

Investigation of Sharp Injuries in an Educational Hospital, Ahvaz, Iran

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Background & Aims of the Study: The Sharp Injuries (SIs) are a percutaneous piercing wound caused by a sharp instrument. Needle Sticks and Sharp Injuries (NSSIs) can increase the incidence of cases of Hepatitis B, C and HIV. The purpose of this study was to Investigation of the relative frequency of NSSIs in healthcare workers (HCWs) in Ahvaz, Iran (Razi hospital) over 3-year period (2011–2013).

Materials and Methods: A descriptive study during 2011-2013 was conducted on 600 HCWs at Razi Hospital, Ahvaz, Iran. To measure NSSIs, has been diagnosis and categorized based on the National Nosocomial Infections Surveillance (NNIS). Data about health workers' age, sex, site of NSIs injury, ward of hospitalization and case of needle stick were collected. Descriptive statistical by SPSS version 16 used for analyzed data in this study.

Results: According to the results of this study, among all nurses, the maximum cases of NSIs were HCWs. Regarding the finding, recapping needle were found in 34.17%, handling needle in 20.25%, suturing in 16.45%, passing needle in 13.92%, transit disposal in 8.86% and dissembling needle in 6.32% of cases. Findings showed that the most NSIs in Razi Hospital were general surgery, emergency, Intensive Care Unit (ICU), Obstetrics and Gynecology (OBGYN), operating room, orthopedic and infectious diseases wards during 2011-2013.

Conclusion: Based on these findings, the number of health care-associated with NSIs between nurses in our study may be due to the shortage of nurses, long working hours during the night shift, fatigue and failure to use an appropriate equipment.

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Background

In healthcare centers one of the most factors that threats for the healthcare workers are Needle Sticks and Sharp Injuries (NSSIs) (1,2).

In recent years, NSIs are one of the most important threats that mention in healthcare workers (3). NSIs commonly occur during drawing blood, needle recapping and other procedures involving sharp injuries (SI), passed needles between personnel, needles penetrate the glove, poorly located sharps container and failure to use an appropriate personal protective equipment (4,5). A major concern about percutaneous exposure incidents (PEIs) such as NSIs and SI are blood borne infections (BBIs) (6). According to report of the Center for Disease Control (CDC) every year, 600,000–800,000 occupational needle stick injuries occur approximately and 23% of NSIs occur during surgery in the United States (3,7). According to the report of the European Biosafety Network, 1 million NSIs injuries occurred in Europe annually (8). In 2007, a study performed by the World Health Organization (WHO) showed that, the rates of global NSIs affect about 2 million individuals per year (8). Based on finding deferent study highest rate risk of NSIs had surgery, anesthesia, ENT, internal medicine and the lowest rate risk of NSIs had radiology and dermatology (8-10). Nurses and physicians are the most common groups who face with NSIs among HCWs (10,11). The greatest concern about NSIs is transferring bacteria, protozoa, viruses and transmit blood-borne diseases (7). NSIs cure in any environment where sharps are encountered poses a risk and the important factors affected on it, including hollow-bore needle, deep penetration and visible blood on the needle (4,12). The costs of treating an injury include treatment of an acquired infection, blood testing and lost time at work are very high for medical centers (7,13). Different studies showed that, by spending much lower cost for hospital hygiene and education of HCWs can be largely avoided incidence of NSIs (14,15). The condition of the patient, used safety instrument, the type of hospital and ward can be associated with NSIs (8,16). Reduce the risk of NSIs can include the reduction of the

use of sharps device, using a useful safety box, training of appropriate resources, using special instruments to grasp needles, load scalpels, avoiding hand-to-hand passing of sharp instruments, decrease direct contact with needles and disposal greatly (4,7). Hashemi et al in 2010 calculated the rate of accidental NSSI during the preceding year among healthcare workers in Hamedan, Iran (17). In the study conducted in Saudi Arabia in 2012, disposable needle were the most caused NSIs. Also, they showed that hands were the most affected body parts (18).

Aims of the study:

The purpose of this study was to estimate the relative frequency of Needle Sticks and Sharp Injuries among healthcare workers in Razi Hospital of Ahvaz, southwest of Iran, during 2011-2013.

Materials & Methods

Methods

This cross-sectional study was conducted in Razi Hospital of Ahvaz, Iran from March 2011 to September 2013. The target population comprised 600 HCWs who worked at day/night in different wards. In this study, the relative frequency and causes of sharps and cutting objects injuries accrued of NSIs in different Category of HCWs were studied. Method of diagnosis and categorized of NSIs were based on the National Nosocomial Infections Surveillance (NNIS) and prevention definitions (19). The system of data collection was based on NNSIS system-designed questionnaire. In this study, the infection control supervisor according to the reported cases of NSIs, observation and after consultation with infectious diseases specialists recorded the cases. Data collection forms consisted of category of HCWs information such as residents, doctors, nurses, midwife, operating room technicians, nurse aid and workers. Also, activity information including handling needle on a tray, suturing, transit of disposal needle device, recapping needle, passing transferring

needle and disassembling needle device. Razi educational hospital with 220 beds, located in the center of Ahvaz, Iran (industrialized city with a population of 1,200,000 in habitants in the center of Khuzestan, located in southwest of Iran) (20,21).

Statistical Analysis

The NNIS data were pre-processed in SPSS version 16. Descriptive statistics (frequency, mean and standard deviation for each variable) was used for Data analysis.

Results

This study was conducted on more than 600 HCWs who were working in Razi educational hospital during 2011-2013. The number of NSSIs and the relative frequency of NSIs in different wards of the hospital are presented in table 1. The predominant NSIs distribution in general surgery, OBGYN, emergency, ICU, operating room, orthopedic and infectious diseases ward were during 2011-2013. Table 1 shows the number of NSSIs versus different wards during 2011-2013. Based on result which is showed in Table 1, the most NSIs at Razi

Hospital were general surgery (n=18, 22.78%) followed by OBGYN (n=17, 21.51%), emergency (n=12, 15.18%), ICU (n=11, 13.92%), operating room (n=7, 8.86%), orthopedic (n=7, 8.86%) and infectious diseases wards (n=7, 8.86%) during 2011-2013. The highest rate of NSIs was observed in the general surgery ward (Table 1).

Distributions of occupational exposure among HCWs were estimated in table 2. Based on results, identified nurses to be at highest risk of NSSIs among other HCWs groups (n=23, 29.11%). Table 2 shows that the numbers of NSSIs between residents, doctors, nurses, midwife, operating room technicians, nurse aid and workers were 10(12.65%), 8(10.12%), 23(29.11%), 7(8.86%), 7(8.86%), 14(17.72%), 10(12.65%), respectively. Totally, the incidence of NSIs was 79 cases in this center. (Table 2)

Table 3 shows the details of the most recent activities at time of NSSIs. Recapping needle, handling needle, suturing, passing needle, transit disposal needle and dissembling needle were the highest amount, respectively.

Table 1) Distribution of occupational NSSIs in the hospital wards during 2011-2013

Hospital ward	Number of NSSIs 2011	Number of NSSIs 2012	Number of NSSIs 2013	Total number and percent NSSIs in wards (2011-2013)
General surgery	6(21.42%)	5(22.72%)	7(24.13%)	18(22.78%)
Emergency	5(17.85%)	3(13.63%)	4(13.79%)	12(15.18%)
Infectious diseases	3(10.71%)	2(9.09%)	2(6.89%)	7(8.86%)
ICU*	5(17.85%)	2(9.09%)	4(13.79%)	11(13.92%)
OBGYN*	4(14.28%)	5(22.72%)	8(27.58%)	17(21.51%)
Orthopedic	3(10.71%)	2(9.09%)	2(6.89%)	7(8.86%)
Operating room	2(7.14%)	3(13.63%)	2(6.89%)	7(8.86%)
Total	28(100%)	22(100%)	29(100%)	79(100%)

*Abbreviations: OBGYN: Obstetrics and Gynecology; ICU: Intensive Care Unit

Table 2) Distribution of occupational NSSIs exposure among HCWs

Category of HCWs	Needle Stick Injuries (2011)	Needle Stick Injuries (2012)	Needle Stick Injuries (2013)	Total number and percent NSSIs among HCWs (2011-2013)
Residents	3(10.71%)	4(18.18%)	3(10.34%)	10(12.65%)
Doctors	5(17.85%)	2 (9.09%)	1(3.44%)	8(10.12%)
nurses	9(32.14%)	5(22.72%)	9(31.03%)	23(29.11%)
Midwife	1(3.57%)	2 (9.09%)	4(13.79%)	7(8.86%)
Operating room	2(7.14%)	3(13.63%)	2(2.53%)	7(8.86%)
Nurse aid	4(14.28%)	4(18.18%)	6(20.68%)	14(17.72%)
Workers	4(14.28%)	2 (9.09%)	4(13.79%)	10(12.65%)
Total	28(100%)	22(100%)	29(100%)	79(100%)

Table 3) Activities at time of NSSIs

Activity	Frequency (2011)	Frequency (2012)	Frequency (2013)	Total number and percent Frequency of NSSIs among HCWs (2011-2013)
Recapping needle	12(42.86%)	6(27.28%)	9(31.03%)	27(34.17%)
Recapping needle	6(21.43%)	3(13.64%)	7(24.14%)	16(20.25%)
Suturing	4(14.29%)	2(9.10%)	7(24.14%)	13(16.45%)
Passing or transferring needle	2(7.14%)	6(27.27%)	3(10.34%)	11(13.92%)
Transit of disposal needle	1(3.56%)	4(18.17%)	2(6.90%)	7(8.86%)
Disassembling needle	3(10.72%)	1(4.54%)	1(3.45%)	5(6.32%)
Total	28(100%)	22(100%)	29(100%)	79(100%)

Discussion

The undertaken study showed, Razi Hospital had high risk injuries related to the needle sticks, contaminated sharp and cutting objects, respectively. Pili et al in their study explained that the needle stick injuries in most cases occurred in the ICU and CCU wards which were 24.7% and 12.4%, respectively (22). In a similar work, Afrasiabi's in Yasuj of Iran reported, 39.3% of operating room ward had coetaneous injury with the highest rate (23). In Ardebil, Iran, the maximum rate of NSIs was in cardiology (64.7%), ICU (57.9%) and emergency (61.9%) wards, respectively (22). The different kinds of observed NSIs in this study was associated with the type of activity in Razi Hospital.

According to table 2, the relative frequency of NSIs was 79 cases in this center. Distribution of occupational exposure among HCWs, among

which nurses with the frequency of 23(29.11%) were the most involved HCWs, followed by 14(17.72%) nurse aid, 10(12.65%) residents, 10(12.65%) workers, 8(10.12%) doctors, 7(8.86%) midwife and 7(8.86%) operating room technicians during 2011-2013. Jaybhaye et al in their study showed, nurses had the highest rate of NSIs as compared to the other HCWs groups (24). Several studies had also shown a high occurrence of NSIs among nurses (25,26). Based on the results of our study, the number of cases of NSIs was similar to other studies.

Based on the results, identified nurses to be at highest risk of NSSIs among other HCWs groups (n=23, 29.11%). This observation is in agreement with the findings of Gholami et al (27) and Talaat et al (28). However, the incidents of NSSI occurred by nurses in our survey were considerably lower than those in the Fars province of Iran (49.6%) (29), Smith's

study in Japan (46%) (30) and Smith's study in Korea (79.7%) (31). Another study reported, doctors were the most frequent NSIs (64.7%), followed by waste workers (25.5%) and nurses (7.8%) (32). In a similar work, Rais et al in Karachi reported, nurses (28.4%) and doctors (21.6%) were the most frequent cases of NSIs (33). Based on result, can be explained this fact that nurses because of use of needles in the major procedures are the most of the group exposure to NSSIs

In our study, the 79 respondents who had experienced NSSIs in this center, (n=27, 34.17%) were recapping needle, handling needle or sharps devices on tray (n=16, 20.25%), suturing (n=13, 16.45%), passing or transferring needle (n=11, 13.92%), transit disposal needle or sharp devices (n=7, 8.86%) and disassembling needle or sharp devices (n=5, 6.32%), respectively. Hashemi et al in 2010 was performed on Hepatitis B vaccination coverage and sharp injuries among healthcare workers in Educational hospitals personnel of Hamedan, Iran. Based on their results, 48.5% of NSSIs were the rate of accidental NSSI during blood sampling or intravenous catheter insertion (17). Nsubuga (34), Buraidah (35) and Cheng (36) showed that recapping of used syringes is responsible for 13%, 29% and 28% of injuries, respectively. According to result of the study of Saleh, Saudi Arabia, needle recapping (26.4%), careless disposal of sharp instruments (16.9%) and blood extraction (11.5%) were responsible for more than 50% of NSSIs (37). These differences may be due to the number of HCWs studied and place of the study. Laishram et al in 2013 conducted a work to find the recapping of the needle was the most important risk factor of NSSIs (38). Based on the result of several studies, the main reason for the high frequency of NSSIs was needle recapping after its use (5,39-40).

Finally, it should be mentioned that contacting with blood, sharp instruments contaminated with blood and the infectious substances of infected patients are the real threats to the

HCWs. It should be noted, we can prevent or reduce the affection to the relative frequency of NSSIs with decrease using of sharp objects, avoid re-capping, regular reporting NSSIs, having a NSIs protocol and education.

Conclusion

Although the frequency rate of Needle Sticks and Sharp Injuries of nurses were maximum cases of NSIs between healthcare workers, it is necessary to maintain continuous surveillance, continuous supervision, careful monitoring of surveillance system, health education, correct use of disposable equipment which are necessary to reduce NSSIs risk and their adverse effects. In summary, we believe this information is useful not only for us, but also for others who are involved in the control of residents in long-term care facilities as much as there are few published data on yearly NSSIs rates among HCWs.

Footnotes

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Conflict of Interest:

The authors stated no conflict of interest.

References

1. Saeidimehr S, Geravandi S, Rahim F, Yosefi F, Salmanzadeh S, Foruozaandeh H, et al. Nosocomial infection rates during one year in Naft grand hospital, Ahvaz, Iran. *Jundishapur J Health Sci* 2015;7(4):e30124.
2. Salmanzadeh S, Yousefi F, Ahmadi F, Geravandi S, Moien M, Mohammadi MJ, et al. Evaluation of Nosocomial infections in a teaching hospital. *Avicenna J Clin Microbiol Infect* 2015;2(3):e29760.
3. Alavi SM, Sharifi M. Percutaneous Injuries and Transmission of HIV Among cases referred for post exposure prophylaxis to Razi hospital in Ahvaz, a city in the southwest Iran. *Jundishapur J Microbiol* 2013;6(10):e8266.

4. Atlanta G, Control CFD, Prevention, Safety O, Administration H. Use of blunt-tip suture needles to decrease percutaneous injuries to surgical personnel. *Safety and Health Information Bulletin* 2007.
5. Mohammadnejad E, Sfanbud M, Ehsani S, Deljo R. Occupational exposure to needle stick among nurses. *Iran J Infect Dis Trop Med* 2009;45(14):47-51. (Full Text in Persian)
6. Thomas WJ, Murray JR. The incidence and reporting rates of needle-stick injury amongst UK surgeons. *Ann R Coll Surg Engl* 2009;91(1):12-7.
7. Makary MA, Al-Attar A, Holzmueller CG, Sexton JB, Syin D, Gilson MM, et al. Needlestick injuries among surgeons in training. *N Engl J Med* 2007;356(26):2693-9.
8. Mischke C, Verbeek JH, Saarto A, Lavoie MC, Pahwa M, Ijaz S. Gloves, extra gloves or special types of gloves for preventing percutaneous exposure injuries in healthcare personnel. *Cochrane Database Syst Rev* 2014;7;(3):CD009573.
9. Wicker S, Jung J, Allwinn R, Gottschalk R, Rabenau HF. Prevalence and prevention of needlestick injuries among health care workers in a German university hospital. *Int Arch Occup Environ Health* 2008;81(3):347-54.
10. Cheraghi MA, Nejad EM, Begjani J, Rabirad N, Ehsani SR, Kaji MA. Knowledge and attitudes of nurses regarding HIV/AIDS (Tehran-2010). *Arch J Clin Infect Dis* 2011;6(3):121-3.
11. Mohammad Nejad E, Jafari S, Mahmoodi M, Begjani J, Ehsani SR, Rabirad N. Hepatitis B virus antibody levels in high-risk health care workers. *Hepatitis Mon* 2011;11(8):662-3.
12. Bhardwaj A, Sivapathasundaram N, Yusof M, Minghat A, Swe K, Sinha N. The Prevalence of Accidental needle Stick Injury and their reporting among healthcare Workers in orthopaedic Wards in General hospital Melaka, Malaysia. *Malays Orthop J* 2014;8(2):6-13.
13. Chambers A, Mustard CA, Etches J. Trends in needlestick injury incidence following regulatory change in Ontario, Canada (2004–2012): an observational study. *BMC Health Serv Res* 2015;15:127.
14. Zhang X, Gu Y, Cui M, Stallones L, Xiang H. Needlestick and Sharps Injuries Among Nurses at a Teaching Hospital in China. *Workplace Health Saf* 2015;63(5):219-25.
15. Ehsani SR, Mohammadnejad E, Hadizadeh MR, Mozaffari J, Ranjbaran S, Deljo R, et al. Epidemiology of Needle Sticks and Sharp Injuries Among Nurses in an Iranian Teaching Hospital. *Arch Clin Infect Dis* 2013;8(1):27-30.
16. Tarigan LH, Cifuentes M, Quinn M, Kriebel D. Prevention of Needle-Stick Injuries in Healthcare Facilities: A Meta-Analysis. *Infect Control Hosp Epidemiol* 2015;36(7):823-9
17. Hashemi SH, Mamani M, Torabian S. Hepatitis B Vaccination Coverage and Sharp Injuries Among Healthcare Workers in Hamadan, Iran. *Avicenna J Clin Microb Infec* 2014;1(2):e19949.
18. Memish ZA, Assiri AM, Eldalatomy MM, Hathout HM, Alzoman H, Undaya M. Risk analysis of needle stick and sharp object injuries among health care workers in a tertiary care hospital (Saudi Arabia). *J Epidemiol Glob Health* 2013;3(3):123-9.
19. System NNIS. National Nosocomial Infections Surveillance (NNIS) System Report, data summary from January 1992 through June 2004, issued October 2004. *Am J Infect Control* 2004;32:470.
20. Geravandi S, Goudarzi Gh, Vosoughi M, Salmanzadeh S, Mohammadi MJ, Zallaghi E. Relationship between Particulate matter less than 10 microns exposures and health effects on humans in Ahvaz, Iran. *Arch Hyg Sci* 2015;4(2):64-72.
21. Mohammadi MJ, Godini H, Tobeh Khak M, Seyed Daryanoosh M, Dobaradaran S, Goudarzi G. An association between air quality and COPD in Ahvaz, Iran. *Jundishapur J Chronic Dis Care* 2015;4(1):e26621.
22. Pili JP, Izadi N, Golbabaie F. Factors Associated with needle stick and sharp injuries among health care. *Int J Occup Hyg* 2013;5(4):191-7.
23. AfrasiabiFar A, Salari M, Zarifi A, Mohebi Z. skin penetrating injuries due to the insertion of sharp medical instruments contaminated with patients' blood or body secretion among the healthcare staffs of Yasuj hospitals and the measures taken after injury. *Armaghan Danesh* 2003;7(28):17-23. (Full Text in Persian)
24. Jaybhaye DR, Dahire PL, Nagaonkar AS, Vedpathak VL, Deo DS, Kawalkar UG. Needle stick injuries among health care workers in tertiary care hospital in tertiary care hospital of rural India. *Int J Med Sci Public Health* 2014;3(1):49-52.
25. Sharma R, Rasanias SK, Verma A, Singh S. Study of prevalence and response to needle stick injuries among health care workers in a tertiary care hospital in Delhi, India. *Indian J Community Med* 2010;35(1):74.
26. Ilhan MN, Durukan E, Aras E, Türkçüoğlu S, Aygün R. Long working hours increase the risk of sharp and needlestick injury in nurses: the need for new policy implication. *J Adv Nurs* 2006;56(5):563-8.
27. Gholami A, Borji A, Lotfabadi P, Asghari A. Risk Factors of Needlestick and Sharps Injuries among Healthcare Workers. *Int J Hospital Res* 2013;2(1):31-8.
28. Talaat M, Kandeel A, El-Shoubary W, Bodenschatz C, Khairy I, Oun S, et al. Occupational exposure to needlestick injuries and hepatitis B vaccination coverage among health care workers in Egypt. *Am J Infect Control* 2003;31(8):469-74.
29. Askarian M, Shaghaghian S, McLaws ML.

Needlestick injuries among nurses of Fars province, Iran. *Ann Epidemiol* 2007;17(12):988-92.

30. Smith DR, Mihashi M, Adachi Y, Nakashima Y, Ishitake T. Epidemiology of needlestick and sharps injuries among nurses in a Japanese teaching hospital. *J Hosp Infect* 2006;64(1):44-9.

31. Smith DR, Choe MA, Jeong JS, Jeon MY, Chae YR, An GJ. Epidemiology of needlestick and sharps injuries among professional Korean nurses. *J Prof Nurs* 2006;22(6):359-66.

32. Prakash K, Patel K. Epidemiology of needle-stick injuries in Mangalore. *J Evolu Med Dent Sci* 2012;1(3):128.

33. Rais N, Jamil HM. Prevalence of needle stick injuries among health care providers. *Int J Endors Health Sci Res* 2013;1(2):73-9.

34. Nsubuga FM, Jaakkola MS. Needle stick injuries among nurses in sub-Saharan Africa. *Trop Med Int Health* 2005;10(8):773-81.

35. Jahan S. Epidemiology of needlestick injuries among health care workers in a secondary care hospital in Saudi Arabia. *Ann Saudi Med* 2005;25(3):233-8.

36. Cheng HC, Su CY, Yen AM, Huang CF. Factors affecting occupational exposure to needlestick and sharps injuries among dentists in Taiwan: A nationwide survey. *PloS One*. 2012;7(4):e34911.

37. Ghamdi SA, Al-Azraqi T, Bello C, Gutierrez H, Hyde M, Abdullah M. Needlestick and sharps injuries at Asir Central Hospital, Abha, Saudi Arabia. *Ann Saudi Med* 2003;23(6):405.

38. Laishram J, Keisam A, Phesao E, Tarao M, Laloo V, Devi H. Prevalence of needle stick injuries among nurses in a tertiary care hospital and their immediate response. *Int J Med Public Health* 2013;3(4):257.

39. Jayanth ST, Kirupakaran H, Brahmadathan KN, Gnanaraj L, Kang G. Needle stick injuries in a tertiary care hospital. *Indian J Med Microbiol* 2009;27(1):44-7.

40. Ayas NT, Barger LK, Cade BE, Hashimoto DM, Rosner B, Cronin JW, et al. Extended work duration and the risk of self-reported percutaneous injuries in interns. *JAMA* 2006;296(9):1055-62.