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Effect of Text Messaging Via Cell Phone on the Knowledge of Critical Care Nurses Regarding Ventilator-Associated Pneumonia

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Abstract

Background: Ventilator-associated pneumonia is a type of hospital-acquired pneumonia, and nurses have an essential role in its prevention.

Aim: This study aimed to determine the effect of text messaging via cell phone on nurses' knowledge in intensive care units about ventilator-associated pneumonia.

Method: This quasi-experimental study was performed in intensive care units of hospitals in North Khorasan Province, Iran. Nurses working in these wards were included in the study through the census sampling method. The research tool was a researcher-made questionnaire about ventilator-associated pneumonia whose qualitative face validity, quantitative content validity, and reliability were assessed. After a pre-test, text messages were sent 4 days a week, once a day for 10 weeks. The post-test was administered 1 and 3 months after that the last message was sent. To compare nurses' knowledge before and after the intervention, repeated measures analysis of variance was used in SPSS software (version 20).

Results: A total of 41 nurses were included whose mean scores of knowledge about ventilator-associated pneumonia were obtained at 9.65 ± 1.89 , 14.56 ± 3.00 , 14.63 ± 2.7 at the baseline and 1 month and 3 months after sending text messages, respectively. It was revealed that the score before sending the messages was different from those 1 and 3 months after the intervention, which was statistically significant ($P < 0.05$).

Implications for Practice: It seems that the use of new educational methods, such as text messaging, can effectively improve nurses' knowledge.

Keywords: Knowledge, Nurses, Text messaging, Ventilator-Associated pneumonia

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Introduction

Hospital-acquired pneumonia is a type of lower respiratory tract infection that occurs 48-72 h after admission to the hospital (1). Ventilator-associated pneumonia (VAP) is a kind of hospital-acquired pneumonia (2) occurring 48 h after the onset of mechanical ventilation. Ventilator-associated pneumonia is one of the most common infections in patients who require mechanical ventilation (3), which develops in 10-40% of such patients (4). Nosocomial infections threaten the patient's safety (5). The risk of VAP in a mechanically ventilated patient increases by 1-3% per day (6). It also prolongs the likelihood of hospitalization stay for 4-9 days (7), imposes a heavy economic burden (3), and increases the mortality rate (8). Since VAP is a challenge in the intensive care unit (ICU), prevention is a priority (9).

Numerous nursing practices can prevent VAP, including hand hygiene compliance, the management of the patient's oral care, prevention of gastric content aspiration, reduction of sedative and opioid dose, removal of endotracheal tubes as soon as the clinical situation allows, and quick removal of mechanical ventilation from patients (10, 11). Still, the results of studies on VAP prevention have indicated a lack of sufficient knowledge in this regard (12-14). The findings of a study conducted by Mohammadi et al. on nurses working in the ICU showed that ICU staff needed more and specialized knowledge about their duties (15). The need for the provision of training to all types of nurses and in different wards is necessary and essential; however, the training of ICU nurses is more prominent and vital due to the complexity of care, importance of their role in preventing complications during hospitalization in the ICU, and higher probability of the complications and vulnerability of patients admitted to the ICU (12).

Traditional educational methods have some limitations, such as the need for space, scheduled time, and trainers. In this respect, decision-makers involved in education are looking for alternative methods (16). One of these methods is mobile learning. Portable equipment contributes to learning by eliminating time and space limitations, providing training according to the learner's level of understanding, and enabling access to resources in any geographical location. One of the essential mobile learning tools is the mobile phone. Mobile phones and text messages can make the learning experience more efficient and allow individuals to work freely and efficiently. Learning through mobile phones increases learners' satisfaction, gives rise to freedom of action, and improves interaction and communication skills in the individual (17). One of the most common uses of mobile phones as a teaching aid is its text messaging service (18). Short Message Service (SMS) is the most critical component of mobile communication. Mobile phones have entered education, health, and treatment as mobile learning methods (19). Considering the importance of complications induced by VAP, the significant role of nurses in preventing VAP, need for training in this field, and novelty of text message-based training, this study attempted to investigate the effect of text message-based training on the knowledge of ICU nurses about VAP prevention.

Methods

This quasi-experimental study was conducted using a before-after design from March 2017 to August 2017 to determine the effect of text message-based training on the knowledge of ICU nurses regarding the prevention of VAP. The ICU nurses participated from two hospitals in Bojnourd, one hospital in Shirvan, and one hospital in Esfarayen, North Khorasan Province, Iran, based on defined inclusion criteria and through census sampling method. The inclusion criteria were being willing to participate in the study, having a bachelor's degree or higher in nursing, being a fixed ICU nurse, and having access to a mobile phone. On the other hand, the individuals who were unwilling to continue the study, did not complete the second round of the questionnaire, and did not receive text messages more than twice in a row despite providing a second contact number. The research instrument used in this study was a researcher-made questionnaire containing 20 items with a dichotomous response format (1=true or 0=false) about VAP and strategies related to VAP prevention. The total minimum and maximum scores of the questionnaire were 0 and 20, respectively. A higher score indicated a higher knowledge about VAP. This questionnaire was designed after studying related textbooks, articles, and guidelines.

The qualitative face validity and quantitative content validity of the questionnaire were evaluated. The questionnaire was given to ten nurses and head nurses to ensure the qualitative face validity to evaluate ambiguity, simplicity, and comprehensibility, and their comments were implemented. The questionnaire was also provided to ten faculty members of North Khorasan University of Medical Sciences, Bojnourd, Iran, and the content validity ratio was calculated to assess the validity. All the

items had a content validity ratio higher than 0.62, and therefore, none of them were omitted. Afterward, the questionnaire was re-evaluated by ten experts, and the item-content validity index was calculated for each item. No item had a content validity index less than 0.79. Kuder-Richardson Formula 20 was used to determine the reliability of the questionnaire (0.82).

The study was initiated after obtaining the approval of the Ethics Committee of North Khorasan University of Medical Sciences. An introduction session was held in each hospital. All the participants were informed about the process and objectives of the study, and written informed consent was obtained. The participants were reminded to save the text messages to access them if needed. The two-way SMS enabled participants to ask their questions via sending text messages. The paper and pencil format of the questionnaire was used. At the end of the introduction session, a pre-test was carried out; after that, sending text messages was initiated through a text messaging panel purchased and managed by the researcher. In this panel, it was possible to send group text messages and schedule the text messages. After sending text messages, the researcher could check the delivery status of messages to each number. Text messages were sent 4 days a week, once a day, at 9 a.m. (according to a survey of participants conducted in the initial introduction session). Sending text messages lasted for 10 weeks, and a total of 20 text messages were sent. The messages were in Persian, and the character limit for a single message was 160 characters. Messages were scheduled in Microsoft Excel 2010. Each message was assigned a number and sent twice to all participants in a scheduled manner (with a specified time interval). If the participant did not receive more than two consecutive text messages, they were called and asked the reason. If necessary, another mobile number was received from them and text messages were sent to that new phone number. If the participant did not receive the message again or was unwilling to continue the study, she would be excluded. The post-test was performed 1 and 3 months after sending the last message. The end of the training program was announced to all participants by sending a message. After data collection and coding, data analysis was performed using SPSS software (version 20). To compare the participants' knowledge before and after the intervention, repeated measures analysis of variance test (ANOVA) was used after controlling the essential prerequisites of this test.

Results

In this study, 50 nurses who met the inclusion criteria were recruited. However, nine subjects were excluded from the study, including one nurse from Imam Khomeini Hospital in Shirvan, four nurses from Imam Reza Hospital in Bojnurd, one nurse from Imam Ali Hospital in Bojnourd, and three nurses from Imam Khomeini Hospital in Esfarayen, due to a change in their place of work, completion of their nursing apprenticeship, and maternity leave. Finally, 41 nurses underwent further investigation. The mean scores of participants' age, nursing work experience, work experience in ICU were obtained at 31.09 ± 4.49 , 6.4 ± 3.95 , and 3.64 ± 2.88 years, respectively. Moreover, the mean knowledge scores of the participants regarding VAP prevention were estimated at 9.65 ± 1.89 , 14.56 ± 3.00 , and 14.63 ± 2.7 at the baseline and 1 month and 3 months after the intervention, respectively. Other demographic characteristics of the participants are presented in Table 1.

Table 1. Frequency of nurses according to demographic variables

Demographic variables		Number (%) n=41
Gender	Male	5 (12.2)
	Female	36 (87.8)
Hospital	Bojnurd (Emam Ali)	10 (24.4)
	Bojnurd (Emam Reza)	11 (26.8)
	Shirvan (Emam Khomeini)	13 (31.7)
	Esfarayen (Emam Khomeini)	7 (17.1)
Position	Nurse	39 (95.1)
	Head nurse	2 (4.9)
Receiving VAP prevention course	Yes	27 (65.9)
	No	14 (34.1)
Receiving infection control course	Yes	14 (34.1)
	No	27 (65.9)

VAP: Ventilator-associated pneumonia

Table 2. Correlation of knowledge score with age and work experience

Variable	Time	R*	P-value
Age	Before	0.251	0.113
	1 month after	0.190	0.233
	3 months after	0.200	0.210
Work experience	Before	0.222	0.162
	1 month after	0.185	0.248
	3 months after	0.167	0.297
Work experience in ICU	Before	0.226	0.154
	1 month after	0.02	0.901
	3 months after	0.003	0.986

ICU: Intensive care unit

*Pearson correlation coefficient

A repeated-measures ANOVA with a Greenhouse-Geisser correction revealed a significant difference in the participants' mean score of knowledge regarding VAP prevention ($P < 0.001$). Post-hoc Bonferroni correction showed that the knowledge score was significantly different before the intervention from those obtained after 1 month and 3 months of the intervention ($P < 0.001$). However, no significant difference was detected between the knowledge scores 1 month and 3 months after the intervention ($P > 0.05$). There was no significant correlation between knowledge score and age, work, nursing work experience, and work experience in the ICU ($P > 0.05$) (Table 2). Furthermore, no significant difference was observed between knowledge scores in terms of gender, position at work, VAP prevention, and infection control courses ($P > 0.05$) (Table 3). The results of one-way analysis of

Table 3. Difference between the mean score of knowledge in different groups of nurses in terms of demographic variables

Variable	Time	Mean±SD	P-value*
Gender	Before	Female	9.52±1.76
		Male	10.60±2.70
	1 month after	Female	14.47±3.13
		Male	15.20±1.78
	3 months after	Female	14.55±2.94
		Male	15.20±1.30
Position at work	Before	Nurse	9.56±1.80
		Head nurse	11.50±3.53
	1 month after	Nurse	14.51±3.05
		Head nurse	15.50±2.21
	3 months after	Nurse	14.58±2.85
		Head nurse	15.50±0.70
VAP prevention course	Before	Yes	9.60±2.16
		No	9.76±1.16
	1 month after	Yes	14.39±3.24
		No	14.92±2.64
	3 months after	Yes	14.39±2.85
		No	15.15±2.67
Infection control course	Before	Yes	9.42±2.56
		No	9.77±1.47
	1 month after	Yes	14.57±3.03
		No	14.55±3.04
	3 months after	Yes	14.46±3.00
		No	14.62±2.73

VAP: Ventilator-associated pneumonia

*Independent t-test

variance showed that the mean scores of knowledge 1 month ($P < 0.05$) and 3 months ($P < 0.05$) after the intervention were statistically different in studied hospitals; nevertheless, the mean pre-test score was not statistically significant in different hospitals ($P > 0.05$).

Discussion

In the present era, there have been changes in educational methods so that distance education walks along with traditional education methods, and individuals are more inclined to use new technologies because these teaching methods and equipment related to programs of distance education are attractive and usable at any time and place (20). Additionally, they have audio and video capabilities that simultaneously engage students more effectively in learning (21). According to Bujak et al., the availability of these equipment supports the learning process of individuals (22). Distance learning can be accomplished through multimedia training, e-learning, software and CD-ROM, emails, and mobile devices. The findings of studies on the effectiveness of mobile training confirm the effectiveness of this method in various fields (21, 23-26). The use of an SMS-based teaching and learning system can be fruitful through providing main points briefly in an SMS platform. The results of the present study and other studies, such as Sarani and Ayati and Azarfar et al., supported this finding (17, 27).

The findings of a study conducted by Alipour et al. (2012) revealed training effectiveness via sending short text messages on gynecologist assistants' knowledge about breast cancer (28). Azarfar et al. (2014) also confirmed the effect of distance learning via SMS on educating medical students in the pediatric ward and reported the students' willingness toward using this method (27). In a study carried out by Woods et al. (2012), 86% of midwives who participated stated that weekly text messages increased their level of knowledge and 76% of them expressed that the text messages also improved their clinical performance (29). The results of a study performed by Boroumand and Moeini (2016) demonstrated that sending short text messages was useful in increasing self-efficacy in patients with coronary artery syndrome (30).

Based on the findings of a study conducted by Valizadeh et al. (2016), SMS effectively increased the level of knowledge about sleep in mothers with neonates (31). In this regard, The results of research performed by Pimmer et al. revealed that mobile learning was useful in educating nurses in remote areas (32). A study was carried out on the efficacy of mobile learning in higher education by McConatha et al. (2008), the findings of which showed that students who used mobile learning tools could achieve better scores than the control group (33). Badiei et al. (2015) also concluded that e-learning had a more significant effect on increasing nurses' knowledge than the manual booklet method (34). The findings of another study indicated that sending text messages, as a cheap and accessible method, increased the quality of the work environment and reduced job stress among the ICU nurses (35). In a nutshell, it can be concluded that training via sending text messages can be considered a relatively new and effective educational method. Although Jafari Manesh et al. (2015) yielded the effectiveness of training through SMS on enhancing nurses' knowledge about diabetic ketoacidosis, they indicated that training via lectures was more effective than training through SMS (36). It can be said that the subject of education and educational content affect the success of the educational method in fulfilling its mission.

In this study, the knowledge of ICU nurses regarding VAP was poor before the intervention. In a study conducted by Lin et al. (2014), the ICU nurses' level of knowledge was low regarding the prevention of VAP (37). Another study was conducted by Al-Shameri (2017) to assess ICU nurses' knowledge regarding VAP prevention. The result of the mentioned study revealed that the nurses' knowledge was low, and training courses were required to enhance their knowledge about VAP prevention (38). Inconsistent with the findings of the present study, those of research carried out by El-Khatib et al. (2014) indicated that the level of knowledge of physicians, nurses, and respiratory care professionals working in ICU was appropriate regarding VAP prevention (39). It is important to pay attention to enhancing nurses' knowledge about nosocomial infections, especially in ICUs, where nosocomial infections can lead to severe consequences. Without sufficient knowledge about this subject, the provision of quality and scientific nursing care cannot be expected.

In the present study, the educational intervention was effective, and the nurses' knowledge scores about VAP increased. The results of numerous studies have confirmed the effect of educational intervention on increasing the knowledge of physicians and nurses about the prevention of VAP. The

findings of several other studies, such as Jam Gatell et al. (2012), Mogyorodi et al. (2016), Subramanian et al. (2013), Apisarnthanarak et al. (2007), and Jansson et al. (2013) have also indicated the effectiveness of training on nurses' knowledge regarding VAP (40-44). In line with the results of the present study, the studies mentioned above have emphasized the need for continuous training of nurses and concluded that continuous training on VAP may also reduce VAP incidence.

In the present study, knowledge scores showed no significant relationship with total work experience and work experience in ICU. The reason for this finding might be attributed to the fact that in various cases, there was no specific nursing plan in these ICUs to prevent this infection. In numerous cases, VAP prevention is not seen in the performance evaluation programs of nurses. Therefore, an increase in work experience did change a person's knowledge status. The fact that there was no difference in the knowledge score of the group participating in the infection prevention training classes with that of individuals who did not participate could also confirm this claim.

Implications for Practice

To provide quality nursing care, improve patient safety, and prevent mortality and morbidity, it is essential to increase nurses' knowledge and improve their performance. It seems that new education methods, such as sending text messages and using mobile phones, have improved nurses' knowledge. Due to being selective and concise, text messaging can be a good distance learning method. In addition, the receiver can review and store the messages. This method of education can be effective for nurses due to the job complexity and time constraints that they face. Although the intervention was beneficial in improving ICU nursing staff's knowledge, long-term evaluation is needed.

It should be noted that the lack of a significant change between nurses' scores 1 month and 3 months after the intervention in the present study might indicate the stability of learning achieved through this method, which seems to be a good point. The limitations of this study were the lack of evaluating nurses' performance and merely studying the effect of the intervention on their knowledge, the absence of a control group to compare the effects of the intervention, and the small size of the sample. Future research is recommended to investigate the effect of new education methods, such as text messaging, on nurses' performance and compare the text messaging methods with other new education methods to find out the best method.

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Conflicts of Interest

The authors declare that there is no conflict of interest.

References

1. Ferrer M, Torres A. Epidemiology of ICU-acquired pneumonia. *Curr Opin Crit Care*. 2018 Oct;24(5):325-31.
2. Ranjbar H, Jafari S, Kamrani F, H. AM, Yaghmaei F, Asgari Ali. Effect of chlorhexidine gluconate oral rinse on preventing of late onset ventilator associated pneumonia and it's interaction with severity of illness. *Ir J Criti Care Nur*. 2010;3(2):81-6.
3. Papazian L, Klompas M, Luyt CE. Ventilator-associated pneumonia in adults: a narrative review. *Intensive Care Med*. 2020;46(5):888-906.
4. Zaragoza R, Vidal-Cortés P, Aguilar G, Borges M, Diaz E, Ferrer R, et al. Update of the treatment of nosocomial pneumonia in the ICU. *Crit Care*. 2020;24(1):1-13.
5. Pazokian M, Borhani F. Nurses' Perspectives on Factors Affecting Patient Safety: A Qualitative Study. *Evid Bas Care*. 2017;7(3):76-81.
6. Afkhamzadeh A, Lahoarpour F, Delpisheh A, Janmardi R. Incidence of ventilator-associated pneumonia (VAP) and bacterial resistance pattern in adult patients hospitalised at the intensive care unit of Besat Hospital in Sanandaj. *Scientific Journal of Kurdistan University of Medical Sciences*. 2011;16(1):20-6.

7. Nadi E, Nekoie B, Mobaien A, Moghimbeigi A, A N. Evaluation of the Etiology of Nosocomial Pneumonia in the ICUs of the Teaching Hospitals of Hamadan University of Medical Sciences. *Avicenna J Clin Med*. 2011;18(1):26-32.
8. Alimi M, Manzari ZS, Mazlom Sr, Bagheri Moghadam A, Rouhani H. Evaluation of the Effects of Oronasal Versus Oral Disinfections with Chlorhexidine on Clinical Criteria of Ventilator-associated Pneumonia. *Evid Ba Care*. 2016;6(3):19-30.
9. Aeen FB, Zolfaghari M, Noghabi AAA, Mehran A. Nurses' Performance in Prevention of Ventilator associated Pneumonia. *Hayat*. 2013;19(3):17-27.
10. Urden L SK, Lough M *Critical care nursing: diagnosis and management*: Elsevier Saunders; 2014.
11. H DK. The Role of Oral Care in Prevention of Ventilator Associated Pneumonia: A Lite Rev. *JSSU*. 2014;21(6):840-9.
12. Shahidi Far S, Emami Zeydi A, Taghipour B, Sharif Nia H, Soleimani MA, Hassan Zadeh Kiabi F, et al. Evaluation of critical care nurses' knowledge of evidence-based guidelines for prevention of ventilator-associated pneumonia. *Mili Ca Sci J*. 2015;2(1):14-23.
13. Akin Korhan E, Hakverdioğlu Yönt G, Parlar Kılıç S, Uzelli D. Knowledge levels of intensive care nurses on prevention of ventilator-associated pneumonia. *Nurs Crit Care*. 2014;19(1):26-33.
14. Toulabi T, Rashnou F, Hasanvand S, Yarahmadi S. Promoting the Quality of Ventilator-Associated Pneumonia Control in Intensive Care Units: an Action Research. *Tanaffos*. 2020;19(3):223-34.
15. Mohammadi GR, Ebrahimian AA, Mahmoudi H. Evaluating the knowledge of Intensive Care Unit nursing staffs. *Ir J Crit Care Nur*. 2009;2(1):41-6.
16. Saffari M, Sanaeinasab H, Masoumbeigi H, Pakpour AH, O'Garro KN, Koenig HG. An Education-Based Text Messaging Program to Improve Nurses' Knowledge, Attitude, and Practice Related to Nosocomial Infections in Intensive Care Settings. *J Contin Educ Nurs*. 2019 May 1;50(5):211-7.
17. Sarani H, Aayati M. The Impact Of Mobile Phone Using (SMS) On Learning English Vocabulary And The Students' Attitude. *Curri Plan Kno Res Educ Sci*. 2014;13(40):48-60.
18. Pedram Razi S, Piroozmand N, Zolfaghari M, Kazemnejad A, Firoozbakhsh S. Education of how-to-use peak flow meter and following up via SMS on asthma self-management. *J Hayat*. 2013;18(4):19-27.
19. Goodarzi M, Ebrahimzadeh I. Impact of Distance Education via short message service of Mobile Phone on metabolic control of Patients with Type 2 Diabetes Mellitus in Karaj-Iran. *Horizon Med Sci*. 2014;19(4):224-34.
20. Kamphuis C, Barsom E, Schijven M, Christoph N. Augmented reality in medical education? *Perspe Med Edu*. 2014;3(4):300-11.
21. A. M, H. K. Meta-analysis of the effectiveness of distance education in higher Education learning-teaching activities. *Tech Edu J*. 2018;13(2):173-88.
22. Bujak KR, Radu I, Catrambone R, Macintyre B, Zheng R, Golubski G. A psychological perspective on augmented reality in the mathematics classroom. *ComEduc*. 2013;68:536-44.
23. Jamali SS, Shiratuddin MF, Wong KW, Oskam CL. Utilising mobile-augmented reality for learning human anatomy. *Proced Soc Beh Sci*. 2015;197:659-68.
24. Barraza Castillo RI, Cruz Sánchez VG, Vergara Villegas OO. A pilot study on the use of mobile augmented reality for interactive experimentation in quadratic equations. *Mathe Prob Eng*. 2015;2015:11-21.
25. Shirazi A, Behzadan AH. Design and assessment of a mobile augmented reality-based information delivery tool for construction and civil engineering curriculum. *J Prof Iss Eng Edu Pra*. 2014;141(3):04014012.
26. Chiang TH-C, Yang SJ, Hwang G-J. An augmented reality-based mobile learning system to improve students' learning achievements and motivations in natural science inquiry activities. *Edu Tech Soc*. 2014;17(4):352-65.
27. Azarfar A, Vakili R, Ravanshad Y, Rabiee M, Mohebi Amin S, Kouzegaran S. Evaluation of the effect of short message service on teaching key points in pediatrics. *Fut Med Edu J*. 2015;5(2):22-5.
28. Alipour S, Moini A, Jafari-Adli S, Gharai N, Mansouri K. Comparison of teaching about breast cancer via mobile or traditional learning methods in gynecology residents. *Asi Pac J Can Prev*. 2012;13(9):4593-5.

29. Woods D, Attwell A, Ross K, Theron G. Text messages as a learning tool for midwives. *Sou Afr Med J*. 2012;102(2).
30. Boroumand S, Moeini M. The effect of a text message and telephone follow-up program on cardiac self-efficacy of patients with coronary artery disease: A randomized controlled trial. *Ir J Nur Midw Res*. 2016;21(2):171.
31. Valizadeh L, Alizadeh M, Jafarabadi MA, Aghajari P, Mousarrezai Z. The Effect of SMS-Based Education on Sleep Knowledge of Mothers of Primary School Students: A Single-Blind Randomized Controlled Trial. *Ir Red Cres Med J*. 2017;19(3): 221-230.
32. Pimmer C, Brysiewicz P, Linxen S, Walters F, Chipps J, Gröbriel U. Informal mobile learning in nurse education and practice in remote areas—A case study from rural South Africa. *Nur Edu Today*. 2014;34(11):1398-404.
33. Mcconatha D, Praul M, Lynch MJ. Mobile learning in higher education: An empirical assessment of a new educational tool. *Tur Onl J Edu Tech*. 2008;7(3):15-21.
34. Badii M, Gharib M, Zolfaghari M, Mojtahedzadeh R. Comparing nurses' knowledge retention following electronic continuous education and educational booklet: a controlled trial study. *Med J Isl RepIr*. 2016;30:364.
35. Bandpey BE, Heravi-Karimooi M, Rejeh N, Nia HS. The effect of health messages on job stress of nurses working in intensive care unit. *J Cri Care Nur*. 2017;10(1):17-22.
36. Jafarimanesh H, Zand S, Ranjbaran M, Varvani Farahani P, Sadrkia GR. Comparing the effectiveness of SMS and lectures on the job training for nurses. *Ir J Med Edu*. 2015;15:579-88.
37. Lin H-L, Lai C-C, Yang L-Y. Critical care nurses' knowledge of measures to prevent ventilator-associated pneumonia. *Ame J Inf Con*. 2014;42(8):923-5.
38. Al Shameri F. Critical Care Nurse's Knowledge of Ventilator-Associated Pneumonia Prevention in Selected Hospitals, Khartoum. *Nurs Heal Int J*. 2017;1(5):1-7.
39. El-Khatib MF, Kazzi AN, Zeineldine SM, Bou-Khalil PK, Ayoub CM, Kanazi GE. Use of noninvasive positive pressure ventilation in emergency departments of public and private hospitals in Lebanon. *Euro J Emer Med*. 2014;21(3):230-2.
40. Jam Gatell MR, Santé Roig M, Hernandez Vian O, Carrillo Santin E, Turegano Duaso C, Fernandez Moreno I, et al. Assessment of a training programme for the prevention of ventilator-associated pneumonia. *Nur Crit Care*. 2012;17(6):285-92.
41. Mogyoródi B, Dunai E, Gal J, Ivanyi Z. Ventilator-associated pneumonia and the importance of education of ICU nurses on prevention—Preliminary results. *Inter Med Appl Sci*. 2016;8(4):147-51.
42. Subramanian P, Choy KL, Gobal SV, Mansor M, Ng KH. Impact of education on ventilator-associated pneumonia in the intensive care unit. *Singapore Med J*. 2013;54(5):281-4.
43. Apisarnthanarak A, Pinitchai U, Thongphubeth K, Yuekyen C, Warren DK, Zack JE, et al. Effectiveness of an educational program to reduce ventilator-associated pneumonia in a tertiary care center in Thailand: a 4-year study. *Clin Inf Dis*. 2007;45(6):704-11.
44. Jansson M, Kaariainen M, Kyngas H. Effectiveness of educational programmes in preventing ventilator-associated pneumonia: a systematic review. *J Hosp Infect*. 2013;84(3):206-14.