Published in final edited form as:

Int J Nurs Stud. 2013 August ; 50(8): 1025–1032. doi:10.1016/j.ijnurstu.2012.07.009.

Factors associated with needlestick and sharp injuries among hospital nurses: A cross-sectional questionnaire survey

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Abstract

Background—The current status of needlestick or sharp injuries of hospital nurses and factors associated with the injuries have not been systematically examined with representative registered nurse samples in South Korea.

Objective—To examine the incidence to needlestick or sharp injuries and identify the factors associated with such injuries among hospital nurses in South Korea.

Design, settings and participants—A cross-sectional survey of hospital nurses in South Korea. Data were collected from 3079 registered nurses in 60 acute hospitals in South Korea by a stratified random sampling method based on the region and number of beds.

Methods—The dependent variable was the occurrence of needlestick or sharp injuries in the last year, and the independent variables were protective equipment, nurse characteristics, and hospital characteristics. This study employed logistic regression analysis with generalized estimating equation clustering by hospital to identify the factors associated with needlestick or sharp injuries.

Results—The majority (70.4%) of the hospital nurses had experienced needlestick or sharp injuries in the previous year. The non-use of safety containers for disposal of sharps and needles, less working experience as a registered nurse, poor work environments in regards to staffing and resource adequacy, and high emotional exhaustion significantly increased risk for needlestick or sharp injuries. Working in perioperative units also significantly increased the risk for such injuries

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Conflict of interest

None declared.

Ethical approval

This study was approved by the Institutional Review Board of Yonsei University (4-2008-0012).

but working in intensive care units, psychiatry, and obstetrics wards showed a significantly lower risk than medical–surgical wards.

Conclusions—The occurrence of needlestick or sharp injuries of registered nurses was associated with organizational characteristics as well as protective equipment and nurse characteristics. Hospitals can prevent or reduce such injuries by establishing better work environments in terms of staffing and resource adequacy, minimizing emotional exhaustion, and retaining more experienced nurses. All hospitals should make safety-engineered equipment available to registered nurses. Hospitals as well as specific units showing higher risk for needlestick and sharp injuries should implement organizational strategies to prevent such injuries. It is also necessary to establish a monitoring system of needlestick and sharp injuries at a hospital level and a reporting system at the national level in South Korea.

Keywords

Needlestick injuries; Burnout; Work environment; Hospitals; Nurses; Occupational health; Republic of Korea

1. Introduction

Needlestick and sharp injuries (NSIs), which are mostly preventable, are one of the major occupational injuries experienced by registered nurses (RNs) in hospitals. Major potential problems induced by NSIs are infectious diseases such as hepatitis B, hepatitis C, and HIV, which are transmitted through blood pathogens from contaminated needles or sharp devices (Clarke et al., 2002a). According to the World Health Organization (WHO), NSIs accounted for about 40% of hepatitis B and C infections and 2.5% of HIV infections in healthcare workers worldwide (World Health Organization, 2002). In addition to the potential risk for infectious diseases, NSIs incur direct costs required for laboratory tests, including tests for HIV antibodies, hepatitis B serology, and a baseline test for anti-hepatitis C, as well as any treatment for these conditions (Lee et al., 2005). There are also the costs associated with post-exposure prophylaxis for RNs along with the economic loss of hospitals brought on by absences from work (Lee et al., 2005). The estimated annual costs for tests and treatments for NSIs varied from \$6.1 million in France to \$118–591 million in the United States (US) (Saia et al., 2010).

In an extensive review of studies (Hanrahan and Reutter, 1997), the occurrence of NSIs was related to three major factors: engineering factors such as the design of sharps and barrier devices, organizational factors such as the availability of supplies and reporting policies, and behavioral factors such as recapping and disposal-related issues. In accordance with the review, two WHO reports addressed risk factors, including the lack of engineering controls to ensure safer needle devices, inadequate hospital staffing, and recapping of needles after use (Prüss-Üstün et al., 2003; World Health Organization, 2003).

According to the International Healthcare Worker Safety Center, in the US injections and drawing venous blood accounted for 23.6% and 11.5% of NSIs, respectively (Perry et al., 2009). A review of literature from the US, United Kingdom, Germany, France, Italy, and Spain found that injections and intravenous-related tasks account for a significant proportion

of NSIs, and recommended safety-engineered needle devices for these tasks (Saia et al., 2010). The US General Accounting Office estimates that safety-engineered needle devices could prevent 29% of NSIs in the US (United States General Accounting Office, 2000).

Earlier studies identified organizational characteristics as a risk for NSIs. In magnet hospitals with adequate staffing and an appropriate work environment, the incidence of NSIs was significantly lower than that seen in non-magnet hospitals (Aiken et al., 1997). RNs who work in hospitals with a poor organizational climate or less adequate resources and nurse leadership (Clarke et al., 2002a,b) had a greater likelihood of needlestick injuries. More recently, RNs in hospitals with the most favorable working environments were found to be about 20–34% less likely to experience NSIs (Clarke, 2007). RNs working on patient care units with lower staffing rates and higher levels of emotional exhaustion related to their jobs also had significantly higher likelihoods of NSIs (Clarke et al., 2002a,b). The association of staffing levels with NSIs among Chinese RNs has also been reported (Smith et al., 2004).

In South Korea, however, the comprehensive NSI status of RNs is unknown because each hospital monitors and manages its surveillance system for NSIs internally without reporting these data to any national system. Only a few published studies from one or two hospitals have revealed the incidence of NSIs in South Korea, and the results are varied: 64.5% (Kim et al., 2005), 79.7% (Smith et al., 2006a), and 83% (Kim, 1996) in the previous year. These rates were higher than those of RNs working in other countries (Clarke, 2007; Clarke et al., 2007; Royal Collage of Nursing, 2008; Smith et al., 2006b,c); however, the ability to estimate the number of overall NSIs among Korean hospital nurses is limited. Therefore, a need exists to assess the level of NSI incidence among RNs in South Korea using representative samples. Further, factors associated with NSIs in South Korea have not been systematically examined with representative RNs samples; this action should be a primary step towards developing hospital-specific programs for NSI prevention. Thus, the aims of this study were to assess the incidence to NSIs among hospital nurses and to identify factors associated with NSIs using nationwide random samples in South Korea.

2. Methods

2.1. Design and participants

This study employed a cross-sectional survey design. The participants were composed of 3079 bedside RNs from 60 hospitals in all 7 metropolitan cities and all 9 provinces in South Korea. The RNs were selected using a two-phase stratified cluster sampling method. First, out of all 295 hospitals with 100 or more beds located in South Korea, 65 hospitals were randomly selected by stratified sample based on region (Seoul, other metropolitan areas, and provinces) and number of beds (100–399, 400–699, 700–799, and 1000 or above). Out of 65 hospitals, 5 declined to participate in the study. As the number of RNs varied by number of beds and types of units, the participants were selected by the following criteria: (a) in case of hospitals with 1000 or more beds, 20% of units were randomly selected from all general wards and 1 from each special unit (intensive care unit, delivery room, perioperative, emergency room, psychiatric ward, hemodialysis unit, pediatrics, newborn, and clinics); (b) in the case of hospitals with 700–999 beds, 50% units were randomly selected from all

general wards and 1 from each special unit; and (c) in hospitals with 100–699 beds, all units were included in the study. All RNs who worked in the selected wards or units on the data collection day were asked to participate in the study. Therefore, 5103 RNs from 60 hospitals were asked to participate in the study, and 4910 of these RNs returned our questionnaires: a response rate of 96.2%. RNs who reported they had cared for either 0 or 41 or more patients on the last shift were excluded in this analysis because they could not be considered bedside RNs. In the end, 3079 bedside RNs were included in our analysis.

2.2. Measures

The questionnaire had four parts: incidence of NSIs, use of protective equipment, nurse characteristics, and organizational characteristics.

2.2.1. NSIs—The incidence of NSIs was measured using two items asking how many times during the past year the RNs had been injured by needlesticks (first item) or sharp devices (second item) that had already been used on a patient.

2.2.2. Protective equipment in the hospital—RNs were asked whether various types of protective equipment were routinely used in their units. Questions assessed the use of safety containers for disposal of sharps and needles, needleless systems for accessing or connecting IV lines, safety-engineered needle–syringe combinations, safety-engineered systems for drawing blood, and safety-engineered systems for starting IV lines.

2.2.3. Nurse characteristics—Nurse characteristics included gender, education, years of experience as an RN, specialties, and two items on needlestick-related procedures on the last shift worked such as starting intravenous (IV) lines and performing a routine phlebotomy. The types of nursing practice specialties consisted of medical and surgical wards, intensive care units, delivery rooms, perioperative areas, emergency rooms, psychiatric wards, hemodialysis units, pediatrics, newborn, clinics, and other/unspecified specialties.

2.2.4. Organizational characteristics—The organizational characteristics addressed in the questionnaire were those used in previous studies (Aiken et al., 2002, 2003, 2008; Clarke, 2007; Clarke et al., 2002b), and included emotional exhaustion related to the job, work environment, location, number of beds, high technology, teaching hospitals, and number of patients per RN. Emotional exhaustion related to the job was measured using the emotional exhaustion subscale of the Maslach Burnout Inventory (MBI) which is a standardized instrument (Clarke et al., 2002b; Maslach and Jackson, 1986; Poghosyan et al., 2009). The emotional exhaustion subscale consisted of nine items, and each item was rated on a 7-point Likert scale ranging from 0 (Never) to 6 (Always). Each score was summed to yield a value between 0 and 54; high scores indicated a high degree of emotional exhaustion. Internal consistency estimated by Cronbach's alpha was 0.93. The scores of 27 or higher were categorized as high emotional exhaustion (Maslach and Jackson, 1986).

Work environments were measured by staffing and resource adequacy, which is a subscale of the Practice Environment Scale of the Nursing Work Index (PES-NWI), which was developed by Lake (2002) based on the Nursing Work Index (NWI) (Kramer and Hafner, 1989). The PES-NWI is composed of 31 items in 5 subscales (nurse participation in hospital

affairs, nursing foundation for quality of care, nurse manager ability-leadership-support of nurses, staffing–resource adequacy, and collegial nurse–physician relationship) (Lake, 2002). Staffing–resource adequacy was used in this study because this subscale shows work environment in regards to staffing and resources, which have been reported as factors associated with NSIs (Clarke et al., 2002a,b; Smith et al., 2004). The subscale of staffing–resource adequacy is composed of four items that assess whether there are enough staff members to get the work done, enough RNs to provide quality patient care, adequate support services to allow RNs to spend time with their patients, and enough time and opportunities to discuss patient care problems with other RNs. RNs were asked to rate each item on a four-point scale ranging from 1 (strongly disagree) to 4 (strongly agree). The mean score of the hospital-level was used in this analysis, and a higher score indicated a better practice environment in regard to staffing and resource adequacy. Cronbach's alpha for this subscale was 0.75; in Lake (2002)'s study, Cronbach's alpha of the same scale was 0.80.

In addition, items about location, number of beds, high technology, teaching hospitals, and number of patients per RN were included. The number of beds was classified as 100–399, 400–699, 700–799, and 1000 or above. The high technology hospitals were those that had facilities for open-heart surgery or major organ transplants (Aiken et al., 2002, 2003; Clarke, 2007). RNs reported the number of patients they had cared for on their last shift.

2.3. Data collection

Data were collected using structured questionnaires from October 2008 to July 2009. The principal investigator explained the purpose and contents of this survey and asked cooperation from the nursing departments of the selected hospitals by telephone. Questionnaires were distributed with a cover page explaining the study purpose, methodology, and instructions on each unit. RNs were asked to seal the completed questionnaires in provided envelopes and put them into survey collection boxes in the units. The collection boxes from the Department of Nursing at each hospital were sent to researchers by mail. This study was approved by the Institutional Review Board of Yonsei University.

2.4. Data analysis

The statistical package for SAS Version 9.2 software was used for all analyses. Descriptive statistics such as frequencies, means, and standard deviation were used to describe nurse characteristics, protective equipment, and organizational characteristics. This study employed logistic regression analysis with generalized estimating equation (GEE) clustering by hospital to assess the factors associated with NSIs considering the clustering of RNs in hospitals. The dependent variable was the occurrence of needlestick or sharps injuries during the past year (none or any), and independent variables included nurse characteristics such as gender, education, number of years they had worked as an RN, procedures conducted on the last shift, and specialties; protective equipment in the hospital such as safety containers for disposal of sharps and needles, needleless systems for accessing or connecting IV lines, safety-engineered needle–syringe combinations, safety-engineered systems for drawing blood, and safety-engineered systems for starting IV lines; and organizational characteristics such as emotional exhaustion related to the job, work environment, location, number of

beds, high technology hospital status, teaching hospital status, and number of patients per RN. The results were expressed as odds ratios with 95% confidence intervals. The value p 0.05 was treated as statistically significant.

3. Results

3.1. Characteristics of the study hospitals and registered nurses

A total of 60 hospitals participated in the study. Table 1 presents organizational characteristics for the study hospitals. Almost half of the hospitals were located in the provinces. Seven hospitals had 1000 or more beds, and 52% of the hospitals had fewer than 400 beds. A quarter of the hospitals were not high-technology hospitals, and 30% of the hospitals were teaching hospitals. The average number of patients per RN was 12.3 (SD = 9.1), and the mean score of the work environment regarding staff and resource adequacy was 1.9 (SD = 0.2), with scores ranging from 1 to 4. Almost half of the RNs (42.9%) worked in a hospital located in the Seoul metropolitan area, while 31.2% of RNs worked in hospitals with 1000 beds or more. High-technology hospitals employed 93.7% of the RNs surveyed, and 9.7% of RNs worked in teaching hospitals (Table 1).

3.2. Characteristics of registered nurses

Table 2 presents general characteristics of the study RNs. The majority (94.9%) was female; 47.6% of RNs were in the age group between 25 and 29 years old with a mean age of 28.0 (SD = 4.9), and 3.1% were 40 years old or above. More than half of the RNs (51.9%) had a diploma as the highest degree in nursing, and 3.9% of RNs had a master's degree or more. Fifty-six percent of RNs had worked as an RN for less than 5 years with a mean number of years worked of 5.5 (SD = 4.6), and only 4.8% of RNs had worked in the field for 15 years or longer. Seventy-four percent of RNs had started intravenous lines, and 64% of RNs performed routine phlebotomy on their last shift. Among RNs, medical–surgical nursing was the most common specialty (32.3%), followed by ICU (18.5%), ER (14.3%), and perioperative care (8.6%). About 66.5% of RNs experienced high emotional exhaustion.

3.3. Needlestick and sharp injuries

Table 3 presents the incidence of NSIs among RNs in the previous year. The majority (70.4%) of RNs experienced at least one NSI in the past year. The percentage of RNs who routinely used safety containers for disposal of sharps and needles was 94.5%. Out of 4 safety-engineered equipment types, a needleless system for accessing or connecting IV lines was most commonly used (78.8%) followed by safety-engineered needle–syringe combinations (18.6%), safety-engineered systems for starting IV lines (18.2%), and safety-engineered systems for drawing blood (16.5%).

3.4. Factors associated with needlestick or sharp injuries

The results of logistic regression are presented in Table 4. This analysis controlled for nurse characteristics, protective equipment routinely used in the hospital, and organizational characteristics. NSIs were significantly associated with years worked as an RN, emotional exhaustion related to the job, work environment, use of safety containers for disposal of sharps and needles, and certain specialties. Specifically, the risk for NSI significantly

decreased as the years working as an RN increased (OR = 0.990, CI = 0.988–0.991). However, RNs who experienced high emotional exhaustion were at significantly increased risk of NSIs than RNs who experienced low or average emotional exhaustion (OR = 1.486, CI = 1.195–1.850). In terms of work environments, the risk for NSI significantly decreased by the increase of staffing and resource adequacy (OR = 0.794, CI = 0.671–0.940). Out of five protective equipment types, safety containers for disposal of sharps and needles (OR = 0.727, CI = 0.580–0.913) significantly decreased risk for NSIs. RNs working in the ICU (OR = 0.561, CI = 0.410–0.767), psychiatry (OR = 0.445, CI = 0.251–0.789), and obstetrics (OR = 0.612, CI = 0.445–0.840) wards tended to have fewer NSIs than those in medical–surgical wards, while RNs working in perioperative units (OR = 1.555, CI = 1.193–2.026) were more likely to have NSIs than those in medical–surgical wards.

4. Discussion

This was the first study to identify the incidence of NSIs and its associated factors, including nurse characteristics, protective equipment, and organizational characteristics with representative hospital nurses in South Korea. The incidence of NSIs among RNs during the past year in this study was 70.4%, which is lower than the 83% reported from two teaching hospitals (Kim, 1996) and also the 79.7% reported by another study in one large hospital (Smith et al., 2006a) but higher than 52.3% and 32.8% reported from another teaching hospital (Kim et al., 2005) in South Korea. These previous studies were conducted with small sample sizes of 250–500 RNs in only one or two hospitals, which limit the generalizability of the findings from these studies. However, the present study analyzed data from 3079 bedside RNs from 60 randomly selected hospitals. Therefore, we believe the findings from this study more accurately represent the current status of NSIs in South Korea.

Compared to RNs in other countries, the findings of this study show that hospital nurses in South Korea experience a much higher incidence of NSIs. The incidence of NSIs from this study was very high compared to 9.6% among American hospital nurses from 188 general hospitals and 7.2% in 23 hospitals with excellent work environments in the US (Clarke, 2007). The large study of hospital nurses from the US, Canada, the United Kingdom (UK), and Germany reported NSIs ranging from 118 RNs per 1000 full-time equivalent positions (FTEs) to 322 RNs per 1000 FTEs each year (Clarke et al., 2007). Hospital nurses in Australia (17.7%) (Smith et al., 2006c), Turkey (68.4%) (Ilhan et al., 2006), and Japan (46%) (Smith et al., 2006b) also reported lower NSIs than those in South Korea.

This study found that NSIs were associated with nurse characteristics, protective equipment, and organizational characteristics. Safety-engineered equipment has been reported as an important factor related to NSIs. This study found that many RNs routinely used safety containers to dispose of sharps and needles (94.5%) and needleless systems for accessing or connecting IV lines (78.8%); however, only a few RNs routinely used safety-engineered needle–syringe combinations (18.6%), safety-engineered systems for starting IV lines (18.2%), and safety-engineered systems for drawing blood (16.5%), while the majority of RNs surveyed conducted IV starts (73.7%) and routine phlebotomy (64.2%). According to an international comparative study, the use of safety-engineered needles was reported to be 37.4% in the US (Clarke et al., 2007). In this study, 18.7% of RNs used safety-engineered

needles, which is much less than statistics from 15 years ago in the US. Therefore, the expansion of availability and education for using protective equipment is needed in South Korea to reduce NSIs. Specifically, safety containers for disposal of sharps and needles should be available to and used by all RNs since RNs who routinely used safety containers for disposal of sharps and needles were 27.3% less likely to have NSIs in this study.

According to the results of this study, working experience as an RN was significantly associated with NSIs. Namely, RNs with fewer years of experience as RNs had more NSIs, which is consistent with other international studies (Clarke, 2007; Clarke et al., 2002a; Ilhan et al., 2006). The high rate of NSIs in South Korea may be related to the shorter working experience as an RN (average 5.5 years) of Korean RNs compared to other countries, such as 17.7 years in Canada, 16.7 years in New Zealand, 15.1 years in the US, 12.5 years in Germany, 9.2 years in Thailand, 8.0 years in China, and 7.3 years in Japan (Aiken et al., 2011). RNs with enough clinical experience may have advanced skills and techniques for handling needles and sharp devices, so they may be at lower risk for occupational injuries from NSIs. Therefore, the causes of early resignation of RNs in South Korea should be explored, and strategies need to be developed to reduce the turnover of RNs, including improvement of the work environment.

Type of nursing practice specialties is significantly associated with the risk for NSIs in this study. In comparison to the medical and surgical wards, the predicted odds of NSIs were 43.9% less in the ICU, 55.5% less in the psychiatry wards, and 38.8% less in obstetrics units; however, the predicted odds of NSIs in the perioperative unit was 55.5% higher than that identified in medical and surgical wards. A study conducted in the US reported that the rate of NSIs in the perioperative unit was 95% higher than medical and surgical wards while psychiatry, pediatric, and neonatal units had fewer NSIs than did medical and surgical wards; ICU and obstetrics NSIs did not differ from those of medical and surgical wards (Clarke, 2007). As the perioperative unit requires various procedures related to surgery, the rate of NSIs in this unit may be higher than in the medical and surgical wards.

This study also provided evidence that organizational characteristics were associated with NSIs. According to the study, emotional exhaustion was found to be one of the factors associated with NSIs. Two-thirds of RNs in this study showed a high level of emotional exhaustion, which is a higher percentage of RNs compared to studies in the US, Canada, the UK, Germany, China, Thailand, and Japan (Aiken et al., 2011). After controlling for other risk factors, this study found that RNs with a high level of emotional exhaustion were 48.6% more likely to have NSIs, which is similar to the findings from another study (Clarke et al., 2002b). Emotional exhaustion has been reported as a risk factor for patient health outcomes, such as mortality and failure to rescue (Aiken et al., 2002; Tourangeau et al., 2007), and this study provides evidence to support that emotional exhaustion is also a factor associated with NSIs in RNs. Therefore, administrators should improve organizational characteristics associated with emotional exhaustion of RNs, consequently improving patient health outcomes and decreasing the occurrence of NSIs.

The number of patients assigned to an RN on the last shift was not significantly linked to the incidence of NSIs. Some studies have reported that number of patients per RN is

significantly associated with NSIs (Clarke et al., 2002a,b), while other studies failed to find a significant association between the number of patients per RN and NSIs (Clarke, 2007). The simple number of patients per RN may not measure staffing level accurately because it does not consider patients' severity or the intensity of care needed, as well as RNs' capacity and experience to provide care to the appropriate number of patients. This study used the subscale of staffing–resource adequacy from the PES-NWI to reflect RNs' perception of the level of staffing and human resource adequacy, and the staffing–resource adequacy was significantly associated with NSIs. A 1-point increase in the staffing–resource adequacy was associated with a 20.6% decrease in the predicted odds of NSIs. Staffing–resource adequacy was measured on a 4 point scale ranging from 1 (strongly disagree) to 4 (strongly agree). Thus, hospitals where RNs strongly agreed that they had enough staff members to get the work done, enough RNs to provide quality patient care, adequate support services allow RNs to spend time with their patients, and enough time and opportunities to discuss patient care problems with other RNs tended to have 61.8% lower odds of NSIs than in hospitals where RNs strongly disagreed with these questions. A similar impact of work environment on NSIs has also been reported in other studies (Aiken et al., 1997; Clarke, 2007; Clarke et al., 2002a).

This study analyzed NSIs retrospectively reported by RNs. The recall of RNs may not be correct, and NSIs could possibly be underreported. In spite of this limitation, to our knowledge, this is the first study on NSIs from representative hospital nurses of South Korea that used nationwide random samples and included all specialties. Furthermore, this study achieved a high response rate (96.2%), which increases the generalizability of the findings.

5. Conclusion

This study attempted to investigate the incidence of NSIs and also to identify factors associated with NSIs among hospital nurses in South Korea. Our study provided evidence that Korean RNs suffer from high NSIs, and the incidence of NSIs among RNs was associated with organizational characteristics as well as protective equipment and nurse characteristics. RNs who do not use safety containers for disposal of sharps and needles, have less working experience as an RN, work in poor work environments in regard to staffing and resource adequacy, and experience high emotional exhaustion had a significantly higher risk of NSIs. In addition, RNs working in perioperative units were more likely, but RNs in ICU, psychiatry, and obstetrics wards were less likely to experience NSIs than those in medical–surgical wards.

Hospitals can prevent or reduce NSIs by establishing better work environments in terms of staffing and resource adequacy, minimizing emotional exhaustion and retaining more experienced nurses. In addition, the access to safety-engineered equipment is the key to reducing NSIs. All hospitals should make safety-engineered equipment available to RNs. Hospitals without safety containers for disposal of sharps and needles as well as specific units of hospitals that have a higher risk for NSIs should implement organizational strategies to prevent such injuries. It is also necessary to establish a monitoring system for NSIs at a hospital level and a reporting system at the national level in South Korea. Education regarding the use of protective and safety equipment and reporting of NSIs should be

promoted on a regular basis. Legislation may be needed to require hospitals to make protective equipment and safety devices available to RNs and other employees.

Acknowledgments

We thank the nurse executives and staff nurses of 60 hospitals for their participation in our study. We are also grateful to the executives of the Korea Hospital Nurses Association, especially Drs. Kwang-Ok Park and Young Hee Sung, for many helpful suggestions during data collection.

Funding

This research was supported in part by a National Research Foundation of Korea (NRF) grant funded by the Government of the Republic of Korea (MEST) (No. 2009-0068921) and a pilot grant from the Center for Nursing Outcomes Research (P30-NR-005043) and Global Research Collaboration Initiative at the Center for Health Outcomes and Policy Research at the University of Pennsylvania.

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What is already known about the topic?

- Needlestick or sharp injuries (NSIs), which are mostly preventable, are one of the major occupational injuries experienced by registered nurses (RNs) working in hospitals.
- Major potential problems induced by NSIs are infectious diseases such as hepatitis B, hepatitis C, and HIV.

What this paper adds

- The majority (70.4%) of Korean hospital nurses had experienced NSIs in the previous year.
- NSIs of RNs were associated with organizational characteristics as well as protective equipment and nurse characteristics.
- NSIs were significantly associated with routine use of safety containers for disposal of sharps and needles, certain specialties, working years as an RN, emotional exhaustion, and work environment.

Table 1

Characteristics of the study hospitals and registered nurses.

Characteristics	Category	Hospitals (<i>n</i> = 60) <i>n</i> (%) or <i>M</i> (SD)	Nurses (<i>n</i> = 3079) <i>n</i> (%)
Location	Seoul (capital)	14 (23.3)	1320 (42.9)
	Other metropolitan	18 (30.0)	777 (25.2)
	Province	28 (46.7)	982 (31.9)
Number of beds	1000 or above	7 (11.7)	961 (31.2)
	700–799	7 (11.7)	633 (20.6)
	400–699	15 (25.0)	806 (26.2)
	100–399	31 (51.7)	679 (22.1)
High technology	Yes	44 (73.3)	2886 (93.7)
	No	16 (26.7)	193 (6.3)
Teaching hospital	Yes	18 (30.0)	300 (9.7)
	No	42 (70.0)	2779 (90.3)
Number of patients per RN	Range: 1–40	12.3 (9.1)	
Work environments (staffing and resource adequacy)	Range: 1–4	1.9 (0.2)	

M, mean; SD, standard deviation; RN, registered nurse.

Table 2Characteristics of registered nurses in the study hospitals ($n = 3079$).

Characteristics	Category	<i>n</i>	%	M (SD)
Gender	Female	2921	94.9	
Age	19 age 24	764	25.0	28.0 (4.9)
	25 age 29	1456	47.6	
	30 age 34	516	16.9	
	35 age 39	230	7.5	
	40 or above	94	3.1	
Education	Diploma	1597	51.9	
	Baccalaureate degree	1358	44.2	
	Masters or doctoral degree	120	3.9	
Working years as an RN	0 RN year < 5	1698	55.7	5.5 (4.6)
	5 RN year < 10	861	28.2	
	10 RN year < 15	347	11.4	
	15 or above	145	4.8	
Procedures on the last shift				
IV start	Yes	2259	73.7	
Routine phlebotomy	Yes	1966	64.2	
Specialty	Medical and surgical	958	32.3	
	ICU	549	18.5	
	Perioperative	256	8.6	
	ER	424	14.3	
	Psychiatry	82	2.8	
	Obstetrics	172	5.8	
	Pediatrics	161	5.4	
	Neonatal	96	3.2	
	Hemodialysis	172	5.8	
	Rehabilitation	29	1.0	
	Clinic	18	0.6	
	Others	48	1.6	
High emotional exhaustion	Yes	1940	66.5	

M, mean; SD, standard deviation; RN, registered nurse; IV, intravenous; ICU, intensive care units; ER, emergency room.

Table 3Needlestick and sharp injuries of registered nurses ($n = 3079$).

Characteristics	<i>n</i>	%
Needlestick or sharp injury (yes)	2140	70.4
Protective equipment used routinely in the work setting		
Safety containers for disposal of sharps and needles (yes)	2890	94.5
Needleless system for accessing or connecting IV lines (yes)	2409	78.8
Safety-engineered needle–syringe combinations (yes)	570	18.6
Safety-engineered systems for drawing blood (yes)	505	16.5
Safety-engineered systems for starting IV lines (yes)	555	18.2

IV, intravenous.

Table 4Logistic regression analysis: factors associated with needlestick and sharp injuries.^a

	OR	95% CI
Working years as a RN	0.990**	0.988–0.991
High emotional exhaustion (Ref: low/average)	1.486**	1.195–1.850
Work environments: staffing and resource adequacy	0.794*	0.671–0.940
Safety containers for disposal of sharps and needles (Ref: no)	0.727*	0.580–0.913
Specialty (Ref: medical–surgical)		
ICU	0.561**	0.410–0.767
Perioperative	1.555**	1.193–2.026
ER	0.774	0.526–1.139
Psychiatry	0.445*	0.251–0.789
Obstetrics	0.612*	0.445–0.840
Pediatrics	1.226	0.902–1.667
Neonatal	0.828	0.517–1.325
Hemodialysis	1.323	0.903–1.938
Rehabilitation	2.193	0.972–4.949
Clinics	1.248	0.458–3.402
Others	1.717	0.886–3.329

Ref, reference; OR, odds ratio; CI, confidence interval; ICU, intensive care unit.

^aThis analysis controls for nurse characteristics (gender, education, working years as an RN, procedures conducted on the last shift such as IV start and routine phlebotomy, and specialties), protective equipment in the hospital (safety containers for disposal of sharps and needles, needleless systems for accessing or connecting IV lines, safety-engineered needle–syringe combinations, safety-engineered systems for drawing blood, and safety-engineered systems for starting IV lines), and organizational characteristics (emotional exhaustion related to the job, staffing and resource adequacy, location, number of beds, high technology, teaching hospital status, and number of patients per RN).

* Significance: $p < 0.05$.

** Significance: $p < 0.001$.