Australian Critical Care 32 (2019) 218–222

Contents lists available at ScienceDirect

Australian Critical Care

journal homepage: www.elsevier.com/locate/aucc

Research paper

Implementing an educational program to improve critical care nurses' enteral nutritional support

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ARTICLE INFORMATION

Article history:
Received 17 November 2017
Received in revised form
29 March 2018
Accepted 1 April 2018

Keywords:
Critical care nursing
Enteral nutrition
Education
Non-randomized controlled trials as topic

ABSTRACT

Background: Although international nutrition societies recommend enteral nutrition guidelines for patients in intensive care units (ICUs), large gaps exist between these recommendations and actual clinical practice. Education programs designed to improve nurses' knowledge about enteral nutrition are therefore required. In Korea, there are no educational intervention studies about evidence-based guidelines of enteral nutrition for critically ill patients.
Objectives: We aimed to evaluate the effects of an education program to improve critical care nurses' perceptions, knowledge, and practices towards providing enteral nutritional support for ICU patients.
Methods: A quasi-experimental, one-group study with a pre- and post-test design was conducted from March to April 2015. Nurses (N = 205) were recruited from nine ICUs from four tertiary hospitals in South Korea. The education program comprised two sessions of didactic lectures. Data were collected before (pre-test) and 1 month after (post-test) the education program using questionnaires that addressed nurses' perceptions, knowledge, and practices relating to providing enteral nutritional support for ICU patients.
Results: After the program, nurses showed a significant improvement in their perceptions and knowledge of enteral nutrition for ICU patients. There was a significant improvement in inspecting nostrils daily, flushing the feeding tube before administration, providing medication that needs to be crushed correctly, changing feeding sets, and adjusting feeding schedules.
Conclusions: The findings indicate that an enteral nutrition education program could be an effective strategy to increase critical care nurses' support for the critically ill. This education program can be incorporated into hospital education or in-service training for critical care nurses to strengthen their perceptions and knowledge of nutritional support in the ICU. This may improve the clinical outcomes of ICU patients.

1. Introduction

Enteral nutrition is the primary method to provide nutritional support for critically ill patients who cannot eat orally. Early enteral nutrition has effects on a reduction in infectious complications, length of stay in intensive care unit (ICU), and hospital cost in critically ill patients, compared to delayed nutrition.[1] Despite advancements in the techniques and equipment for enteral nutrition, inadequate nutritional intake is a significant issue for critically ill patients.[2,3] Underfeeding has detrimental effects on ICU patients' clinical outcomes including delayed wound healing, prolonged mechanical ventilation, increased infectious complications, increased length of stay in ICU, and higher mortality.[4,5]

Critical care nurses are responsible for assessing critically ill patients' nutritional status, initiating and managing enteral or parenteral nutrition, monitoring potential complications, and evaluating and revising nutrition goals.[6] Evidence-based guidelines for nutritional support are intended to be the basis for the standardisation of nurses' practice and contribute to improvements in

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https://doi.org/10.1016/j.aucc.2018.04.001
1036-7314/

nutritional intake.[7] Although some international nutrition societies recommend enteral nutrition guidelines for ICU patients, large gaps between these recommendations and actual clinical practice remain.[8] Previous studies reported that lack of knowledge and perception of the importance of nutrition by nurses and placing a low priority on nutrition in the ICU may contribute to the inadequate translation of these guidelines to practice.[3,6]

Critical care nurses' perceptions, knowledge, and practices towards enteral nutrition can impact patients' nutritional status by preventing insufficient provision of enteral nutrition.[9,10] Previous studies described favourable perceptions of critical care nurses regarding the importance of enteral nutrition; however, nurses lack knowledge and understanding about enteral nutrition,[7,11] suggesting a need for them to be provided with information about nutritional support.[11] It is possible that enhancing critical care nurses' knowledge may contribute to improved nursing practices relating to enteral nutrition.

Critical care nurses typically obtain enteral nutrition information from colleagues, rather than scientific articles or academic conferences.[12] Hospital education and in-service training may provide an alternative to more formal educational programs.[9] To date, no study has been conducted on educational interventions using evidence-based guidelines for enteral nutrition of critically ill patients in Korea. This may be because the priority of enteral nutrition is lower than those of other treatments in the ICU.[11] Consequently, the development of a nutritional education program with up-to-date evidence is the first step to enhance critical care nurses' perceptions, knowledge, and practices.

Therefore, we developed an education program specific for enteral nutrition for critically ill patients. Our aims were to assess if a locally developed educational program improved Korean critical care nurses' perceptions, knowledge, and practices towards providing enteral nutritional support for critically ill patients. We developed the following research question: To-what extent does an education program about enteral nutrition improve the perceptions, knowledge, and practices of critical care nurses? The following hypotheses in the study were developed after participation in the education program: (i) critical care nurses will demonstrate improvement in perception of nutrition support for critically ill patients; (ii) critical care nurses will demonstrate improved knowledge about enteral nutrition; and (iii) critical care nurses will demonstrate improved clinical practices around enteral nutrition following participation in the enteral nutrition education program.

2. Methods

2.1. Design and sample

This was a quasi-experimental, one-group, pre- and post-test design. Critical care nurses were recruited from nine medical and surgical ICUs from four tertiary hospitals in two major cities in South Korea. All nurses responsible for provisions of nutritional support in the ICUs were eligible for inclusion in the study. Paediatric ICUs were excluded because their nutritional guidelines are different from those available for adult patients.

2.2. Instruments

The learning transfer model by Richey[13] guided this study. It provided the rationale for instructional design to promote perception changes, knowledge gains, and transfer of training as educational outcomes. For effective training, the roles of learner characteristics and work environment need to be considered. Therefore, the questionnaire consisted of four sections: critical care nurses' (i) perceptions, (ii) knowledge, (iii) practices in relation to enteral nutrition for ICU patients, and (iv) a demographic survey. The questionnaire's content validity was tested by a professional group that consisted of three ICU team managers, three critical-care advance practice nurses, and three professors from a nursing or nutrition department. It was piloted by 10 critical care nurses working in a hospital who were not involved in this study. Based on their comments, the questionnaire was revised for clarity.

Perceptions of enteral nutrition. Critical care nurses' perceptions were assessed using the Korean version of a scale developed by Persenius et al.[12] The scale consisted of 15 items categorised into three sections: responsibility, knowledge, and documentation. For example, nurses were asked, "To what extent do you have the responsibility, satisfying knowledge, and support from documentation regarding enteral nutrition?" Each item was rated using a 5-point Likert scale that ranged from 1 (*a very small extent*) to 5 (*a very great extent*). The total content validity index (CVI) score for the Korean version was 1.0. The Cronbach's alpha for internal consistency reliabilities for each subcategory (i.e., responsibility, knowledge, and documentation) were .84, .87, and .87, respectively, in the original study[12] and were .91, .90, and .90, respectively, in this study.

Knowledge about enteral nutrition. To evaluate critical care nurses' knowledge, a scale was developed based on a literature review including the American Society for Parenteral and Enteral Nutrition's guidelines,[1] the European Society for Parenteral and Enteral Nutrition's guidelines,[14] and the Korean Hospital Nurses Association's (KHNA) guidelines.[15] It comprised 20-items measuring six aspects of enteral nutrition: its significance (3 items), nutritional assessment (3 items), nutrition goals (2 items), nutrition care plan and implementation (6 items), prevention of complications (4 items), and nutrition evaluation (2 items). The items were answered with either "*yes*/*no*" or multiple-choice options. Each item was scored 1 point for each correct answer and 0 for incorrect answer. The CVI, as evaluated by a group of experts, was 0.99. The Kuder–Richardson Formula 20 was used to assess the internal consistency reliability, which was 0.68.

Enteral nutrition practices. Enteral nutrition practices were also evaluated using the Korean version of the scale developed by Persenius et al.[12] The original scale included how often nurses expressed each of the 15 nursing practices related to enteral nutrition on a 5-point Likert scale, from 1 (*never*) to 5 (*always*). Throughout the validation process of the Korean version by a group of experts, 3 items were deleted due to incongruity with Korean hospital environments. The CVI was 1.0 in the study conducted by Hammad et al.[16] The CVI was 0.98 and the Cronbach's alpha coefficient was 0.71 in this study.

Demographics. Demographic data included age, gender, education level, work unit, length of nursing clinical experience, experience of nutritional education, and nutritional knowledge source.

2.3. Development of an education program

The goal of our education program was to provide critical care nurses with training on evidence-based guidelines for enteral nutrition support. To develop the content of the education program, international guidelines from the American Society for Parenteral and Enteral Nutrition, European Society for Parenteral and Enteral Nutrition, and Canadian clinical practice, and the KHNA's guidelines were adapted.[1,4,14,15] Recently published studies about enteral nutrition for critically ill patients were also reviewed for each of the program's topics.[6,17,18] A focus group interview was conducted to identify critical care nurses' educational needs. Ten critical care

nurses who had been working for more than 3 years participated in this focus group interview. Important topics and content regarding practices from the interview were added to the program.

A preliminary program developed from the literature review and focus group interview was evaluated by the professional group of experts. After removing content that did not apply to Korean hospitals, the final education program was confirmed (Table 1). The education program consisted of two sessions of didactic lectures lasting 50 min followed by 10 min to answer questions. Additionally, a "pocket card" containing the critical information of the program was developed.

2.4. Data collection

This study was approved by both the institutional review board of a university with which the principal investigator was affiliated (ref no.: HIRB-2015-004) and the nursing directors from four hospitals. Flyers were posted in conference rooms and lounges to be seen by critical care nurses. One week before the program commenced, nurses who wanted to participate were provided with an explanation about the goals and methods of the study, its possible benefits, and their rights to withdraw from the study; they were requested to provide written consent. Nurses were asked to respond to the questionnaires to obtain their baseline data (pre-test). Next, the education program was implemented in a series of two sessions from March to April 2015 by one researcher. The second session was provided 1 week after the first session. Because the nurses worked in three different shifts, the program was conducted in both the morning and the afternoon with the same educational materials. Night shift nurses could participate in either program. After the program, the pocket card was distributed to nurses. One month later, the participants were requested to answer the same questionnaires (post-test). All information gathered, including participants' general characteristics, were coded to protect anonymity.

2.5. Data analysis

Based on a power analysis using the G*Power 3.1.2 program (Franz Faul, Universitat Kiel, Germany), the estimated sample size for the paired t-test was 54, with a medium effect size of .5, an alpha of .05, and power of .95. Therefore, the sample provided sufficient power for statistical analysis.

Data were analysed with SPSS, version 23 (IBM, New York, United States). Descriptive analyses were used to characterise the sample. Paired t-test analyses were used to evaluate the changes in critical care nurses' perceptions, knowledge, and practices. Reliability was examined using Cronbach's alpha statistics and the Kuder–Richardson Formula 20.

Table 1
Program topics.

	Topic
1.	Importance of nutritional support for critically ill patients
2.	Assessment of nutritional status in the ICU
3.	Nutritional goals for critically ill patients
4.	Indication for enteral and parenteral nutrition in critically ill patients
5.	Initiation of enteral nutrition in the ICU
6.	Method and rate of administration of enteral nutrition
7.	Recipe to promote enteral nutrition provisions
8.	Preventing and monitoring complications
9.	Management of feeding equipment
10.	Outcome evaluation of nutritional support

ICU = intensive care unit.

3. Results

3.1. Sample characteristics

Among the 209 critical care nurses who participated in the education program, four did not complete the study; data from 205 nurses were included in data analysis. Participants' demographic characteristics are presented in Table 2. Approximately half of the nurses had obtained a bachelors degree. Only 37% reported having had opportunities to receive nutritional education. The main sources of participants' nutrition knowledge were education programs conducted in the hospital (29%) and consultation with colleagues (29%).

3.2. The effects of the education program

Perceptions of enteral nutrition. Nurses' overall perception significantly improved after the program (mean change = 3.18, $p < .001$), including their positive perception of responsibility (1.00, $p < .001$), satisfying knowledge (1.44, $p < .001$), and support from documentation (0.75, $p = .008$). Among the 15 survey items addressing perceptions after the program, prevention of complications scored the highest, whereas nutritional goals scored the lowest in all categories (Table 3).

Knowledge about enteral nutrition. Nurses' knowledge about enteral nutritional support showed a significant improvement after the education program (mean change = 11.2%, $p < .001$). Specifically, they showed improvement in the significance of nutrition (14.2%, $p < .001$), nutritional assessment (11.7%, $p < .001$), nutrition care planning and implementation (4.1%, $p = .003$), prevention of complications (8.5%, $p < .001$), and nutrition evaluation (15.4%, $p < .001$). Notably, knowledge about nutritional goals improved, but not significantly (Table 4).

Enteral nutrition practices. Nurses' total practice score significantly improved after the program (mean change = 2.54, $p < .001$), including their scores on six subscales including inspecting nostrils daily (0.46, $p < .001$), flushing the feeding tube before administration of enteral nutrition or medication (0.41, $p < .001$), providing medication that needed to be crushed properly (0.25, $p = .004$), changing the feeding set every 24 h (0.34, $p = .002$), and adjusting feeding schedules if enteral nutrition is stopped (0.32, $p < .001$) (Table 5).

Table 2
Participants' general characteristics ($N = 205$).

Variables	Category	*n* (%) or mean
Age (years)		29.59
Gender	Male	20 (9.8)
	Female	185 (90.2)
Education	Diploma	75 (36.6)
	Bachelors	107 (52.2)
	≥ Masters	23 (11.2)
Work unit	MICU	85 (41.5)
	SICU	120 (58.5)
Experience as a registered nurse (months)		84.77
Experience as a critical care nurse (months)		44.67
Experience with nutritional education	No	129 (62.9)
	Yes	76 (37.1)
Source of knowledge about nutritional support	Nursing school	43 (13.1)
	Education in hospital	96 (29.3)
	In-service training	44 (13.4)
	Academic conference	9 (2.7)
	Journal articles/literature	16 (4.9)
	Consulting colleagues	95 (29.0)
	Internet	25 (7.6)

MICU = medical intensive care unit; SICU = surgical intensive care unit.

Table 3
Nurses' knowledge of enteral nutrition for ICU patients ($N = 205$).

Variables	No. of items	Pre-test	Post-test	*t*	*p*
		Mean (%) ± SD	Mean (%) ± SD		
Total knowledge	20	48.53 ± 9.09	59.68 ± 12.46	11.235	<.001
Significance	3	41.14 ± 22.72	55.29 ± 24.93	6.775	<.001
Assessment	3	52.68 ± 28.77	64.39 ± 31.40	3.579	<.001
Goal	2	47.07 ± 34.88	51.71 ± 32.23	1.416	.158
Planning & implementation	6	46.50 ± 15.99	50.57 ± 14.14	2.982	.003
Prevention of complications	4	55.88 ± 21.11	64.35 ± 22.19	4.665	<.001
Evaluation	2	45.37 ± 35.42	60.73 ± 33.31	4.854	<.001

ICU = intensive care unit; SD = standard deviation.

Table 4
Nurses' attitude towards enteral nutrition for ICU patients ($N = 205$).

Variables	Pre-test	Post-test	t	*p*
	Mean ± SD	Mean ± SD		
Total attitude	49.58 ± 8.51	52.76 ± 8.13	4.896	<.001
Responsibility	17.48 ± 3.41	18.48 ± 3.41	3.569	<.001
Assessment	3.43 ± 0.87	3.65 ± 0.78	3.169	.002
Goal	3.12 ± 0.81	3.48 ± 0.77	5.483	<.001
Planning and implementation	3.56 ± 0.88	3.77 ± 0.81	2.842	.005
Prevention of complications	3.92 ± 0.85	3.95 ± 0.81	.352	.725
Evaluation	3.44 ± 0.82	3.63 ± 0.80	2.527	.012
Knowledge	14.29 ± 3.18	15.73 ± 3.03	5.342	<.001
Assessment	2.74 ± 0.76	3.05 ± 0.67	4.913	<.001
Goal	2.68 ± 0.75	2.96 ± 0.69	4.720	<.001
Planning and implementation	3.04 ± 0.80	3.28 ± 0.78	3.395	.001
Prevention of complications	3.10 ± 0.84	3.35 ± 0.75	3.546	<.001
Evaluation	2.72 ± 0.76	3.09 ± 0.71	5.552	<.001
Documentation	17.81 ± 3.78	18.56 ± 3.39	2.661	.008
Assessment	3.44 ± 0.86	3.62 ± 0.80	2.650	.009
Goal	3.32 ± 0.90	3.59 ± 0.79	4.020	<.001
Planning and implementation	3.62 ± 0.88	3.75 ± 0.81	1.729	.085
Prevention of complications	3.81 ± 0.87	3.85 ± 0.78	.579	.563
Evaluation	3.61 ± 0.90	3.75 ± 0.81	2.116	.036

ICU = intensive care unit; SD = standard deviation.

Table 5
Nursing practices regarding enteral nutrition for ICU patients ($N = 205$).

Variables	Pre-test	Post-test	*t*	*p*
	Mean ± SD	Mean ± SD		
Total practices	56.13 ± 6.11	58.67 ± 5.97	5.596	<.001
Daily nostril inspection	3.20 ± 1.17	3.66 ± 1.00	5.235	<.001
Confirm tube placement	4.45 ± 0.91	4.40 ± 0.82	.713	.477
Check length of the inserted tube	4.40 ± 0.83	4.51 ± 0.67	1.706	.090
Check gastric residual	4.47 ± 0.87	4.49 ± 0.77	.469	.639
Flush tube before administration	3.81 ± 1.35	4.22 ± 1.11	3.946	<.001
Feeding schedule allows for a night's rest	3.56 ± 1.05	3.63 ± 1.02	.821	.412
Holding a (semi) fowler's position	4.75 ± 0.46	4.74 ± 0.49	.223	.824
Medication to be crushed provided in correct form	3.88 ± 1.19	4.13 ± 0.95	2.940	.004
Flush tube after administration	4.81 ± 0.55	4.74 ± 0.60	1.402	.162
Clean syringe after each use	4.80 ± 0.53	4.79 ± 0.48	.436	.664
Change feeding set every 24 h	2.65 ± 1.44	2.99 ± 1.49	3.098	.002
Adjust feeding schedule if EN has stopped	3.51 ± 1.07	3.83 ± 0.95	3.814	<.001

ICU = intensive care unit; SD = standard deviation; EN = enteral nutrition.

4. Discussion

Adequate nutritional support is crucial for critically ill patients' clinical outcomes. Critical care nurses play an important role in providing sufficient nutrition for ICU patients. To our knowledge, this is the first study that developed and applied an education program about enteral nutrition for nurses working in Korean ICU.

Clinical nurses need to ensure that their practices are underpinned by evidence.[19] Access to ongoing professional development is important in promoting evidence-based practice related to enteral nutrition.[6] We identified that 37% of participants in our study had undertaken some type of nutritional education program previously and that 30% of participants had accessed programs provided by hospitals. Consulting with colleagues was also a major source of nutritional information. Persenius et al.[12] also identified that critical care nurses rely heavily on colleagues for information related to nutrition. Critical care nurses considered that individuals who provided information was more important than the information itself.[20] Although colleagues and peers are important source of information, they may not always provide scientific evidences. Nurses experience difficulty in accessing academic conferences or journal articles due to their heavy workload.[9] However, it is important to ensure that nurses are educated and that nursing practices are evidence-based.[21] Developing evidence based on service educational programs may provide an alternative platform for knowledge translation. The education program we have developed can be provided as in-hospital education because it was structured to provide the necessary information to ICU bedside nurses who are responsible for feeding patients.

We identified that critical care nurses' knowledge about enteral nutrition was significantly improved after the education program. Nutritional assessment and support is a nursing responsibility.[22] Knowledge about critical care patients' nutritional requirements is an emerging and evolving area to calculate nutritional requirements and analyse daily nutritional delivery. Failure to adequately provide nutritional support is associated with negative patient outcomes.[4,5] Therefore, critical care nurses need access to a variety of different types of educational programs to ensure that their practice is contemporary and evidence-based. Our study findings indicate the positive effects of such nutritional education programs on nurses' knowledge. In congruence with our finding, Al-Rafay et al.[19] and Ameri et al.[22] found that the knowledge scores of critical care nurses increased after they were provided with parenteral nutrition training programs.

Critical care nurses' perceptions of enteral nutrition were improved following engagement with our educational program. Specifically, nurses' responsibility scores increased. To promote optimal nutrition for critical care patients requires collaborative practice that involves nurses working with allied health professionals and medical staff.[6] Critical care nurses have important roles in providing adequate enteral nutrition. Therefore, increased responsibility scores of nurses indicate that our education program was successful. The lack of a significant change in nurses' responsibility towards the goals of enteral nutrition could be attributed to a lack of knowledge about nutritional goals,[6] as goals also scored the lowest in the knowledge questionnaire. Low responsibility for enteral nutrition can lead to insufficient delivery and in eventual, contributing to negative nutritional outcomes.[21]

Although critical care nurses' overall perceptions and knowledge improved after education, continuing education concerning goal setting should be reinforced. Critical care nurses should have more attention on their role and responsibility towards nutritional goal. Regular and ongoing education is important to reinforce the change of clinical practice.

In this study, we identified that critical care nurses' practices around enteral nutrition significantly improved following participation in the educational program. This finding is supported by other researchers who also identified improvement in nurses' parenteral nutrition practice following education in a series of four sessions.[19] This contrasted the results of Ameri et al.,[22] who found no significant change in nursing practice after conducting one session of parenteral nutrition training. These results suggest that the length, type, and mode of an education program need further research. In this study, the significant change in many of the individual practices items reveals that Korean critical care nurses require more information about these practices, especially given the low pre-test scores. Therefore, it is recommended to provide a comprehensive in-service education program to reduce a lack of evidence-based nutritional practice and the gap between knowledge and actual practice. Eventually, nutritional education program can ensure adequate nutritional support for ICU patients.

Our study has several limitations. First, internal validity such as maturation effects needs to be considered when interpreting our results, as participants' perceptions and knowledge could have changed 1 month after the program, thus biasing their post-test results. Second, this study may have biased sample because we recruited nurses with an interest in the topic. This may affect the positive effects of our education program. Third, this is a local study for Korean critical care nurses. However, our education program was based on international guidelines as well as KHNA's guideline, and so our findings may be replicated in other international studies.

4.1. Implications for clinical practice and education

Critical care nurses' perceptions and knowledge about nutritional support are important, and clinical practice needs to be evidence-based so that patient outcomes are optimised. As the study findings assured significant improvements in perception, knowledge, and practice after following of a nutritional education program, the developed education program needs to be implemented and evaluated in a multicenter. When developing an education program, the target can be a comprehensive training to eliminate the weak points of perception, knowledge, and practice that have been identified in this study. Importantly, continued in service education is warranted to enhance and update critical care nurses' knowledge and practice with new evidence.

Despite the education programs for critical care nurses, the gap between their knowledge and practice about nutritional support can lead to negative outcomes such as increased morbidity.[21] To reduce this gap, critical care nurses should integrate the latest information into their clinical setting and utilise their knowledge during their practice.

5. Conclusions

In conclusion, we investigated the effects of an enteral nutrition education program on critical care nurses' perception, knowledge, and practice in Korea. The results suggest that nurses obtained more favourable perceptions of their responsibility, satisfying knowledge, and support from documentation and more knowledge about the provisions of enteral nutrition after the education program. In addition, they performed nutrition care more frequently. This education program improved nurses' care of patients in providing more effective nutritional support. Further research is required to evaluate the effectiveness of nutritional education relating to patients' clinical outcomes.

Funding

This work was supported by the National Research Foundation of Korea (NRF) Grant funded by the Korean Government (MSIP) (No. NRF-2013R1A1A1006955), the Hallym University Research Fund (HRF-201702-010), and the 2017 SNU invitation program for distinguished scholar of Seoul National University.

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