Major Article

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 $\pm$ SD): knowledge (19.5 $\pm$ 2.3), perception (69.9 $\pm$ 8.9), attitude (46.9 $\pm$ 5.8), and role model (39.2 $\pm$ 6.0). HH performance of health care workers (HCWs) was 75.2 $\pm$ 15.5. Mean HH performance scores of HCWs ($P = .007$) differed significantly according to infection control experience (3 groups: $\leq$ 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: $Y_1 = 31.638 + 0.067X_1$ (perception of ICNs) $+ 0.133X_2$ (attitude of ICNs) $+ 0.825X_3$ (role model of ICNs) ($P < .001$; adjusted $R^2 = 0.115$).

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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Health care−associated infections (HAIs) critically impact patient outcomes, increase hospital costs, and extend hospital stays.[1-4] The primary transmission of pathogens between patients in HAIs takes place via the hands of health care workers (HCWs).[5] Thus, hand hygiene (HH) is the single most important factor for preventing HAIs.[1,3,4] Proper HH among HCWs is one of the foremost techniques for reducing HAIs.[1,2] However, HH performance among HCWs was reported to be as low as about 38%.[1,6] Therefore, infection control activities focus primarily on enhancing the HH performance of HCWs; various kinds of infection control activities for HH, such as education, monitoring, and feedback, and a convenient supply of HH products, have been recommended and implemented.[1,3,5]

The recommended ratio of infection control nurses (ICNs) was 0.8-1.0 ICN per 100 beds in 2002[7] to 1.2 ICN per 100 beds in 2014[8] in an acute care hospital, because ICNs are key persons to successfully decrease HAIs by managing and developing infection control activities.[7,8]

During the Middle East respiratory syndrome outbreak in the Republic of Korea from May 20, 2015, to July 28, 2015, the importance of infection control in hospitals was highlighted.[9,10] Since 2016, the Korea Institute for Healthcare Accreditation has included the ratio of ICNs to beds as an essential accreditation standard of medical care.[11] Today, numerous new ICNs (whose primary responsibility is infection control) are abruptly assigned infection control activities in many hospitals. The number of ICNs is increasing rapidly because of the recent amendment to the medical law in 2017 that strongly recommended a ratio of 1 ICN per 150 beds in general hospitals.[12] Therefore, as the number of nurses newly assigned to ICN positions surpasses the capabilities of existing education programs for ICNs in Korea, it is necessary to develop a professional HH education and training program. The

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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 study[13] 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 variance. A convenience sample of ICNs was recruited nationally. The participants were aware of the study purposes and voluntarily agreed to take part, so their participation was voluntary and anonymous. Questionnaires were e-mailed 5 times to all members of the Korean Association of Infection Control Nurses and delivered in person to attendees of the Korean ICN's annual conference who agreed to participate 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 collected 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 study[13] and modified for this study.

Demographics included participant age, sex, education level, clinical work experience, ICN experience, department, job title, and position. Hospital characteristics included type of hospital, number of beds, location, presence of an infection control department (ICD), number of HH sinks, and number of alcohol-based hand rub dispensers. Characteristics of infection control activities included experience of HH education within the previous year, HH campaign, and HH monitoring and feedback (yes = 1, no = 0).

The knowledge domain was adapted from the 2009 revision of the World Health Organization (WHO) Hand Hygiene Knowledge Questionnaires 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 Perception Survey for Health-Care Workers to identify perception and performance 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), respectively (0%-100%).

The attitudes and role models domain was adapted from a self-report questionnaire in a previous study,[13,16] 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 models because it lowered the reliability (the Cronbach alpha was 0.796 with all questions and 0.810 after exclusion). Thus, HH attitudes 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 statistically significant. The Cronbach alpha was calculated to determine reliability. Descriptive statistics were calculated for participant demographics, hospital characteristics, and infection control activities. 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 categorized as high ($\geq$ 90%), medium (70%-89%), and low ($\leq$ 69%).[13] Data were found not to be normally distributed based on the Kolmogorov-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 associations 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 participation, written informed consent was obtained from each participant; 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 infection control experience, 82.5% were full-time ICNs, and 86.6% worked in the ICD. Among the study hospitals, 50.8% were general hospitals,

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 college	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)
Gyeonggi-do	99 (25.5)
Gangwon-do	13 (3.4)
Chungcheong-do	46 (11.9)
Gyeongsang-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.

32.0% were located in Seoul, and the mean number of beds was 630.5 ± 492.3; 93.8% of hospitals had an ICD, 94.8% had HH sinks, and 100% had alcohol-based hand rub products. Infection control activities were reported by participants as follows: 79.6% had experienced HH campaigns, 88.9% had experienced HH monitoring, and 77.8% had experienced HAI surveillance. A total of 77.8% of participants had received HH education within the previous year. Other characteristics of participants and hospitals are shown in Table 1.

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

Table 2
Results of scores and proportions of correct answers in knowledge

Variables	Category	Mean (± SD)	Min	Max	Median	No. (%) of questions (N = 25)
Scores of knowledge (range, 0-25)		19.5 (± 2.3)	12	24	20	
Proportion of correct answers in each question (%)		78 (± 20.9)	34	99.7	88.4	
Scale of proportion of correct answer in each question	High (≥ 90%)					10 (40)
	Medium (70%-89%)					9 (36)
	Low (≤ 69%)					6 (24)

Max, maximum; *Min*, minimum.

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	50.0 ($\pm$ 4.6)	8	
		Others	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	$\leq$12 mo	37.3 ($\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	$\leq$12 mo	71.8 ($\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.

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.[13] In terms of infection control activities, the

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	.368**	1						
Role model	−0.040	.380**	.393**	1					
Age	−0.032	.112*	.159**	0.053	1				
Clinical experience	−0.048	0.095	.128*	0.053	.902**	1			
No. of beds	−0.090	0.035	−0.099	0.065	−.318**	−.280**	1		
IC experience	0.086	0.033	0.029	0.087	.415**	.422**	.104*	1	
HH performance of HCWs	0.029	.188**	.182**	.344**	−0.064	−0.051	.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.

Table 5
Results of multiple linear regression analysis

Dependent variables	Independent variables	B (standardized)	SE	t value	P value	95% CI	Partial R	VIF	Adjusted R² (P value)
HH performance of HCWs	(Intercept)	31.638	7.700	4.109	.000	(16.496 to 46.781)			0.115 (<.001)
	Perception	0.067 (0.037)	0.101	0.659	.510	(−0.132 to 0.265)	0.034	1.314	
	Attitude	0.133 (0.049)	0.150	0.889	.374	(−0.162 to 0.428)	0.046	1.261	
	Role model	0.825 (0.310)	0.150	5.512	.000	(0.531 to 1.119)	0.277	1.314	

CI, confidence interval; HH, hand hygiene; SE, standard error; VIF, variance inflation factor.

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.[17] 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 (RNs) (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,[16] 14.25 ± 2.05,[18] and 14.2 ± 2.6,[19] and 17.6 ± 2.5[13]) 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.[13] The proportion of correct answers in the medium and high scale (76%) was higher than 68% in a previous study.[13] Scores of HH perception in this study (69.9 ± 8.9) (total score = 84) were relatively higher than those reported in a previous study[18] (75.2 ± 11.83) (total score = 96) and relatively lower than those in another study[13] (69.3 ± 0.8) (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 ± 11.0 and 86.0 ± 11.0, respectively).[13] 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)[13] 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.[1,3,4] The mean HH role model score (39.2 ± 6.0) was relatively lower than that in a previous study with RNs[13] (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.[20,21] 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,[22,23] 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,[11,12] 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,[24] as well as HH performance in a previous study conducted in Korea with the same study methods[13] and in other studies.[20,21] Further research needs to be conducted on improving the perception of ICNs.

Consistent with previous studies,[20,21,24,25] 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[20,21,25] 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.

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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