

ความชุกและปัจจัยที่เกี่ยวข้องต่อการบาดเจ็บจากเข็มทิ่มต่ำของนักศึกษาพยาบาล ในจังหวัดเทือหาน ประเทศจีน

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บทคัดย่อ

การศึกษาเชิงพรรณนาแบบภาคตัดขวางนี้ มีวัตถุประสงค์เพื่อศึกษาความชุกและปัจจัยเสี่ยงต่อการบาดเจ็บจากเข็มทิ่มต่ำของนักศึกษาพยาบาลในมณฑลเหอหาน ประเทศจีน เลือกกลุ่มตัวอย่างโดยวิธีการสุ่มแบบง่าย จำนวน 400 คน เก็บรวบรวมข้อมูลโดยใช้แบบสอบถาม วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณฯ และสถิติเชิงอนุमาน ได้แก่ Multiple logistic regression ผลการศึกษาพบว่า ความชุกของการบาดเจ็บจากเข็มทิ่มต่ำร้อยละ 67 และปัจจัยเสี่ยงต่อการบาดเจ็บจากเข็มทิ่มต่ำ คือ เพศหญิง ($aOR = 2.9, 95\% CI = 1.1 - 7.9$) ความรู้เรื่องการป้องกันเข็มทิ่มต่ำ ($aOR = 2.8, 95\% CI = 1.6 - 4.8$) และทัศนคติเชิงลบต่อการป้องกันเข็มทิ่มต่ำ ($aOR 9.0, 95\% CI 3.5 - 23.3$) สามารถใช้ผลการศึกษาปรับปรุงกฎข้อบังคับและกำหนดแนวทางการป้องกันเข็มทิ่มต่ำของนักศึกษาพยาบาล

คำสำคัญ: การถูกเข็มทิ่มต่ำ อันตรายจากการทำงาน นักศึกษาพยาบาล

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Prevalence and factors associated with needlestick injuries among nursing students in Henan Province, China

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Abstract

The cross-sectional study was conducted to investigate the prevalence and factors associated with needlestick injuries (NSIs) among nursing students in Henan Province, China. Simple random sampling was used to recruit 400 nursing students for the study. Data were collected through a face-to-face interview using a structured questionnaire. Descriptive statistics and multiple logistic regression were applied to analyze the data. The results of the study showed that the prevalence of NSIs among nursing students was 67%. Factors associated with NSIs were female ($aOR=2.9, 95\% CI=1.1-7.9$), knowledge of NSIs prevention ($aOR= 2.8, 95\% CI =1.6-4.8$) and negative attitude toward NSIs prevention ($aOR= 9.0, 95\% CI =3.5-23.3$). Nursing academic institutions could use results of this study to improve the NSIs prevention guideline for nursing students.

keywords: needlestick injuries; occupational hazard; nursing student

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Background

Needlestick injury (NSI) is defined as an injury that occurs to the skin or mucous membranes that are pierced caused by needles, such as hypodermic needles, blood collection needles, cannula, and needles attached to various parts of the IV system.¹ Globally, approximately 3 million health workers are infected because of NSIs every year. In Asia, the prevalence of NSIs among nurses and nursing students is 46.3%.² In some Asian populations, such as nursing students in India, the prevalence of NSIs is as high as 69%.³ In China, a previous study by Zhang et al. indicated that the prevalence of NSIs among nursing students was higher than 60%.⁴ Similarly, another study reported that the prevalence of NSIs among bachelor nursing students in Henan Province, China was 76.1%.⁵

NSIs confers a potential infection risk from bloodborne pathogens, such as hepatitis B virus, hepatitis C virus, and HIV, among nursing students. According to statistics, the global incidence of NSI-induced infections is 37.6% for hepatitis B, 39% for hepatitis C, and 4.4% for HIV/AIDS.⁶ Moreover, NSIs accountable to an average economic burden of \$747 per reported case among governments, medical institutions, and individuals globally.⁷ The low-income and upper middle-income countries, particularly China, is a major victim of NSIs and it's economical as well as medical burden than developed countries. Nursing students are especially at risk of NSIs because they encounter close contact with body fluids in activities such as surgery, midwifery, and endoscopy when giving injections, passing needles, or removing needles.⁸ However, the lack of awareness of personal

protection and the limited work experience of nursing students increases their risk of NSIs during nursing work. This situation has led to an increase in anxiety and stress among nursing students, with resultant feelings of being useless, awkward, or incapable of nursing work.⁹

Increasing research indicates that levels of the health care facility and departments are common factors in NSIs for nursing students, especially medical clinics, department of internal medicine, and injection rooms are places where nursing students often experience NSIs.¹⁰ Moreover, older age and lower academic grades of some nursing students lodged them to the susceptible of NSIs due to lack of nursing knowledge, negative attitude towards preventing NSIs and lack of awareness on low personal protection.¹¹ Studies have shown that nursing students often suffer from inattention and high workloads in clinical work, which has caused invasive injuries, especially when using needles to administer medicine.¹²

In previous studies in China, the shortage of lesson hours in the occupational safety protection courses and teaching content lags behind the current clinical environment of nursing care are the influencing factors of NSIs among intern students in Chinese hospitals.⁹

In China, several studies have focused on the prevalence and factors associated with NSIs among healthcare workers, nurses, and nursing students at universities. However, there is limited research conducted among nursing students of colleges and secondary schools. Furthermore, several studies highlighted the high prevalence of NSIs in bachelor nursing students in Henan province.

Nonetheless, a study about influencing factors of NSIs among nursing students at all education levels in Henan province is lacked and necessary to uncover. Therefore, this research aimed to determine the prevalence and factors associated with NSIs among nursing students in Henan province, China.

Material and methods

Settings and methods

We conducted a cross-sectional study to investigate the prevalence of NSIs and its associated factors among nursing students in seven nursing education institutions using stratified random sampling in Henan Province, China. The Henan Province, located in the central part of China, has a high population of 38,114 nursing students and a high incidence of bloodborne infectious diseases as compared to other provinces.¹³ The Henan Province has 16 bachelor-level nursing education institutes, 24 college-level nursing education institutes, and 16 nursing education institutes. To maintain the equal proportion of nursing education institutions at all levels, the researchers used a stratified random sampling of the area by following proportionate allocation to determine the study sites of 2 universities, 3 colleges, and 2 secondary schools.

Sample size and sampling procedure

The sample size was calculated based on the single-population proportion formula.⁴ With a 95% confidence level (CI), a sample size of 333 was considered necessary for statistical power; however, after adding an estimated 20% non-response, the sample size was increased to 400. Inclusion criteria were nursing students aged 18–25 years who were enrolled in a clinical nursing internship at hospitals

for 6 to 10 months. Nursing students with severe organic diseases and some functional diseases that prevent them from participating in internships or restricted them in internship programs were excluded.

Questionnaire and data collection

We developed a structured self-report questionnaire to investigate the prevalence and factors of NSIs among nursing students. The questionnaire comprised four parts: general characteristics; prevalence and circumstance of NSIs; knowledge, attitude and practice (KAP) for NSI prevention; and internship environment. All questions in the questionnaire concerning KAP for preventing NSIs were designed based on the NSI prevention guidelines of the World Health Organization (WHO)¹⁴ and the American Nurses Association.¹⁵ Knowledge, attitude, and practice towards the prevention of NSIs among nursing students were classified into three levels according to bloom's taxonomy.¹⁶

Knowledge about NSIs prevention consisted of 18 multiples choice questions. The total score for knowledge was 17 for all items (100%), where 1 score given to each right answer and 0 score to the wrong answer. Furthermore, the scores ranged from 13–17 (80%–100%) were classified as the high knowledge level, the scores ranged from 10–12 (60%–79.99) were classified as the moderate knowledge level, the scores ranged from <10 (<60%) were classified as the low knowledge level.

Attitude towards NSIs prevention included 18 items, in which each items had 5 different score following Likert scale: “Strongly disagree” = 1; “Disagree” = 2; “Neutral” = 3; “Agree” = 4; “Strongly agree” = 5. Moreover, attitude classified

into three levels based on the scores: the scores ranged from more than 68 (80%) were classified as the high attitude level namely the positive attitude, the scores ranged from 51-68 (60~80%) were classified as the moderate attitude, the scores ranged from less than 51 (<60%) were classified as the low attitude level namely the negative attitude.

The practice of prevention NSIs consisted of 18 items and Likert type answers with scores, i.e., “Always” = 3, “Sometimes” = 2, and “Not at all” = 1. The practice was classified into three levels: The scores ranged from more than 45 (80%) were classified as the high practice level, the scores ranged from 34-45 (60%-80%) were classified as the moderate practice level, the scores ranged less than 34 were classified as the low practice level.

The research instrument was submitted for review and obtained recommendations by consultants and experts from Xinxiang Medical University (China). Three experts evaluated the content validity of the questionnaire based on the Index of item-objective congruence (IOC). Fortunately, they found each item of the questionnaire has an IOC score ≥ 0.5 . Then, a pilot study was carried out among 30 students of a university, with similar characteristics but not from study settings. Then, the internal consistency of the questionnaire related to knowledge, attitude, and practice of NSIs prevention was tested by Cronbach’s Alpha value and found as 0.78. The informed written consent was obtained from each participant before the data collection.

Statistical analyses

IBM SPSS Statistics version 26.0 (IBM Corp, Armonk, NY, USA) used for data management and data analysis. Descriptive statistics used to

analyze the participant’s general characteristics and circumstances of NSIs. A binary logistic regression model was used to identify the associated factors of NSIs. The variables with p-value < 0.2 in univariate analysis proceeded for multiple logistic regression model. From the multiple logistic regression model, significant independent related factors of NSIs with adjusted odds ratio at 95% confidence interval (CI) and p-value < 0.05 were detected.

Ethical considerations

This study was approved by the Academic Ethics Committee of the Mae Fah Luang University (approval no. 129/2562). All subjects provided their written informed consent at the sampling sites in China. The investigator approved all research activities, and subject confidentiality was maintained thoroughly in accordance with the relevant regulations. The current study conducted in compliance with the tenets of the Declaration of Helsinki and its subsequent amendments to research on human subjects.

Results

General characteristics

The response rate of the participants in this study was 100%. The majority of nursing students were female (92.3%), and more than half of the respondents participated in a college program (54.5%). More than half of the students had internships at Grade III level A hospitals, and over 90% of students had internships in the departments of surgery and internal medicine. The general characteristics of the study participants are shown in Table 1

Table 1 Frequency and percentage of general characteristics (n = 400)

Characteristics	Number (Percentage)
Gender	
Male	31 (7.8)
Female	369 (92.2)
Education	
University program	80 (20.0)
College program	218 (54.5)
Secondary school program	102 (25.5)
Level of the internship hospital	
Grade III level A hospital	241 (60.3)
Grade III level B hospital	34 (8.5)
Grade II level A hospital	110 (27.5)
Grade II level B and other hospitals	15 (3.7)
Department (more than one answer permitted)	
Operation room (OR)	138 (34.5)
Emergency (ER)	181 (45.3)
Intensive care unit (ICU)	192 (48.0)
Gynecology and child medicine	288 (72.0)
Surgery	378 (94.5)
Internal	385 (96.3)

Prevalence and circumstance of NSIs

The prevalence of NSIs among nursing students in Henan Province was 67% (95% CI 62–72), with 65.7% of the respondents experiencing NSIs 1–3 times. Most of the respondents suffered NSIs during injections (44%), followed by management of venous catheters (22%), and needle waste disposal (20.2%). The majority of respondents experienced NSIs during the day shift (74.6%; Table 2)

Table 2 Prevalence and circumstance of needlestick injuries

Characteristics	Number	Percentage
Needlestick injuries (n = 400)		
Yes	268	67.0 (95% CI 62–72)
No	132	33.0
Type of nursing work (n = 268)		
Injection process	118	44.0
Blood collection	34	12.7
Venous catheter	59	22.0
management process		
Surgical serving	3	1.1
Disposal of all kinds of needle waste	54	20.2
Number of needlestick injuries (n = 268)		
1–3 times	176	65.7
4–6 times	50	18.7
5–7 times	22	8.2
8–10 times	14	5.2
>10 times	6	2.2
Working shift (n = 268)		
Day	200	74.6
Evening	46	17.2
Night	22	8.2

Factors associated with NSIs

Based on the multiple logistic regression analysis (Table 3), female nursing students were 2.9 times (adjusted OR [aOR]; 95% CI, 1.1–7.9) more likely to get NSIs than males. Nursing students who studied at a secondary school program were 2.5 times (95% CI 1.1–6.3) more likely to have NSIs than nursing students who studied in a university program. Nursing students who had a moderate level of knowledge on NSI prevention were 2.8 times (95% CI, 1.6–4.8) more likely to experience NSIs than students who had a high level of knowledge.

Similarly, nursing students who had negative attitudes toward NSIs prevention were 9.0 times (95% CI, 3.5–23.3) more likely to get NSIs than were students with a positive attitude toward NSI prevention. The students who did not attend training

and courses on NSIs prevention were 2.5 times (95% CI, 1.1–6.0) more likely to have NSIs than were the students who completed training and courses on NSI prevention.

Table 3 Binary and multilevel logistic regression of factors associated with needlestick injuries among nursing students in the Henan Province, China

Characteristics	Needlestick injuries		Crude OR (95% CI)	Adjusted OR (95% CI)
	Yes (n=268) n (%)	No (n=132) n (%)		
Gender				
Male	15 (48.4)	16 (51.6)	Referent	Referent
Female	253 (68.6)	116 (31.4)	1.3 (1.1–4.9)	2.9 (1.1–7.9)*
Education				
University program	35 (43.8)	45 (56.2)	Referent	Referent
College program	146 (67.0)	72 (33.0)	2.6 (1.5–4.4)	1.2 (0.7–2.4)
Secondary school program	87 (85.3)	15 (14.7)	7.5 (3.7–15.1)	2.5 (1.1–6.8) *
Knowledge level of NSI prevention				
High	51 (47.7)	56 (52.3)	Referent	Referent
Medium	197 (73.0)	73 (27.0)	3.00 (1.9–4.7)	2.8 (1.6–4.8) *
Low	20 (87.0)	3 (13.0)	7.3 (2.1–26.1)	3.9 (1.0–15.7)
Attitude level of NSI prevention				
High	46 (50.0)	46 (50.0)	Referent	Referent
Medium	148 (65.8)	77 (34.2)	1.9 (1.2–3.2)	1.5 (0.9–2.7)
Low	74 (89.2)	9 (10.8)	8.2 (3.7–18.4)	9.0 (3.5–23.3) *
Trainings and courses on NSI prevention				
Yes	212 (63.1)	124 (36.9)	Referent	Referent
No	56 (87.5)	8 (12.5)	4.1 (1.9–8.9)	2.5 (1.1–6.0)*

Note: NSI, needlestick injury; OR, odds ratio; 95% CI, 95% confidence interval; **p*-value <0.05.

Discussion

We found a high prevalence of NSIs among nursing students in Henan Province, which was 67.0% (95% CI 62% to 72%). The current result is similar to previous studies from other parts of China.⁴ NSIs in nursing students mainly occurred during the injection on the day shift. Most of the patients get injections and other treatments during day time, due to which, the nurses and the nursing

students experience more NSIs on the day shift as compared to the night shift. Studies had shown that in lower-level hospitals, due to the shortage of medical resources in the hospital, indwelling needles cannot be provided for more inpatients.¹¹ The large use of disposable needles increased the risk of NSIs among nursing students. Moreover, compared to China's neighboring countries such as Thailand (27%) has strict occupational health and safety

legislation for health workers than the Henan Province, which could be accountable for a lower prevalence of NSIs than the current result.¹⁷

In the present study, the female gender had a significant association with NSI. Female nursing students were more prone to NSIs than male nursing students, which is consistent with the results of Ghanei's study.¹⁸ Female nursing students were susceptible to emotional influences at work, and negative emotions such as anxiety, depression, and insomnia which surplus their risk of NSIs.¹⁹

Regarding the educational programs, this study showed that nursing students participating in secondary school programs were at a higher risk of NSIs than were nursing students in undergraduate programs. This finding is similar to a finding from Iran.²⁰ The rationale for this finding could be that nursing students in the secondary program had a shorter educational period or short-duration courses related to injection practices. Besides, nursing education in technical secondary schools was severely out of touch with current hospital nursing technology, and most of the course content learned in nursing courses focused on theoretical knowledge instead of its application to the clinical environment. Students have less chance to practice intravenous indwelling needle puncture before the internship.²¹

Concerning the knowledge of NSI prevention, nursing students who were lack of knowledge of NSIs prevention were more vulnerable to NSIs, because the nursing educational institutions and hospitals in the Henan Province did not provide adequate courses on occupational protection or training related to NSIs. In this study, knowledge about using a sharp beveled needle and placing the

beveled face up when doing injection was found significant with NSIs. Furthermore, knowledge of NSIs prevention, i.e., patients who do not comply with the injection treatment, should be assisted by other nursing staff significantly associated with NSIs among Nursing students. It was similar to the results of the Indian study.²² Also, a study found that infection-control guidelines were considered the commonest source of information on nurses to prevent NSI (49%), followed by information from senior colleagues (36%) and continuing medical education (CME).²³

Furthermore, the attitude toward NSI prevention was a significant factor in this study, which is similar to the previous study in Poland.²⁴ In particular, the attitude toward using protective needles and safe blood collection needles; avoiding passing needles by hand, and placing needles in a plate or tray when the needles need to be delivered during the operation; capping needles by one hand; and not separating the needle from the syringe by hand after injection was responsible for NSIs. The underlying reasons for these attitudes are the high load of nursing students in clinical practice, and the inattention and indifference of clinical educators to consequences of NSIs.²⁵ Nursing students in our study did not work for more than three weeks in each department. Nursing managers in some departments think that the use of protective tools and safety needles will increase the cost of the department and, therefore, limiting the use of these tools by nursing students has created a negative attitude of nursing students while using it.

The strength of this study is the high response rate (100%) from the participants, which

helped to get valid and adequate data. However, the fact that nursing students completed their internship at different periods and subjected to have recall bias, which can be considered as a probable limitation of this study. Further qualitative research is recommended to perform an in-depth investigation about specific reasons for lack of knowledge related to the prevention of NSIs in nursing students.

Conclusion

Our study highlights the high prevalence of NSIs among nursing students. Being female, studying in the secondary program, lower knowledge and attitude about NSIs prevention, and courses and training on the prevention of NSIs were factors associated with the increased risk of NSIs. Institutes of nursing education and hospitals should focus more on strengthening their courses and pieces of training on the prevention of NSIs to improve the knowledge and attitudes among nursing students. Nursing academic institutions could use the current study results to improve the NSIs prevention guideline for nursing students.

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References

1. Sriram S. Study of needle stick injuries among healthcare providers: Evidence from a teaching hospital in India. *J Fam Med Prim Care* 2019; 8(2): 599–603. doi:10.4103/jfmpc.jfmpc_454_18
2. Auta A, Adewuyi EO, Tor-Anyiin A, et al. Global prevalence of percutaneous injuries among healthcare workers: A systematic review and meta-analysis. *Int J Epidemiol* 2018; 47(6): 1972–80. doi:10.1093/ije/dyy208
3. Gupta D, Saxena S, Agrawal VK, et al. Study of knowledge, attitude and practice of needle stick injury among nurses in a tertiary care hospital. *Int J Community Med Public Heal* 2019; 6(2): 865. doi:10.18203/2394-6040.ijcmph20190221
4. Zhang X, Chen Y, Li Y, et al. Needlestick and sharps injuries among nursing students in Nanjing, China. *Workplace Health Saf* 2018; 66(6): 276–84. doi:10.1177/2165079917732799
5. Bao J, Wang F, Hu C. Investigation of needlestick injuries among nursing students in the general hospital. *J Nurs Adm* 2015; 15(2): 135–36.
6. Isara AR, Oguzie KE, Okpogoro OE. Prevalence of needlestick injuries among healthcare workers in the accident and emergency department of a teaching hospital in Nigeria. *Ann Med Health Sci Res* 2015; 5(6): 392–6. doi:10.4103/2141-9248.177973
7. Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. *Med Devices (Auckl)* 2017; 10: 225–35. doi:10.2147/MDER.S140846

8. Black Thomas LM. Nursing faculty experiences with students' needlestick injuries [published online ahead of print, 2020 Feb 20]. *Nurse Educ.* 2020;10.1097/NNE.000000000000000810
9. Yao WX, Yang B, Yao C, et al. Needlestick injuries among nursing students in China. *Nurse Educ Today* 2010; 30(5): 435 - 7. doi:10.1016/j.nedt.2009.09.018
10. Zhao F, Zhang M, Xuan J, et al. A large-scale cross-sectional survey on needle-stick injuries related to injections of antidiabetics in China: incidence and infection rates. *Value Heal.* 2018; 21(1): S72. doi:10.1016/j.jval.2018.04.479
11. Suliman M, Al Qadire M, Alazzam M, et al. Students nurses' knowledge and prevalence of needle stick injury in Jordan. *Nurse Educ Today* 2018; 60: 23-7. doi:10.1016/j.nedt.2017.09.015
12. Lukianskyte R, Gataeva J, Radziunaite L. Needle sticks and sharps injuries experienced by staff nurses and nursing students and their prevention. *Int J Infect Control* 2012; 8(1): 3-9. doi:10.3396/ijic.v8i1.002.12.
13. Guo YH, Lyu YY, Yang JH, et al. Data analysis on hepatitis B through pilot surveillance reporting system in Henan Province, 2012-2016. *Zhonghua Liu Xing Bing Xue Za Zhi* 2018; 39(4): 500-04. doi:10.3760/cma.j.issn.0254-6450.2018.04.023
14. World Health Organization. Joint WHO/ILO policy guidelines on improving health worker access to prevention, treatment and care services for HIV and TB. Geneva; 2010.
15. American Nurses Association. Workplace safety and needlestick injuries are top concerns for nurses. Silver Spring; 2008
16. Tirpude AP, Gaikwad M, Tirpude PA et al. Retrospective analysis of prevalent anatomy spotter's examination: an educational audit. *Korean J Med Educ.* 2019; 31(2): 115-24. doi:10.3946/kjme.2019.123
17. Setthamas M, Sawaengdee K, Theerawit T, et al. Incidence and risk factors of needle stick and sharp injuries among registered nurses in Thailand. *J Public Heal Dev* 2018; 16(1): 17-28.
18. Ghanei Gheshlagh R, Aslani M, Shabani F, et al. Prevalence of needlestick and sharps injuries in the healthcare workers of Iranian hospitals: an updated meta-analysis. *Environ Health Prev Med* 2018; 23(1): 44. doi:10.1186/s12199-018-0734-z
19. Zhang MX, Yu Y. A study of the psychological impact of sharps injuries on health care workers in China. *Am J Infect Control* 2013; 41(2): 186-7. doi: 10.1016/j.ajic.2012.02.023
20. Motaarefi H, Mahmoudi H, Mohammadi E, et al. Factors associated with needlestick injuries in health care occupations: A systematic review. *J Clin Diagnostic Res* 2016; 10(8): IE01-04. doi: 10.7860/JCDR/2016/17973.8221
21. Wang C, Whitehead L, Bayes S. Nursing education in China: Meeting the global demand for quality healthcare. *Int J Nurs Sci* 2016; 3(1): 131-6. doi: 10.1016/j.ijnss.2016.02.009

22. Pavithran VK, Murali R, Krishna M, et al. Knowledge, attitude, and practice of needle stick and sharps injuries among dental professionals of Bangalore, India. *J Int Soc Prev Community Dent* 2015; 5(5): 406-12. doi:10.4103/2231-0762.165932

23. Madhavan A, Asokan A, Vasudevan A, et al. Comparison of knowledge, attitude, and practices regarding needle-stick injury among health care providers. *J Fam Med Prim Care* 2019; 8(3): 840-5. doi:10.4103/jfmpc.jfmpc_103_19

24. Garus-Pakowska A, Górajski M. Behaviors and attitudes of Polish health care workers with respect to the hazards from blood-borne pathogens: a questionnaire-based study. *Int J Environ Res Public Health* 2019; 16(5): 891. doi:10.3390/ijerph16050891

25. Gogoi J, Ahmed SJ, Saikia H, et al. A study on knowledge, attitude, practice and prevalence of needle stick injuries among health care workers in a tertiary care hospital of Assam. *Int J Community Med Public Health* 2017; 4: 2031-5. doi:10.18203/2394-6040.ijcmph20172171