**Title:**  **Fear of nosocomial HIV infection may be a barrier to HIV testing among young college and university students in Suzhou, China**

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**Abstract word count**: 150

**Text word count**: 2725

**Number of references**: 46

**Number of tables:** 4

**Number of figures:** 1

**Funding:** Xi’an Jiaotong-Liverpool University

**ABSTRACT**

HIV test uptake among college and university students in China remains suboptimal. This study aimed to identify and weigh the relative importance of HIV testing preferences among university students in China. Qualitative interviews and discrete choice experiments (DCE) were used to identify and assess HIV testing preferences in hypothetical HIV testing scenarios. Study participants were sexually experienced university students in Suzhou city, China. 198 participants completed 1980 DCE choice tasks. Risk of nosocomial HIV infection, accuracy, and distance were identified as the most important factors when deciding whether to test for HIV. Risk of nosocomial HIV infection was the most influential factor, accounting for 35.5% of the variation in participants’ DCE stated choices. Fear of HIV nosocomial infection may be influencing HIV test preferences and possibly test uptake among university students in China. Interventions should consider addressing students’ fear of HIV nosocomial infection as a potential barrier to HIV testing.

**Keyword:** stated choice; Asia; iatrogenic; loss aversion; health seeking behavior

**Introduction**

China has one in five post-secondary students in the world1. By the end of 2015, there were 37 million college and university students in China,1 many of whom are vulnerable to HIV infection. Their HIV vulnerability may be partly due to growing acceptance of casual sex and limited sex education2–4. The Chinese Centers for Disease Control indicated that from 2011 to 2015, the number of newly diagnosed HIV cases among college and university students increased 35% each year5.

HIV testing is the first step in the “cascade of care”6–8, and is critical for identifying cases to prevent further transmission and poorer disease prognosis. In the early 2000s, the Chinese Ministry of Health launched the “Four Frees and One Care” program which was designed to prevent and control the transmission of HIV/AIDS9. The program has improved quality of life and life expectancy among HIV/AIDS patients by providing free and effective treatment9. Moreover, the program has helped identify undiagnosed people living with HIV through voluntary counselling and testing services throughout the country9.

To increase HIV testing among college and university students, the Chinese government has also sponsored innovative options for testing, in addition to traditional hospitals and clinics. For example, by November 2018, vending machines for HIV test kits 3,10 had been installed at 52 universities in 11 provinces11. However, despite such HIV test promotion programs, HIV testing among college and university students in China remains suboptimal. From September 27th to November 5th in 2017, only 37 testing kits from vending machines in ten universities were purchased in Beijing; moreover, only 14 were returned with a specimen sample12. In Guangzhou, a study of 5096 university students showed that only 3.1% of students sought HIV testing services, and that only 11.7% of students reporting risky sexual behaviors had sought HIV testing services13. Previous international research indicates that suboptimal HIV test uptake may be partially due to HIV testing service preferences that are misaligned with existing service options14–17.

Discrete choice experiments (DCE) are a quantitative methodology to estimate the preferences and relative importance of the attributes of a specific good or service. DCEs ask participants to state their preference when presented with multiple hypothetical scenarios18–21. Based on individuals’ stated choices, inferences about service preferences can be made, making it possible to quantify perceived relative importance of service attributes among a target population 22; such quantified measures of attribute relative importance would otherwise be unobtainable using conventional survey methods. DCEs have been widely used to improve health services19,21,23–26 and understand HIV testing preferences among men who have sex with men and the general population27–29. However, we are unaware of any HIV testing DCEs conducted specifically among college or university students in China.

The objective of this study was to examine young college and university student preferences related to HIV testing in Suzhou city, China (population: ~10.8 million) using DCEs. The study city was chosen based on increasing incidence of HIV46 and study feasibility. To the best of our knowledge, there are no published studies on HIV testing among college students in the study city. Identifying and weighting college and university students’ most important HIV testing preferences will be instructive for public health policy makers and practitioners seeking to augment HIV test uptake among college and university students.

**Methods**

**Study design**

In August 2018, an online DCE was conducted among college and university students in Suzhou, China using a mixed method study design that proceeded in three stages: 1) Identification of HIV testing attributes and levels via semi-structured interviews, 2) Development of the DCE design, and 3) Implementation of the DCE.

*Identification of HIV Testing Attributes and Levels*

To identify HIV testing attributes that influence HIV testing decisions among university students, a literature review was performed and 12 one-on-one semi-structured interviews were conducted. Eligibility criteria for the qualitative interviews included the following: 1) current college or university student in the study city; 2) younger than 30 years old; 3) ever had anal, oral or vaginal sex; and 4) provided informed consent. Participants were recruited by posters on campus with recruitment information, and were selected to maximize the variation of age, sex, and sexual orientation. Each participant was provided a 100 RMB gift card (~$15 USD). All 12 interview participants were between 18 to 25 years old, eight were men, and two identified as gay. Participants were able to participate anonymously if they so desired. During the interview, participants were asked to describe their considerations when deciding whether to test for HIV. All qualitative interviews were audio recorded, transcribed, and analyzed. After reaching data saturation30, eight HIV service testing considerations emerged: anonymity, cost/incentive, test type, test accuracy, venue, distance, administrator, and risk of nosocomial HIV infection (**Table 1****)**. Inductive coding was used in qualitative analysis and themes were identified using NVivo software (QSR international, 2018). Four of twelve participants in the qualitative interviews voiced concerns that unclean equipment could potentially cause them to become infected with HIV when testing.

*Development of the DCE design*

D-efficient design matrices are commonly used to develop DCEs31 and was created in the current study with NGENE (Choice Metrics, 2014). Participants were randomly assigned to one of two blocks and each individual was asked to complete ten choice tasks (10 choice tasks per block x 2 blocks = 20 unique choice tasks). For each choice task, the participant was instructed to choose one of three testing alternatives: testing scenario A, testing scenario B, and opt-out (i.e., do not test). Randomization of blocks and attributes were produced in NGENE (Choice Metrics, 2014). Implausible testing scenarios were excluded from the design. For example, participants presented with ‘testing at home’ as the venue could not simultaneously be presented with ‘distance=10km’. An example of a DCE choice task is shown in **Figure 1**.

*Implementation of the DCE*

The survey was conducted online in August 2018. Invitation emails were sent to all students enrolled at a mid-sized English-language university in the study city, and recipients were also encouraged to recruit other university students living in the city. Study participants had to be university students in the study city and had ever had anal, oral or vaginal sex. To increase participation rates, a raffle prize drawing was held, whereby 12 participants who completed the study were awarded a 50 RMB (~$7.50 USD) local restaurant voucher.

**Statistical Analyses**

Multinomial logit (MNL), mixed logit (MXL) models and mixed logit model with interaction (MXL-I) were used. The MNL model was used to assess attribute level main effects on HIV testing preferences based on the overall average of the sample. We used MXL models to assess preference heterogeneity, assuming that main effects were random and normally distributed. Analyses were conducted using the MLOGIT package in R with 1000 Halton draws. The relative importance of each attribute was calculated by dividing the range of all coefficients for a given attribute by the sum of ranges of all attributes, based on MXL model results.

To assess test preference variation across sociodemographic subgroups, two-way interaction models were run by crossing all attribute levels with age, sexual orientation, university, urbanicity, sex, HIV testing history, residence during the school year, and income.

To assess potential interaction effects of “risk of HIV nosocomial infection”, all attribute level effects were crossed with the “risk of HIV nosocomial infection” levels in two-way interactions.

**Ethical Review**

Study protocols were approved by (*institution suppressed for peer review*). Each study participant completed an online consent form before participation.

**Results**

In 17 days, the DCE survey link was clicked 1084 times. 198 participants completed the survey and completed 1980 choice sets. Alternative “A” (choice on the left side) and alternative “B” (choice on the right side) had comparable probabilities of being selected (40.3% vs. 40.2%, respectively); the “opt-out” alternative was selected in 19.5% of all choice sets.

*Participant Characteristics*

As shown in **Table 2**, most participants (85.9%) were 18-23 years old and had urban household registration (90.9%). Most participants identified as heterosexual (84.3%) and most had never tested for HIV (88.9%). 80.3% of participants lived in university dormitories.

*MNL Model*

Results from the MNL model showed that the most preferred testing location was the hospital and the most preferred distance was less than 1 km (**Table 3**). Healthcare professionals were the most preferred test administrators and participants expressed stronger preference for testing without any risk of HIV infection. Preference ranking for all other parameter estimates were in the order as expected.

*MXL Model*

As **Table 4** shows, results of the MXL model were similar to the MNL model results. Noticeably, except for test type and venue, each attribute contained at least one level with statistically significant standard deviation estimates of the coefficient, thus implying substantial heterogeneity of preferences across respondents for all attributes32. Free test was the most preferred cost/incentive (β=0.23, p<0.001); Testing with highest accuracy (99.9% accuracy) was the most preferred level of accuracy (β=0.31, p<0.001); hospital was the most preferred testing venue (β=0.20, p<0.01), while community health center was less preferred (β=-0.23, p<0.01); healthcare professionals were the most preferred test administrator (β=0.32, p<0.001), unlike non-professionals with on-the-job training (β=-0.22, p<0.05); testing with risk of nosocomial HIV infection was strongly not preferred (β=-0.95, p<0.001), even though the risk was presented as one in ten billion (0.0000000001). The MXL model had significantly better fit than the MNL model according to the Log-likelihood test (p<0.001, χ2 = 201.57, DF=17).

*MXL-I Models*

Results of the MXL-I models are presented as tables in the appendix. Results indicated that the sensitivity of the HIV test was less important for participants less than 20 years old (β = 0.33, p < 0.05; β = -0.35, p < 0.05), that males were less likely to opt-out (β = -0.20, p < 0.05), that participants from university “A” had a stronger aversion to risk of nosocomial HIV infection (β = 1.18, p < 0.001) and stronger preference for monetary testing incentives (β = 1.39, p < 0.05), that students with greater income were less likely to opt-out (β = -0.29, p < 0.01), and that participants living in student dormitories were less likely to opt-out (β = -0.37, p < 0.01) and had weaker aversion to risk of nosocomial HIV infection (β = -0.53, p < 0.001). Preferences did not significantly vary by sexual orientation or testing history.

Interaction analyses also indicated that individuals who expressed stronger aversion to risk of nosocomial HIV infection also had stronger aversion to lower test sensitivity (β = -0.28, p < 0.05).

*Relative Importance*

Based on results of the MXL model, risk of nosocomial HIV infection was the most important attribute (35.5%), followed byaccuracy (15.5%), distance (14.6%), test administrator (10.1%), cost (10.1%), venue (8.0%), test type (4.5%) and privacy (1.9%).

**Discussion**

Using semi-structured interviews and a DCE, this study was the first to identify and weigh the relative importance of HIV testing preferences among university students in China. We focus the discussion on several novel and key findings that extend understanding of HIV testing among Chinese University students and bear important theoretical and practical implications for public health research and practice.

*University student concern about nosocomial HIV infection*

Semi-structured interviews in our study revealed that perceived risk of nosocomial HIV infection may be a barrier when university students in China consider whether or not to test for HIV. This finding is consistent with qualitative research among sexual minority men and rural denizens in China3334, but to our knowledge has not been previously reported among college or university students. Fear of nosocomial HIV infection in our study may have been fueled by widely publicized outbreaks of nosocomial HIV infections in China among plasma donors36 and patients receiving lymphocyte immunotherapy33. For example, one qualitative interview participant stated: “I think safety is the most important, for instance, if I don’t have HIV, but I acquire HIV from testing…I saw some news about that.”

*Fear of nosocomial HIV infection dominates other concerns*

Survey-based HIV testing studies of university students in China have often focused on sociodemographic and risk behavior correlates of HIV testing history, and have rarely if ever examined fear of nosocomial HIV infection as a potential barrier to testing45,46. To the best of our knowledge, this experimentally-designed study is the first to quantify the importance of fear of nosocomial infection relative to other HIV testing concerns (e.g., test accuracy or distance to testing location). DCE results demonstrated that perceived risk of nosocomial HIV infection was unequivocally more important than any other measured attribute. In terms of effect on participants’ stated preferences, reducing the perceived risk of nosocomial HIV infection from 1 in ten billion to zero was more influential than reducing the distance of the testing location from >20 km to <1 km, reducing the cost of the test from $15 USD to free, or increasing the sensitivity of the test from 92% to 99.9%, ceteris paribus. Future HIV testing studies should consider DCE designs in order to elucidate insightful test preference metrics otherwise unobtainable through conventional survey methods.

*Unwillingness to accept any perceived risk of nosocomial HIV infection*

Results of this DCE are among the first to indicate that perceptions of even extraordinarily small risks of nosocomial HIV infection may be sufficient to dissuade college and university students in China from HIV testing. This finding is consistent with the principle of loss aversion, whereby individuals are disproportionately averse to personal losses, even when the risk of loss is negligible 35. Given participants’ strong unwillingness to tolerate even a modicum of perceived risk of HIV nosocomial infection, interventions are needed to effectively allay fears of nosocomial HIV infection among college and university students in China. In addition, it is critical for future research to examine how loss aversion tendencies may be impacting uptake of other health services among university students in China.

*Preference for testing at large hospitals over community health centers*

Findings from the DCE indicated that participants preferred to test at large hospitals over community health centers, a result that was consistent with qualitative studies among sexual minority men in China33,38,39. This aversion to testing at smaller community health centers may reflect perceptions and empirical research that large tertiary hospitals are better resourced and staffed by more experienced healthcare professionals 40,41. While large urban hospitals maintain advanced medical equipment, well-trained medical professionals and modern hospital management systems, many primary care institutions remain poorly-resourced with poorer service quality 41. This strong preference for testing at large hospitals is important to note because many efforts to improve HIV test uptake among Chinese college and university students are centered on anonymous self-testing and HIV testing at smaller non-governmental organizations administrated by non-health professionals 4,9,32. Hence, results from this study suggest that interventions to augment testing among urban Chinese university students should ensure diverse testing options for university students, including access to affordable and accurate HIV testing administered by health professionals in hospitals.

*Potential implications for Chinese international students at University in the United States*

Some findings from this study may also be relevant to Chinese university students studying in the United States, as Chinese domestic and international university students share considerable social and cultural values and experiences. However, it is entirely possible that the HIV testing preferences of Chinese students may be fundamentally different in the US healthcare system. Given that Chinese nationals account for approximately 30% of all international students in the United States43, HIV testing preferences of Chinese international students warrant additional research.

*Limitations*

Several study limitations merit noting. First, the study participants primarily came from a single English-language university in a city in Eastern China. Hence, generalizability to other Chinese college and university students may be limited. Second, selection bias in the DCE cannot be ruled out given the fact that most recipients of the email invitation did not complete the survey. Third, the DCE only estimated participants’ stated preferences using hypothetical scenarios. Real-world observed preferences may be substantially different from the stated preferences. Fourth, the measures of relative importance only took into account observed attributes discussed in the qualitative interviews.

**Conclusion:**

We conducted a DCE among students at a university in China and found that fear of nosocomial HIV infection may be a profound influence on HIV test preferences and possibly test uptake. Interventions to increase HIV testing among college and university students in China should ensure diverse testing options and address student fear of nosocomial HIV infection as a potential barrier to HIV test uptake.

**Acknowledgements**: Many thanks to the study participants for sharing their time and experiences in order to make this study possible.

**Conflict of interest declaration:** All authors declare no conflict of interest.

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**Table 1: The attributes and levels of the discrete choice experiment**

|  |  |
| --- | --- |
| **LABEL** | **LEVELS** |
| **Cost/incentive** | Free | 50 RMB incentive | 50 RMB cost | 100 RMB cost |
| **Privacy** | Test without other strangers in the room | Test with other strangers in the room |
| **Test type** | Venipuncture | Finger prick | Oral fluid | Urine |
| **Accuracy** | 92% accuracy | 99.3% accuracy | 99.9% accuracy |
| **Testing venue** | Hospital | Residence during school year | Community health center | Campus health clinic |
| **Distance to testing venue** | < 1 km | 10 km | >20 km |
| **Administrator** | Healthcare professional | Self | Non-professional with on-the-job training |
| **Risk of nosocomial HIV infection** | Zero | 1 in ten billion (0.0000000001) |

**Table 2: Participant sociodemographic characteristics in China, 2018 (n=198)**

|  |  |
| --- | --- |
|  | Number (%) |
| **Age (years)** |  |
|  18~20 | 96 (48.5) |
|  21~23 | 74 (37.4) |
|  24~26 | 18 (9.1) |
|  ≥27 | 10 (5.1) |
| **University** |  |
|  “A” | 191 (96.5) |
|  Other | 7 (3.5) |
| **Residency status** |  |
|  Urban resident | 180 (90.9) |
|  Rural resident | 18 (9.1) |
| **Sex** |  |
|  Male | 101 (51.0) |
|  Female | 97 (49.0) |
| **Ever received HIV test** |  |
|  Yes | 22 (11.1) |
|  No | 176 (88.9) |
| **Living situation** |  |
|  Student dormitory | 159 (80.3) |
|  Other | 39 (19.7) |
| **Income, CNY / month** |  |
|  <2500 (or 375 USD) | 96 (48.5) |
|  ≥2500 | 102 (51.5) |
| **Sexual orientation** |  |
|  Heterosexual | 167 (84.3) |
|  Bisexual | 23 (11.6) |
|  Gay or lesbian | 8 (4.0) |

**Table 3: HIV testing preferences of college and university students in China (MNL model)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate | SE | Z-value | P-value |
| Cost |  |  |  |  |
|  7.5 USD incentive | 0.04 | 0.07 | 0.58 | 0.56 |
|  Free | 0.23\*\*\* | 0.06 | 3.67 | < 0.001 |
|  7.5 USD cost | 0.04 | 0.06 | 0.56 | 0.57 |
|  15 USD cost | -0.30 | 0.06 | -1.61 | 0.11 |
| Privacy |  |  |  |  |
|  Without strangers in the room | 0.01 | 0.04 | 0.33 | 0.74 |
|  With strangers in the room | -0.01 | 0.06 | 1.06 | 0.29 |
| Test type |  |  |  |  |
|  Venipuncture | 0.08 | 0.07 | 1.27 | 0.21 |
|  Finger prick | -0.03 | 0.06 | -0.43 | 0.66 |
|  Oral fluid | 0.01 | 0.06 | 0.21 | 0.84 |
|  Urine | -0.07 | 0.06 | -0.01 | 0.99 |
| Accuracy |  |  |  |  |
|  92% sensitivity | -0.42\*\*\* | 0.05 | -8.46 | < 0.001 |
|  99.3% sensitivity | 0.31\*\*\* | 0.06 | 5.64 | < 0.001 |
|  99.9% sensitivity | 0.10\*\*\* | 0.06 | 7.42 | < 0.001 |
| Venue |  |  |  |  |
|  Hospital | 0.27\*\*\* | 0.06 | 4.50 | < 0.001 |
|  Community health center | -0.16\*\* | 0.06 | -2.62 | 0.01 |
|  Residence during school year | -0.12 | 0.09 | -1.35 | 0.18 |
|  Designated location for health issues at school | 0.02 | 0.10 | -0.21 | 0.83 |
| Distance |  |  |  |  |
|  <1 km | 0.23\*\*\* | 0.05 | 4.47 | < 0.001 |
|  10 km | 0.05 | 0.05 | 0.94 | 0.35 |
|  >20 km | -0.28\*\*\* | 0.05 | -4.96 | < 0.001 |
| Administrator |  |  |  |  |
|  Healthcare professional | 0.23\*\*\* | 0.05 | 4.95 | < 0.001 |
|  Self | -0.08 | 0.07 | -1.22 | 0.22 |
|  Non-professional with on the job training | -0.15\* | 0.05 | -2.22 | 0.03 |
| Risk of HIV infection |  |  |  |  |
|  No risk | 0.57\*\*\* | 0.03 | 18.11 | < 0.001 |
|  1 in ten billion (0.0000000001) | -0.57\*\*\* | 0.03 | -18.56 | < 0.001 |
|  |  |  |  |  |
| Nonrandom parameter |  |  |  |  |
|  Opt-out ASC | -0.58\*\*\* | 0.08 | -7.48 | < 0.001 |
|  |  |  |  |  |
| Model fit statistics |  |  |  |  |
| Number of individuals | 198 |  |  |  |
| Number of completed choice sets | 1980 |  |  |  |
| Log-Likelihood: -1796.4 |  |  |  |

**\*p<0.05; \*\*p<0.01; \*\*\*p<0.001; SE=Standard error; ASC=alternative-specific constant**

**Table 4: HIV testing preferences of college and university students in China (MXL model)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Estimate  | SE | Std-D | SE |
| Cost |  |  |  |  |
|  50 RMB incentive | 0.12 | 0.09 | 0.30 | 0.21 |
|  Free | 0.23\*\* | 0.09 | 0.47\*\* | 0.16 |
|  50 RMB cost | -0.03 | 0.09 | -0.04 | 0.63 |
|  100 RMB cost | -0.31\*\* | 0.08 | 0.00 | 1.75 |
| Privacy |  |  |  |  |
|  Without strangers in the room | 0.05 | 0.05 | -0.36\*\*\* | 0.09 |
|  With strangers in the room | -0.05 | 0.07 | -0.02 | 0.86 |
| Test type |  |  |  |  |
|  Venipuncture | -0.002 | 0.09 | 0.00 | 0.72 |
|  Finger prick | 0.06 | 0.09 | -0.25 | 0.21 |
|  Oral fluid | 0.09 | 0.09 | 0.04 | 0.59 |
|  Urine | -0.15 | 0.08 | 0.04 | 0.63 |
| Accuracy |  |  |  |  |
|  92% sensitivity | -0.52\*\*\* | 0.07 | 0.46\*\*\* | 0.13 |
|  99.3% sensitivity | 0.21\*\* | 0.07 | -0.03 | 0.47 |
|  99.9% sensitivity | 0.31\*\*\* | 0.07 | -0.01 | 0.59 |
| Venue |  |  |  |  |
|  Hospital | 0.20\* | 0.08 | 0.03 | 0.38 |
|  Community health center | -0.23\*\* | 0.09 | 0.18 | 0.27 |
|  Residence during school year | 0.01 | 0.12 | 0.29 | 0.28 |
|  Designated location for health issues at school | 0.01 | 0.12 | 0.28 | 0.27 |
| Distance |  |  |  |  |
|  <1 km | 0.35\*\*\* | 0.08 | 0.45\*\*\* | 0.11 |
|  10 km | 0.08 | 0.08 | -0.09 | 0.36 |
|  >20 km | -0.43\*\*\* | 0.07 | -0.04 | 0.55 |
| Administrator |  |  |  |  |
|  Healthcare professional | 0.32\*\*\* | 0.07 | 0.10\* | 0.27 |
|  Self | -0.10 | 0.09 | 0.32 | 0.16 |
|  Non-professional with on the job training | -0.22\* | 0.06 | -0.19 | 0.20 |
| Risk of HIV infection |  |  |  |  |
|  No risk | 0.95\*\*\* | 0.08 | 0.95\*\*\* | 0.10 |
|  One in ten billion (0.0000000001) | -0.95\*\*\* | 0.07 | 0.86\*\*\* | 0.08 |
| Nonrandom parameter |  |  |  |  |
|  Opt-out ASC | -0.20 | 0.10 |  |  |
| Model fit statistics |  |  |  |  |
|  Number of individuals | 198 |  |  |  |
|  Number of completed choice sets | 1980 |  |  |  |
|  Log-likelihood function |  -1695.6 |  |  |

**\*p<0.05; \*\*p<0.01; \*\*\*p<0.001; SE=Standard error; Std-D=Standard deviation; ASC=alternative-specific constant**

**Figure 1: Example of a choice task in the discrete choice experiment**

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