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ORIGINAL ARTICLE

Effects of a simulated emergency airway management education program on the self-efficacy and clinical performance of intensive care unit nurses

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Abstract

Aim: To examine the effects of a simulated emergency airway management education program on the self-efficacy and clinical performance among nurses in intensive care units.

Methods: A one-group, pre- and post-test design was used. Thirty-five nurses who were working in adult intensive care units participated in this study. The simulation education program included lectures, skill demonstration, skill training, team-based practice, and debriefing. Self-efficacy and clinical performance questionnaires were completed before the program and 1 week after its completion. The data were analyzed by using descriptive statistics and the paired *t*-test to compare the mean differences between the pre-test and post-test. The scores before and after education were compared.

Results: After education, there was a significant improvement in the nurses' self-efficacy and clinical performance in emergency airway management situations.

Conclusion: Simulation education effectively improved the self-efficacy and clinical performance of the nurses who were working in intensive care units. Based on the program for clinical nurses within a hospital, it will provide information that might advance clinical nursing education.

Key words: airway management, clinical competency, nurses, self-efficacy, simulation training.

INTRODUCTION

Medicine is a highly complex field and its practice changes rapidly. Nurses must routinely make clinical decisions quickly, autonomously, and skillfully (Kang, Kim, & Ryu, 2011). They must assess patients' present condition, predict what will happen next, and take steps to prevent the situation from worsening (McEnroe Ayers & Lappin, 2004). Intensive care units (ICUs) are special departments within the hospital that provide close monitoring, care, and treatment for patients with severe, life-threatening illnesses and injuries 24 h per day. Emergency situations occur frequently, sometimes when the patient is brought in, sometimes when a patient's condition suddenly deteriorates. Consequently, nurses in ICUs must have high-quality knowledge and be well-trained and be able to use many different, often complex, medical devices (Dondorp & Haniffa, 2014).

One of the most important skills of ICU nurses is airway management. Operating rooms in hospitals are routinely fully equipped with the necessary supplies and specialized staff and the condition of the patient's airway is known before surgery commences. By contrast, nurses in ICUs often face emergency situations, such as an unconscious patient with a difficult airway or a patient facing respiratory failure who has impaired gas exchange. When confronted with such situations, nurses

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must decide immediately whether intubation is necessary and what medicines and devices should be used (Kovacs *et al.*, 2004). However, unpredicted emergency airway situations are associated with a relatively high frequency of complications. The complexity and the intense demand to act both immediately and correctly can cause medical staff to become flustered and to fail to manage the situation properly (Kim & Hwang, 2010), which can lead to tragic results (Kim *et al.*, 2007).

In order to improve the responses of the nursing staff in ICUs, it is important to develop simulation education programs (Lee, Kim, Kang, Kim, & Kim, 2008) that provide great opportunities for practicing clinical decision-making and high-risk skills without harming anyone (Long, 2005). Indeed, two studies showed that simulation education programs on basic and advanced cardiac life support and resuscitation effectively increased the knowledge of medical staff about treatments and equipment and boosted their confidence in emergency situations (Flisher, 1992; Hoadley, 2009). Moreover, Kim and Pak (2013) showed recently that a simulation education program improved the self-efficacy of nurses; specifically, it improved their confidence towards their ability to acquire theoretical and practical knowledge.

Although the simulation was introduced in nursing education, only a small number of studies have proved their effectiveness for nurses in clinical practice. Most of the research was done on new nurses. In addition, there is a lack of research on professional nurses and career nurses who require clinical reasoning ability (Kim, Park, & Shin, 2013).

Benner (1984) proposed five levels of practice for nursing (novice, advanced beginner, competent, proficient, and expert). Novice and advanced beginners act in clinical situations based on rules and protocol. They focus on organization and prioritization of their task. Competent nurses set the priorities of tasks and care plans. Proficient nurses quickly recognize and integrate clinical situations based on their judgment. Expert nurses operate from a deep understanding of the total situation; their performance is fluid, flexible, and highly capable (Benner, Tanner, & Chesla, 1992).

Emergency airway management must be performed by competent, proficient, and expert nurses because only these nurses have suitably fast decision-making skills, can perform the various tasks in airway management accurately, can handle difficult crisis situations, and can adequately supervise and manage novice and advanced beginner nurses. Therefore, a simulation education program for emergency airway management that targets competent, proficient, expert nurses is needed.

Nurses' self-efficacy is defined as the belief of nurses that they can complete diverse tasks and reach their goals (Song, 2009). A strong sense of self-efficacy enhances nurses' self-confidence regarding their performance and knowledge. Nurses who are assured of their capabilities are likely to set challenging goals for themselves and maintain a strong commitment to them (Bandura, 1977). They also can deal competently with the stress that is associated with emergency situations because they adapt readily to new circumstances (Silberman, Litwin, Fernandez-Fernandez, & Panzarella, 2016). Simulation education programs have been shown to increase the self-efficacy of novice and student nurses (Franklin & Lee, 2014; Leigh, 2008). Simulation can apply knowledge voluntarily in situations that are similar to clinical situations and reduce the fears about the actual situation. Therefore, self-efficacy can be increased through simulation (Kim & Kang, 2016).

Nurses are considered to have good clinical performance when they can deal effectively with clinical situations and obtain the expected results (Barrett & Myrick, 1998). Nurses in the ICU must be able to perform effectively when they are confronted with emergency high-risk situations, such as emergency airway management, because it significantly affects patients' prognosis. In order to obtain good clinical performance in emergency airway management situations, nurses must have ample self-efficacy because it correlates significantly with good clinical performance. Moreover, Kim and Kang (2015) showed that a simulation education program for new nurses in ICUs and emergency rooms improved their clinical performance. However, to the best of the authors' knowledge, studies that assess whether simulated education programs on emergency airway management can increase both the self-efficacy and clinical performance of ICU nurses have not yet been reported.

Therefore, a simulation education program on emergency airway management is likely to improve ICU outcomes; however, such programs and literature addressing their effectiveness are scarce. Consequently, the authors developed and implemented a simulation training program that provided career ICU nurses with the opportunity to practice emergency airway management. It was assessed how the program affected the self-efficacy and clinical performance of the career ICU nurses.

METHODS

Design and setting

This study was a quasi-experimental study of one-group pre–post design. The nurses who participated in a simulation education program on emergency airway management between October and December, 2015 at a tertiary hospital in Seoul, South Korea, were enrolled as the participants.

Participants

The target participants were nurses with a grading of more than CN II who worked in the ICU. CN II nurses are the equivalent of competent nurses in Benner's (1992) model. CN I nurses comprise both novice and advanced beginner nurses and CN III and IV nurses are proficient and expert nurses, respectively. It was felt that including at least CN II nurses was the best target audience of the simulation education program because they play key roles in clinical practice and could teach new nurses after the program.

The sample size was determined by using the G* power 3.1.8 program (Heinrich Heine University, Dusseldorf, Germany). According to the power analysis formula (Cohen, 1988), a medium effect size of 0.5, a significance level of 0.05, and a power of 0.8, the minimum sample size was 34. Considering a 5% drop-out rate, the final number of participants was 36. Given that the effect of the education on self-efficacy and clinical performance would be assessed 1 week after the class ended, a drop-out rate of 10% was expected. The class was planned to be taught four times with 12 people in each class because of the nature of the simulation education and space restrictions. However, 70 participants attended the class, which was much higher than expected. In order to minimize the selection bias, 36 participants were randomly selected from the 70 who attended the classes. One participant was excluded who did not complete the questionnaires; therefore, 35 participants were considered for the analyses.

Intervention

Developing the education program

Eighty nurses who were working in ICUs participated in a survey regarding the needs of nurses for education on emergency airway management. The survey's results showed that there was a need for theoretical and simulation education in various areas, including rapid sequence intubation (RSI), the main types of medicine, how to assess and provide nursing care when a patient has a difficult airway, and the devices (e.g. extraglottis devices) and methods that are available when faced with failed intubation. After choosing the training topic, the learning goals were set and an educational plan and scenarios that would yield the clinical performance and problem-solving skills that are needed for proper emergency airway management in the ICU were established.

The educational plan was based on analyzing the common scenarios and related references regarding emergency airway management in ICUs. The content validity of the educational plan and scenarios was determined by a pulmonologist and two career nurses who worked at a simulation education center and who oversaw airway management education.

Implementing the educational program

Lecture. The lecture started with a simple video that showed a case of adult intubation and a description of an algorithm for safe emergency airway management. The method of assessing a difficult airway and the concept behind, and the nature of RSI, then were explained. The algorithm for emergency airway management that was used in a research institute was grafted onto these instructions and the support system. The role, dosage, and administration directions of RSI medicines that are used frequently in the research institute next were described. Then, the anatomy of the airway tract was described and the reason why certain positions (e.g. the sniffing position or the ear-to-sternal notch position) must be used to improve one's vision during intubation was provided.

Difficult and failed airway management were illustrated by pictures and simple examples. In addition, pictures were used to depict the available tools and devices and the indications for emergency airway management that were used in the research institute. The lecture was 50 min in duration (Table 1).

Simulation. The training room was established to resemble a typical ICU setting; consequently, it contained the standard emergency cart and the supplies, devices, and medicines for emergency airway management that are used in a research institute. The aim was to make the participants feel that they were in familiar surroundings and could cope with the simulated clinical situation. There were two training suites. Suite 1 was used for simulation training with a difficult airway management scenario. Suite 2 was used for simulation training with a scenario comprised of failed airway management and RSI adaptation. The two simulations together took

Table 1 Contents of the simulation-based education program on emergency airway management

Period	Learning objectives	Intervention content
The pretest was conducted from October 6 to October 10 and the post-test was conducted 1 week after the training; education was carried out from November 4 to November 27 for a total of four times	• Understanding the concept of rapid sequence intubation • The method and concept of assessing a difficult airway • The management of a failed airway	Lecture (50 min) Use visual materials, such as photographs and a simple video, on education topics, including the indications of intubation, universal emergency airway algorithm, rapid sequence intubation, back-up system of airway management, difficult airway management, failed airway management, and the available devices of airway management Simulation (90 min) Established to resemble a standard intensive care unit setting Practical training: After demonstration by the educator, practice videolaryngoscope, Frova intubating introducer, i-gel, and bag mask ventilation Rapid sequence (RSI) intubation: How to adapt RSI in an emergency airway situation, which medicines to select, and to monitor vital signs Difficult airway management: Making the decision whether intubation is necessary, preparing the supplies and medicines for intubation, and preparing the support system Failed airway management: Choose devices to use when an intubation fails

90 min; each simulation lasted 45 min. The participants were placed into teams of five-to-six that were rotated between the suites so that all the participants underwent both sets of simulation training (Table 1).

The difficult airway management simulation training in Suite 1 involved an adult manikin (Laerdal Airway Management Trainer; Laerdal, Laerdal, Norway). After demonstration by the educator, the manikin was used by the participants for 20 min to practice how to use a videolaryngoscope (Glidescope Ranger; Verathon, Bothell, WA, USA) and a Frova intubating introducer (Cook Medical, Bloomington, IN, USA). Then, the difficult airway management simulation was run for 10 min. Next, the participants were provided with feedback during a 15 min debriefing session.

During the difficult airway management simulation, SimMan 3G (Laerdal) served as a human patient simulator. The educator provided each participant with a scenario of a respiratory failure patient who required a tracheostomy because of a history of having a difficult airway. The virtual patient had a stiff and swollen airway, had difficulty breathing, and spoke in a hoarse voice due to radiation treatment for supraglottic cancer.

The learning goals consisted of successfully and safely intubating a patient with a difficult airway by first assessing the patient's respiratory condition, making the decision about whether intubation was necessary, preparing the supplies and medicines for intubation, and preparing the support system for the possibility that intubation fails.

The failed airway management and RSI adaptation simulation training in Suite 2 started by dividing the participants into two teams. One team was shown how to adapt RSI in an emergency airway situation, which medicines to select, and how to monitor vital signs. The SimMan ALS (Laerdal) served as the sample of a patient who had pneumonia and end-stage renal failure with dialysis. The simulation took 5 min. This was followed by a 10 min debriefing session. Then, an adult manikin (Laerdal Airway Management Trainer) was used to practice failed airway management for 10 min after demonstration by the educator. All the members practiced how to use extraglottic devices (i-gel; Intersurgical, Workingham, UK) and bag mask ventilation.

The second team, which did not undergo RSI simulation, used a SimMan ALS (Laerdal) for 10 min to practice failed airway management. The scenario was that the patient was diagnosed with bladder cancer and sepsis that was caused by pneumonia. The patient's metabolic acidosis worsens and emergency airway intubation becomes necessary because of dyspnea. Extraglottic devices or bag mask ventilation and the support system must be used properly. Moreover, the supplies that are needed when intubation fails and oxygenation is not maintained must be selected and prepared. After the simulation education, feedback was provided during a 10 min debriefing session.

Instruments

Self-efficacy

Nurses' self-efficacy in emergency airway management situations was measured by using a self-efficacy questionnaire that was based on a tool from Lee and Jung (2014). The content validity of the original questionnaire was determined by two pulmonologists and three career nurses who had worked for >10 years in their field. All but one of the 11 questions in the tool by Lee and Jung was deemed to have an acceptable content validity index (CVI) of ≥0.8. The remaining question "I know proper treatment with oxygen along with a patient's condition" had a CVI of only 0.6; therefore, it was removed. Two of the final 10 questions had a CVI of 0.8: "I can accurately judge situations that require emergency airway management" and "I can apply extraglottic devices." This question and the other seven had a CVI of 1.0: "I know the main anatomy of the airway." The authors obtained permission to use this modified version from Lee and Jung by email.

Each question from the self-efficacy questionnaire was answered by using a five-point Likert scale: 1 = "Strongly disagree" to 5 = "Strongly agree." Higher scores indicated higher self-efficacy. The questionnaire that was used by Lee and Jung (2014) had a Cronbach's α of 0.86. The Cronbach's α of the modified questionnaire that was used in this study was 0.90.

Clinical performance

The nurses' clinical performance in emergency airway management situations was measured by using a clinical performance questionnaire that was based on a tool from Kim and Jang (2011). The validators described above also assessed this tool, which consisted of 43 questions. Sixteen items that were not related to airway management were excluded: chest pain assessment and management, electrocardiogram rhythm analysis, the use of defibrillators etc. Of these, 27 questions that had a CVI of ≥0.8 were included in the modified questionnaire.

There were five subdomains in the modified clinical performance questionnaire: (i) the assessment subdomain (eight questions) comprised: evaluation of the patients' respiratory condition by using accessory muscles, respiratory sound, ventilation, and oxygenation levels, identifying a difficult airway, making the decision to intubate, and measuring and monitoring vital signs; (ii) intubation (eight questions) comprised: preparing and confirming devices, positioning the devices, providing oxygenation with a bag-valve mask, choosing medicines and calculating the dosage, and intubation methods; (iii) confirmation (six questions) comprised: confirming chest movement, use of capnography, confirmation of the place of the endotracheal tube, performing auscultation, performing chest X-rays, and fixing the endotracheal tube; (iv) rescue devices (four questions) comprised: indications for extraglottis devices and the application of bag mask ventilation; and (v) surgical airway (one question) comprised: the indications and preparations for cricothyroidotomy. Examples of questions about clinical performance were: "I can evaluate the patient's breathing status," "I can prepare for tracheal intubation," "I can see how to confirm that the tracheal intubation is inserted in the correct position," "I know the indications of extraglottic devices," and "I know the indications of cricothyroidotomy and I can prepare for cricothyroidotomy."

Each question was answered by using a five-point Likert scale: 1 = "Strongly disagree" to 5 = "Strongly agree." Higher scores indicated better clinical performance. Permission to use this modified version was obtained from Lee and Jung by email. The original questionnaire had a Cronbach's α of 0.96. The Cronbach's α of the modified questionnaire that was used in this study was 0.97.

Data collection

This study collected data by using the form of self-test of the pre–post educational program. Self-efficacy and clinical performance were examined from October 6 to October 10 and the post-test was conducted 1 week after the training. Education was carried out from November 4 to November 27, for a total of four times.

Ethical considerations

This study was approved by the Institutional Review Board at Asan Medical Center, Seoul (approval no. 2015-0509). Consent was obtained from the participants after they were informed about the study.

Data analysis

The data were analyzed by using IBM SPSS Statistics for Windows v. 21.0 (IBM Corporation, Armonk, NY, USA). The participants' general characteristics were expressed as N (%) or mean ± standard deviation. A paired *t*-test was used to test whether the simulation education improved the self-efficacy and clinical performance in emergency airway management; *P*-values of <0.05 were considered to be statistically significant.

RESULTS

Thirty-five nurses (91.4% female, mean age = 28.11 ± 4.05 years) participated in the study. The nurses' general characteristics are presented in Table 1. The highest educational level of the majority ($n = 32$, 91.4%) was a Bachelor's degree. The remaining three participants had a diploma or Master's degree. The majority ($n = 23$, 65.7%) had worked in ICUs for <5 years. The remainder had worked in ICUs for 5–9 ($n = 7$, 20.0%) or ≥10 ($n = 5$, 14.3%) years. The vast majority were CN II nurses ($n = 32$, 91.4%). The remaining three (8.6%) were CN III nurses. Fifteen (42.9%) participants had never previously experienced simulation-based education. Twelve (34.3%) and eight (22.8%) had experienced it once and twice, respectively (Table 2).

The score for self-efficacy was 3.40 ± 0.33 before education and 3.98 ± 0.38 after education. The score after education was 0.58 higher than before. There were statistically significant differences ($t = 6.79$, 95% confidence interval [CI]: 0.45–0.71, $P < 0.001$). The score for clinical performance was 3.90 ± 0.47 before education and 4.23 ± 0.45 after education. The score after education was 0.33 higher than before. There were statistically significant differences ($t = 3.09$, 95% CI: 0.21–0.45, $P = 0.003$). All subdomains of clinical performance were significant, except for "confirmation" (Table 3).

The five individual items in the clinical performance subdomains that exhibited significant improvements after the education are shown in Table 3. The largest improvements were in "indications for extraglottic devices" in the rescue devices. The score was 2.94 ± 0.87 before education and 4.03 ± 0.57 after education. The score after education was 1.09-fold higher than before. There were statistically significant differences ($t = 6.17$, 95% CI: 0.73–1.45, $P < 0.001$). Also, "indications for cricothyroidotomy" in a surgical airway was the second-largest improvement item. The score was 2.60 ± 0.74 before education and 3.60 ± 0.65 after education. The score after education was 1.00 higher than before. There were statistically significant differences ($t = 6.02$, 95% CI: 0.76–1.24, $P < 0.001$).

DISCUSSION

This study showed that a simulation education program on emergency airway management significantly improved the self-efficacy and clinical performance of career nurses who work in ICUs. These results are consistent with a study that showed that simulation-based education significantly improved the self-efficacy of student nurses in professional heart resuscitation situations (Byun, Kwon, & Suh, 2014). Furthermore, simulation-based education has been shown to increase the self-efficacy of nurses who were working with airway management significantly better than did a lecture-based approach (Lee & Jung, 2014).

The improvements that were seen after the program might partially reflect the fact that the design of the program was based on the results of a survey that sought to identify the educational needs of the target participants. Also, the scenarios were constructed based on cases that occurred in the ICU. Moreover, in order to increase the reality of the training setting, the training room was established to resemble a standard ICU setting: it included the standard emergency cart and all the supplies, medicines, and support systems that are needed in an ICU for managing emergency airway situations. The fact that the participants were educated with colleagues from the same ICU also might have contributed to the positive outcomes of the program. These experiences reduced the fear of emergency situations and the achievement in the problem-solving process improved self-efficacy by increasing confidence.

Self-efficacy is the result of practical performance and substitute experience and compliments and encouragement from others (Bandura, 1977). During the simulation training in this study, the participants watched the other participants in emergency airway management situations that, if they encountered them in reality, could

Table 2 General characteristics of the participants (n = 35)

Characteristic	N (%) or Mean ± SD
Age (years)	28.11 ± 4.05
<30	26 (74.3)
30–39	8 (22.8)
≥40	1 (2.9)
Sex	
Female	32 (91.4)
Male	3 (8.6)
Educational level	
Diploma	1 (2.9)
Bachelor's degree	32 (91.4)
Master's degree	2 (5.7)
Years worked in an intensive care unit	5.09 ± 4.04
<5	23 (65.7)
5–9	7 (20.0)
≥10	5 (14.3)
Clinical nurse level	
II	32 (91.4)
III	3 (8.6)
Frequency of simulation-based education experience	0.80 ± 0.80
None	15 (42.9)
1	12 (34.3)
2	8 (22.8)

SD, standard deviation.

cause them to become flustered. In addition, during the debriefing, the participants reviewed their performance, shared ideas with others, and consolidated what they had learned during the program. Moreover, the participants could share with each other their concerns about difficult clinical situations that were being depicted and identify the issues that needed improvement. Such sharing behavior promoted voluntary interactions between the participants, increased their participation in the program, and improved their confidence.

This study showed that a simulation education program on emergency airway management significantly improved the clinical performance of career nurses who work in ICUs. This result was consistent with a study of new nurses who were working in emergency cardiopulmonary management and who performed significantly better after simulation-based education than after lecture-based education (Kim & Jang, 2011). The improvements in clinical performance that were observed in this study might reflect the fact that the program used various complex scenarios that reflected "real" clinical situations. Moreover, this program provided both lectures and skill-practicing that could resolve the situation before introducing the simulations. It has been shown that combining lectures with simulation-based skills training resulted in better clinical performances than when a lecture was used with only partial skills training (Kovacs *et al.*, 2004).

It also was found that the individual clinical performance items that improved the most after the program were the indications for extraglottic devices and cricothyroidotomy. The reason for the marked improvements in these areas is that extraglottic devices and cricothyroidotomy are the last resort for maintaining patients' airways and for providing oxygen in emergency airway management situations with failed intubation or during difficult intubation. Consequently, these techniques are used relatively infrequently in ICUs and the career ICU nurses who participated in the study had

Table 3 Changes of self-efficacy and clinical performance in emergency airway management of career nurses in intensive care units (n = 35)

Variable	Pretest Mean ± SD	Post-test Mean ± SD	Difference Mean	(95% CI)	t-value (d.f. = 34)	P-value
Self-efficacy	3.40 ± 0.33	3.98 ± 0.38	0.58	(0.45–0.71)	6.79	<0.001
Clinical performance	3.90 ± 0.47	4.23 ± 0.45	0.33	(0.21–0.45)	3.09	0.003
Assessment	3.94 ± 0.43	4.16 ± 0.38	0.22	(0.10–0.34)	2.26	0.027
Intubation	4.04 ± 0.60	4.31 ± 0.48	0.27	(0.10–0.44)	2.11	0.039
Confirmation	4.17 ± 0.61	4.34 ± 0.58	0.17	(−0.01–0.35)	1.24	0.219
Rescue devices	3.42 ± 0.64	4.17 ± 0.53	0.75	(0.52–0.98)	5.41	<0.001
Indication for extraglottic devices	2.94 ± 0.87	4.03 ± 0.57	1.09	(0.73–1.45)	6.17	<0.001
Bag mask ventilation	3.66 ± 0.73	4.29 ± 0.62	0.63	(0.37–0.89)	3.89	<0.001
Single-hand mask hold	3.51 ± 0.78	4.17 ± 0.62	0.66	(0.40–0.92)	3.90	<0.001
Two-hand mask hold	3.56 ± 0.79	4.20 ± 0.58	0.64	(0.37–0.91)	3.85	<0.001
Surgical airway						
Indication of cricothyroidotomy	2.60 ± 0.74	3.60 ± 0.65	1.00	(0.76–1.24)	6.02	<0.001

CI, confidence interval; SD, standard deviation.

relatively less exposure to these techniques. Consequently, the training on extraglottic devices and cricothyroidotomy in the program was demanded by a large majority (87%) of the nurses; they recognized that such education would help them and other career nurses to take a leading role in emergency airway management situations. Therefore, the nurses were actively participating in their education and thus were particularly likely to effectively learn from the program.

Simulation education programs on airway management also improve the self-efficacy and clinical performance of other medical staff: pediatric and emergency medicine residents, pediatric ICU nurses, and respiratory therapists (Nishisaki *et al.*, 2011). This suggests that future studies that evaluate the effect of multidisciplinary simulation programs on effective emergency airway management are warranted.

Limitations of the study

The study had some limitations. First, it was a single-center study; therefore, the generalizability of the results to other hospital settings is unclear. Second, the posteducation surveys were performed only 1 week after the simulation education classes; therefore, whether the effects were sustained over a longer term remains unclear. Third, this study might threaten internal validity because knowledge and clinical performance were measured by using a self-report questionnaire. Therefore, there is also a need for an objective assessment of performance. Fourth, the confounding variable and selection bias were not controlled because this study was a quasi-experimental study of one-group pre–post design. Therefore, it is recommended that randomized, controlled trials with a pre–post control group to explain the causality should be instituted, such that they can generalize the results.

CONCLUSION

This study showed that a simulation education program on emergency airway management significantly improved the self-efficacy and clinical performance of career ICU nurses. The results might be useful for clinical nurses in general, especially because a study of this nature has not been conducted before. Moreover, as the program was based on clinical nurses within a hospital, it provides information that could advance clinical nursing education.

This study also yielded a few recommendations. First, the effect of appropriate simulation education on new nurses should be examined more closely. Second, the effect of simulation education on self-efficacy and clinical performance should be measured at various intervals after the classes in order to assess its long-term effectiveness. Third, a study that determines the "cycle of education" also should be conducted.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

M-J. H., J-R. L., Y-J. S., J-S. S., H-R. C., Y-H. O, and S-H. L. designed the study; M-J. H., J-R. L., Y-J. S., J-S. S., and E-J. C. conducted the intervention; M-J. H. and J-R. L. conducted the data analyses. All the authors contributed to the writing of the manuscript.

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