Original Research Article

Effects of Education on the Use of Personal Protective Equipment for Reduction of Contamination: A Randomized Trial

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Abstract

Introduction: Accurate doffing personal protective equipment (PPE) is one of the key practices of infection control because of increased risk of infection transmission caused by medical garments or environmental contamination.

Objectives: The study aimed to develop a reality-based education program and identify its effects on nurses' knowledge, attitudes, and contamination after PPE doffing.

Methods: Randomized control group pretest–posttest design. A total of 56 nurses were randomly assigned to experimental ($n = 28$) and control ($n = 28$) groups. The experimental group underwent a new reality-based education program to improve PPE use. Subsequently, participants were assessed on knowledge of and attitude toward PPE use, as well as number and area of contaminated sites after removing PPE and mask fitting test.

Results: There were no significant differences in knowledge and attitude to PPE use. The experimental group had significantly fewer contaminated sites than the control group (42 vs. 89), and a significantly lower mean contaminated site area (16.63 ± 24.27 vs. 95.41 ± 117.51 cm^2). The tuberculosis mask fitting test success rates were 68% and 50% in the experimental and control groups, respectively, but the difference was not significant.

Conclusion: The reality-based education on use of PPE helps to reduce contamination and improve performance related to the use of PPE for infection control.

Keywords

personal protective equipment, infection control, education, contamination, fluorescent lotion

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The recent rapid spread of Coronavirus disease 2019 and the global pandemic are facing new challenges in the area of infection control (Guan et al., 2020). In this situation, a comprehensive understanding of infection prevention and control is essential for nurses when seeking to protect themselves, patients, colleagues, and the general public from the transmission of infection (Brown et al., 2019). Since a cluster of pneumonia cases of unknown etiology in Wuhan, China, occurred, the virus has spread rapidly to a large extent despite efforts to prevent the propagation (Gralinski & Menachery, 2020; Huang et al., 2020). Despite the global effort to fight the disease, it is very difficult to prevent the spread of the coronavirus disease (Rothan & Byrareddy, 2020). During the doffing of personal protective equipment (PPE), pathogens can be transferred from the PPE to the bodies of nurses, putting nurses and patients at risk of exposure and infection (Phan et al., 2019). These exposure also causes health-care associated infections (HAIs), which have emerged as a serious global health issue because of expansion of invasive procedures, use of anticancer agents and immunosuppressants, and an increase in multidrug resistant bacteria (Centers for Disease Control and Prevention, 2016).

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Review of Literature

HAI incidents usually occur by direct transmission of microorganisms. Therefore, health-care workers have a high risk of being infected by pathogens within the hospital environment or transmitting pathogens to patients or colleagues. Moreover, health-care workers represent a population with a high risk of infection because of frequent direct contact with carriers or patients of infectious diseases and frequent exposure to patient samples and contaminated medical equipment, environment, and air (Zellmer et al., 2015). Recently, health-care workers have an increased risk of contracting COVID-19 (Li et al., 2020). Therefore, protection of health-care workers becomes a priority and access to PPE is a key concern (Black et al., 2020; Poonian et al., 2020) To reduce the transmission risk of HAI through health-care workers, accurate use of PPE by health-care workers is a vital requirement (Jones et al., 2020). Despite wearing PPE, the likelihood of skin and medical garment contamination may increase because of carelessness when taking off contaminated PPE; therefore, the accurate use of personal PPE is an important strategy to protect health-care personnel from contamination and to prevent the transmission of pathogens to subsequent patients (Reddy et al., 2019). However, it is often difficult to practice infection prevention measures because there is insufficient time to comply with PPE use guidelines in emergency situations, heavy workload, or because PPE use interferes with the procedure or treatment being administered (Mitchell et al., 2013).

In a simulation experiment conducted by the University of Pittsburgh (USA) on PPE use by health-care workers, simulations using PPE and full-body protection equipment sets showed a contamination rate of 79.2%, while a follow-up experiment also showed a contamination rate of 82%. These experimental results confirmed that it is not easy for health-care workers to properly put on and take off PPE (Kang et al., 2017). Accordingly, practical education in the use of PPE for infection control must be implemented systematically through personal experience, while accuracy and proficiency should be increased through effective and immediate feedback (Lee & Shin, 2016).

Since the practice of putting on PPE must also consider minimization of environmental contamination, improving performance through direct application in actual patient care situations is of the utmost importance. Therefore, rather than training that artificially simulates such situations, it is necessary to develop an education program that can increase the performance level by familiarizing nurses with patient isolation settings. This training should include personally practicing the use of PPE in isolation rooms where actual patient care is provided to infected patients, clarifying each step of the entire process associated with the use of PPE: entering the isolation room, taking off from the PPE, and exiting the isolation room.

The objective of the present study was to develop an infection control education program regarding PPE use and to test the effects of such an education program.

Methods

Study Design

The present study used a randomized controlled group pre and posttest design to test the effects of a reality-based education program developed to improve nurses' performance in using PPE to improve their ability to perform infection control. Figure 1 shows the data collection procedures.

Participants

This study was approved by the institutional review board of the relevant hospital in June 2018 and conformed to the standards in the Declaration of Helsinki.

The target population consisted of nurses working in a single general hospital (818 beds) in Gyeonggi Province, Korea. The selection criteria consisted of nurses with less than 3 years of experience in providing direct patient care who wished to participate in the study after seeing the announcement on the education schedule. The exclusion criteria consisted of nurses with more than 3 years of experience and administrative nurses.

The sample size was calculated using G-power 3.0.10. The calculation used parameters of effect size of .80, significance level (α) of .05, and statistical power ($1-\beta$) of .80, which were based on a previous study (Hur & Park, 2012) that reported that simulation education was effective in improving performance. Consequently, a sample size of 52 was deemed necessary. Considering a typical dropout rate of 10% for the experimental design used, 56 participants were selected with 28 participants allocated to each group. The objective, content, and schedule of the study were explained to the experimental and control groups, and the study was conducted after receiving their verbal informed consent to participate. Participants were randomly allocated to either the experimental or control group using the Excel random number function.

Tools and Measurement

Knowledge About Using PPE Related to Infection Control. To identify the knowledge level of new nurses with respect to the use of PPE related to infection control, we developed a tool by referencing the "Guideline for isolation precautions: Preventing transmission of infectious agents in healthcare settings" from Siegel et al. (2019) and the

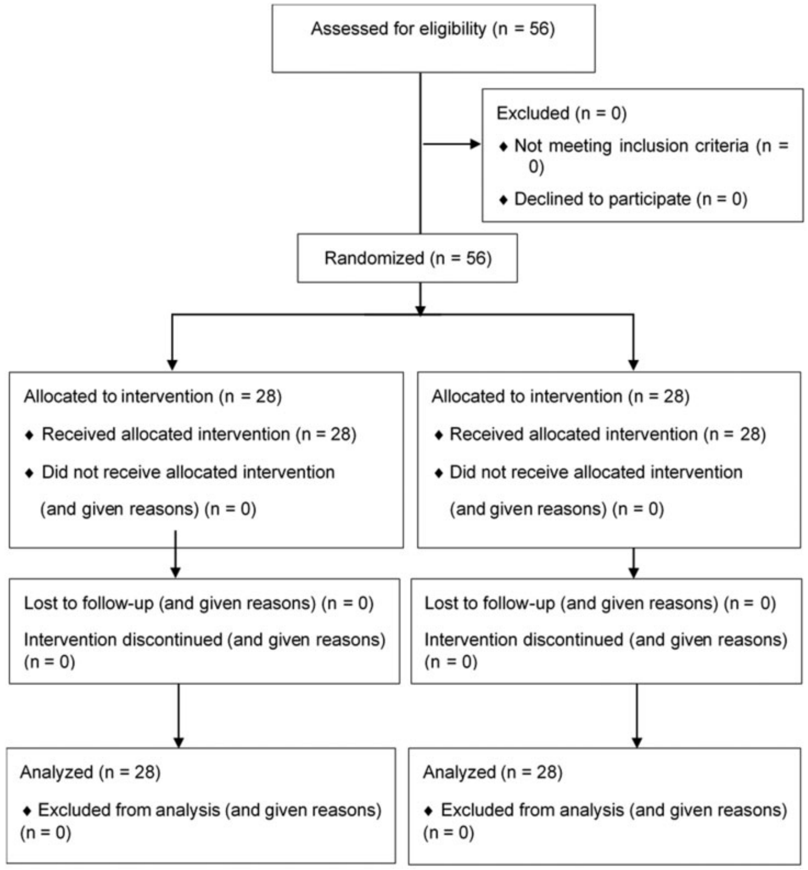

Figure 1. Data Collection Procedure.

Korean Standard Guidelines for the Prevention and Control of Infections in Healthcare (Korean Centers for Disease Control and Prevention, 2017). The tool for measuring knowledge about PPE use consisted of 17 questions across two subcategories: 3 questions concerning hand hygiene, and 14 questions concerning putting on and taking off PPE. A score of 1 was given for right answers and 0 for wrong answers. Total scores ranged 0 to 17 points, with higher scores indicating greater knowledge. Regarding reliability, the tool used in the present study had a KR20 Index of .59.

Attitude Toward Using PPE Related to Infection Control. Attitude toward using PPE related to infection control means how the person felt about using PPE. This was assessed using a modified and supplemented version of the tool used by Hu et al. (2012) and Choi (2016). Approval to use the tool was obtained from the original developer (Bin Du) by email. The tool comprised six questions measured on a 5-point Likert scale (1 = *not at all* to 5 = *very much so*). The scores of negative questions were reversed, and the total score was averaged. Mean scores ranged from 1 to 5 points, with higher scores indicating more positive attitudes toward using PPE. Regarding reliability, Cronbach's α's for the tool were .62 and .77 in Choi (2016) and in the present study, respectively.

Performance in PPE Use Related to Infection Control. Performance in PPE use was evaluated across three categories.

Number of Contamination Sites After Putting Off PPE. After taking off the PPE, ultraviolet light were used to check if any fluorescent material was left on the clothes or skin of the participants, and the number of contaminated sites was counted. Lower numbers indicated higher performance.

Area of Contamination Sites After Putting Off PPE. The area of contaminated sites appearing on clothes or skin was measured. The area was converted to a numeric value using $1\,cm^2 = 1$. Lower values indicated higher performance.

Mask Fitting. Tuberculosis (TB) mask (N95) fitting was measured while participants wore the mask using SIBATA MT-03 (SIBATA, Japan)—a mask-fitting tester widely used in clinical practice. The tester measured the degree of air leaking between the mask and face, as the leak rate (%) based on the number of air particles inside and outside the mask. A leak rate of <5% was determined as the criterion for passing. TB mask N95 is a mask with a rating of 95% filter efficiency by the National Institute for Occupational Safety and Health.

Developmental Process of the Reality-Based Education Program and Program Content. Although the reality-based education program involves simulation education using virtual patients, the researchers called it "reality-based education," because it provided a real environment in which education was conducted in an isolation room of an actual clinical site.

Selection of Educational Topic. For topic selection, "training in putting on and taking off PPE" was selected as the item for which proficiency can be acquired through practical training among the compliance items in the infection control guidelines.

Program Composition. After selecting the educational topic, scenarios were constructed to allow for acquisition of knowledge of and ability to use PPE correctly. The program was developed to practice in an isolation room, which isolates patients with infectious disease, and the scenarios were established to put on and take off the PPE in situations that are often encountered in medical institutions.

We applied a fluorescent lotion on the simulated patient (a mannequin) and bed handrails to create a contamination environment. Participants were instructed to visually confirm the contamination sites by an ultraviolet ray, and the process of putting on and taking off the PPE was monitored by participants with video taken on a mobile phone.

The program consisted of the following tasks in the order shown in Table 1: (a) put on the PPE in the pre-isolation room, (b) enter the isolation room, (c) provide patient care, and (d) take off the PPE. The TB mask-fitting test, which requires skill in putting on PPE, was

Table 1. Order of Tasks in Practical Training.

Task	Category	Content	Time
Orientation	Orientation for practical training	Explain the practical training on use of PPE.	20 minutes
Preparation of the practical training room	Preparation	Practical training is conducted in a negative-pressure isolation room with a preparation room to isolate patients with infectious disease. Use the materials in the isolation room as-is and apply fluorescent lotion over the entire body of the simulation patient and surrounding environment.	
Scenario	Initiation	The participant enters the room with an isolated TB patient with carbapenem-resistant *enterococcus*, a multidrug resistant strain. Transfer the simulation patient from a wheelchair to the bed, perform basic change in body position, and exit the room.	
On-site practical education (video filming)	Hand hygiene	Check to make sure the participant performs the tasks accurately as indicated in the checklist.	30 minutes
	Use of PPE	Enter the room after putting on the PPE (gloves, gown, and TB mask) outside the room.	
	Move patient	Move the patient to allow the contaminant to be applied to the PPE.	
	PPE removal	Take off PPE in proper order and discard it in a medical waste basket.	
	TB mask removal	Remove the TB mask.	
Feedback	Step 1: visual feedback	The educator irradiates ultraviolet light rays to allow participants to visually check for themselves whether the contaminant has touched their body. The educator checks the contamination sites in the checklist.	30 minutes
	Step 2: self-observation feedback	The participants personally check the videos acquired using a mobile phone for identification of problems and recording of checklist items.	
	Step 3: evaluator feedback	The educator compares the checklist items recorded by the evaluator and self-recorded by the participants to provide comprehensive review feedback.	
	Step 4: TB mask fitting feedback	TB mask fitting test is performed to determine whether the mask was put on successfully and feedback is provided on the proper method of use.	10 minutes

PPE = personal protective equipment; TB = Tuberculosis.

performed. If the participant failed the test, the test was repeated until the participant passed.

Upon completion of the practical training, participants checked the video to identify problems with taking off the PPE on their own, and the educator presented the problems and solutions through a checklist.

Educator Training. The education was conducted by two infection control advanced practice nurses who were not part of the research team. The educator personally performed all processes in the practical training to have a clear knowledge of all educational steps through training and gained clear understanding of the education and evaluation criteria, while measuring the total time required to perform the scenario.

Experimental Treatment. The same educational content on the basics of infection control, such as "hand hygiene" and "isolated diseases and the use of PPE," was provided to both the experimental and control groups. The educational content consisted of 1 hour of lectures, including videos.

On the second day of the experiment, the experimental group was instructed to gather at the isolation room, which has a preparation room. Each participant was instructed to put on the gown, gloves, and mask in the preparation room. After putting on the PPE, participants entered the isolation room. Once inside the isolation room, participants moved the virtual patient in a wheelchair by carrying the patient to the bed. Subsequently, participants went through the process of taking off the PPE, which was recorded by a personal mobile phone.

After removing the PPE, ultraviolet irradiation was used to identify the contamination sites, and an instrument was used to perform the TB mask-fitting test to determine whether the mask was put on successfully. If a participant failed the test, the method of use was explained, and the test was performed again. After the practical training, the checklist of the participant was compared with the checklist of the evaluator. After review, feedback was provided on the problems identified.

For ethical considerations related to fairness to the control group, they were provided feedback on problems with performance and reeducation after review of the checklist after completion of the evaluation of performance on the third day.

Data Collection

The present study was conducted between July 4 and August 22, 2018, with a pretest on the measured variables, experimental treatment, and a posttest being performed over three specified days. For allocation of the experimental and control groups, the education schedule was announced, which did not specify the group, blinding each participant about what group he or she belonged to. Both the experimental and control groups received an explanation from the researcher on the course of the study and protection of anonymity prior to taking part in the educational lecture. Nurses who consented to participate in the education program submitted their consent form, and a pretest was performed using a questionnaire to survey their general characteristics (sex, age, work experience, PPE education experience, isolation patient care experience, infection exposure experience, and work department characteristics) and knowledge of and attitude toward the use of PPE for infection control. The survey required approximately 20 minutes.

Performance was evaluated on the third day, with both the experimental and control groups being evaluated by the same method using the items on the checklist in the order they appeared. The evaluator was an infection control advanced practice nurse who conducted the education. The average time required was 5 minutes for preparation and 15 minutes for actual evaluation.

The posttest was performed immediately after the performance evaluation. Knowledge of and attitude toward the use of PPE for infection control were measured again using a questionnaire. The time required was approximately 20 minutes.

Data Analysis

SAS version 9.4 (SAS Institute, Cary, NC, USA) was used for data analyses. Data were summarized as means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Homogeneity of the experimental and control groups was tested using chi-square and independent t tests. To evaluate the effects of the reality-based education program, independent t tests were used for differences in the number and area of contamination sites, knowledge, and attitude, while a chi-square test was used for differences in pass rates according to the level of mask leakage.

Results

Participants' Characteristics

A total of 56 nurses participated in the study. Regarding sex, there were 28 women (100%) in the experimental group and 27 women (97%) and 1 man (4%) in the control group. Mean age was 25.21 ± 2.17 years and 26.29 ± 4.05 years in the experimental and control groups, respectively. Mean work experience was 22.21 ± 12.75 months and 22.14 ± 11.69 months in the experimental and control groups, respectively, with no significant differences between groups.

Concerning the question about infection control education experience regarding PPE use, 16 (57%) and 14 (50%) nurses in the experimental and control groups, respectively, had such experience, while 25 (89%) and 23 (82%) nurses in the experimental and control groups, respectively, had experience in caring for isolation patients. Furthermore, there were 19 nurses (68%) each in both the experimental and control groups who had experience with infection exposure (Table 2).

Prehomogeneity Test of Dependent Variables of the Experimental and Control Groups

The analysis of homogeneity in the knowledge of and attitude toward use of PPE showed no significant differences between groups, assuring prehomogeneity (Table 3).

Differences in Knowledge of and Attitude Toward Use of PPE

Regarding the level of knowledge concerning use of PPE by participants, the experimental group, which received training via the reality-based education program, showed no significant difference compared with the control group. There was also no significant difference in the mean attitude score between groups (Table 3).

Differences in Performance in Using PPE

Regarding the number of contamination sites for different body parts, participants' hands showed the highest number of contamination sites: 38 (90%) and 63 (71%) sites in the experimental and control groups, respectively, which was a significant difference ($p = .007$). On the face, the number of contamination sites was 3 (7%) and 9 (10%) in the experimental and control groups, respectively; however, this difference was nonsignificant. In the hair, there were no contamination sites in the experimental group and 8 (9%) sites in the control group, showing a significant difference ($p = .009$). On the trunk, the number of contamination sites was 1 (3%) and 9 (10%) in the experimental and control groups, respectively; however, this difference was nonsignificant.

The areas of contamination were 16.63 ± 24.27 and 95.41 ± 117.51 in the experimental and control groups, respectively, showing a significant difference ($p = .002$).

The success rates in the TB mask-fitting test were 68% and 50% in the experimental and control groups, respectively; however, this difference was nonsignificant (Table 3).

Discussion

In this study, we developed and applied a reality-based education program using practical education and intensive feedback based on actual clinical practice in an isolation room setting to improve nurses' performance in using PPE and tested the effects of the program. About half of the experimental and control groups responded that they had experience receiving infection control education about PPE use, which demonstrated that education about PPE use has not been made generally available. With infection control gaining greater importance, more opportunities for such education should be provided. Approximately two thirds of participants had experience with infection exposure, with most being exposed to needle stick injury. This result was higher

Table 2. Comparison of General Characteristics Between the Experimental and Control Groups.

Variables	Experimental group ($n = 28$); N (%) or $M \pm SD$	Control group ($n = 28$); N (%) or $M \pm SD$	t or χ^2	p value
Age	25.21 ± 2.17	26.29 ± 4.05	−1.23	.223
Gender			1.02	.313
Female	28 (100)	27 (96)		
Male	0	1 (4)		
Length of employment (months)	22.21 ± 12.75	22.14 ± 11.69	0.02	.983
PPE education experience			0.29	.592
Yes	16 (57)	14 (50)		
No	12 (43)	14 (50)		
Isolation patient care experience			0.58	.445
Yes	25 (89)	23 (82)		
No	3 (11)	5 (18)		
Infection exposure				
Yes	19 (68)	19 (68)		
No	9 (32)	9 (32)		

PPE = personal protective equipment.

Table 3. Differences Between the Two Groups in Knowledge, Attitude, and Personal Protective Equipment Performance Before and After Education.

	Variables	Experimental group ($n = 28$); N (%) or $M \pm SD$	Control group ($n = 28$); N (%) or $M \pm SD$	t or χ^2	p
Before	Knowledge	13.85 ± 1.15	13.68 ± 1.26	−0.01	.989
	Attitude	3.96 ± 0.60	3.95 ± 0.55	0.32	.748
After	Knowledge	15.57 ± 1.26	15.28 ± 0.98	1.54	.129
	Attitude	4.23 ± 0.48	4.14 ± 0.52	0.65	.518
	PPE performance				
	Total no. of contamination sites*	42 (100)	89 (100)	−3.96	.000*
	Hand	38 (90)	63 (71)	2.78	.007*
	Face	3 (7)	9 (10)	1.65	.107
	Hair	0	8 (9)	2.82	.009*
	Body	1 (3)	9 (10)	2.02	.052
	Contamination area (cm^2)	16.63 ± 24.27	95.41 ± 117.51	−3.47	.002*
	Mask fit test			−0.93	.354
	Pass	19 (68)	14 (50)		
	Fail	9 (32)	14 (50)		

PPE = personal protective equipment.
*$p < .05$.

than what was previously reported: 41.5% of emergency room nurses were exposed to infectious disease (Ahn et al., 2015). Nurses are usually exposed to infection because of their inexperience; as participants in the present study were nurses with less than 3 years of nursing experience, participants may have shown higher experience with infection exposure.

Concerning participants' knowledge of PPE use, both groups showed improvements in knowledge in the posttest; however, the group differences were nonsignificant. Considering that there was no significant difference in the knowledge score between experimental and control groups after applying simulation-based education in emergency situations for nurses (Yang, 2012), these results suggest that simulation-based education is not more effective in improving knowledge than traditional theory-based education. Accordingly, it is believed that, to prevent infection, it is necessary to improve knowledge through systematic and repeated education in the use of PPE.

Regarding attitude toward infection control, the group differences were again nonsignificant. Compared with the attitude toward PPE among intensive care unit staff in study by Hu et al. (2012) or critical care or emergency care nurses in studied by Kim and Lee (2016), participants in the present study showed a more positive attitude toward PPE use. The question with the most positive response was "I believe the spread of infectious diseases can be prevented by using the recommended PPE" (4.48 out of 5 points), while the question with the most negative response was "I am willing to care for infectious patients if the opportunity is presented" (3.55 out of 5 points).

It is believed that such results reflect lingering fears about transmission of infection from encountering various domestic epidemic crises, such as the Middle East Respiratory Syndrome outbreak. However, it is believed that participants recognized the importance of using PPE, and of having a positive attitude toward the use of PPE. Strategies that include support at the hospital level, support from department colleagues, and encouragement from department heads are needed. As the pandemic accelerates, health-care workers are putting themselves at high risk from COVID-2019. In this situation, it is vital that health-care workers can access and proper use of PPE (The Lancet, 2020).

Performance in using PPE was significantly higher in the experimental group that received the reality-based education program than in the control group. Moreover, the experimental group also showed greater changes in performance after the training than did the control group. The area of the body with the highest number of contamination sites was the hands for both groups, followed in order by the face, trunk, and hair. Such results supported the fact that most microbial transmission occurs by direct contact and that the hands are the primary cause of cross infection or environmental contamination (Suleyman et al., 2018). The entire area of contamination was significantly higher in the control group than in the experimental group. Although previous studies identified and examined contamination sites, there are no studies that quantified the effects of programs through actual measurement of the area of contamination sites. Therefore, comparisons to other studies cannot be made.

In the control group, the cause of hand contamination was grabbing the outer part of the glove when taking off the glove and spreading the contamination by cross touching the outside of the contaminated gown, which was sometimes unknowingly reversed during the rolling process. Moreover, hand contamination was increased by unconsciously touching the front of the mask when taking off the TB mask instead of removing it by the strings. These findings were similar to the results in Kang (2018), who reported that contamination occurred from the bare hand touching the contaminated glove in the process of taking off the gloves by flipping them inside-out, and that bare hands were contaminated by touching the outer surface of the gown when gloves were taken off before the gown. In addition, by not following the order in which the PPE should be taken off, the trunk became contaminated during the process of taking off the gloves and gown together, while contamination of the face occurred by trying to take off the gown by lifting over the head instead of ripping it off.

PPE has become an important and emotive subject during the current coronavirus disease 2019 epidemic. Appropriate use significantly reduces risk of viral transmission. PPE should logically be matched to the potential mode of viral transmission occurring during patient care—contact, droplet, or airborne (Cook, 2020). PPE must be taken off in order according to the guidelines on proper removal to reduce self-contamination and contamination of the clinical environment (Andonian et al., 2019). Not following the order of removal can increase the severity of contamination; however, existing studies have demonstrated that health-care workers do not always follow these guidelines (Zellmer et al., 2015). A recent study reported that PPE doffing errors impacted on health worker contamination with multidrug-resistant organism and 39.2% of healthcare workers made multiple doffing errors following a patient interaction (Okamoto et al., 2019).

The large difference concerning contamination between the experimental and control groups demonstrated that the reality-based education program conducted in an isolation room environment, similar to an actual clinical setting, had a direct effect on improving performance in using PPE. Moreover, in a review of another study that showed the effect of individual feedback from health-care workers recording videos of putting on and taking off PPE in person and watching the videos together (Kang et al., 2017), the current findings support the fact that various kinds of feedback can affect performance.

Furthermore, successful TB mask-fitting was also tested as an additional item to determine performance in using PPE. The differences were nonsignificant; however, in the current situation, in which TB mask-wearing education is not mandatory, the high success rate shown by the experimental group may demonstrate the clinical significance of such education.

Strengths and Limitations

The study demonstrates the importance of emphasizing compliance with guidelines by reporting data on contamination that occurs when taking off PPE, and interventional education on infection control is effective in improving nurses' performance.

One limitation of this study is that we recruited nurses from a single hospital to ensure homogeneity, and therefore, the diffusion effect of the experimental and control groups could not be completely controlled. Consequently, repeated studies using this program with nurses from other hospitals are needed. Additional studies are needed concerning whether applying the reality-based education program to infection control education from nurses with diverse work experience can continue to improve their PPE use performance. Moreover, repeated studies are needed concerning whether applying a reality-based education program to various occupations can show improvement in PPE use performance.

Implications for Practice

PPE is a vital aspect of infection control, and the present findings showed that the novel reality-based education program was an effective program that can improve performance and understanding of using PPE among nurses through onsite education. It can be applied immediately in situations with a high probability of infection transmission. Since the program was conducted in an isolation room that represented an actual clinical setting, the findings can also be applied directly to infection control education for clinical nurses.

Conclusions

Converting the degree of contamination due to improper use of PPE to numeric values, we further emphasized the importance of correctly using PPE, while also emphasizing the importance of infection control by demonstrating the process and sites of contamination. Such aspects inform the advancement of nursing education. Furthermore, by applying a TB mask-fitting test using an instrument, the effect of education was increased to qualitatively improve nurses' ability to use PPE.

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Declaration of Conflicting Interests

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