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A Convergence Study on the Factor Influencing to Healthcare-Associated Infection Control Guidelines of Nursing Students

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간호학생의 의료관련감염 관리지침 준수 영향요인에 관한 융합연구

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Abstract In this preliminary study exploring the development of an convergent educational program, we identified the factors that affect adherence to healthcare-associated infection (HAI) control guidelines. The data were collected using a self-reported questionnaire of 183 nursing students. The collected data were analyzed using AMOS 21.0 and SPSS 21.0 program. The model fit was χ^2=52.06 (df=9, p<.01), GFI=.93, RMSEA=.16, NFI=.85, and CFI=.90, and the explanatory power was 26.2%. As a result in this study, it was found that the theory of planned behavior(TPB) was appropriate for explaining the intention about healthcare-associated infection control guidelines. It is necessary to develop an education program that can reinforce the concepts of TPB, and iterate research to verify its effectiveness.

Key Words : Convergence, Nursing students, Healthcare-associated infection, Theory of planned behavior, Beliefs

요 약 이 연구는 임상실습 전 간호대학생의 의료관련감염 관리지침 수행에 관한 영향 요인을 파악하여 융합적 교육프로그램 개발을 위한 사전조사로서 시행된 연구이다. 자료수집은 일 지역 간호학과 2학년 183명을 대상으로 자가보고식 설문지를 이용하여 수행하였으며, 수집된 자료는 AMOS 21.0과 SPSS 21.0을 이용하여 분석하였다. 분석 결과 모형 적합도는 χ^2=52.06 (df=9, p<.01), GFI=.93, RMSEA=.16, NFI=.85, CFI=.90 이었으며, 설명력은 26.2%였다. 이를 통해 간호대학생의 의료관련감염 관리지침 수행의도의 설명에 계획된 행위이론이 적절함을 알 수 있었으며, 향후 간호대학생의 의료관련감염 관리지침 준수를 높일 수 있도록 계획된 행위이론의 하위개념들을 강화할 수 있는 교육프로그램을 개발하고, 이의 효과를 검증할 수 있는 반복연구가 필요하다.

주제어 : 융합, 간호학생, 의료관련감염, 계획된 행위이론, 신념

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1. Introcuction

During the 2015 outbreak and transmission of Middle East Respiratory Syndrome (MERS) in South Korea, inefficient management resulted in various challenges such as poor initial response of the broadcasting authorities, delayed disclosure of information, unclear roles and responsibilities of each agency, lack of infrastructure related to infectious diseases in Korea Centers for Disease Control & Prevention (KCDC) and medical institutions, and inadequate infection control measures in healthcare facilities[1,2]. Therefore, Korean government solicited a diverse range of opinions through special committees in the National Assembly, on-the-spot meetings, public hearings, and the Infection Control Committee. As a result, policies were developed such as renewed systems for prevention of emerging infectious diseases nationally[1,2] and legislation to establish and enhance the infection control infrastructure in healthcare facilities.

This concern is reflected in the healthcare-associated infection (HAI) control segment of healthcare accreditation as a major factor in the evaluation and certification by the Korea Institute for Healthcare Accreditation[3] or the Joint Commission of International Accreditation Standards[2]. And the evaluation criteria for these institutions recommend implementation and management of HAI education for students studying at medical institutions[3]. In addition, Kim, O.S [4] suggests that infection control education is needed for the students on the basis of the high detection rate of multi-drug resistant bacteria in nursing and medical students during hospital practice. However, the curriculum of the HAI control guidelines is not reflected in the nursing curriculum. This recommendation suggests that students should develop adequate contact with the patients during their practice and consider training before working as medical staff to effectively manage the infection. Based on this, the researchers determined that proper infection control education program should be operated before the hospital practice. For this purpose, after completing basic nursing and the preliminary investigation of the students who have not yet experienced the clinical practice are necessary.

Experts studying human behavior believe that individual actions are highly affected by personal attitudes, beliefs, subjective norms, and self-efficacy[5]. Therefore, inculcation of appropriate beliefs and attitudes during impressionable and formative years is expected to result in acceptable behaviors[6]. Therefore, training to alter the perceptions and attitudes of nursing students regarding infection control measures in a clinical setting is necessary and desirable to develop future healthcare providers equipped with the requisite knowledge, skills, and attitudes.

Previous studies investigating infectious diseases report the nurse's beliefs about factors influencing infection management behavior[7], work intensity at the job site[8], intensive education for improved individual performance, the need for observation and feedback, and evidence-based knowledge[9]. In addition, it suggests that positive attitude and social awareness are required.

Adherence to these guidelines requires strong positive attitudes and social awareness, and intensive university education before becoming a nurse. However, studies related to nursing students have been limited to their knowledge level, awareness, and exposure to body fluids[10-17]. Nevertheless, these studies suggest the need for a pre-clinical training course, to establish a training program under HAI control.

In order to increase the effectiveness of education as discussed in the studies, it is necessary to strengthen the positive attitudes, beliefs, and subjective norms[7,18,19].

The purpose of this study was to identify the

factors influencing the intention of the nursing students, in implementing infection management guidelines. Toward this end, based on a literature review[17,20-22], we used Ajzen's theory of planned behavior as a conceptual framework, which describes the behavioral intentions in various studies analyzing medical infection management.

Since the attitude, PBC, and subjective norms are not shaped instantly but develop over a long period of time, the researcher believes that it is necessary to study the intentions of nursing students to fulfil their obligations as nurses to carry out infection control guidelines. Of course, in the study of Moon and Jang[23], although the organizational factors such as organizational culture and resource support are influential factors in nurses' performance of HAI control guidelines, the influence of individual attitudes, PBC, and subjective norms cannot be excluded. Thus, it is important to strengthen personal beliefs and confidence in nursing college students who are in the process of learning knowledge, skills, and attitudes.

Therefore, we aim to identify the factors affecting performance intention by analyzing the relationship between intention, attitude, perceived behavioral beliefs, and subjective norms in the implementation of HAI control guidelines by second-year nursing students, who have yet to experience clinical practice.

2. Methods

2.1 Study Design

We used convenience sampling to select participants among second-year nursing students at 4 nursing schools located in Gwangju, South Korea, and calculated the sample size using the G-power program version 3.1.2 (Franz Faul, Germany). Based on a median effect size of .15, a type I error of .05, and statistical power of .95, we calculated the sample size as 172. However, considering the dropout rate, we decided to use a sample size of 200 subjects.

We collected data from October 1st to October 20th, 2018, using a structured self-reported questionnaire. We conducted the study in accordance with the Declaration of Helsinki, and its ethical principles for medical research involving human subjects. We explained the study goals and procedures to potential participants and included those who were willing to volunteer following written informed consent. We informed the participants of their rights to withdraw their participation at any time and that the anonymity of their data was guaranteed. The paper questionnaire was distributed to the volunteers participating in the study using a second-grade mailbox, with a participant response time of 10 ~ 15 min.

We received 195 responses (97.5% response rate) to 200 questionnaires distributed. We excluded surveys containing more than 10% missing values as well as 11 forms that had outliers (Z-score ±3)[24]. Ultimately, we used the data from 183 surveys for our analyses.

2.2 Study Tool

We completed the questionnaire according to the method reported previously using TpB[25]. We developed study questionnaires to determine the general characteristics and the TPB variables associated with implementation of HAI control guidelines such as behavioral beliefs, attitude, normative beliefs, subjective norm, control beliefs, perceived behavioral control and intention. Except for the questions related to general characteristics, we modified and revised the study questionnaire based on questionnaires that were originally developed by Whitby, McLaws, and Ross[7] and modified by Moon and Song[20]. Table 1 lists the definitions, item numbers, and confidence of each variable.

The reliability of the attitude measurement

instrument consisting of 5 items, Chronbach's α, was .70 and the reliability of the behavioral belief comprising 5 items was .84. The subjective norm was composed of 5 items, with a reliability of .70; and the normative belief consisted of 5 items, with a reliability of .91. The PBC consisted of five items, with a reliability of .94, and the control belief comprised of three items, with a reliability of .87. Finally, the intentional component was composed of 3 items with a reliability of .79.

Attitudes were evaluated on a 7-point semantic differential scale. All other variables were measured with a 5-point Likert scale. Each measurement variable was based on the average of the items constituting the variable. The reliability coefficient for question 3 was sufficiently low on the questionnaire that measured attitudes toward adherence to HAI control guidelines, and therefore, was excluded from the analysis. We also reversed the scales for the scores associated with the control belief items that were negatively worded.

2.3 Data Analysis

We analyzed the collected data using SPSS Statistics 21.0 (IBM Inc., Chicago, IL, USA) and IBM SPSS Amos ver 21.0 (IBM Corp., Build 1178) program. We analyzed the participants' general characteristics using descriptive statistics and reported the data as percentiles, means and, standard deviations. We measured internal consistency and reliability using Cronbach's alpha, and measured the correlations between the predictors using Pearson's correlation coefficient. Finally, in oder to confirm the estimation possibility of the structual equation model, the model identifiation evaluation was performed.

3. Results

3.1 General Characteristics of Participants and TPB Test

We analyzed the participants' general characteristics using descriptive statistics and the results of baseline analysis for each variable are presented in Table 2. The participants included 154 (84.2%) females and 29 (15.8%) males, with a mean age of 21.85±4.09 years. In terms of educational experience involving HAI control in or out of curriculum, we analyzed beliefs, attitudes, subjective norms, PBC, and intentions by calculating the means for those items based on the TPB questionnaire construction manual [25]. Attitude scored the highest value (6.54±0.68), followed by normative beliefs (6.27±0.72), behavioral

Table 1. Reliability of the Theory of Planned Behavior Variables in Increasing Adherence to Healthcare-Associated Infection Control Guidelines

Variables	Definition	No. of Items	α coefficient
Attitude	Emotional and cognitive evaluation of nursing students regarding compliance with HAI control guidelines	5	.70
Behavioral beliefs	Cognitive evaluation of nursing students based on the results of compliance with HAI control guidelines	5	.84
Subjective norm	The degree to which nursing students perceive the social pressure to follow HAI control guidelines	5	.70
Normative beliefs	The belief that those who were important to nursing students expect the students to follow HAI control guidelines	5	.91
PBC	The overall degree to which nursing students were able to follow HAI control guidelines	5	.94
Control beliefs	The belief that nursing students can use or access the resources needed to follow the HAI control guidelines	5	.87
Intention	Nursing students' plans to adhere to HAI control guideline recommendations	3	.79

HAI=Healthcare-associated infection; PBC=Perceived behavioral control

Table 2. General Characteristics of Participants and Descriptive Statistics of Variables (*N*=183)

Characteristics		n (%)	M (SD)	Min	Max
Age	<20	114 (62.3)	21.85 (4.09)		
	20-24	39 (21.3)			
	25-29	20 (10.9)			
Gender	Male	29 (15.8)			
	Female	154 (84.2)			
Education about HAI	Yes	102 (55.7)			
	No	81 (44.3)			
Behavioral beliefs			6.17 (0.81)	3.33	7.00
Normative beliefs			6.27 (0.72)	3.80	7.00
Control beliefs			3.26 (1.30)	1.00	7.00
Attitude			6.54 (0.68)	4.00	7.00
Subjective norms			5.99 (0.77)	3.67	7.00
PBC			5.00 (1.65)	1.00	7.00
Intention			6.03 (0.82)	3.33	7.00

HAI=healthcare-associated infection; PBC=perceived behavior control

beliefs (6.17±0.81), intentions (6.03±0.82), subjective norms (5.99±0.77), PBC (5.00±1.65), and control beliefs (3.26±1.30).

3.2 Analysis of Correlation and Hypothetical model

Correlation analysis on measurement variables and feasibility analysis results on measurement concepts are shown in Table 3. Behavioral beliefs (r=.437, p<.001), normative beliefs (r=.335, p<.001), attitude (r=.338, p<.001), subjective norm (r=.395, p<.001), and PBC (r=.418, p<.001) were significantly correlated with intentions to follow HAI control guidelines. However, control beliefs were not significantly correlated with intentions (r=.082, p=.269). Further, the variance inflation factor (VIF) for independent variables including behavioral beliefs, normative beliefs, attitude, subjective norms, PBC, and infection control education did not exceed 10 (1.00 - 1.28), and the tolerance ranged between 0.1 and 10 (0.78 - 0.92). These results indicated the absence of multicollinearity between independent variables. We tested the independence of residuals using the Durbin-Watson test, and the results were close to 2 (1.85) indicating lack of auto correlation. Therefore, we concluded that the residuals were normally distributed and met the homoscedasticity assumption. Factor load (standardized coefficient) of each measured variable ≥.5, C.R. [Threshold]> ± 11.97, AVE [Average Dispersion Extraction Index] ≥.50 The discriminant validity of the correlation coefficient between normative beliefs and behavioral beliefs is less than the minimum AVE .50. Table 4 show that Covariance structure analysis for confirm the validity of the causal model established. As a result, χ^2=52.06 (df=9

Table 3. Correlation of Planned Behavioral Variables among Nursing Students (*N*=183)

Variables	BB	NB	CB	Att	SN	PBC	Int
BB	1						
NB	.676**	1					
CB	-.046	-.048	1				
Att	.246**	.219**	.239**	1			
SN	.419**	.489**	.039	.390**	1		
PBC	.279**	.234**	.381**	.368**	.172*	1	1
Int	.437**	.335**	.082	.338**	.395**	.418**	
AVE[a]	.501	.501	.515	.501	.500	.500	.501

BB=Behavioral beliefs; NB=Normative beliefs; CB=Control beliefs; Att=Attitude; SN=Subjective norm; PBC=Perceived behavioral control; Int=Intention; AVE=Average Variance Extract

*. Correlation is significant at the 0.05 level

**. Correlation is significant at the 0.01 level

p<.001), GFI=.93, RMSEA=.16, NFI=.85, CFI=.90, showed above-average adequacy.

Table 4. Goodness of Model Students

	χ^2 (p)	(df)	GFI	RMSEA	NFI	CFI
Critera	Low (≥.05)	≥.0	≥.9	≤.1	≥.9	≥.9
Model Fit	52.06 (p<.001)	9	.93	.16	.85	.90

SE=Standard error; Adj.=adjusted

3.3 Analysis of the effects of hypothetical models

Fig.1 is the hypothetical model. and Table 5 is the result of hypothesis test. As a result, The analysis of the estimates of the parameters confirmed the non-standardized coefficient (B) and the rejection rate (C.R.) [24], and the effectiveness analysis of the model was tested using the standardized coefficient (β). As a result of hypothesis test, all the path toward the intention about perform of HAI guidelines was statistically significant. Specifically, behavioral beliefs, normative beliefs, and control beliefs are characterized by attitudes (β=.17 p=.016), subjective norms (β=.49, p<.001), PBC (β=.35, p<.001) has a significant effect, attitude (β=.14, p=.040), subjective norms (β=.29, p<.001) and PBC (β =.34, p <.001) was statistically significant influence on the intention.

Table 5. Path Coefficient of Hypothetical Model

Path between variables	B	β	S.E	C.R.
Behavioral belief→Attitude	.14	.17	.06	2.40
Normative belief→Subjective norm	.49	.46	.07	7.27**
Control belief→PBC	.43	.35	.09	5.10**
Attitude→Intention	.16	.14	.08	2.05
Subjective norm→Intention	.30	.29	.07	4.25**
PBC→Intention	.16	.34	.03	5.24**

PBC, perceived behavioral control, **p<.001

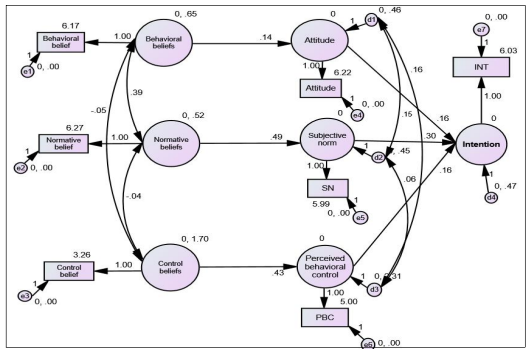

Fig. 1. Hyprotheical Model

The table 6 is the results of the direct, indirect and total effects of the variables. The result were as follows to examine the causal relationship between the intention about perform of HAI control guidelines. There is a direct effect; behavioral beliefs are about attitudes (β=.17, p=.003), normative beliefs are about subjective norms (β=.46, p=.00), and control beliefs are about PBC (β=.35, p=.004). Behavior belief (β=.02, p=.074), norm belief (β=.13, p=.004), control belief (β=.12 , p=.001) have an indirect effects. and attitude(β=.14, p=.115), subjective norm (β =.29, p=.005), and PBC (β=.34, p=.002) have direct effects to intention. The explanatory power by these variables was 26.2%.

Table 6. Effects of Predict Variables on Endogenous variables in the Hypothetical Model

Endogenous variables / Predict variables	Standardized			SMC
	Direct effect	Indirect effect	Total effect	
Attitude				.03
Behavioral belief	.17	–	.17	
Subjective norm				.22
Normative belief	.46	–	.46	
PBC				.12
Control belief	.35	–	.35	
Intention				.26
Behavioral belief	–	.02	.02	
Normative belief	–	.13*	.13*	
Control belief	–	.12*	.12*	
Attitude	.14*	–	.14*	
Subjective norm	.29*	–	.29*	
PBC	.34*	–	.34*	

PBC, perceived behavioral control; *p<.05

4. Discussion

We conducted this study as a preliminary study to identify variables that affect nursing students' intentions to comply with HAI control guidelines before embarking on clinical practice. We focused on the identification of factors that enhanced individual intention when designing programs to improve nursing college students' awareness of HAI control guidelines.

We tried to identify the factors that influence nursing students' intention to perform HAI control guidelines through the model test. Attitudes, subjective norms, and PBC account for about 26.2% of intentions for performance. This is higher than the explanatory power of 11% to 23.8% shown in similar previous studies[8,20,23]. The hypothetical model of this study can be judged as a suitable model for explaining and predicting the intention to perform HAI control guidelines.

First, it is noteworthy that in the correlation analysis between variables, control beliefs did not show a significant correlation with intention. Control beliefs reflect confidence in the ability to access relevant resources for compliance with the guidelines under any circumstance, whereas normative beliefs suggest peer pressure to follow the guidelines. As mentioned above, our results significantly differ from another study reporting that nursing students' attitudes toward MERS significantly affected their adherence to infection prevention guidelines (β=.383, p<.001) and that the students were more diligent with the guidelines when they had better attitude (r=.28, p<.001) [21]. Thus, based on the discrepancy between our study findings reported here and previous studies of nurses suggesting that control beliefs (β=.120, p=.002) and normative beliefs (β=.080, p=.004) affected the intention to follow HAI control guidelines[20,22], we concluded that the second-year nursing students in our study were not experienced clinically and failed to include their professor in the range of "Others," which might have restricted their responses. Therefore, depending on the level of curriculum experience, further research may be needed to establish a link between the intention of the nursing student and the beliefs mentioned above.

Second, analyzing the factors affecting guideline intentions, perceived behavior control (R^2=.34 p=<.001), subjective norms (R^2=.29 p=<.001), attitude (R^2=.14 p=<.001). The influence of attitudes on performance intentions shows different results depending on the subjects [15.20,23,26], and it is thought that repetitive studies on the same participants group are necessary. Attitude(that is, in favour of perform the HAI control guidelines), subjective norm ("behavioral expectations of people who are considered significant to me.") and PBC (confidence in displaying the behavior, that is, following the guidelines[25] influenced the nursing students' response to implement the guidelines. The explanatory power of variables, 26.2%, supported the results of Armitage and Conner's[27] study based on the TPB in which the explanatory power of behavior or behavioral intention was 20% to 40%. Thus, using the TPB to explain nursing students' intentions to follow HAI control guidelines was an appropriate step. Sundal et al.[17] reported that hand hygiene of nursing students improved significantly after contacting patients compared with lack of such experience (p<.05) and also insisted that nursing students were more likely to be aware of hand hygiene following appropriate feedback from a professor or practitioner. Therefore, to improve compliance with HAI control guidelines, continuous feedback is necessary for future healthcare providers to foster positive beliefs, attitudes, and confidence. Professors and healthcare practitioners in the field need to serve as exemplary role models.

Finally, The limitation of this study is that the researcher did not consider knowledge of infection control guidelines for the second grade

nursing students who had been studying basic skills in nursing through the basic nursing course. In the study of Moon and Jang[23], the knowledge of nurses did not influence the intention of the HAI control guidelines of nurses (β=−.05, p=.317). However, the other research findings suggest that the nurses' knowledge of multidrug−resistant organisms dictated their ability to implement HAI control guideline(t=2.80, p=.006)[10]. In the same context, according to the results of the study that the knowledge of MRSA of nursing students influenced the performance of infection prevention(t=2.73, p=.007)[3], it is necessary to repeat the study on how the knowledge of infection control of nursing students affects performance intention. This requires reconfirming how knowledge of nursing college students relate to the components of TpB, and therefore, further research is needed to recognize awareness of HAI control guidelines and the current level of education among nursing college students. In addition, there is a need to develop and apply convergent educational contents composed of theoretical knowledge and practical education about infection control guidelines applied in the clinical settings of nursing students.

5. Conclusion

This study was conducted to identify the structural causal relationship between beliefs, attitudes, subjective norms, perceived behavioral control, and performance intentions for the implementation of HAI guidelines for nursing students. Therefore, we intend to use the results in designing an effective educational program that will enhance the expertise of nursing college students for accurate implementation of the HAI control guidelines.

Results suggested that the intention to adhere to HAI control guidelines was significantly correlated with behavioral beliefs, normative beliefs, attitude, subjective norms, and PBC. Personal (behavioral) beliefs, attitudes, PBC expressed by confidence, and subjective norms of others might play a key role in implementation of HAI control guidelines.

This study suggests that nursing students who are expected to be engaged in clinical practice in the future need strategies to strengthen positive attitudes, confidence, and desirable role modeling. This study may be associated with bias involving self−reported questionnaires, and is a preliminary study of students who never experienced clinical practice. While caution is needed in generalizing the results of this study, the following findings are suggested:

First, additional research is needed, involving instructors and team members in practical class, to expand the range of influential groups that can affect student beliefs and behavior.

Second, in consideration of the fact that the results of research on whether the education or knowledge affect the intention to perform the HAI control guidelines vary depending on the study participants, the study is repeated on the same group as the study participants.

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