

Risk factors for safe injection practice performance among nurses in general hospitals



Original article

Hyeon Jin Jang^a, Soonyoung Shon^b, Inah Kim^b, Mi-So Shim^{b,*}

^aDepartment of Nursing, Graduate School, Keimyung University, Daegu, Republic of Korea

^bDepartment of Nursing, College of Nursing, Keimyung University, Daegu, Republic of Korea

Received: 18 November 2024; Accepted: 18 December 2024; Published: 20 December 2025

Abstract: **Objective:** Nurses must follow safe injection practices to prevent healthcare-associated infections (HAIs). This study aimed to identify the risk factors for safe injection practice among nurses in general hospitals.

Methods: This cross-sectional study included 215 nurses employed in Korean general hospitals. Data were collected from September 22 to October 9, 2023. Multiple linear regression analysis was performed using SPSS Statistics 27.0.

Results: The regression analysis revealed that a higher level of patient safety priority in the patient safety culture perception, increased knowledge of safe injection practices, and fewer working hours per week were associated with improved performance of safe injection practices among general hospital nurses.

Conclusions: To enhance the performance of general hospital nurses in safe injection practice, it is necessary to establish a patient safety culture so that nurses recognize patient safety as a top priority. Additionally, an effective educational program is needed to increase the practical knowledge of safe injection practices, along with a supportive working environment that ensures appropriate working hours to prevent patient safety incidents.

Keywords: infection control • nurse • patient safety • safe injection practice • work environment

© Shanxi Medical Periodical Press Co., Ltd.

1. Introduction

Safe injection practices refer to the implementation of guidelines recommended to prevent infections arising from improper injections.¹ Healthcare-associated infections (HAIs) encompass all infections related to medical procedures and treatments within healthcare facilities.²

In this context, safe injection practices represent fundamental standard precautions for preventing infections during patient care in all medical environments.³ Unsafe injection practices, such as the reuse of syringes or needles, can expose patients to various pathogens,

How to cite this article: Jang HJ, Shon S, Kim I, Shim MS. Risk factors for safe injection practice performance among nurses in general hospitals. *Front Nurs*. 2025;4:537–546.

*Corresponding author.

E-mail: misoshim1111@gmail.com (M. -S. Shim).

including hepatitis B, hepatitis C, and human immunodeficiency virus (HIV).⁴ Bloodborne infections, which are particularly prevalent among nurses providing direct patient care, pose a heightened risk.⁵ Thus, adherence to safe injection practices is crucial for nurses to prevent HAIs.⁴

One of the key factors influencing the implementation of safe injection practices is the knowledge of such practices.¹ According to previous research surveying nurses, the higher the knowledge of safe injection practices of nurses, the better their performance of safe injection practices.^{6,7} Consequently, professional organizations such as the Infusion Nurses Society (2024) and the Hospital Nurses Association in Korea (2021) have released guidelines and practical instructions to enhance the knowledge levels of healthcare professionals regarding safe injection practices, aiming to minimize infections.^{8,9} However, recent studies on nurses in general hospitals and tertiary healthcare settings found that 70.1% and 68.2%, respectively, have limited knowledge about injection guidelines.^{6,10} Therefore, it is necessary to assess the level of knowledge regarding safe injection practices among nurses and to identify areas for improvement.

Perception of patient safety culture refers to shared beliefs, values, and behavioral patterns at the organizational, departmental, and individual levels that aim to prevent medical errors while providing healthcare services, ensuring that preventable adverse events do not occur.¹¹ The level of patient safety culture in a healthcare institution is reflected in the safety performance of its staff. When a patient safety culture prioritizing patient safety is established within an organization, the execution of safety practices increases, leading to a reduction in patient safety incidents.¹² In other words, nurses' attention to and perception of patient safety culture are crucial elements in patient safety. Previous research has shown that a higher perception of patient safety culture is associated with greater adherence to, and awareness of standard precautions for reducing HAIs.^{13,14} However, research evaluating the relationship between the performance of safe injection practices and the perception of patient safety culture is inadequate.

Prior studies have explored the factors influencing the overall infection management tasks performed by nurses.^{15,16} However, studies focusing on the factors that influence safe injection practices are relatively scarce. One study that analyzed the factors influencing safe injection practice performance among nurses in a general hospital identified age, department of employment, awareness of the importance of infection management when using injectables, and completion of infection management education as significant influencing

factors.¹⁰ Characteristics of nurses' work environment, such as nurse-to-patient ratio, total working hours per week, and perception of patient safety culture, have been reported to be closely related to patient outcomes and adverse events^{17,18}; however, there is a lack of research examining these factors as risk factors for safe injection practices. To improve nursing practices, it is essential to identify the impacts of both individual and environmental characteristics on nurses, as well as to determine areas that require appropriate interventions and policy implications. Therefore, this study aimed to analyze the key risk factors affecting safe injection practices, including knowledge of safe injection practices, perception of patient safety culture, and nurses' working environmental characteristics.

2. Methods

2.1. Study design

This study utilized a cross-sectional design to investigate the risk factors of safe injection practices among nurses in general hospitals.

2.2. Setting and participants

This study's participants were nurses working in general hospitals in the Republic of Korea. Inclusion criteria were nurses employed at a general hospital for at least 3 months, who voluntarily agreed to participate in the study after understanding its purpose and methods. The exclusion criteria were nurses working in administrative roles without involvement in injection practices and those with <3 months of work experience. Nurses with <3 months of overall work experience were excluded from the study because of their potentially insufficient independence in performing injection practices.

The study's sample size was determined using G*Power 3.1.9.7. With a significance level of 0.05, effect size of 0.15, power of 0.80, and 25 predictors, the minimum required sample size for the multiple linear regression analysis was calculated to be 172. The sample size was determined to be 215 participants, considering a missing rate of 20%. Subsequently, no missing or unreliable responses were identified, and 215 surveys collected were included in the final analysis.

2.3. Measures

2.3.1. General and working environmental characteristics of study participants

In this study, the general and working environmental characteristics of the participants included 12 items:

sex, age, marital status, educational level, clinical experience (years), position, department of employment, hospital size (number of beds), hospital type (public or private), number of patients in charge per nurse, total working hours per week, and the presence of safe injection practice guidelines within the hospital.

2.3.2. Perception of patient safety culture

The scale used to assess the perception of patient safety culture was developed by Lee,¹¹ and permission for its use was obtained from the developer. The tool consists of 35 items across 7 subdomains, including leadership (9 items), patient safety policy and procedure (4 items), patient safety improvement system (4 items), teamwork (6 items), non-punitive environment (4 items), patient safety knowledge and attitude (5 items), and patient safety priority (3 items). Each item is rated on a 5-point Likert scale, ranging from “strongly disagree” (1 point) to “strongly agree” (5 points). A higher total score indicates a higher level of perception of patient safety culture. The scale demonstrated reliability with a Cronbach’s α of 0.925 during its development¹¹ and 0.893 in this study.

2.3.3. Safe injection practice knowledge

We utilized the safe injection practice knowledge measurement scale developed by Choi,⁷ with permission obtained from the developer. The scale comprises 29 items evaluating safe injection knowledge in areas such as infection prevention during hand hygiene and handling multi-dose vials, single-dose vials, and intravenous equipment.⁷ Participants responded to each item with “Yes,” “No,” or “Unknown,” and correct responses were scored as 1 point, while incorrect and “Unknown” responses scored 0 points. The total score, ranging from 0 to 29, reflects the level of knowledge of safe injection practices. The reliability of the scale during its development, assessed using Kuder–Richardson 20 (KR-20), was 0.46,⁷ and 0.693 in this study.

2.3.4. Safe injection practice performance

We employed the scale developed by Choi⁷ to assess safe injection practice performance in this study with explicit permission from the developer. The scale comprises 23 items evaluating safe injection performance related to infection prevention during hand hygiene and handling multi-dose vials, single-dose vials, and intravenous equipment.⁷ Each item is rated on a 5-point Likert scale, ranging from “Never perform” (1 point) to “Always perform” (5 points). Nine negatively worded items were

reverse scored during the total score calculation, and a higher score indicated a higher proficiency in safe injection practice performance. The scale demonstrated reliability with a Cronbach’s α of 0.84 during its development⁷ and 0.873 in this study.

2.4. Data collection

The data collection for this study was conducted from September 22 to October 9, 2023, targeting nurses employed in Korean general hospitals nationwide. For 5 veteran hospitals, institutional consent was obtained after explaining the purpose and methods of the research, with recruitment notices distributed via email. Additionally, announcements were posted on an online community for nurses in Korea, a platform widely frequented by nurses, allowing interested and eligible participants to engage in the survey voluntarily. The self-administered survey required approximately 30 min, and participants received a small token of appreciation for their involvement in the study.

2.5. Data analysis

The data were analyzed using SPSS Statistics 27.0 (IBM Corporation, Armonk, New York, United States). The specific analytical methods used were as follows:

- (1) Descriptive statistics, including frequencies, percentages, means, and standard deviations (SDs), were used to examine the general and working environmental characteristics of the participants and the main variables.
- (2) Differences in safe injection practice performance based on participants’ general and working environmental characteristics were investigated using independent *t*-tests and 1-way analysis of variance (ANOVA). The Scheffe test was used for post hoc analysis for 1-way ANOVA.
- (3) Pearson’s correlation analysis was used to explore the relationships between participants’ perceptions of patient safety culture, safe injection practice knowledge, and safe injection practice performance.
- (4) Multiple linear regression analysis was conducted to identify the risk factors for participants’ safe injection practice performance.

2.6. Ethical approval and consent to participate

This study was approved by the Institutional Review Board (IRB) of Keimyung university (IRB No: 40525-202307-HR-019-02). The participants were required to

read the research information and voluntarily sign an informed consent form before completing the online survey. Only those who reviewed the provided information and voluntarily agreed to participate took part in the self-administered survey.

3. Results

3.1. Characteristics of participants and differences in safe injection practice performance based on those characteristics

The characteristics of the study participants and differences in safe injection practice performance based on these characteristics are summarized in Table 1. Among the 215 participants, 200 (93.0%) were females, and the average age of the participants was 30.84 years (SD: 6.42). The average years of clinical career among the participants was 6.91 years (SD: 6.33), with the highest proportion of participants (29.8%) having <3 years of experience. Most participants were staff nurses (93.0%). The predominant work department was the surgical unit, comprising 112 participants (52.1%), and most participants worked in hospitals with bed capacities ranging from 301 to 500 beds (38.1%). The average number of patients per nurse was 11.70 (SD: 6.09), and the average working hours per week was 44.85 (SD: 5.73) h.

The results revealed statistically significant differences in safe injection practice performance based on the following characteristics: working department ($F = 3.25$, $P = 0.023$), type of hospital ($t = 2.64$, $P = 0.010$), number of patients in charge per nurse ($F = 18.94$, $P < 0.001$), total weekly working hours ($F = 5.63$, $P = 0.001$), and existence of safe injection practice guidelines within the hospital ($t = 2.06$, $P = 0.041$).

3.2. Levels of safe injection practice performance, safe injection practice knowledge, and perception of patient safety culture among participants

The levels of safe injection practice performance, safe injection practice knowledge, and perception of patient safety culture among participants are presented in Table 2. To assess the normality of the dependent variable, we examined the skewness (-1.418) and kurtosis (1.042) for safe injection practice performance; both met the criteria for normal distribution as proposed in a previous study.¹⁹ The average score for safe injection practice was 4.40 ± 0.52 out of 5 points. Within the 5

subdomains, "Hand hygiene" achieved the highest score at an average of 4.64 ± 0.57 out of 5 points, followed by "Intravenous equipment" (average 4.48 ± 0.50) and "Intravenous medication" (average 4.45 ± 0.65). The areas with the lowest scores were "Handling of multi-dose vials," averaging 4.19 ± 0.69 , followed by "Handling of single-dose vials" (4.27 ± 1.15).

The participants obtained an average score of 24.22 ± 3.99 out of 29 points in safe injection practice knowledge. Within the 5 subdomains, "Hand hygiene" had an average score of 1.95 ± 0.28 out of 2 points, "Injection medication" recorded an average of 7.56 ± 1.43 out of 9 points, "Handling multi-dose vial" attained an average of 4.14 ± 0.92 out of 5 points, "Handling single-dose vial" recorded an average of 1.77 ± 0.46 out of 2 points, and "Intravenous equipment" achieved an average of 8.80 ± 1.72 out of 11 points.

The participants obtained an average score of 3.72 ± 0.60 out of 5 points in the perception of patient safety culture. Among the 7 subdomains, the highest-scoring area was "Patient safety knowledge and attitude," with an average of 4.13 ± 0.61 points, followed by "Teamwork" (average 3.95 ± 0.63), "Leadership" (average 3.92 ± 0.68), and "Patient safety policy and procedure" (average 3.85 ± 0.73). Conversely, the lowest scoring domain was "Patient safety priority," with an average of 3.16 ± 0.92 , followed by "non-punitive environment," with an average score of 3.38 ± 1.03 .

3.3. Correlation between the perception of patient safety culture, safe injection practice knowledge, and safe injection practice performance

The correlation analysis between the participants' perceptions of patient safety culture, safe injection practice knowledge, and safe injection practice performance is presented in Table 3. Safe injection practice performance was significantly positively correlated with the perception of patient safety culture ($r = 0.49$, $P < 0.001$) and safe injection practice knowledge ($r = 0.75$, $P < 0.001$). Further analysis of the subdomains within the perception of patient safety culture revealed that patient safety knowledge and attitude ($r = 0.49$, $P < 0.001$) exhibited the highest correlation with safe injection practice performance. Additionally, teamwork ($r = 0.47$, $P < 0.001$), leadership ($r = 0.45$, $P < 0.001$), non-punitive environment ($r = 0.36$, $P < 0.001$), patient safety policy and procedure ($r = 0.35$, $P < 0.001$), patient safety improvement system ($r = 0.33$, $P < 0.001$), and patient safety priority ($r = 0.30$, $P < 0.001$) demonstrated significant positive correlations with safe injection practice performance.

Variables and categories	N (%)	Mean $\pm$ SD	t/F (P-value)
Sex			-1.63 (0.124)
Male	15 (7.0)	4.09 $\pm$ 0.80	
Female	200 (93.0)	4.43 $\pm$ 0.49	
Age (years)			1.83 (0.201)
≤ 25	39 (18.1)	4.33 $\pm$ 0.41	
26–29	68 (31.6)	4.51 $\pm$ 0.45	
30–39	90 (41.9)	4.35 $\pm$ 0.61	
≥ 40	18 (8.4)	4.47 $\pm$ 0.46	
Marital status			-0.26 (0.791)
Unmarried	154 (71.6)	4.40 $\pm$ 0.52	
Married	61 (28.4)	4.42 $\pm$ 0.53	
Education level			0.89 (0.412)
College	20 (9.3)	4.47 $\pm$ 0.46	
University	181 (84.2)	4.39 $\pm$ 0.54	
$\geq$ Graduate school	14 (6.5)	4.56 $\pm$ 0.38	
Total clinical career (years)			1.09 (0.355)
< 3	64 (29.8)	4.41 $\pm$ 0.44	
3–5	47 (21.9)	4.31 $\pm$ 0.70	
5–10	53 (24.7)	4.39 $\pm$ 0.47	
≥ 10	51 (23.6)	4.50 $\pm$ 0.46	
Position			-1.40 (0.164)
Staff nurse	200 (93.0)	4.39 $\pm$ 0.53	
$\geq$ Charge Nurse	15 (7.0)	4.59 $\pm$ 0.33	
Working department			3.25 (0.023), a < b
Medical Unit ^a	63 (29.3)	4.24 $\pm$ 0.62	
Surgical Unit ^b	112 (52.1)	4.49 $\pm$ 0.45	
Comprehensive Nursing Care Unit	12 (5.6)	4.45 $\pm$ 0.53	
Special Unit	28 (13.0)	4.43 $\pm$ 0.47	
Hospital size (number of beds)			1.45 (0.230)
≤ 300	17 (7.9)	4.24 $\pm$ 0.50	
301–500	82 (38.1)	4.49 $\pm$ 0.41	
501–1000	63 (29.3)	4.39 $\pm$ 0.56	
> 1000	53 (24.7)	4.36 $\pm$ 0.62	
Type of hospital			2.64 (0.010)
Public hospital	149 (69.3)	4.48 $\pm$ 0.43	
Private hospital	66 (30.7)	4.24 $\pm$ 0.66	
Number of patients per nurse			18.94 (<0.001), d < a, b, c
$< 10^a$	88 (40.9)	4.58 $\pm$ 0.36	
10–14 ^b	47 (21.9)	4.48 $\pm$ 0.39	
15–19 ^c	60 (27.9)	4.31 $\pm$ 0.53	
$\geq 20^d$	20 (9.3)	3.74 $\pm$ 0.74	
Weekly duty hours			5.63 (0.001), c < a, b
$\leq 40^a$	86 (40.0)	4.50 $\pm$ 0.43	
41–47 ^b	54 (25.1)	4.50 $\pm$ 0.38	
$\geq 48^c$	75 (34.9)	4.22 $\pm$ 0.65	
Guidelines for safe injection practice in the hospital			2.06 (0.041)
Yes	185 (86.0)	4.43 $\pm$ 0.52	
No	30 (14.0)	4.22 $\pm$ 0.46	

Note: N, number; SD, standard deviation.

Table 1. Differences in performance of safe injection practices by participants' characteristics (N = 215).

Variables	Mean $\pm$ SD	Range
<i>Performance of safe injection practice</i>	4.40 $\pm$ 0.52	2.87–5.00
Hand hygiene	4.64 $\pm$ 0.57	2.50–5.00
Intravenous medication	4.45 $\pm$ 0.65	2.60–5.00
Multi-dose vial	4.19 $\pm$ 0.69	2.40–5.00
Single dose vial	4.27 $\pm$ 1.15	1.00–5.00
Intravenous equipment	4.48 $\pm$ 0.50	2.56–5.00
<i>Knowledge of safe injection practice</i>	24.22 $\pm$ 3.99	3.00–29.00
Hand hygiene	1.95 $\pm$ 0.28	0.00–2.00
Intravenous medication	7.56 $\pm$ 1.43	1.00–9.00
Multi-dose vial	4.14 $\pm$ 0.92	0.00–5.00
Single dose vial	1.77 $\pm$ 0.46	1.00–2.00
Intravenous equipment	8.80 $\pm$ 1.72	1.00–11.00
<i>Perception of patient safety culture</i>	3.72 $\pm$ 0.60	2.37–4.96
Leadership	3.92 $\pm$ 0.68	2.00–5.00
Teamwork	3.95 $\pm$ 0.63	2.17–5.00
Patient safety knowledge and attitude	4.13 $\pm$ 0.61	2.40–5.00
Patient safety policy and procedure	3.85 $\pm$ 0.73	2.00–5.00
Non-punitive environment	3.38 $\pm$ 1.03	1.00–5.00
Patient safety improvement system	3.67 $\pm$ 0.72	2.00–5.00
Patient safety priority	3.16 $\pm$ 0.92	1.00–5.00

Note: SD, standard deviation.

Table 2. Level of performance and knowledge of safe injection practice and perception of patient safety culture.

3.4. Risk factors for safe injection practice performance among participants

The analysis of risk factors for safe injection practice performance among the participants is presented in Table 4. The multiple linear regression analysis was conducted by including all predictors that showed statistically significant differences and correlations, such as working department, type of hospital, number of patients in charge per nurse, total weekly working hours, the existence of safe injection practice guidelines in the hospital, subdomains of patient safety culture perception, and safe injection practice knowledge. The regression model was statistically significant ($F = 20.61$, $P < 0.001$), with an explanatory power of 62%. The Durbin–Watson statistic was 1.91, indicating no violation of the assumption of independence of residuals, and the variance inflation factor was below 10, confirming the absence of multicollinearity. The significance test of the regression coefficients revealed that the subdomain of patient safety priority ($\beta = 0.13$, $P = 0.044$) within the perception of patient safety culture and safe injection practice knowledge ($\beta = 0.63$, $P < 0.001$) had a significant positive association with safe injection practice performance. The total weekly working hours had a significant negative association, indicating that if the total weekly working hours exceeded 48 h, the performance of safe injection practices decreased ($\beta = -0.16$, $P = 0.038$). In summary, a higher perception of patient safety priority and knowledge of safe injection practice was positively associated with safe injection practice performance. Additionally, working for >48 h a week was associated

Variables	1	2	3	4	5	6	7	8	9
Performance of safe injection practice (1)	1								
Knowledge of safe injection practice (2)	0.75***	1							
Perception of patient safety culture (3)	0.49***	0.35***	1						
Leadership (4)	0.45***	0.33***	0.88***	1					
Teamwork (5)	0.47***	0.35***	0.87***	0.85***	1				
Knowledge and attitude (6)	0.49***	0.43***	0.81***	0.77***	0.82***	1			
Policy and procedure (7)	0.35***	0.23**	0.86***	0.80***	0.83***	0.75***	1		
Non-punitive environment (8)	0.36***	0.27***	0.70***	0.46***	0.41***	0.40***	0.39***	1	
Improvement system (9)	0.33***	0.23**	0.79***	0.73***	0.71***	0.68***	0.76***	0.34***	1
Patient safety priority (10)	0.30***	0.17*	0.72***	0.47***	0.46***	0.37***	0.47***	0.63***	0.39***

Note: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table 3. Correlation between performance and knowledge of safe injection practice and perception of patient safety culture.

Variables and categories	B	SE	β	<i>t</i>	<i>P</i> -value
Working department (Ref. medical unit)					
Surgical unit	0.04	0.06	0.04	0.67	0.503
Comprehensive Nursing care unit	0.04	0.11	0.02	0.32	0.746
Special unit	−0.04	0.08	−0.02	−0.43	0.671
Type of hospital (Ref. public hospital)					
Private hospital	0.01	0.08	0.01	0.12	0.902
Number of patients per nurse (Ref. <10)					
10–14	0.00	0.07	0.00	0.04	0.965
15–19	−0.08	0.07	−0.07	−1.17	0.245
≥20	−0.02	0.10	−0.01	−0.17	0.864
Weekly duty hours (Ref. ≤40)					
41–47	−0.07	0.06	−0.06	−1.14	0.254
≥48	−0.17	0.08	−0.16	−2.09	0.038
Guidelines for safe injection practice in the work setting (Ref. yes)					
No	0.01	0.07	0.01	0.16	0.874
Perception of patient safety culture					
Leadership	0.04	0.07	0.05	0.51	0.613
Teamwork	0.13	0.08	0.16	1.60	0.111
Knowledge/attitude	0.02	0.07	0.02	0.22	0.825
Policy/procedure	−0.08	0.07	−0.12	−1.21	0.228
Non-punitive environment	0.02	0.03	0.04	0.72	0.474
Improvement system	0.02	0.05	0.02	0.33	0.742
Patient safety priority	0.07	0.04	0.13	2.02	0.044
Knowledge of safe injection practice	0.08	0.01	0.63	11.69	<0.001

Note: $R^2 = 0.65$; adjusted $R^2 = 0.62$; $F = 20.61$; $P < 0.001$; Ref, reference group; SE, standard error.

Table 4. Risk factors for the performance of safe injection practices.

with a higher risk of lower performance in safe injection practices compared to working ≤40 h a week.

4. Discussion

This study identified the risk factors for the safe injection practice performance of nurses working in general hospitals. It provided fundamental data for developing educational programs and policies to enhance nurses' safe injection practices. In this study, the safe injection practice performance of nurses in general hospitals was rated at 4.40 ± 0.52 out of 5 points. Similar results were found in a study by Choi,⁷ which targeted nurses in small- and medium-sized hospitals. However, a study by Yun⁶ targeting nurses in tertiary general hospitals reported higher scores than those in this study. Among the performance items, the task "Prepare multi-dose vials (e.g., insulin vials, heparin vials) next to the patient's bed" had the lowest performance score of 2.64. The preparation of nurse-administered medications frequently occurs in areas that are not adequately cleaned, leading to

a higher risk of infection. Therefore, it is essential to emphasize the importance of medication preparation and administration in clean environments.¹⁰ Additionally, the item "Replace the infusion set for lipid solutions" within 12 h scored 3.97, indicating a lower performance level. According to the Hospital Nurses Association in Korea (2021),⁹ lipid solutions promote microbial growth; hence, the infusion set should be replaced every 12 h or when changing to a new solution. Continuous education regarding the use of intravenous infusion devices, including medication administration sets, is warranted to improve safe injection practices.

Safe injection practice knowledge has been identified as a critical factor in the performance of safe injection practices. Previous studies have consistently shown that nurses' increased knowledge of safe injection practices is associated with better performance.^{6,20} Therefore, enhancing the level of knowledge of safe injection practices through education and training is crucial for improving the performance of safe injection practices. The results of this study, especially the lower

correct response rate (43.3%) for the item “Prepare and use multi-dose vials (e.g., insulin vials, heparin vials) at the patient’s bedside,” highlight the need for reinforced education regarding the management of multi-dose vials and medication administration. Therefore, to improve nurses’ knowledge of safe injection practices, it is essential to strengthen the education and training that has proven effective in previous studies, including providing theoretical content and practical training using simulators.^{21,22}

Efforts are also required to improve the perception of the patient safety culture and enhance the performance of safe injection practices. Previous studies have also reported that nurses’ perceptions of patient safety culture are significantly related to adverse events in hospitals.^{23,24} Specifically, in this study, the subdomain of patient safety priority within the perception of patient safety culture emerged as a significant factor related to safe injection practice performance. The prioritization of safety within the organization plays a crucial role in shaping the safety culture and motivating employees to take ownership and responsibility for safety-related actions.²¹ Therefore, to improve the performance of safe injection practices, a shift in perception is necessary for nurses to prioritize patient safety and consider it a top priority in their duties. Additionally, according to Lee et al.²⁵ the nursing work environment and staffing shortages influence the prioritization of patient safety. Consequently, diverse strategies should be explored, including healthcare policy development, active support from hospital management, and securing sufficient nursing staff to enhance perceptions of patient safety culture.

The performance of safe injection practices was significantly lower when nurses worked >48 h per week than when they worked fewer hours. The nursing work environment is a crucial factor influencing various aspects such as nursing performance, job satisfaction, and healthcare service quality.^{26,27} Creating an optimal nursing work environment is essential for enhancing patient safety and the quality of nursing services, as a supportive environment allows nurses to focus on patient care. According to previous studies on Korean hospital nurses, the pool of nursing staff in hospitals is poor, resulting in frequent overtime and a lack of day-offs,²⁸ which is more serious in small- and medium-sized general hospitals.²⁹ To prevent safety incidents related to injection practices among nurses in general hospitals, more proactive intervention is essential, focusing on improving working conditions, including working hours.

This study has some limitations. First, the study participants were restricted to nurses working in general

hospitals in Korea, which may limit the generalizability of the findings to nurses in various hospitals and community settings where injection practices are performed. Second, the scale used to measure safe injection practice knowledge had a low reliability. In future research, it is necessary to consider scales with enhanced validity and reliability. Third, the assessment of safe injection practice performance was conducted using self-reported surveys, introducing the potential influence of social desirability bias. Future research should evaluate safe injection practice performance through direct observations.

5. Conclusions

Our findings revealed that the risk factors for safe injection practice performance among nurses from general hospitals included patient safety priority, a subdomain within the perception of patient safety culture, safe injection practice knowledge, and total weekly working hours. To enhance safe injection practice performance, establishing a robust patient safety culture within hospitals is crucial; this would ensure that nurses prioritize patient safety effectively. We propose the development of tailored educational programs based on our research findings to promote nurses’ knowledge of safe injection practices. Finally, efforts to secure an adequate nursing workforce and reduce working hours are necessary to create a favorable work environment and prevent patient safety incidents related to nurses’ safe injection practice performance. These findings can provide a foundational basis for policy improvements aimed at enhancing nurses’ work environments. Furthermore, we propose future research to investigate the causal relationship between nurses’ work environment and safe injection practices, as well as the impact of specific interventions on improving these practices.

Acknowledgments

This study was revised and supplemented from the first author’s master’s thesis.

Ethical approval

This study was approved by the Institutional Review Board (IRB) of Keimyung university (IRB No: 40525-202307-HR-019-02).

Conflicts of interest

All contributing authors declare no conflicts of interest.

References

1. Dolan SA, Arias KM, Felizardo G, et al. APIC position paper: safe injection, infusion, and medication vial practices in health care. *Am J Infect Control*. 2016;44:750–757.
2. Korea Centers for Disease Control & Prevention. *Guidelines for Prevention and Control of Healthcare Associated Infections*. Cheongju, Korea: Korea Centers for Disease Control & Prevention; 2017. <https://www.ksid.or.kr/board/list.html?num=2758&code=pds>. Accessed September 10, 2024.
3. Korea Centers for Disease Control and Prevention. *Injection Safety*. Cheongju, Korea: Korea Centers for Disease Control & Prevention; 2012. <https://www.cdc.gov/injectionsafety/index.html>. Accessed September 10, 2024.
4. World Health Organization. *WHO Best Practices for Injections and Related Procedures Toolkit*. Geneva, Switzerland: World Health Organization; 2010. <https://www.who.int/publications/item/9789241599252>. Accessed August 18, 2024.
5. Joung S, Park KY. Knowledge on blood-borne infections, compliance and barriers on blood-borne infection control among nurses in hemodialysis units. *J Korean Acad Fundam Nurs*. 2018;25:22–32 (in Korean).
6. Yun SG. Effect of Nurses' Knowledge, Organizational Culture, and Work Load on the Performance of Safe Injection Practices. Ulsan: The Graduate School of Ulsan University; 2022 (in Korean).
7. Choi SA. Factors Influencing Compliance of Intravenous Practice for Infection Prevention Among Nurses in Small and Medium Hospitals. Daejeon: The Graduate School of Konyang University; 2019 (in Korean).
8. Nickel B, Gorski L, Kleidon T, et al. Infusion Therapy Standards of Practice, 9th edition. *J Infus Nurs*. 2024;47:S1–S285.
9. Hospital Nurses Association. *Evidence-Based Nursing Practice Guidelines. Central Venous Infusion Therapy*. Seoul, Republic of Korea: Hospital Nurses Association; 2021. https://khna.or.kr/home/data/230223/khna_guide_2023_1.pdf. Accessed August 18, 2024.
10. Roh MJ, Han MA, Park J, et al. The performance of infection control for injection and related procedures among nurses. *J Korean Soc Health-Syst Pharm*. 2017;34:410–421 (in Korean).
11. Lee SG. Development and Psychometric Evaluation of the Korean Patient Safety Culture Survey Instrument for Hospitals. Seoul: The Graduate School of Chung-Ang University; 2015 (in Korean).
12. Park MY, Kim EA. Perception of importance of patient safety management, patient safety culture and safety performance in hospital managerial performance of hospital nurses. *J Korean Acad Nurs Adm*. 2018;24:40–50 (in Korean).
13. Kwon HK, Jeong JS, Lee BI, et al. Awareness and correlation of patient safety culture and standard precautions among health care personnel. *Qual Improv Health Care*. 2015;21:58–72.
14. Hessels AJ, Wurmser T. Relationship among safety culture, nursing care, and standard precautions adherence. *Am J Infect Control*. 2020;48:340–341.
15. Lee SH, Yang IS. Infection control knowledge and standard precaution practice among clinical nurses in small and medium-sized hospital. *J Convergen Inf Technol*. 2022;12:107–115 (in Korean).
16. Choi K, Moon M. Effect of infection control knowledge and nursing work environment on infection control performance among general hospital nurses. *J Muscle Joint Health*. 2023;30:120–128 (in Korean).
17. McHugh MD, Aiken LH, Sloane DM, et al. Effects of nurse-to-patient ratio legislation on nurse staffing and patient mortality, readmissions, and length of stay: a prospective study in a panel of hospitals. *Lancet*. 2021;397(10288):1905–1913.
18. Han Y, Kim JS, Seo Y. Cross-sectional study on patient safety culture, patient safety competency, and adverse events. *West J Nurs Res*. 2020; 42:32–40.
19. Kim HY. Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. *Restor Dent Endod*. 2013;38:52–54.
20. Adejumo PO, Dada FA. A comparative study on knowledge, attitude, and practice of injection safety among nurses in two hospitals in Ibadan, Nigeria. *Int J Infect Control*. 2013;9:1–6.
21. de Souza-Junior VD, Mendes IAC, Marchi-Alves LM, et al. Peripheral venipuncture education strategies for nursing students: an integrative literature review. *J Infus Nurs*. 2020;43:24–32.
22. Uzelli Yilmaz DU, Sari D. Examining the effect of simulation-based learning on intravenous therapy administration' knowledge, performance, and clinical assessment skills of first-year nursing students. *Nurse Educ Today*. 2021;102:104924.
23. Kakemam E, Gharaee H, Rajabi MR, et al. Nurses' perception of patient safety culture and its relationship with adverse events: a national questionnaire survey in Iran. *BMC Nurs*. 2021;20:60.
24. Lee YM, Oh H. The influence of patient safety culture and patient safety error experience on safety

- nursing activities of emergency nurses in South Korea. *J Emerg Nurs*. 2020;46:838–847.e2.
25. Lee HK, Kim GM, Kim EJ. The effect of organizational commitment and perceived patient safety culture on patient safety nursing activities in public hospital nurses. *J Korean Acad Soc Home Health Care Nurs*. 2019;26:145–154 (in Korean).
26. Kang H, Shin S. The effects of tertiary hospital nurses' ageism and nursing practice environment on geriatric nursing performance. *J Korean Gerontol Nurs*. 2022;24:355–365 (in Korean).
27. Kim B, Lee SY, An GJ, et al. Influence of communication competency and nursing work environment on job satisfaction in hospital nurses. *J Health Inform Stat*. 2019;44:189–197 (in Korean).
28. Yun MR, Yu B. Strategies for reducing hospital nurse turnover in South Korea: Nurses' perceptions and suggestions. *J Nurs Manag*. 2021;29:1256–1262.
29. Shin S, Oh SJ, Kim J, et al. Impact of nurse staffing on intent to leave, job satisfaction, and occupational injuries in Korean hospitals: a cross-sectional study. *Nurs Health Sci*. 2020;22:658–666.