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FROM AROUND THE GLOBE

The epidemiology of needle stick and sharp Injuries in central sterile supply department of hospitals in Hunan Province, China

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Abstract

The aim of this descriptive study was to determine the prevalence and explore the potential risk factors of Needle Stick and Sharps Injuries (NSIs) among nurses and nursing assistants in central sterile supply department (CSSD) of Hunan hospitals, China. This cross-sectional study was conducted in Hunan province, China. Sample of the study comprised 247 nurses and 95 nursing assistants. Data were collected using a semi-structured questionnaire developed by researchers.

Of the 342 participants interviewed, 304 (88.9%) and 288 (84.2%) were exposed to at least one NSI in their lifetime and in the previous year, respectively, with a total of 431 self–reported NSIs having occurred during the previous 12 months. Those who were registered nurses (OR 0.313), reported after exposure (OR 0.292), thought of NSIs avoidable (OR 0.442), received more sources of occupational safety knowledge (OR 0.451) and by whose hospitals preventive measures adopted (OR 0.731) had lower risk of sustaining a NSIs. While those who worked in high noise level environment (OR 1.649) and contacted sharps frequently (OR 1.388) had more probability of having an injury.

This study shows that a significant percentage of nurses and nursing assistants in CSSD sustain NSIs. Prevention of occupational infection requires a comprehensive approach to reduce exposure and provide pre-exposure and post-exposure prophylaxis for NSIs.

Keywords: Needlestick Injuries and Epidemiology, Accidents – occupational, Nurses

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Introduction

Needle stick and sharps injuries (NSIs)[1] represent an important source of morbidity and economic costs in the healthcare environment.[2,3] Every year, hundreds of thousands of health care workers (HCWs) are at risk of occupationally acquired blood-borne diseases as the result of NSIs.[4,5] It is estimated that annual NSIs are causing a great direct financial burden of $500 million in the United States[6] and substantial indirect costs including those related to absenteeism and distress on the part of affected HCWs.[7] Even a minor injury caused by a sharp instrument but with little loss of blood carries the risk of transfer of over 20 pathogens.[8] NSIs may cause a potentially fatal infection with hepatitis B virus (HBV), hepatitis C virus (HCV), or human immunodeficiency virus (HIV)[9,10] and other blood-borne pathogens including cytomegalovirus, herpes simplex virus and parvovirus B19.[11] The risk of infection following needle stick exposure is 1.9% to greater than 40% for HBV infections, 2.7% to 10% for HCV infections, and 0.2% to 0.44% for HIV infections. It is estimated that NSIs cause approximately 66,000 HBV infections, 16,000 HCV infections, and 200 to 5000 HIV infections among HCWs annually.[12] These blood-borne infections have serious consequences, including long-term illness, disability and death,[13-15] and often accompanied by a considerable and long-lasting emotional impact.[7] However, still we don't pay so much attention to NSIs as it deserves. Although doctors and nurses are aware of the benefits of early reporting, a culture of silence persists.[16] It is estimated by Centers for Disease Control (CDC) that about half of NSIs go unreported.[17]

Although there are many studies about NSIs in hospitals home and abroad, the studies on NSIs in central sterile supply department (CSSD) are rare. After the implementation of three health industry standards put forward by the Ministry of Health in China in 2009, the working mode of CSSD has changed from decentralized management into centralized management. Then the working load in CSSD nearly doubled, but the staffs didn't increase, increasing the risk of NSIs. CSSD bears the responsibility of collecting, counting, classifying, cleaning, disinfecting, checking, packaging, storing, distributing and sending all sorts of repeated used medical apparatus, instruments, devices and materials from each department of hospitals. It is the place where various medical pollutants concentrate, and the majority staffs there are nurses and the rest are nursing assistants among whom most haven't received regular training before working. In China, with the speedy increasing prevalence of HIV, there were 1,000,000 people infected with HIV in 2010, and China is also a high-risk country for HBV and HCV. However, in CSSD, we just consider the medical instruments and materials contaminated by HIV, HBV, HCV as ordinary contaminated items, and deal with them in the procedure of first cleaning and then disinfection, increasing the risk of the blood-borne infectious diseases spreading. CSSD is a special department, different from other clinical wards in hospitals, so it can't share completely the same experience on management of NSIs in other departments. In order to develop effective policy measures for reducing the risk of NSIs in CSSD, it is essential to understand the epidemiology of NSIs in CSSD and then analyze what contributes to the incidence of these injuries in clinical practice. The purpose of this study is to collect data on self-reported NSIs to develop best practices to reduce them.

Methods

Study population

Data was collected between October and November 2012, and a total of 30 hospitals were included in the study including 18 public tertiary hospitals, 9 public secondary hospitals and 3 public specialized hospitals. All the staffs in CSSD of these hospitals participated in the study, except for those who don't contact sharps during their working time and those who don't want to participate. The questionnaire was completed by 348 of 372 staffs surveyed, for a response rate of 93.5%. Six invalid questionnaires were excluded because of incomplete or missing responses, leaving a final total of 342 for analysis. The final sample of the study comprised 247 nurses and 95 nursing assistants, 98.5% were women and 86.5% were married, age between 18 to 58 years old with mean age 38.8 years old. Nearly half (48.0%) of them had working for less than 10 years and 68.1% didn't have to be on night duty. Written informed consent was obtained from all subjects and all participants had the right to comply or refuse participation.

Study Design

Permission to perform the study was obtained from the hospital ethics committee. This study followed the principle of voluntary participation, filling in questionnaire anonymously and maintaining privacy. Based on literature reviews, we developed a semi-structured questionnaire. A pilot study was carried out among randomly selected 100 staffs in CSSD at 10 public hospitals in September, 2012, to evaluate the readability and simplicity of the questionnaire and then modify and improve it. A week later, we did repeated measurements among the same sample to test the reliability and validity of the questionnaire. The final questionnaire consists of questions inquiring about three topics:

1) demographic characteristics and general information, consisting of 15 items such as gender, age, marriage, religion, character, education, title, vaccination status and so on;
2) experience of NSIs since working and in the previous year, including time, location, physical and psychological status of occurrence, object causing injury, circumstances surrounding injury, methods of disposal, reporting and so on;
3) respondents' habit, knowledge, attitudes and practice concerning the prevention and management of NSIs and the working environment.

The study was introduced to the staffs in CSSD and they were asked to complete a self- report questionnaire when they were off duty. All participants were informed of the nature and objectives of the survey and their consent was obtained before they filled in the questionnaire individually.

Statistical Analysis

Data was analyzed using the Statistical Package for Social Sciences (SPSS) for Windows, Version 18.0. Extent of NSIs was evaluated using lifetime and recent exposure to NSIs during the previous year. The percentage was adopted for statistical description, and χ^2 test and multivariate analysis were performed to explore factors relating to the occurrence of NSIs. P-values under 0.05 were considered to indicate statistical significance.

Results

Frequency of exposure to NSIs

A total of 342 subjects were available for analysis. Distribution of demographic characteristics of the study population are presented in Table I. Among the participants, 304 (88.9%) reported having experienced at least one NSI in their lifetime while only 11.1% had not experienced any such injury. Of the injured participants, 57.6% (197) sustained 1-5 injuries, 17.3% (59) had 6-10 injuries, 14.0% (48) sustained more than 10 injuries. And among the participants, 288 (84.2%) reported having experienced at least one NSI in the previous year and about 50.0% (144), 38.0% (109) and 12.0% (35) of the respondents had been exposed to contaminated materials, contamination undetermined, non-contaminated materials, respectively. And among the blood- or body fluid-contaminated materials, 83.2% (120) can't be ensured whether the patients have blood-borne infectious diseases or not. A total of 431 self–reported NSIs occurred among staffs in CSSD during the previous year.

Table I. Demographic characteristics of participants in CSSD (n= 342)

Characteristic	Number	Percent
Hospital level		
Participants from tertiary hospital	282	82.5
Participants from secondary hospital	45	13.1
Participants from specialized hospital	15	4.4
Gender		
Male	5	1.5
Female	337	98.5

Characteristic	Number	Percent
Age		
< 25	49	14.3
25 ~	11	3.2
28 ~	25	7.3
30 ~	36	10.5
35 ~	120	35.1
45 ~	75	21.9
> 55	26	7.6
Marriage		
Unmarried	44	12.9
More than once	296	86.5
Divorced	2	0.6
Education		
Secondary schooldiploma or under	114	33.3
Junior	148	43.3
Undergraduate	78	22.8
Postgraduate	2	0.6
Title		
Associate chief nurse	14	4.1
Supervisor nurse	111	32.5
Senior nurse	52	15.2
Nurse	70	20.4
Nursing assistant	95	27.8
Employment		
Staff nurse	164	48.0
Employed nurse	68	19.9
Probation nurse and intern	15	4.3
Nursing assistant	95	27.8
Registeredor not		
Yes	235	68.7
No	107	31.3
Whether or not on duty of night shift		
Yes	109	31.9
No	233	68.1
HBV vaccination		
Yes, strictly	111	32.5
Yes, but not strictly	150	43.9
No	81	23.7
HBsAb		
Positive	186	54.4
Negative	132	38.6
Unclear	24	7.0

Religious belief		
Yes	12	3.5
No	330	96.5
Job category		
Nurse	247	72.2
Nursing assistant	95	27.8

Distribution of time and sites of NSIs

This survey showed that the majority of exposures occurred during 10:00 am in the morning, and then 15:00 pm in the afternoon (Figure 1). All the participants reported being right handed. The most commonly affected sites were the left index finger (32.4%), left thumb (15.7%) and right index finger (13.2%). Each of other injury sites accounted less than 10%. Totally, 66.6%, 31.2% and 2.2 % of NSIs occurred to the left hand (non-dominant hand), right hand (dominant hand) and other positions such as foot, respectively.

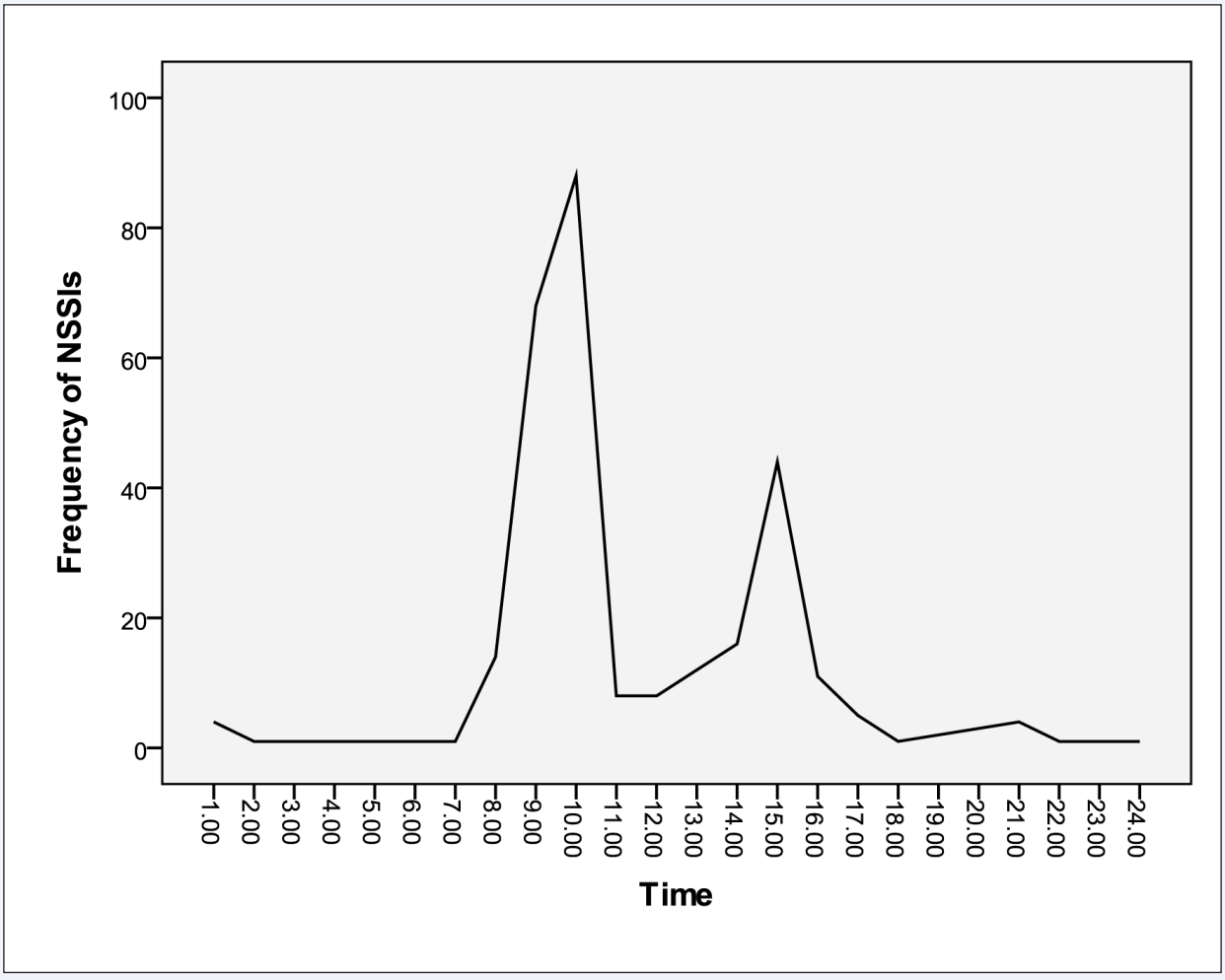

Figure 1. Time distribution chart of NSIs for the staffs in CSSD during the previous year.

Type of instrument associated with NSIs

The most common device involved in the injury was a disposable syringe needle in 139 cases (32.3%), 127 cases (29.5%) occurred with scalpel or lancet, 116 cases (26.9%) occurred with a puncture needle, 32 cases (7.4%) involved a stitch and 10 (2.3%) occurred with a blade. Only 7 (1.6%) occurred with other sharps such as scissors (Figure 2).

Operating processes associated with NSIs

As mentioned above, the whole operating process in CSSD is divided into 10 different stages. This survey showed that NSIs occurred only in the following 5 stages, among which the most common stage at the time of incident was the cleaning stage, accounting for 40.1% (173 cases) of the NSIs, and 24.1% (104 cases), 18.6% (80 cases), 14.4% (62 cases) and 2.8% (12 cases) occurred to the counting, collection, classification, checking and packaging stages, respectively (Figure 3).

Post-exposure treatment of NSIs

The majority (89.6%) knew to clean and disinfect the injury site immediately, but only a minority (44.8%) would take post-exposure prophylaxis. What's worse, some people (6.9%) considered NSIs as minor injuries and adopted no treatment (Figure 4).

Reporting of NSIs

This study showed only 46.5% reported after exposure to NSIs; more than half didn't report. There were reasons for underreporting. 27.2% were not aware of

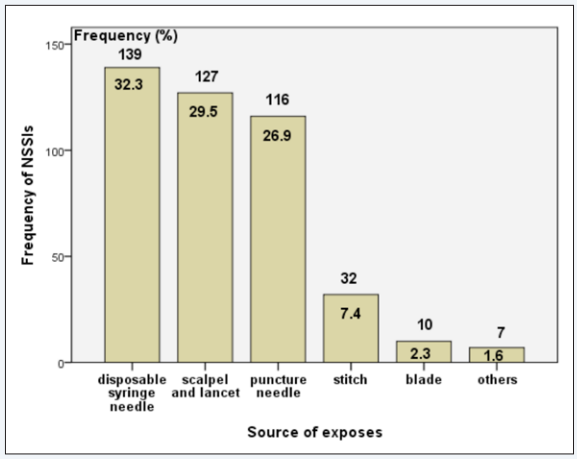

Figure 2. The history of being classified as high-risk among sources of occupational exposures in CSSD (N=431).

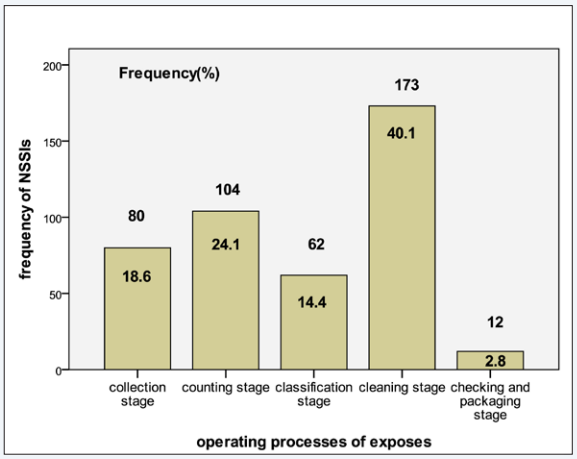

Figure 3. The exposure to NSIs in persons working in CSSD during different operation process in the previous year (N=431).

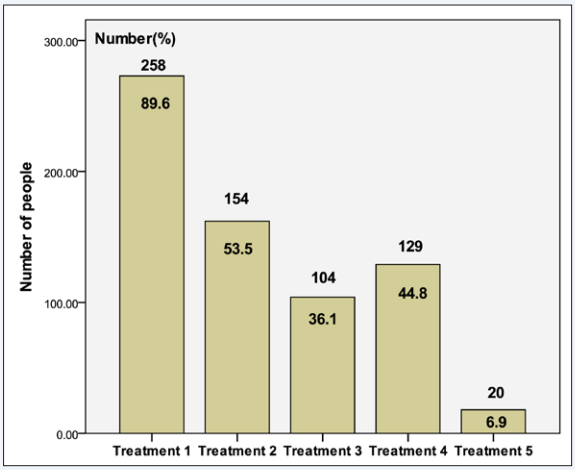

Figure 4. Treatment after exposure to NSIs for the injured staffs in CSSD (N=288)

- Treatment 1: Clean and disinfect immediately
- Treatment 2: View patients' history to determine whether the patient has HBV, HCV, HIV or other infectious diseases
- Treatment 3: When lacking of related test results, recommend their doctors immediately to do the relevant check-up to determine whether the patient has HBV, HCV, HIV or other infectious diseases
- Treatment 4: Do the necessary check-up in hospitals and adopt prophylactic treatment (such as the injection of hepatitis B immune globulin)
- Treatment 5: Consider NSIs as minor injuries and adopt no treatment

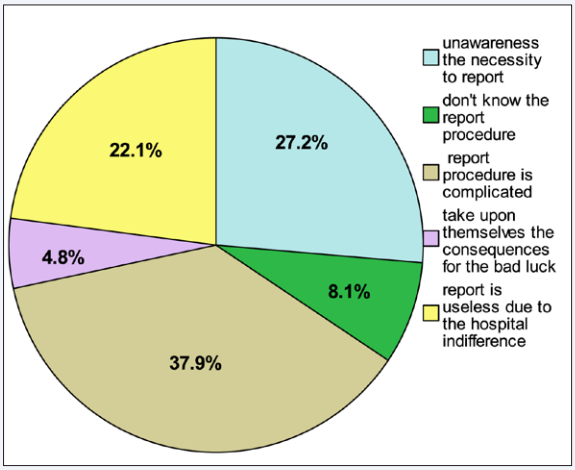

Figure 5. Reasons distribution for underreporting after exposure to NSIs in CSSD

the necessity to report; 8.1% didn't know the report procedure; 37.9% thought the report procedure was complicated; 4.8% considered NSIs as their own mistakes and took upon themselves the consequences for the bad luck and 22.1% held the opinion that report is useless due to the hospital indifference to it (Figure 5).

Risk factors for NSIs

Possible risk factors for injuries were evaluated. In the univariate analysis 14 variables were found to be statistically significant risk factors of NSIs: personal characteristics (education, title, type of employment, job category, registered or not, HBV vaccination, sources of occupational safety knowledge, necessity to reported or not, thinking of NSIs avoidable or not), factors of working environment (noise level, rationality of materials and medical waste disposal, sharps contact frequency, preventive measures adopted or not, periodic check-up provided by hospital or not). These variables were included in the multivariate model. In order to adjust for confounding factors, a backward stepwise conditional logistic regression was employed using all of the statistically significant variables above. Multivariate logistic regression analysis of the odds ratio (OR) for sustaining injuries in relation to the potential risk factors listed below was presented in Table II. Only 7 variables were found to be significant after the stepwise procedure ($p < 0.001$). The results showed that the strongest NSIs risk factor was high noise level compared with low noise level (OR 1.649). Another factor significantly related with increased odds ratio for injuries was sharps contact frequency, being high frequency when compared with very low frequency (OR 1.388). In this study, those who were registered nurses (OR 0.313), reported after exposure (OR 0.292) and thought of NSIs avoidable (OR 0.442) had less probability of having an injury. Those who received more sources of occupational safety knowledge (OR 0.451) and by whose hospitals preventive measures adopted (OR 0.731) had lower risk of sustaining a NSIs.

Table II. Binary logistic regression analysis of odds ratio (OR) for NSIs in relation to potential risk factors.

Variable	Partial regression coefficient	Standard error	Waldyχ^2	Degree of freedom	Percent	OR	Assignmet instructions
Registered nurse or not							
	-1.160	0.352	10.850	1	0.0001	0.313	No: 0 Yes: 1
Report or not							
	-1.228	0.288	18.150	1	0.000	0.293	No: 0 Yes: 1
Thinking of NSIs							
	-0.816	0.339	5.780	1	0.016	0.442	No: 0 Yes: 1

Variable	Partial regression coefficient	Standard error	Waldyχ^2	Degree of freedom	Percent	OR	Assignmet instructions
Source of occupational safety knowledge							
	-0795	0.297	7.512	1	0.007	0.451	No: 0 One source:1 Two sources: 2 Three or more sources: 3
Sharps contact frequency							
	0.328	0.208	2.497	1	0.114	1.388	Very few:1 Once ina while: 2 Very often: 3
Noise level							
	0.500	0.190	6.907	1	0.009	1.649	Low: 1 Moderate: 2 High: 3
Preventive measures							
	-0.313	0.212	2.186	1	0.139	0.731	Unclear: 1 No: 2

Note: Wald=73.897, P<0.00l, R^2=0.280

Discussion

NSIs present the single greatest risk to health care workers, primarily due to accidental exposure to infected blood and body fluids.[17] There are few studies of NSIs prevalence and risk factors in China, so the authors conducted a cross-sectional survey to reveal the current station of NSIs and identify potential risk factors. This study showed that the majority of staffs in CSSD involved in the study were exposed to the risk of blood-borne diseases such as HIV, HBV and HCV through NSIs in their routine activities. A total of 88.9% had experienced at least one injury in their lifetime and 84.2% in the previous year and about 50% had had exposure to blood or body fluid. It was lower than the 91.5% reported by Huang Qiong-hui[18] in a study carried out in CSSD of Xiang Ya hospital, Hunan province, China. It had been reported that the rate of NSIs was 48.0% for the nurses and nursing assistants in China.[19] However, the rate of NSIs observed in this study was greatly higher than the 17.2% reported by Gessessew and Klashu[20] in Ethiopia, 23.5% reported by Rampal *et al.*[21] in their study carried out in Malaysia, and 39.4% reported by Hofranipour *et al.*[22] in Iran. The high incidence of NSIs in CSSD maybe partially result from the department itself. CSSD is a special department. The main difference from other departments is that staffs here don't contact with patients. During the study, we interviewed the head nurses of the participated CSSDs, they all agreed that after the working mode of CSSD had changed from decentralized management into centralized management, the working load in CSSD nearly doubled, but the staffs didn't increase. And most of the nurses here are unskilled and elder coming from other departments of hospital, and almost all the nursing assistants are casual workers with low level of education and few training. CSSD bears the responsibility of dealing with repeated used medical apparatus, instruments, devices and materials from each department of hospitals but all the sharp disposable objects such as blades and injection

needles are mixed in them instead of being discarded into a sharp box from other departments. All the factors determine CSSD is a high risk department for NSIs.

In our study, most incidents occurred in the morning. This finding maybe explained by heavy workload pressure and time constraints at this time of the day. Similarly, in an Abu-Gad study in the eastern province of Saudi Arabia, the most needle stick injuries occurred in the first half of the shift during the daytime.[23] Most of the NSIs occurred to the left hand fingers (non-dominant hand), which was consistent with previous studies. A survey conducted by Mbirimtengerenji *et al.*[24] revealed the most injured site by the right handed healthcare workers were the left hand fingers front which was 46.4%. The right hand was the dominant hand and left hand fingers were found to be the most at risk for needle stick injuries. The most common device involved in the injury was all kinds of needles. For the puncture needles such as lumbar puncture needle, bone needle, ultrasound needle , each of them was consisted of two parts (needle set and needle core). In the cleaning stage, needle core should be taken out from the needle set, while in the packaging stage, the needle core should be put into the needle set, which leads to NSIs easily. And for the disposable needles, due to the wrong disposable of staffs in other departments and the small size of the needle itself, it can causes needle sticks injuries easily during the busy working process. The majority of NSIs occurred during the cleaning stage. Cleaning is the major working process, and all the items soaked in the cleaning agents should be kept the sharp sections open fully and some of them should be cleaned forcefully to meet the standard of complete cleanliness, which increases the risk of NSIs. In previous investigations underreporting of NSIs to the workplace monitoring system was estimated to be about 50%.[25-27] While in our study, it was 53.5% and the majority didn't take proper treatment after exposure. The high underreporting rate and poor post exposure treatment mainly due to the staffs' and hospital's lack of knowledge and unawareness of the harm of NSIs. Underreporting may lead to inaccurate information regarding the overall risk of exposure to pathogens, and full documentation of exposure injuries would guide improvements in prevention.[5] Post exposure prophylaxis has been shown to be effective after these injuries,[28] a system should be introduced to ensure that all health care workers know about where to seek medical treatment after the occurrence of NSIs.

The occurrence of NSIs is significantly related to one's knowledge, behaviors, attitudes and the working environment. In the univariate analysis 14 variables were found to be statistically significant risk factors of NSIs including 9 variables of personal characteristics and 5 variables of working environment. However, in multivariate logistic regression analysis, only 4 variables (registered or not, report or not, thinking of NSIs avoidable or not, source of occupational safety knowledge) of personal characteristics and 3 variables (sharps contact frequency, noise level, preventive measures adopted by hospital or not) of working environment were included. The unregistered nurse has higher risk than the registered nurse, because most of them are nursing assistants lacking of formal medical education background and others are probation nurses and interns. Actually, due to their low education, poor training, lack of self-protection awareness and heavy workload, it's easy for them to be sustained NSIs. Reporting of injuries to occupational health departments can reduce rates of injury by self-reflecting the reasons and identifying risk-prone behaviors and practices. The awareness that NSIs are avoidable can remind staffs of taking preventive measures to protect themselves and adhering to the universal precautions. In our study, we found about 1/3 didn't realize the protective effect of wearing gloves. And previous study showed that adherence to the universal precautions recommendations was an important factor for the prevention of NSIs in Mongolia, a finding which is in accord with past studies in other countries.[29,30] Occupational safety knowledge is another protective factor, with 62.0% in our study having learning about the knowledge of NSIs through one or more sources. But the HBV vaccination status was not optimistic in our study with only 32.5% having been injected 3 doses of HBV vaccine. They have not fully realized the importance for being vaccinated against hepatitis B. Unfortunately, it was also reflected by some of the participants that some of NSIs were caused by colleagues or incorrect disposal of needles. So education should be enhanced that exposures to sharp injuries and their consequences are highly preventable through simple interventions, such as HBV vaccination and proper disposal of

used needles. Sharps contact frequency in CSSD is higher than that of other department. In our study, the incidence of NSIs was greatly higher than that of the previous studies performed in other departments, not in CSSD. A survey showed that noise could increase the stress of staffs, make them speed up and influence the standardization of operation then increase the risk of NSIs.[31] Preventive measure adopted by hospitals is also an important protective factor. However, in our study, 59.7% reported no such measures taken by hospital; 13.2% were unclear about this and only 27.1% reported some measures taken by hospital. Therefore, less importance is attached to NSIs in hospital. So it's urgent to elaborate and implement new regulations, introduce and train in the use of new and safer equipment, establish an advanced monitoring system and carry out periodical control by appointed inspectors to decrease the occurrence of NSIs in CSSD of hospital. Successful implementation of these prevention measures will result in progress for public health and staffs' health and safety.

This study had several limitations that need to be considered when interpreting the results. First, the estimated incidence of NSIs and their associated factors may be subject to reporting errors, because all the information came from the self-report of the survey participants themselves. Second, the cross-sectional design of the survey did not explore the risk factors systematically and in much detail due to lack of mature questionnaire about NSIs in CSSD. Finally, this study did not evaluate interventions on risk factors, which remain to be investigated in future studies. However, the nature of this study as one of several assessments of NSIs among a considerable number of staffs in CSSD at 30 hospitals in China far outweighs these disadvantages.

In conclusion, reducing NSIs is an important component of the occupational safety program at CSSD of Hunan hospitals in China since NSIs are common risks for infection among health care workers. However, the serologic observation of blood-borne pathogens after injury has not been studied at CSSD of Chinese hospitals, so further investigations are needed to identify the risk of contracting these potentially infections. The research described in this study allowed the hospital to provide targeted interventions to reduce NSIs such as heightening their awareness, adhering to standard measures and universal precautions, acquiring deft operating skills, using pertinent protective measures and improving the working environment to avoid injury. Additional practical and useful research should be performed in other parts of China to inform the active members of health system about the warning trends and their consequences, which could be considered beneficial in this part of China and in other provinces as well.

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