Factors Affecting Patient Safety Culture in Terms of Compliance With Practices Promoting Prevention of Bloodborne Pathogens Among General Hospital Nurses

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Research article

Keywords: Patient safety, patient safety culture, bloodborne pathogen, nurses

DOI: https://doi.org/10.21203/rs.3.rs-28983/v1

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Abstract

Background: The present study aims to investigate the effects of patient safety culture on the prevention of transmitting bloodborne pathogens among nurses at a general hospital.

Methods: The participants were 284 nurses working at a general hospital located in P city, and the data were collected between April 26 and May 15, 2019. Questionnaires on patient safety culture and prevention of bloodborne pathogens were used, and the data were examined on SPSS version 22.0 using frequency analysis, percentages, mean, standard deviation, t-test, ANOVA, Pearson's correlation, and hierarchical regression analysis.

Results: The results showed that the following factors affected the prevention of bloodborne pathogens: experience of needle stick and sharp injuries ($\beta=-0.94$), teamwork ($\beta=0.41$), knowledge and attitude toward patient safety ($\beta=0.34$), leadership ($\beta=0.15$), and priority of patient safety ($\beta=0.14$). The model's explanatory power was 53% ($F=32.26, p=<0.001$).

Conclusions: In order to increase the compliance of general hospital nurses with the practices that promote prevention of bloodborne pathogens, it is necessary to actively prevent needle stick and sharp injuries. It is also necessary to prioritize patient safety, and to develop and verify the effects of various programs that emphasize factors of patient safety culture, such as leadership, teamwork, knowledge, and attitude.

Background

As the standard of living has improved, and the provision of medical services and public interest in health have increased, patients and caregivers who use hospitals have increasingly demanded high quality medical services in safe environments [1]. Access to appropriate medical services is regarded as a basic patient right [2]; however, the increasing severity of patient conditions and complexity of medical services still threaten patient safety. Improving both patient safety and the quality of medical care has become a critical public health issue [3, 4].

Patient safety aims to minimize potential risks in medical services to prevent errors, and to minimize the risk factors, with the ultimate goal of decreasing the incidence of medical malpractice [5, 6]. Incidents of medical malpractice cause financial loss, distrust in healthcare professionals and hospitals, and longer hospital stays, directly influencing patients' health and lives; therefore, medical malpractice is an important factor that decreases the quality of medical care [7]. The American Institute of Medicine (IOM) [8] emphasizes the need to mitigate medical malpractice and suggests fostering a culture that prioritizes patient safety.

Patient safety culture refers to an organizational culture where all hospital staff recognize patient safety as a priority. This is not only guided by patient safety policies and improved organizational systems, but also the management of patient safety through active communication and teamwork between the
members [9]. Nurses' awareness of patient safety culture has been seen to increase their compliance with safe nursing practices; thus, creating a safe medical environment [10]. Nurses often encounter situations requiring them to make critical judgements and independent decisions, and where factors, such as teamwork, knowledge, techniques, attitude, leadership, and communication, are necessary for efficient workflow and problem solving [11].

Among the various healthcare-associated infections (HAI), bloodborne infections are caused by exposure to blood and bodily fluids of a patient. Although prevention is of utmost importance, when such an exposure occurs, team members often criticize one another without communicating effectively, which creates obstacles in patient safety [10, 12]. Nurses who provide direct care to patients are under high risk of exposure to bloodborne infections, such as hepatitis B, hepatitis C, and human immunodeficiency virus (HIV) [13, 14, 15].

Nurses are sensitive to the awareness of patient safety, and their efforts to prevent HAI can directly influence the quality of infection control and management at a hospital. Therefore, the present study aims to investigate the effects of the awareness of patient safety culture on compliance with practices that prevent bloodborne infections. The ultimate goal is to provide basic data to promote patient safety culture and compliance with practices that promote the prevention of bloodborne infections.

**Methods**

**Study design**

The present study is a descriptive survey that attempts to investigate the effects of patient safety culture on compliance with practices which promote the prevention of bloodborne infections among the nurses of a general hospital.

**Setting & Participants**

Participants were selected through convenience sampling and included: nurses working at P General Hospital (which is located in P city and has more than 500 beds), who could understand and answer the survey questions, and had no difficulties communicating.

Sample size was calculated on G*Power 3.1.9.2, which revealed that a minimum of 256 participants were needed to perform a regression analysis with median effect size 0.15, significance level 0.05, statistical power 0.95, and 29 predictors. To account for a 10% drop-out rate, the questionnaires were distributed to 284 participants. All 284 questionnaires were collected, with a non-response rate of 0%.

**Measurement Tools**
Patient safety culture

The Korean Patient Safety Culture Survey Instrument for Hospitals, developed by Lee (2015) [16], was used to measure patient safety culture. The tool consists of 35 questions in 7 domains. The questions are divided into 3 dimensions: organization, department, and individual. The subdomains of the organization dimension include questions on leadership (9), patient safety policy and procedures (4), and patient safety improvement system (4). The subdomains of the department dimension include questions on teamwork (6) and non-punitive environment (4). The subdomains of the individual domain comprise questions on knowledge and attitude toward patient safety (5) and the priority of patient safety (3). Each question is rated on a 5-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). Higher scores indicate higher awareness of patient safety culture. In terms of reliability, Cronbach’s α was 0.93 in Lee (2015) [16], 0.93 in Sung (2018) [17], and 0.87 in the present study.

Compliance of blood-born pathogen prevention

To measure compliance with practices promoting prevention of bloodborne pathogens, the Compliance with Bloodborne Pathogens Prevention Scale developed by Lee (2017) [14] was used. The tool consists of 18 questions in 4 domains which include questions on compliance with standard precautions (8), compliance with infection exposure prevention when using instruments (3), emergency treatment after exposure to infections (3), and post-exposure reporting and follow-up management (4). The questions are rated on a 4-point Likert scale: “never” = 1, “sometimes” = 2, “often” = 3, and “always” = 4. The total score ranges between 18 – 7; a higher total score indicates higher compliance with practices promoting prevention of bloodborne pathogens. In terms of the reliability of the tool, Cronbach’s α was 0.88 in Lee (2017) [14] and 0.93 in the present study.

Data Collection

The data for this study were collected between April 26 and May 15, 2019, using structured self-reported questionnaires distributed to nurses working at P General Hospital located in P City. Prior to data collection, the director of nursing services granted approval by telephone. Subsequently, the researcher visited the nursing department to explain the study purpose and obtain approval for data collection. The purpose and methods of the study were explained in detail to the head nurses of the respective departments, and the questionnaires were explained and distributed in the nurses lounge of each department. Nurses who wished to participate were then asked to complete the questionnaires. The researcher visited the participants in their respective departments during each shift to explain the purpose of the study, methods involved, and how the questionnaire should be completed. Participants were assured that the collected data would be used solely for research purposes, their identities would remain anonymous, and they could withdraw their participation at any point. The nurses who provided voluntary consent were asked to complete the questionnaires, and the completed questionnaires were collected in an envelope by the researcher. A total of 284 questionnaires were distributed and collected for final analysis.
Statistical Methods

The collected data were analyzed using the software SPSS/WIN 22.0. The demographic characteristics, patient safety culture, and compliance with bloodborne pathogen prevention were analyzed using frequency, percentage, mean, and standard deviation. The relationship between patient safety culture and the participants’ compliance with practices promoting prevention of bloodborne pathogens was assessed using the Pearson correlation coefficient. A hierarchical multiple regression analysis was conducted to investigate the factors that influence participants’ compliance with practices promoting the prevention of bloodborne pathogens.

Ethical Considerations

The present study was approved by the Institutional Review Board (IRB, 40525-201901-HR-126-02) at K University in D Metropolitan City. The participants provided written consent after the study purpose was explained to them. The consent form outlined that participation is voluntary, participants’ anonymity will be protected, participants may withdraw their participation whenever they desire with no repercussions, and the collected data will be used solely for research purposes. Small gifts were provided to the participants who completed the questionnaires.

Results

Table 1 shows the demographic and clinical characteristics of the participants. It was noted that 275 (96.8%) participants were female, and 202 (71.1%) and 82 (28.9%) were below 30 and above 30, respectively. Of the total participants, 205 (72.1%) had a bachelor's degree and 234 (82.4%) were staff nurses. In terms of total work experience, 199 (70.1%) had less than 5 years of experience, and 85 (29.9%) had more than 5 years. Further, 234 (82.4%) were noted to have been working in their current unit for less than 5 years, and 50 (17.8%) had been working in their current unit for more than 5 years. Of the total, 55 (19.4%) worked in non-surgical internal medicine units. In terms of experiencing needle stick and sharp injury (NSSI), 221 (77.8%) had experienced NSSI, in contrast with 63 (22.2%) who had not. Further, 37 (58.7%) experienced NSSI from disposable syringes, and 21 (33.3%) experienced NSSI while disassembling needles or sharp instruments. It was noted that 253 (89.1%) never experienced mucous membrane exposure to blood and bodily fluids, and 249 (87.7%) never experienced skin exposure to blood and bodily fluids. Of the total, 257 (90.5%) never completed a report on infection exposure, and 231 had received the hepatitis B vaccine (81.3%). The results showed that 142 completed 0 patient safety case reports (50%), and 135 (47.5%) completed 1–5 patient safety case reports. Further, 259 (91.2%) participants received education on prevention of bloodborne pathogens, and 119 (41.9%) and 123 (43.3%) received education at hospital and at both school and hospital, respectively.
Table 1
Demographic and clinical characteristics of the subjects (N= 284)

| Characteristics                      | Categories       | n   | (%)    |
|--------------------------------------|------------------|-----|--------|
| Gender                               | Female           | 275 | (96.8) |
|                                      | male             | 9   | (3.2)  |
| Age group                            | < 30             | 202 | (71.1) |
|                                      | ≥ 30             | 82  | (28.9) |
| Education level                      | Diploma          | 72  | (25.4) |
|                                      | Bachelor’s       | 205 | (72.1) |
|                                      | >Master’s        | 7   | (2.5)  |
| Position                             | Staff nurse      | 234 | (82.4) |
|                                      | Charge nurse     | 31  | (10.9) |
|                                      | Head nurse       | 19  | (6.7)  |
| Work experience                      | ≤ 5              | 199 | (70.1) |
|                                      | > 5              | 85  | (29.9) |
| Current unit employed                | ≤ 5              | 234 | (82.4) |
|                                      | > 5              | 50  | (17.6) |
| Work unit                            | Medicine (non-surgical) | 55 | (19.4) |
|                                      | Surgery          | 52  | (18.3) |
|                                      | Intensive Care Unit | 46 | (16.2) |
|                                      | Emergency        | 30  | (10.6) |
|                                      | Operating room   | 27  | (9.5)  |
|                                      | Women            | 7   | (2.5)  |
|                                      | Others           | 67  | (23.5) |
| Experienced NSSI for last 1 year     | Yes              | 63  | (22.2) |
|                                      | No               | 221 | (77.8) |
| Type of devices causing NSSI         | Disposable syringe | 37 | (58.7) |
|                                      | Blood glucose lancet | 14 | (22.2) |
| Characteristics                                      | Categories                           | n (%)     |
|------------------------------------------------------|--------------------------------------|-----------|
| Other sharp device                                   | 12                                   | (19.1)    |
| Procedures causing NSSI                             | Inserting a needle                   | 5         | (7.9)     |
|                                                      | Disposing of used items              | 10        | (15.9)    |
|                                                      | Recapping a needle                   | 8         | (12.7)    |
|                                                      | Disassembling needle or sharp instrument | 21      | (33.3)    |
|                                                      | Others                               | 19        | (30.2)    |
| Blood and Body fluid exposure experience of Mucous membrane | Yes                                  | 31        | (10.9)    |
|                                                      | No                                   | 253       | (89.1)    |
| Blood and Body fluid exposure experience of skin     | Yes                                  | 35        | (12.3)    |
|                                                      | No                                   | 249       | (87.7)    |
| Report Infection Exposure                            | Yes                                  | 27        | (9.5)     |
|                                                      | No                                   | 257       | (90.5)    |
| Vaccination of Hepatitis B                           | Yes                                  | 231       | (81.3)    |
|                                                      | No                                   | 30        | (10.6)    |
|                                                      | Do not know                          | 23        | (8.1)     |
| Number of patient safety case reports                | 0                                    | 142       | (50)      |
|                                                      | 1~5                                  | 135       | (47.5)    |
|                                                      | 6≤                                   | 7         | (2.5)     |
| Education experience for Bloodborne Pathogens Prevention | Yes                                  | 259       | (91.2)    |
|                                                      | No                                   | 25        | (8.8)     |
| Characteristics                                    | Categories | n (%) |
|---------------------------------------------------|------------|-------|
| Educational palace for Bloodborne Pathogens Prevention | College    | 17    | (6.0) |
|                                                   | Hospital   | 119   | (41.9)|
|                                                   | Both       | 123   | (43.3)|
|                                                   | Others     | 25    | (8.8) |

NSSI = Needlestick and sharp injuries

According to the participants’ demographic characteristics, compliance with practices promoting prevention of bloodborne pathogens was higher in participants older than 30 ($F = -2.04, p = 0.042$), head nurses and those in higher positions ($F = 3.89, p = 0.021$), and participants without NSSI experience ($t = -2.29, p = 0.024$) (Table 2). A significant correlation was found between awareness of patient safety culture and compliance with bloodborne pathogen prevention ($r = 0.36, p < 0.010$). In terms of sub-categories, leadership had the highest correlation ($r = 0.85, p < 0.010$), followed by teamwork ($r = 0.82, p < 0.010$), patient safety policy/procedures ($r = 0.77, p < 0.010$), knowledge and attitude toward patient safety ($r = 0.76, p < 0.010$), system to improve patient safety ($r = 0.61, p < 0.010$), and non-punitive environment ($r = 0.17, p < 0.050$). Priority of patient safety, which was also a sub-category of patient safety culture awareness did not show a significant correlation ($r = 0.07, p = 0.223$) (Table 3).
**Table 2**
Compliance of bloodborne pathogen prevention according to subjects characteristic \((N=284)\)

| Variables                          | Categories      | Compliance of bloodborne pathogen prevention | M ± SD  | t/F  | p     |
|------------------------------------|-----------------|---------------------------------------------|---------|------|-------|
| Gender                             | Female          |                                             | 3.40 ± 0.40 | 0.49 | 0.631 |
|                                    | Male            |                                             | 3.27 ± 0.75 |      |       |
| Age group                          | < 30            |                                             | 3.41 ± 0.42 | -2.04| 0.042 |
|                                    | ≥ 30            |                                             | 3.53 ± 0.42 |      |       |
| Education level                    | Diploma         |                                             | 3.44 ± 0.45 | 0.75 | 0.474 |
|                                    | Bachelor's      |                                             | 3.38 ± 0.39 |      |       |
|                                    | > Master's      |                                             | 3.34 ± 0.52 |      |       |
| Position                           | Staff nurse     |                                             | 3.43 ± 0.43 | 3.89 | 0.021 |
|                                    | Charge nurse    |                                             | 3.47 ± 0.42 |      |       |
|                                    | < Head nurse    |                                             | 3.70 ± 0.34 |      |       |
| Work experience                    | ≤ 5             |                                             | 3.42 ± 0.42 | -1.21| 0.227 |
|                                    | > 5             |                                             | 3.49 ± 0.42 |      |       |
| Current unit employed              | ≤ 5             |                                             | 3.44 ± 0.42 | -0.48| 0.627 |
|                                    | > 5             |                                             | 3.47 ± 0.44 |      |       |
| Work unit                          | Medicine (non-  |                                             | 3.41 ± 0.37 | 0.60 | 0.729 |
|                                    | surgical)       |                                             |          |      |       |
|                                    | Surgery         |                                             | 3.34 ± 0.44 |      |       |
|                                    | Intensive Care  |                                             | 3.46 ± 0.40 |      |       |
|                                    | Unit            |                                             |          |      |       |
|                                    | Emergency       |                                             | 3.33 ± 0.40 |      |       |
|                                    | Operating room  |                                             | 3.42 ± 0.50 |      |       |
|                                    | Women           |                                             | 3.52 ± 0.29 |      |       |
|                                    | Others          |                                             | 3.39 ± 0.41 |      |       |
| Experienced NSSI for last 1 year   | Yes             |                                             | 3.33 ± 0.49 | -2.29| 0.024 |
|                                    | No              |                                             | 3.48 ± 0.39 |      |       |
| Type of devices causing NSSI       | Disposable      |                                             | 3.33 ± 0.50 | 0.14 | 0.868 |
|                                    | syringe         |                                             |          |      |       |
| Variables | Categories | Compliance of bloodborne pathogen prevention |
|-----------|------------|---------------------------------------------|
|           |            | M ± SD | t/F | p    |
|           | Blood glucose lancet | 3.31 ± 0.38 |     |      |
|           | Other sharp device | 3.25 ± 0.61 |     |      |
| Procedures causing NSSI | Inserting a needle | 3.43 ± 0.44 | 1.14 | 0.347 |
| Procedures causing NSSI | Disposing of a needle | 3.57 ± 0.66 |     |      |
| Procedures causing NSSI | Recapping a needle | 3.19 ± 0.67 |     |      |
| Procedures causing NSSI | Disassembling needle or sharp instrument | 3.20 ± 0.38 |     |      |
| Procedures causing NSSI | Others | 3.31 ± 0.41 |     |      |
| Blood and Body fluid exposure experience of Mucous membrane | Yes | 3.47 ± 0.51 | 1.05 | 0.293 |
| Blood and Body fluid exposure experience of Mucous membrane | No | 3.38 ± 0.40 |     |      |
| Blood and Body fluid exposure experience of skin (1 year) | Yes | 3.34 ± 0.40 | -0.77 | 0.445 |
| Blood and Body fluid exposure experience of skin (1 year) | No | 3.40 ± 0.41 |     |      |
| Report Infection Exposure | Yes | 3.29 ± 0.35 | -1.42 | 0.157 |
| Report Infection Exposure | No | 3.40 ± 0.42 |     |      |
| Vaccination of Hepatitis B | Yes | 3.40 ± 0.40 | 0.17 | 0.848 |
| Vaccination of Hepatitis B | No | 3.37 ± 0.42 |     |      |
| Vaccination of Hepatitis B | Do not know | 3.36 ± 0.53 |     |      |
| Number of patient safety case reports | 0 | 3.38 ± 0.42 | 1.16 | 0.314 |
| Number of patient safety case reports | 1~5 | 3.41 ± 0.40 |     |      |
| Number of patient safety case reports | 6≤ | 3.18 ± 0.43 |     |      |
| Education experience for | Yes | 3.40 ± 0.41 | 0.98 | 0.327 |
| Variables                          | Categories                  | Compliance of bloodborne pathogen prevention | M ± SD  | t/F  | p        |
|-----------------------------------|-----------------------------|---------------------------------------------|---------|------|----------|
| Bloodborne Pathogens Prevention   | No                          |                                             | 3.32 ± 0.43 |     |          |
| Educational palace for Bloodborne Pathogens Prevention | College education |                                             | 3.20 ± 0.44 | 1.74 | 0.160    |
|                                   | Hospital education          |                                             | 3.41 ± 0.42 |     |          |
|                                   | Both                        |                                             | 3.41 ± 0.39 |     |          |
|                                   | Others                      |                                             | 3.37 ± 0.25 |     |          |

Scheffé test
| Variables | Sub-category |
|-----------|-------------|
| Patient safety culture | Compliance of blood borne pathogens |
| Leadership | Teamwork |
| Knowledge | Policy/attitude |
| /procedures | Non-punitive responses |
| Improvementsystem | Prioritized |

| | Leader ship | Teamwork | Knowledge | Policy/attitude | Non-punitive responses | Improvementsystem | Prioritized |
|---|-------------|----------|-----------|----------------|----------------------|------------------|-------------|
| $r(p)$ | $r(p)$ | $r(p)$ | $r(p)$ | $r(p)$ | $r(p)$ | $r(p)$ | $r(p)$ |

| Patients safety culture | 1 |
|-------------------------|---|

| Leadership | 1 |
|------------|---|

| Leadership | 8 | 5 |
|------------|---|---|

| Leadership | 0 | 1 | 0 |
| Teamwork | 0.52 (< 1 | 0.010) |<| 8 |
| Knowledge | 0.37 (< 1 | 0.30 (< 1 | 0.10) |<| 7 |
| Policy/procedures | 0.58 (< 1 | 0.39 (< 1 | 0.36 (< 1 | 0.010) |<| 7 |
| Non-punitive Approach |       |       |       |       |       |       |
|----------------------|-------|-------|-------|-------|-------|-------|
|                      | 1     | .07(  | .10(  | -.01( | .13(< | 1     |
|                      | 17    | .066  | .812  | .050  |       |       |

| Safety System        |       |       |       |       |       |       |
|----------------------|-------|-------|-------|-------|-------|-------|
|                      | .6    | .41(< | .29(< | .26(< | .49(< | .11(  |
|                      | 61    | .010  | .010  | .010  | .001  | .062  |

| Prioritized          |       |       |       |       |       |       |
|----------------------|-------|-------|-------|-------|-------|-------|
|                      | 0     | .14(< | .07(  | .13(< | .14(< | .11(  |
|                      | 07    | .050  | .188  | .050  | .050  | .053  |

Page 14/22
A hierarchical multiple regression analysis was conducted to identify factors that influence compliance with bloodborne pathogen prevention. In the analysis, job position (demographic characteristic) and experience of NSSI (clinical characteristic) were used as the dummy variables, and patient safety culture and its sub-categories were used as independent variables. Model 1, which included job position, explained 1% ($F = 4.26, p = 0.040$) of compliance with practices promoting prevention of bloodborne pathogens, and the explanatory power increased by 2% in Model 2, which included NSSI experiences ($F = 4.79, p = 0.009$). In Model 3, the following sub-categories of patient safety culture awareness were found to have significant effects on compliance with bloodborne pathogen prevention: leadership ($β = 0.15$), teamwork ($β = 0.41$), knowledge and attitude toward patient safety ($β = 0.34$), and priority of patient safety ($β = 0.14$). The model had an explanatory power of 53% ($F = 32.26, p < 0.001$) (Table 4).
Table 4  
Factors influencing compliance of bloodborne pathogen prevention (N= 284)

| Variables                  | Model 1          | Model 2          | Model 3          |
|----------------------------|------------------|------------------|------------------|
|                            | \(\beta(p)\)     | \(\beta(p)\)     | \(\beta(p)\)     |
| **Demo graphi c**           |                  |                  |                  |
| Job positio n*              | - .12 (.040)     | - .10 (.092)     | - .67 (.119)     |
| **Clinica l-related**       |                  |                  |                  |
| Sharp injured               |                  | - .14 (.023)     | - .94 (.029)     |
| **Patien t safety culture** |                  |                  |                  |
| Leadership                 |                  | - .85 (.466)     |                  |
| Team work                  | .15 (.031)       | .41 (<.001)      |                  |
| Knowledge/attitude         | .34 (<.001)      |                  |                  |
| Policy/procedures          | .04 (.494)       |                  |                  |
| Non-punitiv e approac h     | .57 (.311)       |                  |                  |
| Safety syste m             |                  | - .00 (.956)     |                  |
| Prioritized                |                  | .14 (.005)       |                  |
| F(\(p\))                   | 4.26 (.040)      | 4.79 (.009)      | 32.26 (<.001)    |
| R\(^2\)                    | .02              | .03              | .54              |
| Adjusted R\(^2\)           | .01              | .03              | .53              |

*Dummy variables: Job position (Staff nurse & Charge nurse 1, Nursing unit manager 0), Sharp injury (yes 1, no 0)

Discussion
The present study analyzed the effects of patient safety culture on nurses’ compliance with bloodborne pathogen prevention. When the participants’ compliance with practices promoting prevention of bloodborne pathogens was analyzed according to their demographic and clinical characteristics, compliance was found to be higher among head nurses, those in higher positions, and participants who had not experienced NSSI in the preceding year. This finding was in contrast with previous studies that found no difference based on job position in compliance with practices promoting prevention of bloodborne pathogens. Further, the finding can be compared to previous research that reported compliance was higher among those who had not experienced NSSI than among those who had experienced NSSI [18, 19, 15]. At the hospital where this study was conducted, head nurses and nurses in higher positions are responsible for the overall management of the unit, including monitoring of infection control, instead of providing direct care to patients; this might explain the results indicating higher awareness of infection prevention practices among higher ranking nurses compared to staff nurses. Thus, in order to improve compliance with practices promoting prevention of bloodborne pathogens, education on NSSI should be improved, and continuous monitoring of prevention compliance should be implemented.

A significant correlation was seen between the participants’ awareness of patient safety culture and compliance with practices promoting prevention of bloodborne pathogens. In terms of patient safety culture, the subcategories of leadership, teamwork, patient safety policy, procedures, knowledge or attitude toward patient safety, patient safety improvement system, and priority of patient safety were significantly correlated, whereas non-punitive responses had no correlation with compliance with practices promoting prevention of bloodborne pathogens. Although direct comparisons are difficult to make due to a lack of similar previous studies, one study reported that awareness of patient safety culture in nursing hospital nurses had a significant relationship with compliance with standard precautions [20]. Thus, as shown in the present study, since patient safety culture can influence the prevention of bloodborne pathogens, including standard precautions, it is necessary to understand and pay attention to patient safety culture and relevant factors in order to prevent bloodborne infections [21].

According to a hierarchical regression analysis to analyze factors that influence compliance with bloodborne pathogen prevention, experience of NSSI and patient safety culture were found to be significant factors. Among the sub-categories of patient safety culture, the significant factors were found to be teamwork, knowledge and attitude toward patient safety, leadership, and priority of patient safety.

First, participants who had never experienced NSSI were found to be more compliant with bloodborne pathogen prevention than those who had experienced NSSI. This finding coincides with a previous study that reported higher compliance with practices promoting bloodborne infection control among those who had never experienced blood exposure [15]. Moreover, our finding also agrees with another previous study reporting higher compliance with standard precautions among those who had never experienced needle stick injuries [22]. This seems to be the case because nurses’ compliance with practices that protect them from infection would have prevented NSSI, and the finding further indicates the importance of preventing exposure to blood. Therefore, cases of bloodborne pathogen infections should be introduced in infection
prevention trainings to emphasize the seriousness of the situation, and efforts should be made to help nurses habitually perform practices promoting prevention of infections. Moreover, nurses' awareness should be improved to encourage prioritization of their own protection when providing care in situations where bloodborne infections are possible [18].

NSSI is a major cause of bloodborne infections, and considering that more than half of nurses who experience NSSI encounter repeated injuries [23, 24], it is important to prevent NSSI in the first place. Furthermore, in order to improve compliance with practices promoting prevention of bloodborne pathogens, continued safety training on safe use of syringes and NSSI is necessary. In particular, in the present study, NSSI was seen to occur most often in the process of disassembling needles or sharp instruments, mostly while disposing and washing used instruments and while recapping used needles.

Therefore, these specific cases should be included in periodic infection education for nurses, and further training should be provided on precautions while using sharp instruments. In addition, appropriate administration or legislation should be implemented to prevent recapping of used needles and to promote the wider use of safe injection devices [15, 25]. Furthermore, we found that more nurses received infection education at hospitals than during their regular nursing curriculum at school. Infection education programs should instead be a part of nursing curricula. It is also crucial to provide access to continuing education in clinical settings [26, 27].

Second, within patient safety culture awareness, the sub-categories of knowledge and attitude toward patient safety, leadership, and priority of patient safety were found to have positive effects on bloodborne pathogen prevention. This result is comparable to previous research findings which suggest that compliance with standard precautions is higher among those with higher awareness of patient safety culture [10], and that awareness and compliance with practices promoting infection control are higher among those with higher awareness of patient safety culture [17]. These findings indicate that it is important to cultivate positive patient safety culture through leadership, and that patient safety culture is an important factor in the prevention of bloodborne pathogens. In terms of leadership in patient safety culture, which was found to be a significant factor in the present study, it was found that leadership WalkRound programs that aim to change patient safety culture awareness inside and outside of South Korea have led to improved awareness and are a meaningful way to improve patient safety cultures [28, 29].

The present study is significant in that it confirmed how patient safety culture influenced compliance with practices promoting prevention of bloodborne pathogens as a variable. In other words, the findings of the present study should be considered in developing programs for HAI prevention and training on infections. Second, this study used tools of Korean patient safety culture which were developed through the consideration of Korean culture. A notable difference from the globally used Hospital Survey on Patient Safety Culture (HSOPSC) and Safety Attitudes Questionnaire (SAQ) [30, 31, 32] is the exclusion of questions from patient safety culture tools on the openness of communication, staff distribution, and handover. Instead, the Korean tools used in the present study added questions on policy or procedures,
knowledge and attitude toward safety, and priority of patient safety [16]. The tools have different questions probably because the medical systems are different and the awareness of patient safety culture in Korea differs from that in other countries.

Since the data were collected through convenience sampling at a general hospital in one city, it is difficult to generalize the findings due to regional bias. Moreover, the number of reports on patient safety accidents over the past year exceeded that of NSSI, because the hospital's reporting system includes NSSI as well as pressure ulcers, falls, and near misses.

**Conclusion**

The present study analyzed the effects of hospital nurses' awareness of patient safety culture on compliance with bloodborne pathogen prevention and found that NSSI experience, leadership, and priority of patient safety had significant effects. Therefore, to increase the compliance of hospital nurses with practices promoting the prevention of bloodborne pathogens, it is necessary to carefully prevent NSSI and to implement various programs that emphasize factors of patient safety culture, such as leadership, teamwork, and priority of patient safety.

**List Of Abbreviations**

Institute of Medicine (IOM)

Healthcare-associated infections (HAI)

Human immunodeficiency virus (HIV)

Needlestick and sharp injury (NSSI)

Hospital Survey on Patient Safety Culture (HSOPSC)

Safety Attitudes Questionnaire (SAQ)

**Declarations**

**Ethics approval and consent to participate**

The present study was approved by the Institutional Review Board (IRB, 40525-201901-HR-126-02) at K University in D Metropolitan City. The participants provided written consent after the study purpose was explained to them. The consent form outlined that participation is voluntary, participants’ anonymity will be protected, participants may withdraw their participation whenever they desire with no repercussions, and the collected data will be used solely for research purposes.
Consent for publication
Not applicable.

Availability of data and materials
Not applicable

Competing interests
The authors declare that they have no competing interests.

Funding
The Ministry of Education, South Korea

Authors' contributions
Conceptualization or/and Methodology : KJM, NYK,

Acknowledgements
“This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) founded by the Ministry of Education(2019R1I1A3A01060561)”

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