Original Article

Risk of sharps exposure among health science students in northeast China

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Summary **Previous studies have demonstrated that sharps-related infectious disease is a global concern. Several papers have also reported that students are at a higher risk than healthcare workers. The prevalence of sharps exposure in China, however, is unknown. This study explored the incidence of sharps exposure and its related risk factors among students in all academic years and majors at a medical university in China. This cross sectional study was conducted at a Chinese medical university in May 2005. Stratified random sampling was used. Students in all five academic years (Y1-Y5) who were majoring in clinical medicine, nursing, dentistry, medical technology, pharmacology, acupuncture/massage, and public affairs management were provided questionnaires. Nine hundred seventy of 1,070 (90.7%) students completed the questionnaire. One hundred twenty-two of 968 (12.6%) students reported a total of 131 sharps exposures during the previous 12 months. Of these exposures, 24.7% occurred in academic year five (Y5) students, followed by 23.4% in academic year four (Y4) students. Dental students had the highest incidence rate at 20.6%, followed by medical students (16.0%), nursing students (12.2%), and acupuncture/massage students (5.0%). Only 45 (34.4%) of sharps exposures were reported to a supervisor, and the students displayed a general lack of knowledge of occupational exposure standards (OES). In conclusion, sharps exposures most frequently occurred among students from 3 majors: dentistry, nursing, and clinical medicine. Sharps exposures were underreported to supervisors. Effective OES educational programs need to be developed and should be implemented early in health science students' education.**

Keywords: Sharps exposure, Sharps injuries, Occupational exposure, Bloodborne pathogens, Medical education

1. Introduction

Among 35 million healthcare workers worldwide, approximately 3 million experience percutaneous exposure to bloodborne pathogens each year, including 2 million to Hepatitis B Virus (HBV), 0.9 million to Hepatitis C Virus (HCV) and 170,000 to Human Immunodeficiency syndrome (HIV) (*1-3*). The risk of infection resulting from a single percutaneous exposure to virus-infected blood varies, with rates ranging from 6-30% for HBV, 0-7% for HCV, and 0.2-0.5% for HIV (*2*). In developing countries, where more than 90% of occupational exposures occur (*3*), the danger of bloodborne pathogen transmission to medical workers by needle stick and other injuries is of particular concern. Excessive handling of contaminated needles, high demand for injections, and improperly sterilized injection equipment enhance the risk of occupational exposure to bloodborne pathogens (*4*).

A German study reported a higher incidence of occupational exposure in medical students (24.2%) versus health care workers (15.8%) (*5*). Students

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majoring in dentistry, nursing, and clinical medicine face the greatest threat of needle-stick injury and other sharps injuries, with the risk of acquiring bloodborne infections while working in a clinical setting (*5-9*).

Dental students have been shown to be at high risk of sharps exposures. At a United Kingdom dental school, for example, the students' occupational sharps exposure rate during a 12-month period was 39.8%. Y4 and Y5 students were more likely to experience an exposure than Y3 students, and underreporting was common (*10*). In a Nigerian dental school, 58% of dental students experienced at least one occupational exposure (*11*), while 32.8% of students experienced occupational exposure in a dental school in the United States (*12*). Another study from the United States found that the majority of sharps exposures were needle-stick injuries (*13*).

Medical students throughout the world show a similarly high rate of sharps exposures. One study in Malaysia found a high incidence (23.5%) of sharps injuries among medical students over one year (*14*). Another study found that 84% of surveyed medical students suffered at least one occupational sharps exposure during their clinical training (*6*). Lack of experience and technical expertise is related to risk of needle-stick injuries (*15*), suggesting that unskilled students may be at a heightened risk during their medical training (*16,17*).

Similarly, nursing students experienced a high prevalence (61.5%) of sharps exposures in a Taiwan nursing school (*18*). In mainland China, course work for nursing students includes limited information about accidental sharps-related transmission of bloodborne pathogens, and students receive neither conceptual nor concrete information about occupational safety (*19*).

Educational programs can produce positive changes in both knowledge of and attitudes toward safety protocols (*20*). Inclusion of blood and body fluid safety precautions in medical school curricula resulted in a more compliant attitude toward safety procedures that protect against accidental bloodborne pathogen transmission (*21*). There is still little information, however, on bloodborne pathogen transmission prevention in China (*19*). To address this gap in the literature, this study explored the incidence of sharps exposures and associated risk factors among all academic years and majors at a medical university in China.

2. Materials and Methods

2.1. *Study methods and material*

This cross sectional study was conducted at a Chinese medical university in the northeast part of China in May 2005. Thirty-item questionnaires were anonymously sent to 1,070 out of approximately 4,000 registered students. Fourteen instructors (two for each major) were recruited to administer the survey. All participants were informed of the survey's objectives and gave oral consent before completing the questionnaire. On average, it took approximately 20 min to complete the questionnaire.

Demographic data collected included age, ethnicity, academic year, medical training experience, and evidence of having taken a course on bloodborne pathogen transmission prevention. The students were also asked to recall the frequency of their sharps-related injuries. Knowledge-based questions included: transmission routes of bloodborne pathogens, procedures for using syringes, post-exposure procedures, adherence to universal precaution policy guidelines, and prevalence of HBV and HIV in China.

2.2. *Sampling and analysis*

Stratified random sampling was used such that students from all five academic years and all seven majors (clinical medicine, nursing, dentistry, medical technology, pharmacology, public affairs management, and acupuncture/massage) were included. Fifteen questions were asked to ascertain the students' knowledge of the risk of bloodborne pathogen transmission following sharps exposure. Correct answers were credited with a score of one and incorrect answers with a score of zero, for a maximum aggregate knowledge score of fifteen points.

The variables, including knowledge score, bloodborne pathogens risk perception, adherence of universal precaution, taken course on Occupational Exposure Standards (OES), and hospital training were not normally distributed. For these factors, medians were considered the cut off point. Data analysis was divided into descriptive and inferential groups. Univariate analysis and logistic regression was performed with SPSS 13.0 for Windows. P values < 0.05 were considered to be statistically significant.

3. Results

3.1. *Sample demographics*

Nine hundred seventy of 1,070 (90.7%) registered students completed the questionnaire. Of these participants, 138 (14.3%) were minorities (not of Han nationality). Demographic characteristics are given in Table 1. There were a disproportionate number of females (67%) in the study.

3.2. *Sharps exposures*

Table 2 breaks down the incidence of sharps exposure by major and year. One hundred twenty-two of 968 (12.6%) students reported at least one sharps exposure

Table 1. Demographic characteristics (N = 970)[1]

	Frequency	Percentage[2]
Gender		
Male	342/966	35%
Female	642/966	67%
Age (years)[3]		
18 - 20	335/970	35%
21 - 22	367/970	38%
23 - 27	268/970	28%
Major		
Clinical Medicine	302/970	31%
Nursing	213/970	22%
Dentistry	126/970	13%
Medical Technology	99/970	10%
Pharmacology	99/970	10%
Public Affairs Management	91/970	9%
Acupuncture and Massage	40/970	4%
Academic Year		
First year	248/968	26%
Second year	247/968	26%
Third year	177/968	18%
Fourth year	154/968	16%
Fifth year	142/968	15%
Medical Training Experience		
No	618/964	64%
Yes	346/964	36%
Taken Course on Occupational Exposure Standards		
No	807/967	84%
Yes	160/967	17%

[1] Missing data were not included in some analyses.
[2] The sum of some percentages is not 100% due to rounding.
[3] The median age was 21 years (interquartile range = 20 - 23 years).

during the previous twelve months. Acupuncture/massage was a new major, so for these students, academic years three to five did not exist in 2005. Nursing students only studied for four academic years. Upon combining data from all majors, the highest incidence was 24.7% in Y5, followed by 23.4% in Y4.

Dental students had the highest incidence of sharps exposure (20.6%), followed by medical students (16%), nursing students (12.2%), and acupuncture/massage students (5%). Medical technology students and pharmacology students both showed an incidence rate of 9.1%. Students majoring in public affairs management ranked lowest in incidence rate among majors (2.2%). In a sampling of 131 exposures, only 45 (34.4%) were reported to the student's supervisor, and thus a majority of students displayed a lack of knowledge of OES.

3.3. *Knowledge on preventing bloodborne pathogens exposure*

Fifteen questions (divided into five categories) were asked to ascertain the students' knowledge regarding the risk of bloodborne pathogen transmission following sharps exposure. The results are presented in Table 3. In the first category of questions, the majority of students knew the bloodborne pathogen transmission routes except for HCV (34%). Overall, the students had a good grasp of how HIV was spread. However, only 58% of students knew that blood transmission was the easiest way to transmit HIV, and 62% of them thought professional blood donation could be a risk factor of HIV transmission.

Table 2. Incidence of sharp exposure by major and academic year

Majors	Number of students who reported at least one sharp exposure during the last year (%)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Clinical Medicine	0 N = 61	12 (20) N = 60	3 (5) N = 60	14 (23.3) N = 60	19 (32.2) N = 59	48 (16) N = 300
Nursing	2 (2.3) N = 84	9 (11.4) N = 79	4 (12.9) N = 31	11 (57.9) N = 19	— —	26 (12.2) N = 213
Dentistry	1 (3.4) N = 29	4 (13.8) N = 29	3 (10.3) N = 29	7 (53.9) N = 13	11 (42.3) N = 26	26 (20.6) N = 126
Medical Technology	2 (10) N = 20	4 (20) N = 20	1 (5) N = 20	0 N = 19	2 (10) N = 20	9 (9.1) N = 99
Pharmacology	0 N = 16	0 N = 22	2 (9.5) N = 21	4 (19.1) N = 21	3 (15.8) N = 19	9 (9.1) N = 99
Acupuncture and Massage	1 (5) N = 20	1 (5) N = 20	— —	— —	— —	2 (5) N = 40
Public Affairs Management	1 (5.6) N = 18	0 N = 17	1 (6.3) N = 16	0 N = 22	0 N = 18	2 (2.2) N = 91
Total	7 (2.8) N = 248	30 (12.1) N = 247	14 (7.9) N = 177	36 (23.4) N = 154	35 (24.7) N = 142	122 (12.6) N = 968

Missing data were not included in analyses.

Table 3. Knowledge of bloodborne pathogen risk following sharps exposure[1]

Items in the questionnaire[2]	Correct response	Percent correct
Transmission Routes of Bloodborne Pathogens		
Which of these diseases do you think can be transmitted by unsterilized syringes or sharp injections?		
1. Hepatitis A Virus (No)	687/970	71
2. Hepatitis B Virus (Yes)	724/969	75
3. Hepatitis C Virus (Yes)	327/970	34
4. Hepatitis E Virus (No)	754/970	78
5. Human Immunodeficiency Virus (Yes)	860/968	89
By which of the following ways may HIV be transmitted?		
1. Ingestion (No)	947/969	98
2. Air (No)	958/970	99
3. Blood (yes)	956/969	99
4. Unprotected sexual Contact (Yes)	960/960	99
5. During pregnancy or breast-feeding (Yes)	930/969	96
6. Daily contact (Handshake, hug, *etc*) (No)	959/970	99
7. Mosquitoes or other insects (No)	742/969	77
Which is the easiest way to transmit HIV? (Blood transmission)	560/964	58
Do you think professional blood donors are a dangerous source of HIV? (Yes)	593/964	62
Procedures of dealing with syringes:		
Which of the following procedure is correct?		
1. New disposable syringes should be used on all of patients (Yes)	819/967	85
2. Reuse disposable syringes (No)	926/968	96
3. Reuse syringes and sharps but sterilize every time between uses (Yes)	672/966	70
4. Use new sharps every time but reuse the syringes (No)	806/969	83
5. Reuse the glass syringes and sharps; sterilization is not always required (No)	890/966	92
If used syringes are thrown away with regular trash, they pose a danger for people (Yes)	910/961	95
Do you think recapping the used syringes should be done before you throw them away? (No)	107/963	11
Do you think there is something wrong with reusing needles or other sharp instruments on different people without sterilization? (Yes)	937/970	97
Which is the proper way of sterilizing a glass syringes? (Use high pressure)	530/969	55
Post-exposure procedures:		
If you are injured by sharp instruments, what would you do?		
1. Inject the immunity globulin or hepatitis B vaccine as soon as possible (Yes)	275/970	28
2. Let the wound bleed then wash the wound with water (Yes)	714/968	74
3. Put pressure on the wound then bandage (No)	824/970	85
4. Test the blood (Yes)	502/970	52
5. Report to your superior (Yes)	557/970	58
6. Do nothing (No)	962/970	99
When you are injuried by syringes or sharp instruments contaminated with blood of HIV patients, if you get treatment as soon as possible, can you reduce the chance of HIV infection? (Yes)	315/963	33
Universal precaution and policy:		
All human blood and certain human body fluids should be treated as if they are known to be infectious for HIV, HBV and other bloodborne pathogens (Yes)	533/960	56
In our country, many provinces are using glass syringes. Which do you think is the best policy? (using the disposable syringes and reuse the sterilized glass syringes)	720/970	74
Current prevalence of HBV and HIV in China, 2005:		
Approximately, what percentage of the country's population are hepatitis B virus carriers? (10%)	359/967	37
At present, which number is closest to the actual number of people living with HIV in the country? (840,000)	249/967	26

[1] The sum of some percentages is not 100% due to rounding. The median total score was 11 points (interquartile range = 9-12 points).
[2] Correct answers are shown in parentheses.

In the second category of questions, the students understood the procedures of handling syringes, but only 11% of students knew that used syringes should not be recapped before being thrown away, while 55% knew that high pressure sterilization was the proper way of sterilizing glass syringes. In the third category of questions, not all students were knowledgeable about post-exposure procedures. Following a sharps exposure, 28% of students indicated that they would receive immune globulin or HBV vaccination, while 52% would perform blood testing, and 58% would report the incident to a superior. In the last two categories of questions, 56% students were knowledgeable of universal precaution guidelines, and most students did not know the current prevalence of HBV and HIV in China.

3.4. *Risk factors related to sharps exposures*

Table 4 shows the crude and adjusted odds ratios (OR)

Table 4. Crude and adjusted odds ratios and their 95% confidence intervals for risk factors of sharps exposures among 970 Chinese students

Factor	Total	At least one sharps exposure during the last year		Crude OR			Adjusted OR*		
		(*N*)	%	OR	95% CI	*p* value	OR	95% CI	*p* value
Academic year									
First year	248	(7)	2.8	1					
Second year	247	(30)	12.1	4.8	2 - 11.1	<0.01	4.4	1.9 - 10.5	0.01
Third year	177	(14)	7.9	3.0	1.2 - 7.5	0.02	2.4	0.9 - 6.5	0.08
Fourth year	154	(36)	23.4	10.5	4.5 - 24.3	<0.01	6.5	1.9 - 21.7	<0.01
Fifth year	142	(35)	24.6	11.3	4.8 - 26.1	<0.01	6.8	2.1 - 22.5	<0.01
Major									
Clinical medicine	302	(49)	16.2	8.6	2.1 - 36.1	<0.01	10.8	2.5 - 47.0	<0.01
Dentistry	126	(26)	20.6	11.6	2.7 - 50.1	<0.01	15.2	3.4 - 68.2	<0.01
Medical technology	99	(9)	9.1	4.5	0.9 - 21.1	0.04	5.4	1.1 - 27.0	0.04
Pharmacology	99	(9)	9.1	4.5	0.9 - 21.1	0.04	5.5	1.1 - 26.9	0.04
Nursing	213	(26)	12.2	6.2	1.4 - 26.6	<0.01	13.0	2.9 - 58.9	<0.01
Acupuncture and massage	40	(2)	5.0	2.3	0.3 - 17.2	0.39	7.6	1.0	0.05
Public affairs management	91	(2)	2.2	1					
Knowledge score									
High	463	(65)	14.0	1.3	0.9 - 2.0	0.14	0.9	0.6 - 1.4	0.60
Low	453	(49)	10.8						
Bloodborne pathogens risk perception									
High	486	(80)	16.5	2.0	1.4 - 3.0	<0.01	1.3	0.8 - 2.0	0.30
Low	484	(43)	8.9						
Adherence of Universal Precaution									
Yes	533	(60)	11.3	0.8	0.5 - 1.2	0.23	1.4	0.9 - 2.2	0.15
No	427	(59)	13.8						
Taken course on OES									
Yes	160	(31)	19.4	1.9	1.2 - 3.0	<0.01	0.6	0.4 - 1.0	0.06
No	807	(91)	11.3						
Medical training in hospital									
Yes	346	(76)	22.0	3.5	2.3 - 5.2	<0.01	1.8	0.7 - 4.6	0.19
No	618	(46)	7.4						

CI, confidence interval; OR, odds ratio.
*Adjusted for all variables significant in the univariate analysis.

between risk factors and incidence of sharps exposure. Compared with Y1 students, Y2 students (OR: 4.8; 95% CI: 2-711.1; $p < 0.01$) and Y3 students (OR: 3.0; 95% CI: 1.2-7.5; $p = 0.02$), Y4 students (OR: 10.5; 95% CI: 4.5-24.3; $p < 0.01$) and Y5 students (OR: 11.3; 95% CI: 4.8-26.1; $p < 0.01$) were more likely to have encountered a sharps exposure.

Compared with public affairs management majors, who displayed the lowest incidence of sharps exposure, dental students (OR: 11.6; 95% CI: 2.7-50.1; $p < 0.01$), medical students (OR: 8.6; 95% CI: 2.1-36.1; $p < 0.01$), nursing students (OR: 6.2; 95% CI: 1.4-26.6; $p < 0.01$), and medical technology students and pharmacological students (OR: 4.5; 95% CI: 0.9-21.1; $p = 0.02$) were more likely to encounter a sharps exposure. In contrast, acupuncture/massage students showed no significant difference from public affairs management majors.

The odds of sharps exposure was significantly increased in students who had higher bloodborne pathogen transmission risk perception (OR: 2; 95% CI: 1.4-3; $p < 0.01$), had taken courses on preventing bloodborne pathogen transmission (OR: 1.9; 95% CI: 1.2-3; $p < 0.01$), or had medical training experience in a hospital (OR: 3.5; 95% CI: 2.3-5.2; $p < 0.01$).

Odds radios were subsequently adjusted by binary logistic regression analysis. Among all of the significant risk factors noted above, only academic year and choice of major remained significant following regression analysis. Specifically, students in academic years Y2, Y3, and Y5 were more likely to encounter a sharps exposure. Furthermore, dentistry, clinical medicine, and nursing majors were over ten times as likely and medical technology, pharmacology and acupuncture/massage majors were over five times as likely to encounter sharps exposure than public affairs management majors.

4. Discussion

In our study, sharps exposures occurred frequently among students majoring in dentistry (20.6%), clinical medicine (16%), and nursing (12.2%), consistent with

previous research (*22-24*). The prevalence of sharps exposure among dental students in their final academic year (42.3%) is similar to other reports, including a study of 204 students in a United States dental school (32.8%) (*12*). and of 153 dental students in a Nigerian dental school (58.8%) (*11*). In this study, Chinese nursing students in their final academic year had a higher incidence of sharps exposure (57.9%) compared with 13.9% at an Australian nursing school (*24*) and 21.6% at a Brazilian nursing school (*9*).

Among medical students in this study, 32.2% had experienced at least one sharps exposure during their final year of training. This prevalence is similar to that observed at medical universities in Brazil (34.2%) (*25*) and England (30%) (*10*), higher than that observed at medical universities in Denmark (22%) (*8*) and Germany (24.2%) (*5*), and lower than the United States (48%) (*7*).

Acupuncture/massage majors displayed a low incidence of sharps exposure, although these students may still be at risk. This major was established 2 years before our study, and thus their Y5 training had not yet begun. It is important to note that students in public affairs management following graduation will be responsible for enacting policies directed at the prevention of occupational exposure to bloodborne pathogens in the future. Even though their current incidence of sharps exposure is low, they still need to be educated in OES.

From a sampling of 131 students who experienced sharps exposure, only 34.4% had reported the incident to supervisors. This underreporting rate (65.6%) is much higher than that observed in a Taiwan nursing school (39%) (*26*), and three Malaysian medical universities (35.6%) (*14*). Underreporting rates in this study may also correspond to the relative lack of knowledge of post-exposure procedures and universal precaution guidelines (see Table 3).

The majority of students were knowledgeable of bloodborne pathogen transmission routes, except for HCV (34%). Still, further education is needed, since only 58% of the students knew that blood transfusion confers the highest-likelihood risk of transmitting HIV, and only 62% also think professional blood donors could be a dangerous source of HIV. Furthermore, only 37% and 26% of students know the prevalence of HBV and HIV, respectively, in China, suggesting the need for further epidemiological education.

In August 2004, the National Guidelines for the Detection of HIV/AIDS (*27*) provided instructions for handling used syringes. Since the present study was conducted in May 2005, the dangers of recapping needles (an action which could increase the prevalence of bloodborne pathogens infections due to needle-stick injury) may not have yet been communicated to the local teaching hospital where we conducted this study. This may account for the fact that only 11% of students knew that recapping needles should not be performed.

According to crude and adjusted odds ratios, Y4 and Y5 students are at least six times as likely to encounter a sharps exposure than Y1 students. This suggests that OES training should occur in earlier academic years. Students majoring in dentistry, clinical medicine, medical technology, pharmacology, and nursing are at the greatest risk and are thus educational priorities. However, training of public affairs management majors should not be ignored, as they represent future policy makers. Finally, binary logistic regression modeling found that acupuncture/massage majors are at least five times more likely to encounter sharps exposures than public affairs management majors.

Surprisingly, students who have knowledge of bloodborne pathogens, have taken courses on bloodborne pathogen risk prevention, or have experienced hospital medical training, are more likely to have sharps exposure than other students. Multiple experiences of sharps exposure may engender students with a higher risk perception and a greater desire to taking training courses. Indeed, 77% of students want to learn more about occupational exposure risks that lead to bloodborne pathogen transmission. Reducing bloodborne pathogen transmission resulting from sharps exposure requires more effective educational programs.

5. Conclusions

In this study, we found that sharps exposure occurred frequently at a Chinese medical university. Sharps exposure was highest among dental, nursing, and medical students. Y4 and Y5 students were more likely to encounter sharps exposure than Y1 students. We discovered a lack of knowledge of syringe handling, post-exposure procedures, and universal precaution guidelines. Sharps exposures were underreported to supervisors. While more effective educational programs may be needed in the future, current students should be trained in OES during the earlier academic years of all majors.

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References

1. Prüss-Üstün A, Rapiti E, Hutin Y. Sharps injuries: global burden of disease from sharps injuries to health-care workers. Geneva, World Health Organization, 2003: WHO Environmental Burden of Disease Series, No. 3.
2. CDC. Updated U.S. Public health service Guidelines for the management of occupational exposures to HBV,

HCV, and HIV and Recommendations for postexposure prophylaxis. MMWR 2001; 50(RR11):1-42.
3. World Health Organization. AIDE-MEMOIRE for a strategy to protect health workers from infection with bloodborne viruses. 2003; WHO/EHT/03.11.
4. Sagoe-Mose C, Pearson RD, Perry J, Jagger J. Risks to health care workers in developing countries. New Engl J Med 2001; 345:538-541.
5. Schmid K, Schwager C, Drexler H. Needlestick injuries and other occupational exposures to body fluids amongst employees and medical students of a German university: incidence and follow-up. J Hosp Infect 2007; 65:124-130.
6. Kwee SA, Ka'anehe L. Occupational exposures and knowledge of universal precautions among medical students. Hawaii Med J 1999; 58:21-23.
7. Koening S, Chu J. Medical student exposure to blood and infectious body fluids. Am J Infect Control 1995; 23:40-43.
8. Jepsen MP, Smith E. Needlestick injuries among medical students at the University of Copenhagen. Ugeskr Læger 2003; 165:2275-2279.
9. Gamester CF, Tilzey AJ, Banatvala JE. Medical students' risk of infection with bloodborne viruses at home and abroad: questionnaire survey. BMJ 1999; 318:158-160.
10. Stewardson DA, Palenik CJ, McHugh ES, Burke FJT. Occupational exposures occurring in students in a UK dental school. Eur J Dent Educ 2002; 6:104-113.
11. Sofola OO, Folayan MO, Denloye OO, Okeigbemen SA. Occupational exposure to bloodborne pathogens and management of exposure incidents in Nigerian dental schools. J Dent Educ 2007; 71:832-837.
12. Kotelchuck D, Murphy D, Younai F. Impact of underreporting on the management of occupational bloodborne exposures in a dental teaching environment. J Dent Educ 2004; 68:614-622.
13. Osborn EH, Papadakis MA, Gerberding JL. Occupational exposure to body fluids among medical students: A seven-year longitudinal study. Ann Intern Med 1999; 130:45-51.
14. Norsayani MY, Noor Hassim I. Study on incidence of needle stick injury and factors associated with this problem among medical students. J Occup Health 2003; 45:172-178.
15. Boyan JF. Reported hospital needlestick injuries in relation to knowledge/skill, design, and management problems. Infect Control Hosp Epidemiol 1992; 13:259-264.
16. Jeffe DB, Mutha S, L'Ecuyer PB, Kim LE, Singal RB, Evanoff BA, Fraser VJ. Healthcare workers' attitudes and compliance with universal precautions: gender, occupation, and specialty differences. Infect Control Hosp Epidemiol 1977; 18:710-712.
17. Wiwanitkit V. Knowledge survey concerning universal precaution among the Thai preclinic year medical students: a medical school-based study. Am J Infect Control 2002; 30:255-256.
18. Shiao JSC, Mclaws ML, Huang KY, Guo YL. Student nurse in Taiwan at high risk for needlestick injuries. Ann Epidemiol 2002; 12:197-201.
19. Chen XP. Strengthen self-protection for student nurses. Tian Jin Nursing 2001; 9:94-96. (in Chinese, English abstract)
20. Uwakwe CBU. Systematized HIV/AIDS education for student nurses at the University of Ibadan, Nigeria: Impact on knowledge, attitudes and compliance with universal precautions. J Adv Nurs 2000; 32:416-424.
21. Jeffe DB, Mutha S, Kim LE, Evanoff BA, Fraser VJ. Evaluation of a preclinical, educational and skills-training program to improve students' use of blood and body fluid precautions: One-year follow-up. Prev Med 1999; 29:365-373.
22. Rapiti E, Prüss-Üstün A, Hutin Y. Sharps injuries, Assessing the burden of disease from sharps injuries to health-care workers at national and local levels. World Health Organization Protection of the Human Environment Geneva, Environmental Burden of Disease 2005; Series, No. 11.
23. Birenbaum D, Wohl A, Duda B, Runyon M, Stearns B, Willett M. Medical students' occupational exposures to potentially infectious agents. Acad Med 2002; 77:185-189.
24. Smith DR, Leggat PA. Needlestick and sharp injuries among nursing students. J Adv Nurs 2005; 51:449-455.
25. Reis JMB, Filho AL, Rampinelli CA, de Souza Soares EC, da Silva Prado R, Pedroso ERP. Training-related accidents during teacher-student-assistance activities of medical students. Rev Soc Bras Med Trop 2004; 37:405-408.
26. Yang YH, Wu MT, Ho CK, Chuang HY, Chen L, Yang CY, Huang HY, Wu TN. Needle stick/sharps injuries among vocational school nursing students in southern Taiwan. AJIC 2004; 32:431-435.
27. Chinese Center for Disease Control and Prevention. Occupational exposure to HIV/AIDS among healthcare workers. In: National Guidelines for the Detection of HIV/AIDS. 2004.

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