HIV epidemic in China in recent years: the diversifying routes of transmissions and increasing trend of infections in certain high-risk groups, for example, Men having Sex with Men (MSM) and sex workers[6,7,8]; the increasing genetic diversity of the virus[9]; and the surging demand for transfusion due to the introduction of advanced of medical and surgical procedures and a recent health insurance reform giving access to medical care for rural residents[10].

In the absence of NAT application in routine donation screening, the donor health history deferral questionnaire plays an important role in guarding the safety of blood supply. The Chinese donor health history deferral questionnaire used in 2008–2010 included questions about whether donors were diagnosed with HIV/AIDS, hepatitis, syphilis, tuberculosis, cancer, malaria and other common non-infectious diseases including cardiovascular diseases, hypertension, and whether a donor had received blood transfusion in the past 5 years. In addition, a few high-risk behaviors were queried, such as having used illicit drug use, being MSM, or having had multiple sex partners, having had sex with anyone involved in illicit drug use, MSM, having multiple sex partners, or diagnosed with HIV/AIDS, syphilis, gonorrhea, and other sexually transmitted diseases, or having a tattoo in the past 12 months. Ideally, the pre-donation health screening questionnaire should have deferred all donors who have had medical history, family history, or risk behaviors associated with infectious diseases including HIV infection. Yet, reports on the increasing serological reactive rates for syphilis and HIV infections among Chinese blood donors have raised questions about the effectiveness of the current donor health screening questionnaire[11,12]. Little is known about the major risk factors and the importance of such risk factors for HIV infection among Chinese blood donors. With sexual transmission becoming the leading route of HIV transmission and the rising HIV infection rates among high-risk groups such as MSM and sex workers [6,7,8], the potentially accelerating spread of HIV from high-risk groups to the general population[13] may protend into an increasing threat to the safety of blood supply.

We conducted a multi-blood center survey study in four HIV high-prevalence regions to explore the primary risk factors for HIV infection in Chinese blood donors and the relative importance of these risk factors. Based on 821,320 donations collected in 2008–2010 and Western blot confirmatory test results of anti-HIV-1/2 ELISA screen reactive samples, the

estimated average HIV prevalence among blood donors in these regions was 66 (range 2–100) per 100,000 first time donors and the incidence among repeat donors was 9 (range 1–13) per 100,000 person-years[11]. The specific risks we examined included illegal drug use, hetero- and/or homo-sexual behavior, transfusion history, history of previous whole blood or plasma donation, self and family history of hepatitis, HIV, and other infectious diseases, medical injections and acupuncture, as well as having tattoo or body piercing etc. as routes of transmission for HIV. An understanding of the major risk factors for HIV infection among blood donors will not only shed light on the effectiveness of the donor health screening questionnaire but also reveal the current risk factors associated with HIV infection among prospective donors to help develop effective donor screening policies and standards as well as to inform broader surveillance of HIV risk factors in China and other countries.

MATERIALS AND METHODS

Enrollment and study procedures

This study followed all policies and rules established by the Chinese government to protect the confidentiality and rights of HIV infected individuals. All four participating blood centers, Kunming, Urumqi, Luoyang, and Mianyang are located in HIV high prevalence areas where > 10,000 HIV/AIDS cases have been cumulatively reported since the beginning of the epidemic[5]. They were participants of the Retrovirus Epidemiology Donor Study-II China Program (REDS-II China)[14] funded by U.S. National Heart, Lung, and Blood Institute (NHLBI), which was a collaboration between the Institute of Blood Transfusion (IBT) of Chinese Academy of Medical Sciences, China and Johns Hopkins University. Routine HIV screening tests are conducted at blood centers using two different ELISA kits approved by Chinese Food and Drug Administration (FDA). Confirmatory testing is performed by local Chinese CDC laboratories using Western blot assays. Local CDC laboratories are also responsible for notifying, counseling, and follow-up care of donors with confirmed anti-HIV results.

Between March 2010 and March 2011, blood donors whose donations screened reactive for HIV by ELISA at blood centers and confirmed positive by Western blot at local CDC laboratories were considered candidates for HIV positive donors for our study. These donors were approached during routine donor follow-up procedures. Meanwhile, donors whose donations screened non-reactive for ALT, HBsAg, anti-HCV, anti-HIV-1/2, and anti-Syphilis from the same blood center during the same month were randomly selected as controls.

Candidate HIV positive and HIV negative donors were first contacted by blood center personnel by phone for verbal consent for participation and confirmation of current mailing address. A study enrollment packet was then mailed to consented donors, along with instructions for completing the questionnaire and blood center contact information if donors had questions about the study or their donation testing results. Both HIV positive and negative donors received the same packet with the following contents: study information sheet, Risk Factor Questionnaire, a pre-stamped envelope for returning the completed questionnaire to the blood center, and a 100 Yuan incentive (approximately $15) for completing the questionnaire.

The study information sheet described the purpose of this study, the confidential and voluntary nature of participation, and the amount of monetary incentive for the participants. A donor’s infectious disease testing result was not revealed in the mailing packet because HIV status notification is the sole responsibility of CDC. The donor was simply informed that he/she might or might not be infected with infectious diseases and that if they had been notified by the blood center or CDC with positive infectious disease testing result, they

should follow the instructions of the blood center or CDC for additional testing, consultation and follow-up care. Two reminder calls or text messages followed the initial mail packet, one in four days after the mailing to confirm that the donor had received the package, another one in 10 days if a completed questionnaire was not received by the blood center. A maximum of five follow up calls would be made if the questionnaire was not returned to the blood centers.

Risk Factor Questionnaire

The Risk Factor Questionnaire (RFQ) included 42 questions with multiple choice responses on the following components: 1). general demographics such as age, gender, marital status, and education; 2) donor opinion on donation as an easy way to get blood tested; 3) history of transfusion, cosmetic and medical surgery, acupuncture, dental cleaning, finger sticks (for blood sample collection), as well as subcutaneous injection; 4) self or family member history of hepatitis or sexually transmitted disease; 5) self or family member drug abuse; 6) Sexual behaviors and sexual partner's drug use information. Except for the questions about donor's opinion on donation as an easy way to get blood tested and a few questions about the frequency of drug injection or condom use, only three choices of responses were given for each question: Yes, No, Don't Know. For the questions about donor's opinion, choices of responses were: Totally Disagree, Somewhat Disagree, Somewhat Agree, Totally Agree. The questions selected for our study were developed based on a thorough review of the current international and Chinese literature to ensure that the risk factor questions were comprehensive and culturally appropriate, and was revised based on preliminary focus group discussion and cognitive testing. A version of the final questionnaire in Uyghur language was used for Uyghur donors in Urumqi, Xinjiang.

Statistical Analysis

Demographic characteristics and responses to individual questions (items) about risks of HIV infection were compared between HIV positive and negative donors using Chi-square statistics. Exploratory and confirmatory factor analyses with item reduction were conducted in sequential fashion to identify the number of risk factors and clusters of items that were most reliably associated with each risk factor category[15]. Both conceptual reasons and statistical criteria were considered in the evaluation of the number of factors and the questions that loaded on these factors to finalize the factor analysis model. Item-level risks included in final factor analysis were compared by HIV status using Chi-square statistics with significance level p-values adjusted for multiple comparisons. The final factor scores for all factors were dichotomized into two groups: Above median vs. median and below, indicating higher vs. lower risks. Dichotomized factor scores were compared between HIV positive and negative groups in bivariate logistic regression analysis. Multivariable logistic regression analyses were performed to evaluate the importance of individual risk factors in relation to HIV status after adjusting for age, gender, education and center differences.

All analyses were performed using SAS Windows version 9.2 (SAS Institute).

RESULTS

During March 2010-March 2011, we estimated that there were 97 donors whose donations were confirmed as HIV positive by Western blot assays at participating blood centers. We successfully located 55 (57%) of these positive donors. The rest of these positive donors either did not give correct contact information (n=11) or could not be linked to identified at the individual level due to the loss of blood samples for confirmation (n=31). An additional 32 confirmed HIV positive donors in surrounding areas of Mianyang and Luoyang were recruited based on information about their HIV positive donations in January - October

2009. We mailed enrollment packages to these 87 HIV positive and 800 HIV negative donors. 77 HIV positive and 649 HIV negative donors consented and completed the questionnaires.

Sample characteristics

Table 1 presents the demographic characteristics of the enrolled donors by HIV confirmed positive and negative status. The overall characteristics of the enrolled HIV negative subjects were similar to those of the donor population in these areas[16]. The majority of donors (58.7%) were younger than 36 years old. There were more males than females (64.9% vs. 35.1%), and more Han than ethnic minority donors (92.9% vs. 7.1%), p values < 0.05. However, more males (81.8% vs. 64.9%), donors with less than high school education (38.2% vs. 15.5%), and divorced, separated, or widowed donors (14.3% vs. 4.1%) were found in the HIV positive than negative group. HIV positive donors were less likely to have completed above high school education (34.2% vs. 56.0%), $p < 0.05$. A higher proportion of 26–35 years old were found in the HIV positive than negative donors (41.9% vs. 26.9%), $p = 0.02$. There was also a higher proportion of ethnic minorities in the HIV positive than HIV negative group (14.3% vs. 7.1%), $p < 0.001$.

Factor analysis

Exploratory and confirmatory factor analyses with item reduction identified three factors based on 24 items: test-seeking tendency, medical-related risks (including surgery, transfusion history, and acupuncture et al.), and behavioral risks (including lived with a person with illegal drug use, had multiple sexual partners, MSM, et al.). Table 2 presents the comparison of the 24 items by HIV positive and negative donors grouped by the three factors.

Test-seeking tendency—The three questions that loaded on this factor were related to donor's opinion on the importance of blood donation as an easy way to get their blood tested. A response of "YES" to these questions indicated the donor's likelihood of being a test-seeker, which is often associated with higher serological marker rates[17]. Compared with HIV negative donors, more HIV positive donors responded "YES" to the questions about the importance of getting blood test result (77.9% vs. 64.7%) and knowing their HIV or hepatitis status as a reason for donation (20% vs. 10.7%), p values = 0.02. However, when multiple comparisons for all 24 items were performed, the adjusted p-value for a single comparison (i.e., comparing responses to one item between the HIV positive and negative group) to be statistically different was reset at p-value < 0.002. Therefore, such differences were not statistically significant.

Medical-related risks—The questions about medical related risks varied from major and minor in-patient and out-patient surgeries including receiving blood transfusion, intramuscular (IM) or intravenous (IV) injection, ear-piercing, dental cleaning and endoscopy. Compared to HIV negative donors, more HIV positive donors reported having had blood transfusion (8% vs. 2.7%), injection (IM or IV) in the past 12 months (54.7% vs. 23.4%), endoscopy (14.5% vs. 7.0%) and had been deferred as a blood donor (12% vs. 3.9%). Other than injection in the past 12 months, none of these differences were significant at the adjusted p-value of 0.002. Meanwhile, HIV positive donors were not different from the negative donors on nine other medical related risks included in the final factor analysis, such as medical, dental, or in-patient or out-patient surgeries, p values > 0.10.

Behavioral risks—Among all of the behavioral risk questions in the questionnaire, significant differences between HIV positive and negative donors were found in 5 questions, suggesting that HIV positive donors were more likely than HIV negative donors to have the

following high risk behaviors: having two or more sexual partners (55.3% vs. 14.9%), paying or receiving money for sex (21.9% vs. 3.8%), and being MSM (20% vs. 0.2%), having been diagnosed with a sexually transmitted disease (15.8% vs. 0.2%), and having a tattoo (15.1% vs. 3.5%), p values < 0.002. In addition, living with a person involved with illegal drug injection was a marginal risk factor for HIV infection, albeit only a small number of donors responded YES to this question (4.1% vs. 0.5% among HIV positive and negative donors respectively), p = 0.01.

Correlation between risk factors and HIV infection

Among 77 HIV positive donors, 55 (71.4%) belonged to the higher test-seeking tendency group; 47 (61%) belonged to the higher medical-related risk group; and 62 (80.5%) belonged to the higher behavioral risk group, in contrast to 319 (49.2%), 299 (46.1%), and 291 (44.8%) among the 649 HIV negative donors respectively.

In bivariate analysis, the association between dichotomized factor scores and HIV infectious status was examined in logistic regression analysis. Test seeking tendency was associated with HIV positivity at an odds ratio of 2.72 (95% CI: 1.62–4.56), suggesting that donors who expressed a greater tendency for testing seeking were about 3 times more likely to be HIV positive than donors with lower tendency for test seeking. Above median medical related risks were also correlated with HIV positive status, OR: 1.83 (CI: 1.13–2.97). Similarly, donors who had above median behavioral risks were more likely to be HIV positive than those with median and below risks, OR: 5.09 (CI: 2.83–9.13). Table 3 displays these results.

In the multivariable logistic regression analysis (lower section of Table 3), we examined the independent correlation between risk factors and HIV infection status after adjusting for other factors. After adjusting for center, age, sex, and education differences, greater test-seeking tendency and higher behavioral risks were significantly associated with HIV infection, adjusted OR: 2.23 (1.23–4.05) and 3.77 (1.79–7.93) respectively, p values < 0.05. However, medical risks were not related to HIV infection, OR: 1.15 (0.59–2.22), p = 0.68. Meanwhile, male donors had a marginally higher likelihood than female donors to be HIV positive, OR: 1.90, CI: 0.96–3.77, p =0.07. Donors with high school or above education were much less likely to be HIV positive than those with less than high school education, OR: 0.35, CI: 0.17–0.70 for High school education and OR: 0.17, CI: 0.09–0.33 for above high school education, p < 0.01. Age was not an independent predictor of HIV infection after adjusting for gender, education, and risk factors, p = 0.18.

Questions not included in the final analyses

Among the questions not included in the current analyses, some were about donor's or their sex partner's illegal drug use. For example, "Ever used needles to shoot street drugs?" 'Ever shared needles to inject street drugs?" "Used illegal oral or intranasal drugs without doctor's prescription?" Very few donors (<=2) responded YES to these questions. A second group of questions were excluded because of low response rates and lack of distinguishing power (no difference between HIV positive and Negative groups). Examples of these questions are "Ever been diagnosed with hepatitis?" and "Any family members had hepatitis?" "Had household contact with someone who had hepatitis or HIV/AIDS?" A third group of excluded questions are "Number of previous donations", "Had contact with human blood or body fluids?" "Do you always use disposable needle during injection?" Although a few donors responded YES to these questions, due to the ambiguity of the words and/or lack of distinguishing power, we removed them from the final analyses. Overall, items excluded from the analysis did not have any significant impact on the results.

DISCUSSION

The present study explored the type of risk factors for HIV infection among Chinese blood donors, the importance of different risk factors, and the specific risks for HIV infection composing each factor. All three types of risk factors identified in our study, i.e., test-seeking tendency, medical related risks, and behavioral risks, were associated with HIV infection in bivariate analyses. However, after adjusting for age, sex, education, center differences, and each other, only test-seeking tendency and behavioral risks were independent predictors of HIV infection, whereas medical related risk factors were not. Donors with above median behavioral risks were 3.77-fold more likely to have HIV infection than those with median or lower behavioral risks. Having multiple sexual partners, having paid or received payment for sex, MSM, and having a tattoo were among the major behavioral risks associated with HIV infection. Meanwhile, HIV positive donors were about twice likely to report test-seeking tendency than HIV negative donors.

In the present study, a substantial number of donors, about half of the HIV positive donors and 15% of the negative donors, reported having multiple sexual partners in the past 12 months, and not surprisingly, they were also more likely to be diagnosed with a sexually transmitted disease (15.8% vs. 0.2%). In other studies, having two or more concurrent sexual partners was reported to increase the risk of acquiring as well as transmitting HIV infection to the partners at least at the individual level[18,19]. For example, back in the late 1990s, having multiple sex partners or casual sex or having sex with people who had such behaviors were found to be risk factors for HIV infection among blood donors in Italy[20]. In the past few decades, the social economic development in China has resulted in changes in social norms about sexual practices, which have accelerated the spread of sexually transmitted diseases including HIV infections[21,22]. Since high rates of STD including HIV have been consistently reported among sexually active young adults[22] who also contribute the majority of the Chinese blood supply, their health status is not only a public health issue but also critical to the safety of Chinese blood supply.

The importance of behavioral risks especially MSM and commercial heterosexual sex in HIV transmission among Chinese blood donors is evident and reflective of the changing HIV epidemiology in China. Sexual transmission is becoming the leading route of HIV infection in China[5,6], replacing IDU or history of blood (plasma) donation. The transition of HIV/AIDS epidemic from IDU and MSM groups to individuals with unsafe sex in the general population has been reported in Western as well as Eastern European countries (e.g., Russian Federation and Ukraine), where the increase in the proportions of women and newborns in new HIV infections followed a decrease of the proportion of IDUs[23,24]. The lack of significant association between gender and HIV status after adjusting for other factors in our blood donors, to a certain extent, also reflects the changing routes of HIV transmission[5]. In our study, MSM composed a substantial proportion of HIV positive donors (20%). Meanwhile, 22% of HIV positive donors reported having had commercial sex, in comparison to 3.8% among HIV negative donors. MSM and having commercial sex are two important routes of spreading sexually transmitted diseases from high risk groups to the general population[6,21,25]. Thus, the substantial number of HIV infections among blood donors with MSM and commercial sex behaviors preludes the spread of HIV infection into the general population and a resurging threat to blood safety, especially in regions where increasing HIV infections among MSM and sex workers have been reported[8,26]. In the United States, new HIV infections among gay and bisexual men are rising annually despite all the scientific breakthroughs and decades of effort in HIV prevention, intervention, and treatment[27,28]. In the context of strong social stigmas against HIV infected persons and MSM in China[29–31], China will be facing a greater challenge than the United States to combat the rising HIV epidemic among MSM and its increasing threat to public health and

blood safety. And, given the large size of the Chinese population and the increasing number and mobility of international travelers, it is important to curb the HIV spread quickly and effectively to restrain the HIV epidemic in China from evolving into a threat to global public health.

Although medical related risks overall were not associated with HIV infection after adjusting for other risk factors and we didn't find significant difference in major or minor medical procedures by HIV infection status, more than half HIV positive donors and about a quarter negative donors reported having had injections prior to their most recent donation. While the question about injection might not clearly distinguish illicit drug injections from medical injections, the difference between HIV positive and negative donors was significantly above chance level, which at least illuminates the greater likelihood of injection drug use as a transmission route among HIV positive than negative donors. Meanwhile, the robust association between test-seeking tendency and HIV infection suggests that many HIV positive donors were aware of their risk behaviors and possible consequences prior to donation. These donors, known as 'test-seekers', have been found in Hong Kong[32] and other countries such as Brazil and United States[17,33,34.] Test seeking behavior is reportedly associated with less education but high risk for HIV infection[32] and presents a public health problem especially if the persistent social stigmas against HIV positive people and MSM left unresolved [29–31]. Increasing the availability and convenience of anonymous testing facilities should help to reduce the risks for blood supply contamination incurred by this group of donors.

In our study, a larger proportion of HIV positive donors were divorced, separated, or widowed than those HIV negative donors (14.3% vs. 4.3%), suggesting the importance of understanding the psychosocial characteristics of HIV positive donors and implementation of behavioral and therapeutic interventions to prevent further spread of the infection[34–36]. Overall, the HIV positive donors in our study are much younger than previously reported former plasma donors (26–35 vs. 30–49), and were more likely to have high-risk sexual behaviors, i.e., having multiple sex partners[37], although age was not an independent predictor of HIV status after adjusting for education, sex, and other factors. The association between less education and high risk for HIV infection, and lack of association between medical-related risks and high risk for HIV infection found in the present study was consistent with the same report on former plasma donors who were mostly infected at illegal plasma collection stations through a donation procedure that would pool the same ABO type of blood from several HIV untested people before returning the red blood cells to donors[37]. To hinder the spread of new infections among donors as well as in the general population with less education, it is important to develop and consistently implement education programs regarding HIV knowledge and effective prevention strategies that help convert HIV knowledge into behavior intervention.

One limitation of this study relates to the fact that all of our study participants came from HIV high-prevalence regions, the generalizability of our findings to the donor population in other parts of China needs further evidence. Additionally, we were not able to analyze responses to some questions due to the low response rate and lack of statistical power in analysis; however, this may indicate that these questions pertain to risks that are minuscule among the blood donor population. A larger scale study including donors from more regions with higher response rates will help to validate and extend our findings. Finally, we were only able to keep track of a little more than half of those HIV positive donors because HIV positive donors often gave incorrect phone numbers and addresses, an indication of the fear of social stigma and as well as a potential risk for further spread of the HIV infection.

In summary, our findings suggest that high risk sexual behaviors especially having multiple concurrent sexual partners, MSM, and having commercial sex are among the top behavioral risks for HIV infection among Chinese blood donors, and that HIV positive donors tended to acknowledge their test-seeking tendency. Other risks such as major or minor medical procedures, illegal drug abuse, and family member's health history are not reliable correlates of HIV infectious status among blood donors. The majority of HIV positive donors acknowledged having one or more high risk behaviors during the survey yet passed the routine donor pre-donation screening process prior to the survey. Two possible explanations are that they either misunderstood the Health History Inquiry questions or lied about their behaviors in the donor selection process. The consequence is not only extra cost of blood center staff effort and lab materials but also a potential threat to blood safety. In either scenario, regardless of these donors' ultimate motivation for donation, development and distribution of appropriate educating materials in different formats through different mass communication channels to educate potential donors about HIV infectious window period, availability of alternative testing and counseling services, and the importance to maintain the safety of blood supply may help high-risk donors to defer themselves. On the other hand, improvement of the screening questionnaire by increasing the number of questions about specific high risk behaviors and test-seeking tendency, or modifying the questionnaire language or design to facilitate potential donors' fast reading and comprehension, or improving the facilities where donors may have more privacy while completing questionnaires, are a few alternatives to optimize the effectiveness of donor screening. For example, using Audio Computer Assisted Self Interview (ACASI) in a private room has shown some advantages over face-to-face interview or paper questionnaire in donor selection process[38,39]. If applied in Chinese blood centers, ACASI may help reduce the potential misunderstanding of questions due to poor education and maximize the ease for donors with high-risk behaviors to accurately answer certain sensitive questions.

During the development of this manuscript, the Chinese MOH released a new national standard for Health History Inquiry for donor selection[40], including individual items on high risk behaviors such as having multiple sex partners and commercial sex, having a tattoo, as well as medical risks such as having a medical surgeries or transfusion. The new standard was to be implemented in July 2012. We hope, with the implementation of the new standard health screening questionnaire and NAT testing in post donation screening in the near future, as well as the dedicated effort of multiple levels of Chinese government in reducing HIV new infections, the safety of blood supply in China will continue to improve.

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Table 1

Demographic distribution among blood donors by HIV infection status

Demographic Category	HIV positive, n =77 (%)	HIV negative, n=649 (%)	p-value
Age (years) †			0.02
≤ 25	21 (28.4)	201 (31.8)	
26 – 35	31 (41.9)	170 (26.9)	
> 35	22 (29.7)	262 (41.4)	
Education †			<0.0001
< high school	29 (38.2)	98 (15.5)	
High school	21 (27.6)	180 (28.5)	
Some college and above	26 (34.2)	354 (56.0)	
Gender			0.003
Male	63 (81.8)	412 (64.9)	
Female	14 (18.2)	223 (35.1)	
Ethnicity			0.03
Han	66 (85.7)	591 (92.9)	
Other	11 (14.3)	45 (7.1)	
Marital status			0.0003
Married	33 (42.9)	361 (56.9)	
Never married	33 (42.9)	247 (39.0)	
Divorced/separated/widowed	11 (14.3)	26 (4.1)	
Donation center‡			<0.0001
Kunming	38 (49.4)	165 (25.4)	
Urumqi	8 (10.4)	116 (17.9)	
Luoyang	7 (9.1)	174 (26.8)	
Mianyang	24 (31.2)	194 (29.9)	

† Missing data result in totals less than 77 for HIV positive or 649 for HIV negative group.

‡ The differences between the number of HIV positive and negative donors by center were a consequence of the lack of matching between the two groupsat center level.

Table 2

Itemized comparison by donors' HIV infection status and each risk factor

Questionnaire items composing each factor	HIV Positive n=77 (%)	HIV Negative n=649 (%)	p-value*
Test-seeking intention			
1. Blood donation is good/fast/anonymous way to get blood tested.	36(48.0)	266 (42.0)	0.32
2. It is important for you togetblood test results.	60 (77.9)	416 (64.7)	0.02
3. One reason to donate blood is to find out about HIV and /or hepatitis.	15 (20.0)	68 (10.7)	0.02
Medical risks			
4. Ever had in-patient medical surgery?	17 (22.7)	126 (19.6)	0.53
5. Ever had cosmetic surgery?	3 (3.9)	21 (3.3)	0.77
6. Ever received a blood transfusion?	6 (8.0)	17 (2.7)	0.01
7. Ever had dental surgery?	21 (27.6)	142 (22.1)	0.27
8. Ever had finger sticks?	51 (66.2)	429 (66.8)	0.92
9. Ever received acupuncture?	14 (18.2)	79 (12.4)	0.15
10. Ever had ears or body parts pierced?	22 (30.1)	144 (22.6)	0.15
11. Ever had out-patient medical surgery?	3 (4.0)	54 (8.4)	0.26
12. Ever had dental cleaning?	20 (26.0)	163 (25.2)	0.88
13. Ever had injections in 12 months prior to most recent donation?	41 (54.7)	147 (23.4)	<0.0001
14. Ever been deferred as a blood donor?	9 (12.0)	25 (3.9)	0.006
15. Ever told you are at risk for spreading diseases through your blood?	7 (9.7)	33 (5.2)	0.17
16. Ever had an endoscopy?	11 (14.5)	45 (7.0)	0.02
Behavioral risks			
17. Ever lived with a person with illegal injection?	3 (4.1)	3 (0.5)	0.02
18. In past 10 years, ever had a sex partner diagnosed with hepatitis or HIV/AIDS?	1 (2.4)	7 (1.2)	0.41
19. Ever diagnosed with a sexually transmitted disease?	12 (15.8)	1 (0.2)	<0.0001
20. Ever paid or received money for having sex?	16 (21.9)	24 (3.8)	<0.0001
21. Had 2 or more sexual partners of the opposite sex?	42 (55.3)	96 (14.9)	<0.0001
22. Ever had a tattoo?	11 (15.1)	22 (3.5)	<0.0001
23. In the past year, had sexual contact with someone receiveda blood transfusion?	2 (5.6)	25 (4.2)	0.66
24. Ever had sex with another male? (for males only)	15 (20.0)	1 (0.2)	<0.0001

* P-values were calculated based on Chi-square test or Fisher's exact test, for comparisons between HIV negative and positivedonors. To adjust for multiple comparisons, p-values of less than 0.002 would be considered statistically significant.

Table 3

Bivariate and multivariable logistic regression predicting HIV positive status

	Odds ratio	95% CI	P-Value
Bivariate Analysis			
Test-seeking tendency	2.72	1.62 – 4.56	0.0002
Medical related risks	1.83	1.13 – 2.97	0.01
Behavioral risks	5.09	2.83 – 9.13	< .0001
Multivariable Analysis			
Age			0.18
<=25 (reference)	1		
26 – 35	1.80	0.90 – 3.57	
>35	1.13	0.53 – 2.42	
Sex			0.07
Female (reference)	1		
Male	1.90	0.96 – 3.77	
Blood center			0.003
Kunming (reference)	1		
Mianyang	0.54	0.28 – 1.06	
Urumqi	0.31	0.13 – 0.77	
Luoyang	0.21	0.08 – 0.53	
Education			< .0001
Less than high school (reference)	1		
High school	0.35	0.17 – 0.70	
Some college or higher	0.17	0.09 – 0.33	
Test-seeking tendency			0.01
< median	1		
>= median	2.23	1.23 – 4.05	
Medical related risks			0.68
< median	1		
>= median	1.15	0.59 – 2.22	
Behavioral risks			0.0005
< median	1		
>= median	3.77	1.79 – 7.93	