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Effects of active and passive implementation of ventilator associated pneumonia guideline on nurses' performance in critical care units: A controlled clinical trial

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ABSTRACT

Background & Aim: Ventilator associated pneumonia (VAP) is the most common infections in critical care units, which leads to more length of hospital stay, costs, and high mortality. Therefore, prevention is a priority according to clinical guidelines. The aim of this study is determine the effects of passive versus active implementation of VAP guidelines on nurses' performance in critical care units.

Methods & Materials: In this controlled clinical trial, 110 nurses who working in critical care units in selected hospitals affiliated to Tehran University of Medical Sciences were enrolled to study by convenience sampling at three groups, including active intervention group (n = 40), passive intervention (n = 36), and control (n = 34). First, nurses' performance in prevention of VAP was evaluated by an observational checklist. In passive intervention group, posters containing recommendations of prevention of VAP was installed over the wall for each bed. In active intervention group, in addition to poster installation, there were training sessions with feedback on nurses' performance. In control group without any intervention, just nurses' preventative performance was evaluated before and 1 month later. A month later the nurses' performance were observed. Data were analyzed by descriptive and inferential tests (Fisher's exact test, chi-square, ANOVA, and paired t-test) in SPSS version 16.

Results: Results showed that the nurses' mean percentage score in three groups was 46.80 ± 5.79 and after intervention it changed from 47.76 ± 4.61 to 63.32 ± 6.97 ($P < 0.001$) in active group, from 45.24 ± 5.72 to 55.03 ± 10.20 ($P < 0.001$) in passive group and 47.33 ± 6.86 to 47.90 ± 6.06 in control group ($P = 0.263$). Nurses' performance in active group improved significantly in comparison to passive group and in passive group, it improved significantly in comparison to control group ($P < 0.001$).

Conclusion: The results of this study showed that both active and passive methods are effective on nurses' performance in prevention of VAP. Therefore, considering the existing situation in the country and the high workload of nurses, we can offer VAP guideline as a protocol in critical care units.

Introduction

Nosocomial infections are common problems, especially in patients hospitalized in critical care units (1). Nosocomial pneumonia is the second prevalent infection (2), and mechanical ventilation considered to be the most important risk factor for it (3). Ventilator associated pneumonia (VAP) is a form of pneumonia occurring more than 48 h after the initiation of endotracheal intubation and mechanical ventila-

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tion and is one of the most common infections in intensive care units (ICUs) with 6-52% incidence (4). This infection is one of the most important causes of mortality in ICUs (5). The incidence of pneumonia in a hospital in Mashhad was reported 12.74% (6) and in Semnan 9.20% (7). VAP mortality rate is from 24% to 50% and in high-risk patients is 70% also (8). Predisposing factors include changes in level of consciousness, an endotracheal tube, nasogastric tube, malnutrition, and inadequate flow of saliva leading to the oropharyngeal colonization in patients. Aging effectively reduces the cough reflex due to changes in the immune system, making individuals more susceptible to pneumonia (9). VAP increases oxygen demand, production of sputum, alveolar collapse and impaired gas exchange (2). It increases the duration of mechanical ventilation, length of stay, use of health care resources, cost of treatment, and mortality rate (10-12).

Increasing numbers of ill patients with impaired immune systems, a high mortality rate due to VAP and drug resistance stresses on the importance of interventions to prevent this infection (13). VAP considered being a challenge for critical care nursing (10), so prevention is a priority in the ICUs (11).

The nursing profession one of the largest source of health care workforce, has a direct impact on patient care and outcomes (14). Therefore, nurses are expected to play an important role in prevention of nosocomial infections, particularly VAP (8). Many of these preventative strategies are the direct responsibilities of nurses at the bedside (10). Nurses' lack of knowledge in the field of mechanical ventilation is an obstacle to the principles of VAP prevention. Clinical guidelines should be considered as a basis for nursing care (14). Prevention recommendations in clinical guidelines are classified based on available evidence, theoretical rationale, applicability, and potential economic impacts (15). Despite numerous evidence-based clinical guidelines on the prevention of VAP, they are not commonly used in wards (16). Personnel education and their adherence to infection prevention protocols play an important role in the prevention of VAP (3). Active implementation strategies that include staff education, evaluating nurses' performance, giving feedback, organizational change, and multidimensional approaches are associated with improvements in care (11). Multi-dimensional intervention for prevention of VAP are associated with a higher compliance and significant reduction in its incidence (17). Passive implementation strategies are relatively easier, cheaper and do not need organization, so they are appropriate (18). Previous studies have shown that education and awareness of health care providers are effective in the prevention of VAP. In several studies that surveyed the impact of VAP prevention protocol on the incidence of infection, it was seen that this protocol could reduce VAP significantly (8, 14, 19). Regarding the importance of VAP prevention in ICUs and the consequences of infection and the lack in nursing personnel, high workload and difficulties related to the conventional learning methods, it is necessary to design and implement effective measures to be enforced it seems that implementing prevention of VAP guideline in passive form can be effective in improving nurses' performance. Hence, considering the high functionality of this training method and the lack of evidence-based research, researchers were prompted to discuss the effect of active and passive implementation of VAP guideline on nurses' performance in critical care unit.

Methods

This controlled clinical trial was conducted on 110 nurses working in Medical, Surgical, Emergency and General ICUs in selected hospitals affiliated to Tehran University of Medical Sciences (Shariati, Imam Khomeini, and Prophet Mohammad) from early February 2013 to May 2013. The reason to select these hospitals was the hemoginity of employment, nurses' performance and ease of access to samples. These hospitals were randomly divided into three groups, including active intervention, passive intervention, and control group. After obtaining permission from the Ethics Committee of Tehran University of Medical Sciences and written informed consent, all registered nurses in the ward that who eligible for inclusion in this study were available for sampling. Inclusion crite-

ria included a bachelor's degree or higher, having at least 3 months of service in critical care units, not attending educational classes related to prevention of VAP within the past 3 years and exclusion criteria included not having the tendency to continue participation the study and transferring to other wards.

The study tools were researcher made, including a demographic form and an observational checklist with 32 items about contact precautions and hand hygiene (items 1-5), oral hygiene (items 6-8), suctioning (items 9-18), endotracheal tube cuff care (items 19-22), prevention of aspiration (items 23-27), and prevention of contamination (items 28-32). These questions were extracted after a careful study of clinical guidelines on prevention of VAP, provided by centers such as the Center for Disease Control and Prevention in America (20), Institute for Healthcare improvement (21), Hong Kong Center for Health Protection (22), the Canadian Association of Medical Microbiology and Infectious Diseases (23), Health Protection Surveillance Center in Ireland (24), and the Society of Healthcare Epidemiology of America (25). Grading scale of observation checklist was as: yes (1) and no (0), respectively. That, proper performance rated "one point" and incorrect one rated "zero". Validity was studied by 15 members of the Faculty of Nursing and Midwifery of Tehran University of Medical Sciences and three critical care specialist. Reliability of tools was evaluated by observant assessments, so that the performance of 10 nurses were observed by the researcher with the checklist, and then a week later, the performance of the same 10 persons was observed by an assistant researcher who was a nursing student. The correlation coefficient ($r = 0.90$) was found that confirmed reliability.

At first the performance of each nurse was evaluated by the observational checklist in three times and in three different shifts, morning, afternoon, and evening. Thus, at any observation, correct performance was rated "one point," while incorrect performance was given "zero". So each one could gain at most 3 scores out of each item, two appropriate performance led to score "two" and one appropriate performance led to score "one" while no appropriate performance led to score "zero". In case of no procedure available, the item "no case available" was added with no score.

The sum of scores obtained by each individual was calculated. Based on the number of scored items, the mean score was calculated. Furthermore, total score of each person (0-96 score) was calculated as a percent. Then, we categorize nurses' performance as unfavorable levels (below 50%), fairly favorable (50-75%) and favorable (above 75%).

In passive intervention group, guidelines of prevention of VAP after summarizing were put up in the ward as 70 cm × 100 cm posters. Some summaries (in A3 paper dimensions) put up over each patients bed. The nurses were asked to take care of ventilated patients according to this guideline.

In active intervention group, in addition to posters installation, oral and face-to-face training sessions about prevention of VAP were conducted and pamphlet was given to the nurses. The content of the pamphlet was about VAP definition and pathophysiology, risk factors, side-effects, and prevention strategies (Table 1). Training sessions were held during patient care for half an hour per each nurse.

Trainings were given according to the educational needs of each caregiver and weaknesses in each of the areas, so nurses' performance was studied based on six care categories discussed before intervention. Furthermore, nurses were provided with comprehensive educational pamphlets for extensive training. In this method, the researcher was in the ward for a month while reminding nurses to comply with the recommendations of the guidelines. Nurses' performance was studied in the control group without any intervention before and 4 weeks later by the check list. Moreover, because the presence of the researcher could affect nurses' performance, observers were in the ward in different shifts for a long time in order to normalize the situation as well as reducing the impact of their presence as much as possible to watch actual performance of the nurses. The procedure was evaluated three times to reduce confounding factors and an assistant researcher helped in data collection. Ethical considerations were followed, all samples

willingly participated in the study, and they could stop cooperation in case of dissatisfaction. Furthermore, the approval of the Ethics Committee of Tehran University of Medical Sciences received before the study began. Diagram of the procedure is given in figure 1.

Table 1. The main training points of poster

General principles of infection prevention	Prevention of oropharyngeal colonization
Hand hygiene	Oral hygiene
Washing hands with soap and water.	Brushing teeth and tongue
Disinfect hands with alcohol-based solution available in the unit	Use of chlorhexidine
	Use a lip moisturizer
	Mouth suction
Contact precautions	
Wearing gloves, masks, goggles, and gowns when needed	
Prevention of aspiration	Suction
Elevating head of the bed 30-45° unless a contraindication	Indications for suctioning
Care before, during and after nasogastric feeding	How to properly suction the patient
Care of endotracheal tube cuff and regular measurement of pressure	Use an endotrachael tube with a dorsal lumen to drain sub-
cuff with manometer or stethoscope, making sure that cuff is fixed	glottic secretions
Prevention of contamination	Medicine strategies
Correct change of ventilator circuits and humidifiers	Restrictions on frequent blood transfusions
Use sterile water to fill the humidifier and nebulizer	Avoid indiscriminate use of stress ulcer prophylactic agents
Proper draining the discharge from ventilator circuits	
Proper disinfection of respiratory equipment	
Management of mechanically ventilated patients	More
Orotracheal intubation is preferred instead of nasotracheal intubation	Avoid unnecessary transfer of patients out of the ward
Extubate patients quickly	Prevention of deep vein thrombosis

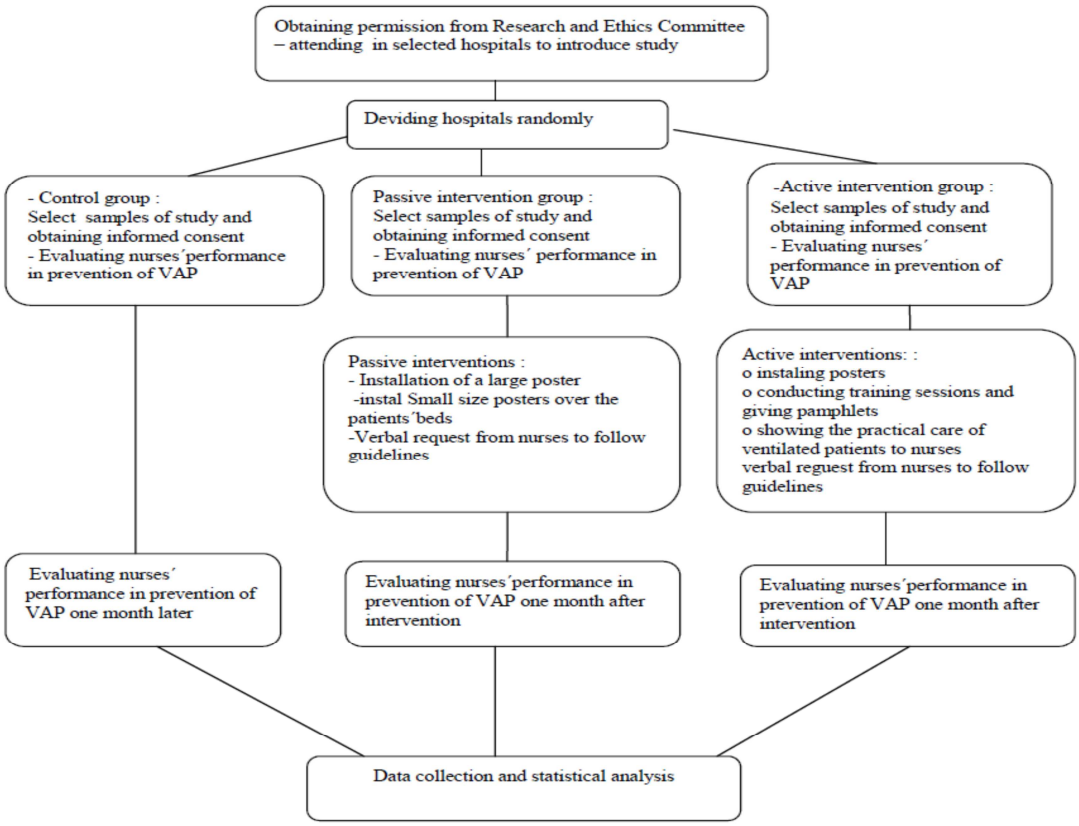

Figure 1. Methodology diagram

Statistical analysis was done using descriptive analysis, Fisher's exact test, chi-square, ANOVA, paired t-test in SPSS for Windows (version 16.0, SPSS Inc, Chicago, USA).

Results

The mean age of nurses participating in this study was 30.52 ± 4.91 years. The majority of nurses (46.4%) had a history of 1-5 years working experience. Other demographic information based on groups is presented in table 2. In this study, subject's variables of age, gender, education level, employment status, work experience in nursing, work experience in critical care units and attending infection control classes in all three groups were similar. Furthermore, ANOVA test showed that the mean score of nurses' performance is similar in all three groups before intervention (P = 0.136).

Before intervention, the mean percentage score in three groups was 46.80 ± 5.79. Before intervention more than half of the nurses (60%) in the active intervention group had unfavorable performance in prevention of VAP while after intervention, the majority of nurses (97.5%) had relatively favorable performance. Paired t-test results showed that the performance of nurses in this group had significant difference before and after the intervention (P < 0.001). In passive intervention group, the majority of nurses (75%) had unfavorable performance before intervention while after intervention 69.4% of nurses had relatively favorable performance. Paired t-test results showed that the performance of nurses in this group had significant difference before and after the intervention (P < 0.001), and in the control group more than half of nurses (64.7%) had unfavorable performance before intervention. After 4 weeks and reviewing performance, 61.8% of individuals had unfavorable performance. Paired t-test showed that nurses' performance in this group before and after the intervention had no significant difference (P = 0.263) (Table 3).

Table 2. Distribution of nurses working in specific demographic groups studied separately

Demographic	Active intervention		Passive intervention		Control		Test result
	N	%	N	%	N	%	
Age (mean ± standard deviation)	30.55 ± 5.50		30.58 ± 4.86				
Sex							
Female	38	95.0	33	91.7	34	100.0	P = 0.320
Male	2	5.0	3	8.3	0	0.0	
Education							
BS	39	97.5	35	97.2	33	97.1	P = 1.000
MS	1	2.5	1	2.8	1	2.9	
Work experience in critical care unit (year)							
< 1	7	17.5	4	11.1	7	20.6	
1-5	23	57.5	24	66.7	17	50.0	P = 0.741
6-10	5	12.5	6	16.7	7	20.6	
> 10	5	12.5	2	5.6	3	8.8	
Employment							
Employed	7	17.5	4	11.1	5	14.7	
Under contract	22	55.0	23	63.9	2	64.7	P = 0.804
Temporary	4	10.0	6	16.7	4	11.8	
Training	7	17.5	3	8.3	3	8.8	
Shift type							
Morning fixed	2	5.0	3	8.3	5	14.7	
Afternoon fixed	0	0.0	1	2.8	0	0.0	P = 0.583
Evening fixed	3	7.5	1	2.8	1	2.9	
Round	35	87.5	31	86.1	28	82.4	
Attending infection control class							
Yes	29	72.5	21	58.3	22	64.7	P = 0.429
No	11	27.5	15	41.7	12	35.3	

BS: Bachelor of Science; MS: Master of Science

Table 3. Comparison of ventilator associated pneumonia prevention in nursing practice changes before and after the separation of the studied groups

Stages	Performance	Groups						Test result
		Active intervention		Passive intervention		Control		
		N	%	N	%	N	%	
Before intervention	Favorable	0	0	0	0	0	0	ANOVA
	Fairly favorable	16	40.0	9	25.0	12	35.3	F = 2.033
	Unfavorable	24	60.0	27	75.0	22	64.7	$df_1 = 2$
	Mean ± standard deviation	47.76 ± 4.61		45.24 ± 5.72		47.33 ± 6.86		$df_2 = 107$ P = 0.136
After intervention	Favorable	1	2.5	0	0	0	0	ANOVA
	Fairly favorable	39	97.5	25	69.4	13	38.2	F = 34.87
	Unfavorable	0	0	11	30.6	21	61.8	$df_1 = 2$
	Mean ± standard deviation	63.32 ± 6.97		55.03 ± 10.20		47.90 ± 6.06		$df_2 = 107$ P < 0.001
Sum		40	100	36	100	34	100	
Test result		Paired t-test, P ≤ 0.001		Paired t-test, P ≤ 0.001		Paired t-test, P = 0.263		

Considering the significant difference in the mean percentage score of nurses after intervention, the average comparison between the two studied groups is in table 4.

Table 4. Comparison between the average performance rating percentages of nurses in the field of the prevention of pneumonia, related to both groups between the two to two interventions studied after intervention in all three groups

Studied groups	Mean difference	Tukey test results
Active and passive	8.28	P < 0.001
Control	15.42	P < 0.001
Active and passive	−8.28	P < 0.001

Considering the significant difference in the mean percentage score of nurses after intervention and comparison between the two groups studied, Tukey test showed a significant difference between active and passive groups in mean percentage score (P < 0.001). This indicates that nurses' performance in the active group improved after intervention more than passive group. Furthermore, there was a significant difference in mean percentage score between passive and control groups after intervention (P < 0.001) (Tables 4).

Discussion

Since VAP are related to many complications; therefore, its prevention with the help of evidence-based recommendations in clinical guidelines is a priority in ICUs. The purpose of this paper was to study the effects of active and passive implementation of VAP guideline on 110 nurses' performance in critical care unit. Results showed that nurses' performance was unfavorable before the intervention [mean ± SD (46.80 ± 5.79)]. Allah-Bakhshian et al. in Tabriz (2010) in a self-reported study that surveyed nurses' performance in nosocomial infection showed that almost all nurses (99.10%) had a moderate level of performance (26). But, Reiss-Karimian in her study in Yasoj (2003) indicated that the majority of subjects (72.30%) have good performance in nosocomial infection control [mean ± SD (103.98 ± 11.67) of maximum score of 120] which is inconsistent with the results of our study (27). The reason for this difference could be due to differences in the type of performance evaluation, because the performance has been studied as a self-report survey, so it is likely that the true picture of performance has not been shown and a direct observation can show a more realistic picture.

The overall results of this study also showed that both active and passive method of implementing of prevention of VAP guidelines could promote nurses' performance, though active method showed more improvements. It seems that clinical guidelines in the form of posters in required numbers served as reminders and could improve the quality of care of ventilated patients, and also requesting nurses to comply with these evidence-based recommendations increases their awareness of prevention of VAP strate-

gies, which was effective in passive method. While active method comprising of nurses' education, reminding them to follow guideline and giving feedbacks can highly increase their quality of care. Hawe et al. (2009) who studied the effects of active and passive implementation of prevention of VAP guidelines on nurses' performance indicated that passive method showed less compliance with guides. In that study, the use of passive guideline was consistent with usual operational policy and management practice in that ICU, while they are inconsistent with the results of the current study. In that study, the mortality rate reduction during the period of the active application was more than passive period ($P = 0.060$). In total, Hawe et al. concluded that active implementation of guidelines is associated with better compliance and significant reduction in VAP. The results of this study are consistent with our research, which shows that active methods are more effective than passive one (11). Ban (2011) in Korea studied the impact of a series of short term and long term interventions in prevention of VAP on nurses' knowledge and performance indicated that these interventions promoted nurses' knowledge ($P = 0.008$) and performances ($P < 0.001$), which is in consistence with this study result (8). It needs to be mentioned that after intervention only in one case a desirable performance was found in the active group, while there was no desirable performance in passive one, this may be due to high workloads, the lack of time and the quality of services that can cause damage.

Biancofiore et al. (2007) stated that the reasons for poor adherence to these guidelines are barriers such as not involving nurses in development and implementation of protocols, lack of necessary resources, the high cost, lack of time, skills, and knowledge. Successful application of the guidelines is not guaranteed, but is influenced by many factors such as environmental conditions (28).

Overall, the study showed that both active and passive methods of implementing prevention of VAP guidelines have been able to promote nursing practice. Regarding this issue and the importance of VAP in ICU, lack of staffs and high workload of nurses which prevents them from the chances of participating in educational classes, it should be said that application of guidelines in passive form as posters could improve nurses' performances, enabling them to provide better services and to help improve the quality of patient care.

This study results provide nurses with information to make more informed decisions regarding the care of the patients, also, with the increased awareness of nurses about strategies for the prevention of VAP it is possible to prevent the creation of this disease, long hospitalizations and increased patients services, costs as well as to upgrade health and comfort level of patients.

Nurses' performances have been evaluated by obvious and continuous observation, but the presence of researchers as well as written approvals signed by nurses, hindered nurse's actual performances, which was out of researcher's control. In this study, nurses' knowledge and attitudes regarding the method of prevention of VAP were not evaluated, and only the performance of nurses was evaluated. What is certain is that the weakness in performance is not only the result of a lack of knowledge, but also many environmental factors such as existing facilities, and high workload could affect this issue. Another limitation was the short time of intervention, since it is not possible to create drastic changes in individual performances and it is better to perform trainings and feedbacks constantly and periodically. It is suggested to conduct another study with a longer intervention time in two time periods with a longer interval to and survey VAP incidence as main consequence.

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