네덜 서개발지역 간호사들의 의료관련감염에 대한 지식, 태도, 이행
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Knowledge, Attitude, and Compliance of Healthcare-associated Infection Control among Nurses in the Western Development Region, Nepal
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Background: Healthcare-associated infection (HAI) affects the morbidity and mortality of inpatients worldwide. Nepal is a developing country in which HAIs pose a major problem in terms of patient safety. Therefore, this study was designed to assess the level of knowledge and attitude toward HAIs and compliance for infection control among nurses.

Methods: A cross-sectional survey was conducted using a self-administered questionnaire including general characteristics, and knowledge of, attitude toward, and compliance with HAI control practices, on a sample of 259 nurses from 11 hospitals in 3 cities in Nepal, from July 17 to August 5, 2014.

Results: The average score on knowledge of HAI was 6.56, on a 13-point scale. In total, 59 nurses had undergone HAI control training and 211 nurses reported that they were governed by some guidelines, but there were no significant differences. The overall level of compliance with HAI control guidelines was 79.2 points based on a 100-point scale, which did not differ in terms of age, exposure to infection control training, and the presence of any guidelines.

Conclusion: The level of knowledge of HAI control among nurses was very low and a majority had never undergone any HAI control training. Evidently, there is an urgent need to provide HAI control training to nurses, and to develop infrastructure to provide training for them.

Keywords: Attitude, Compliance, Healthcare-associated infection, Knowledge, Nepalese nurses

Introduction
A healthcare-associated infection (HAI) or nosocomial infection (NI) refers to a case in which a symptom of infection appears in patients within a healthcare setting, not at the time of hospitalization, but during or after their hospitalization. Such infections not only increase the duration of hospital stay but also cause deterioration in the patients’ condition [1-3]. In the United States, HAI decreased gradually from 4.5% of all inpatients in 2002 to 4% in 2011, while in four European countries, it was reported to occur in 7.6% of inpatients [4]. The resultant annual economic burden was approximately US $ 6.5 billion in the U.S. and about €7 billion in Europe [3]. HAIs occur in 15.5% to 27% of inpatients in underdeveloped countries, which is more
severe than the rate observed in developed countries [3-6]; however, the degree of actual economic loss and mortality as a result of HAIs has not been accurately reported [7,8]. The World Health Organization carried out the “Clean Care is Safer Care” program in 2005 to prevent HAI in underdeveloped countries, making it the first priority in healthcare [1,2].

In Nepal, an underdeveloped country, there have been no governmental efforts to control HAI. Studies are being conducted on HAI, but they are still insufficient, and most of these have been conducted in the capital city Kathmandu or in other large cities [9-12]. One survey revealed that out of 17 hospitals in Kathmandu, Nepal, nine hospitals were using guidelines for HAI control, but these guidelines were more than five years old or included inappropriate content. Seven hospitals had never provided education on infection control (IC), 7 hospitals provided such education for a small number of personnel, 2 hospitals had provided the same to their entire staff, and 1 hospital did not mention details about such education [11]. To guarantee high quality healthcare and patient safety, HAI control is very important [11], but even hospitals in the large cities in Nepal have not been found to follow any guidelines for HAI control or to conduct related educational programs.

One of the most effective methods of preventing HAI is to adhere to guidelines on isolation precautions [13]. However, in general, nurses lack accurate information on the isolation precautions. Thus, often due to insufficient knowledge or time, or negligence, nurses do not practice the isolation precautions. Moreover, most nurses do not receive any systematic education about the isolation precautions [7,10,11]. Thus, in order to increase the practice of HAI control, education on IC [7,14-16], including isolation precautions are very important [10,14].

The Western Development Region of Nepal has low accessibility to healthcare services due to low economic status, insufficient healthcare institutions, and its geographical condition: being surrounded by the highest mountains in the world [10,11,17]. In addition, the poor hygiene conditions of hospitals make things worse [11]. In such an environment with a high necessity of HAI control, there is almost no training or study on HAI control for nurses. Therefore, to improve the awareness of HAI control and the practice of education for nurses, important resources such as personnel for HAI control education are needed in western Nepal. The present study was conducted to assess the level of knowledge and attitude toward HAI control, including isolation precautions, and compliance with HAI control among nurses, and to develop an educational program for Nepalese nurses.

Materials and Methods

1. Study design

A cross-sectional survey was conducted to identify the level of knowledge of and attitude towards HAI control, including isolation precautions, and compliance with HAI control among nurses from 11 hospitals in 3 cities, Tansen, Ranigaon, and Butwal, in the Western Development Region of Nepal.

2. Setting and participants

The participants in this study were nurses working in hospitals in Western Development Region, Nepal, who agreed to participate in the investigation after understanding its purpose and intention. In total, 13 hospitals in 3 cities were approached, but 2 hospitals were excluded because 1 hospital did not agree to participate in the study while another did not have registered nurses except the superintendent. Thus, all the 381 registered nurses (RN) who worked in the 11 selected hospitals were the target of this study. A total of 310 copies of the questionnaire were distributed to RNs who agreed to participate in the study and 305 were collected. Out of these, 46 questionnaires, 3 of which had not been com-
pleted, more than 50% of questionnaires, 3 answered by assistant nurses (Auxiliary Nurse Midwife; ANM), 38 by head nurses, 1 by a supervisor, and 1 by a superintendent were excluded. Therefore, only 259 were included in the final analysis.

3. Instruments

The study instrument was a self-reported questionnaire (47 questions) that included items on the participants’ general information (14 questions), knowledge of IC (13 questions, hereafter referred to as “knowledge”), attitudes toward HAI control (5 questions, hereafter referred to as “attitude”), and compliance with HAI control (15 questions). The questionnaire for this study was used in previous studies [9,14], and was reviewed for content validity by 2 Korean HAI control practitioners working in IC units.

General information included age, gender, years of professional experience, working department, and exposure to training sessions.

Knowledge of HAI control was measured with items designed by Sax et al. [14], and three Nepalese nursing professors approved the English level in the questionnaire for use with Nepalese nurses in the present study. It has 13 multiple-choice questions that are scored 1 point for a correct answer and 0 for an incorrect answer. The total knowledge scores ranged from 0 to 13.

Attitude toward HAI control included items on the preferred single prevention measure, self-assessment of knowledge on standard precautions, preferred source of information on HAI control, peer action against healthcare workers’ noncompliance with HAI control, and obstacles to compliance with guidelines. Four out of the 5 questions on attitude involved choosing the best answer out of 4 or 5 possible answers, and the last question on obstacles was measured on a 3-point scale (not important, important, very important). The score on attitude towards HAI control was not the sum of the item scores but was analyzed with frequency and percentage.

The questionnaire for compliance with HAI control was developed by Paudyal et al [9]. Compliance with HAI control was measured by a set of 15 questions which were categorized as always (1 point) or sometimes or never (0 points). Therefore, compliance scores ranged from 0 to 15.

4. Ethical considerations

The study was conducted after receiving approval from the Pusan National University Institutional Review Board (PNU IRB: 2014_48_HR4). After providing information about the purpose of study, and guaranteeing anonymity and credibility for voluntary participants, written informed consent was obtained from all participants who agreed to participate in the study, and a gift about 50-cents was given to those who participated in the study.

5. Data collection

Data were collected in the 11 selected hospitals between July and August 2014. Before visiting the 11 hospitals, we contacted the matron and asked for permission after explaining the purpose of the study. We also conducted a short interview with the matrons to ascertain the presence or absence of an IC team and guidelines before distributing the questionnaire. In total, 4 researchers collected the data. Two research assistants and 2 researchers were trained on the main aspects to be assessed and the scoring system. Every hospital was visited by 2 or 4 researchers for 1 or 2 days with permission of the hospital directors and matrons. Data were collected after all questionnaires were filled, except for 3 hospitals, where data were collected the next day.

6. Statistical analysis

Statistical analysis was performed using the SPSS software version 21.0 (IBM, Armonk, NY, USA). Descriptive statistics, including frequencies, percentages, means, and standard deviations were used to identify the general characteristics of the partic-
participants, and their knowledge, attitude, and compliance levels. The correlation between knowledge and compliance was analyzed with the Pearson’s correlation coefficient. The difference in the mean of the compliance with IC by general characteristics was analyzed with the t-test.

**Results**

All participants were female and their mean age was 22.8 (±3.78) years. Their average number of years of job experience was 2 years, and only 19 nurses (7.3%) had more than 5 years’ experience. Further, 59 nurses (22.8%) had undergone HAI control training and 211 (81.5%) nurses answered that they were governed by some guidelines, which were mainly limited to the hand washing posters developed by WHO. None of 11 hospitals had any guidelines except for the hand washing posters.

Table 1 illustrates the differences in knowledge according to the general characteristics of the participants. The mean knowledge score was 6.56±1.76 (50.5%). There were no significant differences in knowledge by age group (t=0.85, P=0.395), those who had undergone HAI control training (t=−1.94, P=0.053), and being governed by guidelines (t=0.53, P=0.595).

Table 2 shows the findings related to knowledge of HAI control. The proportion of participants who answered the question “the indication for mask use in a regular care situation” correctly was the highest (83.8%), followed by that for the question “the bi-

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**Table 1.** Differences in knowledge according to the general characteristics of participants (N=259)

| Characteristics                | Category | No. of correct answer (maximum score=13) | 100 based score of the mean | t      | P     |
|--------------------------------|----------|-----------------------------------------|-----------------------------|--------|-------|
| Total knowledge score          |          | 6.56±1.76                               | 50.5                        | 0.85   | 0.395 |
| Age (years)                    | < 25     | 6.60±1.73                               | 50.8                        |        |       |
|                                | ≥ 25     | 6.36±1.90                               | 48.9                        |        |       |
| Ever undergone infection control training | Yes     | 6.16±1.89                               | 47.4                        | −1.94  | 0.053 |
|                                | No       | 6.67±1.70                               | 51.3                        |        |       |
| Had any guidelines             | Yes      | 6.59±1.75                               | 50.7                        | 0.53   | 0.595 |
|                                | No       | 6.43±1.83                               | 49.5                        |        |       |

**Table 2.** Knowledge about healthcare-associated infection control (N=259)

| Contents                                                                 | Correct answer (%) |
|--------------------------------------------------------------------------|--------------------|
| 1. The most important vehicle in pathogen transmission                   | 67.2               |
| 2. The main purpose of glove use                                          | 52.9               |
| 3. The main benefit of hand hygiene                                      | 65.3               |
| 4. The adequate preventive measures in a complex care situation          | 52.5               |
| 5. The adequate preventive measures in a regular care situation          | 48.3               |
| 6. The indication for mask use in a regular care situation               | 83.8               |
| 7. The anticipated timing of isolation precaution                         | 41.3               |
| 8. The adequate procedures in contact precaution                          | 15.8               |
| 9. The basic concept of standard precautions                              | 27.4               |
| 10. The risk-guided application of a preventive strategy                 | 66.0               |
| 11. The ubiquitous risk of coming in contact with body fluids            | 38.2               |
| 12. The bidirectional risk of pathogen transmission                     | 71.8               |
| 13. Being aware of environment-associated risks for immunosuppressed patients | 25.5               |
| Total                                                                    | 50.5               |
directional risk of pathogen transmission” (71.8%). In contrast, the proportion of participants who answered the question “adequate procedures in contact isolation” correctly was the lowest (15.8%), followed by that for the question “being aware of environment-associated risks for immunosuppressed patients” (25.5%).

Table 3 demonstrates the findings related to attitudes towards HAI control. “Hand hygiene” was the most preferred prevention measure (79.5%). Further, 69.9% of the respondents reported “know well” regarding the knowledge on the concept of standard precautions. About one third of the respondents (33.2%) indicated that the preferred source of information for handling an unknown communicable disease was “local guidelines.” Further, 59.5% of the participants considered “lack of knowledge” as a very important obstacle to adhering to guidelines, followed by lack of time (48.3%), lack of means (37.1%), and forgetting (27.4%).

Table 4 shows the findings related to compliance for HAI control. The highest compliance was reported for the item “putting used needles and other sharp objects into the designated sharp containers” (98.4%), followed by “putting all the contaminated items in a disposal bag” (96.9%). The lowest compliance was for “never recapping needles” (35.5%) and more than half of the respondents reported that they always wore “waterproof apron whenever there is a possibility of exposure to blood or other body fluid splashing” (51.0%). Table 5 illustrates the nurses’ compliance level for HAI control according to the general characteristics of participants. Overall compliance regarding the 15 items for HAI control was 11.88 out of the possible 15 points (79.2 based on the 100-point scoring). There was no significant difference by age, having ever undergone infection training, and presence of any guidelines.

The correlation between knowledge and compliance was nonsignificant (r=0.075, P=0.226).

**Table 3.** Attitude towards healthcare-associated infection control (N=259)

| Contents | A | B | C | D | E |
|----------|---|---|---|---|---|
| 1. Preferred means of prevention | "Mask" | "Gloves" | "Hand hygiene" | "Apron" | NA |
| 17 (6.6) | 36 (13.9) | 206 (79.5) | | |
| 2. Self-assessment of knowledge on isolation precaution | "No idea" | "Heard about" | "Know vaguely" | "Know well" | NA |
| 2 (0.8) | 68 (26.2) | 8 (3.1) | 181 (69.9) | |
| 3. Peer action | "Inform the peer immediately" | "Say nothing" | "Inform the peer later" | "Inform a superior" | NA |
| 184 (71.0) | 2 (0.8) | 54 (20.9) | 19 (7.3) | |
| 4. Information source | "Infection control team" | "Hospital information" | "Colleague" | "Book" | "Local guidelines" |
| 15 (5.8) | 76 (29.4) | 63 (24.3) | 19 (7.3) | 86 (33.2) |

Most common reasons for noncompliance with guidelines

| 5a. Obstacle to compliance: lack of knowledge | "Not important" | "Important" | "Very important" | NA | NA |
| 23 (8.9) | 82 (31.6) | 154 (59.5) | | |
| 5b. Obstacle to compliance: forgetting | "Not important" | "Important" | "Very important" | NA | NA |
| 77 (29.7) | 111 (42.9) | 71 (27.4) | | |
| 5c. Obstacle to compliance: lack of means | "Not important" | "Important" | "Very important" | NA | NA |
| 43 (16.6) | 120 (46.3) | 96 (37.1) | | |
| 5d. Obstacle to compliance: lack of time | "Not important" | "Important" | "Very important" | NA | NA |
| 27 (10.4) | 107 (41.3) | 125 (48.3) | | |

**Discussion**

The findings of this study indicated that the nurses in the Western Development Region of Nepal had a lower level of knowledge than did
Table 4. Compliance with Healthcare-associated Infection Control (N=259)

| Contents                                                                 | Always n (%) | Sometimes n (%) | Never n (%) |
|-------------------------------------------------------------------------|--------------|-----------------|-------------|
| 1. Washing hands before and after examining a patient                   | 243 (93.8)   | 16 (6.2)        |             |
| 2. Drying hands after washing them                                      | 214 (82.6)   | 42 (16.2)       | 3 (1.2)     |
| 3. Wearing gloves whenever there is a possibility of exposure to blood or other body fluids | 234 (90.3)   | 25 (9.7)        |             |
| 4. Washing hands after removing disposable gloves                        | 246 (95.0)   | 13 (5.0)        |             |
| 5. Wearing a waterproof apron whenever there is a possibility of exposure to blood or other body fluid splashing | 132 (51.0)   | 88 (34.0)       | 39 (15.0)   |
| 6. Wearing a face mask whenever there is a possibility of exposure to blood or other body fluid splashing | 170 (65.6)   | 80 (30.9)       | 9 (3.5)     |
| 7. Wearing a clean washed uniform everyday                               | 234 (90.3)   | 24 (9.3)        | 1 (0.4)     |
| 8. Putting all the contaminated items in a disposal bag                   | 251 (96.9)   | 8 (3.1)         |             |
| 9. Immediately wiping up all spills of blood or any other body fluids    | 250 (96.5)   | 9 (3.5)         |             |
| 10. Covering broken skin before coming to work                           | 198 (76.4)   | 58 (22.4)       | 3 (1.2)     |
| 11. Changing usual care methods if the patient has an infectious disease | 154 (59.5)   | 59 (22.8)       | 46 (17.8)   |
| 12. Consuming food and beverages in patient/resident care areas*        | 167 (64.5)   | 40 (15.4)       | 52 (20.1)   |
| 13. Protecting oneself against the blood and body fluids of all patients, regardless of their diagnosis | 237 (91.5)   | 22 (8.5)        |             |
| 14. Putting used needles and other sharp objects into the designated sharp containers | 255 (98.4)   | 3 (1.2)         | 1 (0.4)     |
| 15. Recapping used needles*                                              | 92 (35.5)    | 20 (7.7)        | 147 (56.8)  |

*Reverse coding.

Table 5. Compliance for infection control according to the general characteristics of participants (N=259)

| Characteristics          | Category | Compliance (maximum score=15) mean±SD | 100 based score of mean | t    | P     |
|--------------------------|----------|---------------------------------------|------------------------|------|-------|
| Total compliance         |          | 11.88±1.87                           | 79.2                   |      |       |
| Age (years)              | <25      | 11.52±1.81                           | 76.8                   | 1.412| 0.799 |
|                          | ≥25      | 11.21±1.85                           | 74.7                   |      |       |
| Ever undergone infection control training | Yes | 11.49±1.66                           | 76.6                   | −0.106| 0.169 |
|                          | No       | 11.52±1.85                           | 76.8                   |      |       |
| Had any guidelines       | Yes      | 11.61±1.73                           | 77.4                   | 1.847| 0.067 |
|                          | No       | 11.08±2.08                           | 73.9                   |      |       |

nurses in the capital city of Nepal, Kathmandu (80.7%), as reported in Paudyal et al.’s study [9]. This score was also lower than that of nurses in Korea, whose mean score for knowledge of HAI control was 8.6 (66.3%) out of 13 [18], and lower than nurses in Ethiopia and Nigeria [16,19].

The proportion of correct answers was the higher for the question “the indication for mask use in a regular care situation” (83.8%) in this study, which was much higher than that reported in Sax et al.’s study (53.2%) [14]. However, the lowest proportion of correct answers was to the question “the adequate procedures in contact precaution” (15.8%), which was much lower as compared to that reported in Sax et al.’s study (63.1%) [14]. In this regard, more than half of the respondents (66.4%) reported that mask, gloves, and antisepsis should be applied for contact precaution. However, most of the participants (83.8%) were not aware of contact precaution, which may be attributed to a lack of proper education and training about transmission-based precaution. In Sax et al.’s study, the highest
The majority of the study participants (81.5%) reported that they were governed by some guidelines but it was mainly related to the chart for handwashing with soap. Only 22.8% of the nurses had been trained in IC, which was slightly lower than the 27% reported in Paudyal et al.’s study [9]. Considering the lower level of knowledge and exposure to HAI control training, it is evident that education on HAI control, including isolation precaution, is an urgent need for nurses in the Western Development Region of Nepal.

In the present study, nurses preferred “hand hygiene” (79.5%) as a prevention measure for HAI control; however, this was substantially lower than that reported in Sax et al.’s study (97.6%) [14], which used the same measurement instrument. Most respondents showed a positive attitude toward HAI control in terms of self-assessment of knowledge on standard precautions and peer action to healthcare workers’ noncompliance with HAI control. In the present study, lack of knowledge was reported as the most important obstacle to compliance with guidelines, followed by lack of time, lack of means, and forgetting. In the study by Sax et al. [14], this order was lack of knowledge, lack of time, forgetting, and lack of means. Evidently, lack of knowledge and time are common obstacles to compliance with guidelines for nurses in developing and developed countries. However, lack of means is one of the important obstacles for nurses in developing countries. Therefore, in addition to systematic education on HAI control, including isolation precautions, Nepalese nurses and Nepalese health authorities should try to optimize the IC practices within the limited resources.

The mean score on compliance with HAI control was 79.2 points on the 100-point scoring scale. This finding of high compliance in a context of low knowledge regarding HAI control was somewhat unexpected. The score is also high when compared to that reported in Paudyal et al.’s study (70%) [9], which used the same tool in hospitals in Kathmandu, and another previous study [16]. The highest compliance score was for the item “putting used needles and other sharp objects into the designated sharp containers” (98.4%). On the other hand, the score for “recapping of used needles” was reported by 56.8% of the participants, which was lower than that reported in Paudyal et al.’s study (69%) [9]. Recapping of used needles causes needle stick injuries and occupational transmission of blood-borne pathogens [20]. Therefore, effective education for the safe handling of needles is necessary for reducing the frequency of recapping.

In the present study, the compliance score was not related with age, having ever undergone IC training, being governed by any guideline, and knowledge of HAI control. This finding was similar to that reported in a previous study on healthcare workers in Nepal. In that study, the compliance with use of masks showed no relationship with age, profession, and HAI control training [9]. Interestingly, though the present participants perceived lack of knowledge as the most important obstacle to compliance with guidelines, the knowledge score did not correlate with the score on compliance with HAI control. In the present study, knowledge was measured with objective questions, but compliance was assessed subjectively. Therefore, the latter may have been overestimated due to a social desirability bias, which failed to show a relationship with knowledge. Further observational studies are needed to accurately determine actual behaviors related to HAI control.

In conclusion, the level of knowledge on HAI control among nurses was very low and a majority
had never undergone any IC training. Therefore, there is an urgent need to provide HAI control training, including isolation precautions, to the nurses in Nepal. Additionally, enhanced infrastructure, such as an HAI control team, is needed for appropriate HAI control. However, this study was conducted only on nurses from 3 towns in western healthcare facilities, which may limit the generalizability of the present findings to other professions and areas. Further studies covering various areas and healthcare workers are needed to improve the generalizability of the findings. Additionally, we could not measure the reliability of the instruments, and recommend assessment of the test-retest reliability of each instrument used in the present study.

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