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Knowledge, perception, performance, and attitude regarding hand hygiene and related factors among infection control nurses in South Korea: A cross-sectional study

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Background: We assessed the current status of knowledge, perception, attitude, and role model regarding hand hygiene (HH) among infection control nurses (ICNs) and identified the factors influencing these variables.

Methods: A structured questionnaire was adapted from a World Health Organization survey. Data were collected from November 8, 2017, to February 2, 2018.

Results: ICNs showed the following scores (mean ± SD): knowledge (19.5 ± 2.3), perception (69.9 ± 8.9), attitude (46.9 ± 5.8), and role model (39.2 ± 6.0). HH performance of health care workers (HCWs) was 75.2 ± 15.5. Mean HH performance scores of HCWs (P = .007) differed significantly according to infection control experience (3 groups: ≤ 12 months, 13-24 months, > 24 months). Perception, attitude, and role model scores showed positive correlations with each other (P < .01). The regression model for HH performance of HCWs was calculated as follows: Y1 = 31.638 + 0.067X1 (perception of ICNs) + 0.133X2 (attitude of ICNs) + 0.825X3 (role model of ICNs) (P < .001; adjusted R2 = 0.115).

Discussion: Perception, attitude, and role model scores of ICNs were significant predictors of HH performance of HCWs.

Conclusions: Specialized well-structured HH education programs should be developed for ICNs that will help improve HH performance of HCWs.

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Key Words: Health care−associated infection Hand disinfection Healthcare workers Infection control practitioner Nursing
knowledge and perception of ICNs regarding HH can also affect
the HH performance of other HCWs because ICNs are responsible
for HH performance improvement activities such as HH education,
campaigns, monitoring, and feedback.1,3,4,7 Therefore, ICNs
should first acquire knowledge and receive professional education
and training in HH.

This study aimed to assess the current status of knowledge,
perception, attitude, and performance regarding HH among ICNs to
identify the factors influencing these variables and provide basic data
for developing professional HH education and training programs for
newly assigned ICNs.

METHODS

Study design

A cross-sectional design based on a previous study13 was used,
involving the completion of a self-reported questionnaire, which
took approximately 20 minutes.

Participants

We performed a power analysis (G’power, version 3.1.9.2; Franz
Faul, Universität Kiel, Germany) to determine that a sample size of
305 would be required to achieve a power of 0.95 and an effect size
of 0.12 with a level of significance of 0.05 for a 1-way analysis of vari-
ance. A convenience sample of ICNs was recruited nationally. The par-
ticipants were aware of the study purposes and voluntarily agreed to
take part, so their participation was voluntary and anonymous. Ques-
tionnaires were e-mailed 5 times to all members of the Korean Asso-
ciation of Infection Control Nurses and delivered in person to
attendees of the Korean ICN’s annual conference who agreed to par-
ticipate in this study. Inclusion criteria included being an active ICN
registered with the Korean Association of Infection Control Nurses
and voluntarily consenting to participate in this study. Data were col-
clected via e-mail and offline questionnaires from November 8, 2017,
to February 2, 2018. Questionnaires were e-mailed to 399 ICNs, and
143 were returned (response rate = 35.8%); 300 offline questionnaires
were distributed, and 250 were returned (response rate = 83.3%).
After excluding incomplete questionnaires, a total of 388 were used
for analyses.

Measures

The questionnaire included participants’ demographics, hospital
characteristics, and infection control activities, and the other 3
domains: (A) HH knowledge, (B) HH perception and performance,
and (C) HH attitude and role model. The format of this questionnaire
was developed in a previous study13 and modified for this study.

Demographics included participant age, sex, education level, clini-
cal work experience, ICN experience, hospital characteristics, and
infection control activities included experience of HH education within
the previous year, HH campaign, and HH monitoring and feedback.

The knowledge domain was adapted from the 2009 revision of the
World Health Organization (WHO) Hand Hygiene Knowledge Ques-
tionnaires for Health-Care Workers.14 The 25 items include multiple
choice, true and false, and yes and no questions (right answer = 1,
wrong answer = 0), with a total score range of 0-25 points.

The perception domain was also adapted from the WHO Percep-
tion Survey for Health-Care Workers to identify perception and per-
formance of HH.15 To maximize internal consistency, 3 questions
(B2, B3, and B4 in the supplementary tables) were excluded from the
total score because they lowered the scale’s reliability (the Cronbach
alpha was 0.863 with all questions and 0.872 after exclusion). Twelve
of the 16 items are rated on a 7-point scale (not effective = 1, very
effective = 7; or very low = 1, very high = 7), for a total score range of
12-84 points. Questions B5 and B11 were analyzed separately as self-
reported HH performance of self and of others (other HCWs), respect-
ively (0%-100%).

The attitudes and role models domain was adapted from a self-
report questionnaire in a previous study13,16 consisting of 8 items
rated on a 7-point scale (not effective = 1, very effective = 7) and
total scores ranging from 8-56. To maximize internal consistency, 1
question (“I think that the physician is performing HH according
to the hospital’s regulations”) was excluded from the HH role mod-
els because it lowered the reliability (the Cronbach alpha was
0.796 with all questions and 0.810 after exclusion). Thus, HH atti-
itudes and role models were finally assessed with 7 items on a 7-point
scale, with a total score range from 7-49. A higher score in each domain
indicated better knowledge, perception, performance, attitudes, and
role models.

Data analysis

Data were analyzed using SPSS Statistics for Windows, Version
24.0 (IBM, Armonk, NY), and alpha < 0.05 was considered as statisti-
cally significant. The Cronbach alpha was calculated to determine
reliability. Descriptive statistics were calculated for participant demog-
raphics, hospital characteristics, and infection control activ-
ities. Descriptive data of knowledge, perception, self-reported HH
performance, attitudes, and role models were presented as mean ±
SD, minimum, maximum, and median. The percentage of correct
answers for each question in the knowledge domain was catego-
rized as high (≥90%), medium (70%-89%), and low (< 69%).13 Data
were found not to be normally distributed based on the Kolmo-
gorov-Smirnov test (P < .001). Nonparametric univariate statistics
were determined using Mann-Whitney U and Kruskal-Wallis tests.
A Pearson correlation analysis was conducted to identify associa-
tions between continuous variables. Multivariate analysis involved
multiple linear regression with forward selection using variables
that were confirmed as statistically significant in the univariate
and correlation analyses.

Ethics

The study was approved by the Sunchon National University
institutional review board (104173-201709-HR-024-02). Prior to par-
ticipation, written informed consent was obtained from each partici-
 pant; participants were also informed that they could withdraw their
participation at any time during the study.

RESULTS

Reliability

Cronbach alpha values were 0.872 (perception), 0.759 (attitudes),
and 0.810 (role models) in this study.

Descriptive statistics

Characteristics of participants, hospitals, and infection control activities

Participants were enrolled nationally. General characteristics of
participants were as follows: clinical experience (mean ± SD) was
177.3 ± 97.4 months, 54.9% of participants had < 24 months of infec-
tion control experience, 82.5% were full-time ICNs, and 86.6% worked
in the ICD. Among the study hospitals, 50.8% were general hospitals,
Knowledge

Participants’ mean score (mean ± SD) of HH knowledge was 19.5 ± 2.3 (range, 12–24), and 76.0% of the questions showed a high or medium level of correct answers (Table 2). The following questions showed a low proportion of correct answers (Supplementary Table 1): A3: “What is the most frequent source of germs responsible for health care–associated infections?” (37.6%); A4-2: “Hand rubbing causes skin dryness more than hand washing” (54.4%); beginning of A7, A7-2: “Immediately after risk of body fluid exposure” (34.0%); A7-3: “After exposure to the immediate surroundings of a patient” (35.8%); beginning of A8, A8-3: “After exposure to the immediate surroundings of a patient” (50.3%).

HH perception and performance

Participants’ mean perception score (mean ± SD) was 69.9 ± 8.9. Some questions showed low mean scores as follows (Supplementary Table 2): B6-3: “Hand hygiene posters are displayed at points of care as reminders” (5.6 ± 1.4); B8: “What importance do your colleagues attach to the fact that you perform optimal hand hygiene?” (5.7 ± 1.1); B9: “What importance do patients attach to the fact that you perform optimal hand hygiene?” (5.4 ± 1.4); B10: “How do you consider the effort required by you to perform good hand hygiene when caring for patients?” (5.2 ± 1.2). HH performance of HCWs was 75.2 ± 15.5, and self-reported HH performance was 78.3 ± 24.2.

Attitude and role model

Participants’ mean scores of attitude and role model were 46.9 ± 5.8 and 39.2 ± 6.0, respectively. Some questions showed low mean scores of attitude as follows (Supplementary Material 2): C6: “Hand hygiene is not annoying” (5.0 ± 1.7), C7: “Hand hygiene is convenient” (4.9 ± 1.5), and C8: “Hand hygiene is protective” (4.2 ± 1.7). Some questions showed low mean scores of role models as follows (Supplementary Material 2): CR1: “I think that the charge nurse is performing hand hygiene according to the hospital’s regulations” (5.1 ± 1.2); CR3: “I think that the head nurse is performing hand hygiene according to the hospital’s regulations” (5.2 ± 1.2); and CR7: “I think that the colleague nurse is performing hand hygiene according to the hospital’s regulations” (4.9 ± 1.2).

Univariate analysis

Mean perception scores differed significantly according to marital status, job title, HH sinks, and HH surveillance. Mean attitude scores differed significantly according to job title, existence of an ICD, and department. Mean role model scores differed significantly according to job title, HH sinks, and infection control experience (3 groups: ≤ 12 months, 13-24 months, > 24 months). Mean score of HH performance of other HCWs differed significantly according to infection control experience (3 groups: ≤ 12 months, 13-24 months, > 24 months) (Table 3).

Correlation analysis

Knowledge scores did not show significant correlations with perception, attitude, role model, and other variables. However, perception, attitude, and role model scores showed positive correlations

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### Table 1

| General characteristics of participants and hospitals (N = 388) |
|---------------------------------------------------------------|
| Variables | N(%) |
| Age, mean ± SD, y | 38.6 ± 8.3 |
| Clinical experience, mean ± SD, mo | 177.3 ± 97.4 |
| Infection control experience, mean ± SD, mo | 40.8 ± 44.6 |
| ≤ 12 mo | 99 (25.5) |
| 13-24 mo | 114 (29.4) |
| > 24 mo | 166 (42.8) |
| Education level |  |
| 3-y degree | 48 (12.4) |
| Bachelor degree | 200 (51.5) |
| Master’s or doctoral degree | 131 (33.8) |
| Job titles |  |
| Full time | 320 (82.5) |
| Part time | 48 (12.4) |
| Others | 17 (4.4) |
| Positions |  |
| Staff nurse | 178 (45.9) |
| Charge nurse | 58 (14.9) |
| Head nurse | 59 (15.2) |
| Team manager | 76 (19.6) |
| Departments |  |
| ICD | 336 (86.6) |
| Nursing | 27 (7.0) |
| Quality control | 4 (1.0) |
| Administrative | 3 (0.8) |
| Central supply service/Operating room/Outpatient | 8 (2.1) |
| Others | 7 (1.8) |
| Types of hospitals |  |
| Advanced general hospital | 126 (32.5) |
| General hospital | 197 (50.8) |
| Hospital | 48 (12.4) |
| Clinic | 2 (0.5) |
| Others | 12 (3.1) |
| Locations |  |
| Seoul | 124 (32.0) |
| Gyeongsang-do | 99 (25.5) |
| Gangwon-do | 13 (3.4) |
| Chungcheong-do | 46 (11.9) |
| Gyeongbuk-do | 58 (14.9) |
| Jeolla-do | 37 (9.5) |
| Jeju-do | 9 (2.3) |
| No. of beds (mean ± SD) | 630.5 (± 492.3) |
| HH sink (Yes) | 368 (94.8) |
| Hand rubbing (Yes) | 388 (100.0) |
| ICD (Yes) | 364 (93.8) |
| Received HH education within past year (Yes) | 302 (77.8) |
| HH campaign (Yes) | 309 (79.6) |
| HH monitoring experience (Yes) | 345 (88.9) |
| Surveillance (Yes) | 302 (77.8) |

HH, hand hygiene; ICD, infection control department.

### Table 2

| Scores of knowledge (range, 0-25) | Category | Mean (± SD) | Min | Max | Median | No. (%) of questions (N = 25) |
|-----------------------------------|----------|-------------|-----|-----|--------|-------------------------------|
| Scores of knowledge (range, 0-25) | Category | Mean (± SD) | Min | Max | Median | No. (%) of questions (N = 25) |
| High (≥ 90%) | 19.5 (± 2.3) | 12 | 24 | 20 | 10 (40) |
| Medium (70%-89%) | 17 (± 2.7) | 8 | 24 | 20 | 9 (36) |
| Low (≤ 69%) | 13 (± 2.9) | 6 | 24 | 20 | 6 (24) |

| Proportion of correct answers in each question (%) | Medium (70%-89%) | Low (≤ 69%) |
|-----------------------------------|-----------------|-------------|
| Hand hygiene is protective | High (≥ 90%) |
| Immediately after risk of body fluid exposure | Medium (70%-89%) |
| Other hands | Low (≤ 69%) |

Max, maximum; Min, minimum.
with each other. Age was positively correlated with perception and attitude scores. Clinical experience showed a positive correlation with attitude scores. Number of beds showed a positive correlation with HH performance of HCWs. Infection control experience was not significantly correlated with knowledge, perception, attitude, and role model scores. HH performance of HCWs showed a positive correlation with perception, attitude, and role model of ICNs (Table 4).

**Multiple linear regression analyses**

The regression model for HH performance of HCWs was calculated as follows: $Y_1 = 31.638 + 0.067X_1$ (perception) + $0.133X_2$ (attitude) + $0.825X_3$ (role model); coefficients were statistically significant for the intercept and role models, and the regression model was statistically significant ($P < .001$; adjusted $R^2 = 0.115$) (Table 5).

**DISCUSSION**

Participants’ qualities, such as mean length of clinical career, educational background, and position as a full-time ICN, were confirmed to be high compared with the shortness of their infection control experiences.

In terms of HH infrastructure, existence of sinks for HH (94.8%) and alcohol-based hand rub products (100%) were higher than in a previous study. In terms of infection control activities, the

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### Table 3

Results of univariate analysis of knowledge, perception, attitude, role model, and self-reported HH performance of HCWs

| Domains          | Variables                  | Mean ($\pm$ SD) | N   | $P$ value* |
|------------------|----------------------------|-----------------|-----|-------------|
| Perception       | Marital status             | Unmarried       | 68.7 ($\pm$ 9.0) | 141 | .029        |
|                  |                            | Married         | 70.1 ($\pm$ 9.9) | 243 |             |
|                  | Job title                  | Full time       | 69.2 ($\pm$ 9.6) | 320 | .008        |
|                  |                            | Part time       | 70.8 ($\pm$ 9.7) | 48  |             |
|                  |                            | Others          | 75.5 ($\pm$ 7.5) | 17  |             |
|                  | HH sink                    | Yes             | 70.1 ($\pm$ 9.0) | 367 | .042        |
|                  |                            | No              | 66.9 ($\pm$ 6.5) | 19  |             |
|                  | Surveillance               | Yes             | 69.2 ($\pm$ 9.7) | 302 | .010        |
|                  |                            | No              | 72.2 ($\pm$ 8.5) | 81  |             |
| Attitude         | Job title                  | Full-time       | 46.6 ($\pm$ 5.9) | 320 | .045        |
|                  |                            | Part-time       | 48.7 ($\pm$ 5.3) | 48  |             |
|                  |                            | Others          | 47.9 ($\pm$ 5.6) | 17  |             |
|                  | ICD                        | Yes             | 46.7 ($\pm$ 5.8) | 364 | .012        |
|                  |                            | No              | 49.7 ($\pm$ 5.5) | 23  |             |
|                  | Department                 | IC              | 46.6 ($\pm$ 5.8) | 336 | .010        |
|                  |                            | Nursing         | 50.4 ($\pm$ 4.5) | 27  |             |
|                  |                            | Quality control | 45.0 ($\pm$ 6.2) | 4   |             |
|                  |                            | Administrative  | 45.0 ($\pm$ 7.5) | 3   |             |
|                  | Central supply service/Operating room/Outpatient | Yes | 50.0 ($\pm$ 4.6) | 8 | .019 |
|                  |                            | No              | 45.6 ($\pm$ 5.9) | 7   |             |
| Role model       | Job title                  | Full time       | 39.0 ($\pm$ 5.3) | 320 | .029        |
|                  |                            | Part time       | 39.0 ($\pm$ 8.4) | 48  |             |
|                  |                            | Others          | 41.5 ($\pm$ 9.0) | 17  |             |
|                  | HH sink                    | Yes             | 39.3 ($\pm$ 6.0) | 368 | .019        |
|                  |                            | No              | 36.5 ($\pm$ 4.9) | 19  |             |
|                  | IC experience              | ≤ 12 mo         | 37.3 ($\pm$ 6.9) | 99  | .004        |
|                  |                            | 13-24 mo        | 39.5 ($\pm$ 5.2) | 114 |             |
|                  |                            | > 24 mo         | 39.8 ($\pm$ 5.6) | 166 |             |
| HH performance of HCWs | IC experience | ≤ 12 mo         | 71.8 ($\pm$ 18.3) | 93  | .007        |
|                  |                            | 13-24 mo        | 78.3 ($\pm$ 14.5) | 109 |             |
|                  |                            | > 24 mo         | 75.1 ($\pm$ 13.9) | 159 |             |

Nonparametric univariate analysis (*Mann-Whitney; **Kruskal-Wallis).*

HCWs, health care workers; HH, hand hygiene; IC, infection control; ICD, infection control department.

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### Table 4

Results of correlation analysis of variables to knowledge, perception, attitude, role model, and self-reported HH performance of HCWs

|                           | Knowledge | Perception | Attitude | Role model | Age | Clinical experience | No. of beds | IC experience | HH performance of HCWs |
|---------------------------|-----------|------------|----------|------------|-----|---------------------|-------------|---------------|------------------------|
| Knowledge                 | 1         |            |          |            |     |                     |             |               |                        |
| Perception                | −0.055    | 1          |          |            |     |                     |             |               |                        |
| Attitude                  | −0.040    | 0.368***   | 1        |            |     |                     |             |               |                        |
| Role model                | −0.040    | 0.380***   | 0.392**  | 1          |     |                     |             |               |                        |
| Age                       | −0.042    | 0.112      | 0.359**  | 0.078      | 1   |                     |             |               |                        |
| Clinical experience       | −0.048    | 0.095      | 0.128*   | 0.053      | 0.902** | 1                   |             |               |                        |
| No. of beds               | −0.090    | 0.035      | −0.099   | 0.065      | −0.318** | −0.280** | 1           |             |                        |
| IC experience             | 0.086     | 0.033      | 0.029    | 0.087      | 0.415** | 0.422** | 0.104* | 1           |                        |
| HH performance of HCWs    | 0.029     | 0.188**    | 0.182**  | 0.344***   | −0.064 | −0.051 | 0.107 | −0.017 | 1           |

HCWs, health care workers; HH, hand hygiene; IC, infection control.

* $P < .05$ (2 tailed).
** $P < .01$ (2 tailed). Pearson’s correlation analysis.
percentages of participants who had experience with surveillance (77.8%) and HH monitoring (88.9%) were relatively low compared with HH monitoring (94.0%) and surveillance (92.5%) in a previous study of ICNs in 2016. The percentage of nurses receiving HH education within the previous year (77.8%) was lower than that reported in a previous study of registered nurses (94.5%).13 These results indicate the need to provide more opportunities for HH education and training to newly assigned ICNs.

Mean HH knowledge scores among our participants (19.5 ± 2.3) were higher than those reported in previous studies (8.1 ± 1.4, 14.25 ± 2.05, and 14.2 ± 2.6) and 17.6 ± 2.5) conducted using the same tools (the WHO questionnaire). The mean proportion of correct answers for all questions (78.0%) was higher than 70.3% reported in a previous study with RNs. The proportion of correct answers in the medium and high scale (76%) was higher than 68% in a previous study. Scores of HH perception in this study (69.9 ± 8.9) (total score = 84) were relatively higher than those reported in a previous study (75.2 ± 11.83) (total score = 96) and relatively lower than those in another study (69.3 ± 8) (total score = 77). However, almost all items on the perception questionnaire showed lower scores than in a previous study where participants were RNs. Self-reported HH performance (78.3 ± 24.2) was higher than that of others (HCWs) (75.2 ±15.5). These figures are lower than those reported in a previous study with RNs (88.2 ± 110 and 86.0 ± 110, respectively). Attitude about HH in our study had a relatively lower mean score (46.9 ± 5.8) than in a previous study with RNs (50.5 ± 5.5) and showed lowest scores for convenience and protectiveness of HH. Therefore, strategies to promote the convenience and protectiveness of HH products are needed to improve HH. The mean HH role model score (39.2 ± 6.0) was relatively lower than that in a previous study with RNs (46.9 ± 3.3). ICNs considered the charge nurse, head nurse, and physician as important role models, apart from colleagues, to improve HH compliance, as in previous studies. Infection control experience was significantly associated with HH role model and HH performance of HCWs (significantly lower in groups with <12 months of experience).

Through descriptive and univariate analyses, some weaknesses in knowledge, perception, attitude, and role model were found in relation to some questions. Therefore, the importance of ICNs who usually teach and monitor HCWs’ HH practice to other HCWs should be considered. Complementary HH education programs addressing certain weaknesses found in this study should be developed and sufficiently provided to all ICNs who have been newly appointed with <12 months of experience, and this program should be operated continuously to promote the ICNs’ specialty in the long term.

Perception, attitude, and role model showed positive correlations with one another. Therefore, it may be worth investigating whether enhancing perception can improve attitude and role model score. Perception has been identified as a significant predictor of nurses’ HH intentions and adherence, as well as HH performance in a previous study conducted in Korea with the same study methods and in other studies. Further research needs to be conducted on improving the perception of ICNs.

Consistent with previous studies, our study found that HH performance rate of other HCWs (reported by participants) was positively correlated with participants’ HH perception, attitude, and role model scores. Perception of being a role model for one’s colleagues is very important for improving HH compliance among HCWs. Therefore, strategies for the promotion of ICNs’ HH perception, attitude, and role model could be used in future HH promotion strategies for HCWs.

Although this was not an observational study of HH performance, and has some limitations in terms of HH performance being self-reported, it yields important findings consistent with existing knowledge. The status and related factors of ICNs’ HH knowledge, perception, attitude, role model, and HH performance of HCWs in Korea were identified.

CONCLUSIONS

In conclusion, specialized and well-structured HH education programs addressing some of the weaknesses identified in this study should be developed and provided to all new ICNs, and further studies about enhancing the perception, attitude, and role model of ICNs should be conducted. These will contribute to improving HH performance of HCWs.

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SUPPLEMENTARY DATA

Supplementary data associated with this article can be found in the online version, at https://doi.org/10.1016/j.ajic.2018.09.006.

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