

Undergraduate Nursing Students' Knowledge, Attitude: Care of Patients of Mechanical Ventilators

¹Badria A Elfaki

¹Faculty of Nursing, Umm Al-Qura University, Makkah, Saudi Arabia & Faculty of Nursing, Al-Neelain University, Khartoum, Sudan
Corresponding author: Badria A Elfaki, Assistant professor, Faculty of Nursing, Umm Al-Qura University, Makkah, Saudi Arabia.

ABSTRACT

Objective: To determine the knowledge and attitude of student nurses about mechanical ventilators (MVs) and analyze the impact of a one-week educational program. **Methods:** Fifty student nurses were included in a one-week training program about MVs' fundamental favorable knowledge and attitude in January 2021 at MG nursing Institute, Tamil Nadu. Student nurses in critical nursing courses were assessed before an education program. A pre-validated survey questionnaire comprised of knowledge and attitude items was adopted to collect data before and after the training program (post-course assessment). The program adopted a lesson plan and simulation procedures for learning, and it took seven days to complete. **Findings:** According to the study's findings, 35 (70%) participants (student nurses) were females, and 15 (30%) were males. The pre-test knowledge and attitude were inadequate at 74% and 25% respectively. In the post-test, it increased to adequate with 44% and 64%. The mean knowledge score pre-test MV assessment was 8.58 (17%), and the post-test was 19.18 (38%). While their attitude on the pre-test was 12.64 (25%), their post-test score was 32.38 (64%). A statistically significant difference was found between knowledge and attitude among student nurses prior to and following the MVs training session. **Novelty:** One-week training program on care for patients with mechanical ventilators enhanced students' knowledge and attitude at $p < 0.005$. Computer-aided education with simulation dramatically improved student nurses' knowledge and attitudes about mechanical ventilator care, according to our study findings. The study recommended that simulation training on care for patients of MVs is an effective strategy to render efficient quality care to patients admitted to intensive care units.

Keywords: Attitude, Computer-assisted teaching program, simulation, Knowledge, mechanical ventilator, patient Care, student Nurses

1. Introduction

Air enters and exits the lungs during ventilation, allowing the alveolar-capillary membrane to exchange gases. A process known as mechanical ventilation (MV) was developed and refined in the second part of the 20th century. The mortality rate of Intensive Care Unit patients who are mechanically ventilated is greater [1]. The risk is most commonly associated with insertion and placement, lung injuries, and MVs-associated pneumonia [2]. Care for ventilated patients necessitates thorough familiarity with ventilator processes and techniques to avoid potential complications [3]. Management of MV-related adverse consequences needs unique skills. It is mandatory to acquire specific knowledge and analyzing skills [4]. In addition, nurses must have enriched knowledge and exceptional skills associated with mechanical ventilator management and be trained when they are students as baseline learners [2]. A higher level of competence and confidence is needed for nursing students before collaborating with the healthcare team and becoming registered nurses [5]. Appropriate unique skills are mandatory to manage MV-related complications such as pneumonia and hemodynamic instability [6]. A study among senior residents emphasized evidence-based training to guide them to follow instructions correctly. Critical care student nurses as healthcare providers play a crucial role in adopting the efficient practices of working with MVs [7]. It is expected that student nurses should understand the criteria, the modes of ventilation delivery, and the most common associated strategies of early diagnosis of identifying ventilator-associated complications before their clinical placements [8]. A growing number of intensive care unit patients

require mechanical breathing, and nursing students' ability to provide quality care for those who require it is becoming increasingly critical [9]. In the simulation lab, nursing students learn the fundamentals of intensive care job responsibilities, such as airway care, posture, dental care, and immaculate hand hygiene [10]

Despite the students having health assessment (HA) training in their first year of nursing education, a study suggests that only 11–29% of the skills are acquired from HA, and fewer competencies from HA are applicable in ICU when students transit to critical training course [11]. ICU patients require an advanced high skilled approach to care to rely on specific KA to observe individuals with MV. Adequate knowledge and a good attitude are essential to guide appropriate quality care. The student nurse is usually the "first-line care provider" challenged to care for patients with ventilator-related problems. In order to be prepared, it is mandatory that student nurses thoroughly understand the fundamentals of delivering care to patients with ventilator support, including modes, settings, practices during and before endotracheal suctioning, and indicators of alarms. It is also vital to be proficient in prompt identification and management of executing quality care for patients with MVs to develop patient-focused care and prevent complications [12].

ICU students' trainees' crucial tasks are critical to preventing risk factors related to mechanical ventilators (MV). Trainee nurses must retrain themselves to adequately care for MV patients by becoming familiar with the symptoms and treatment options. Our project was conducted to explore the value and benefits of a simulation-assisted education program on KA for nursing students about caring for patients with mechanical ventilators in a selected college at Coimbatore.

Research questions are

What are the baseline knowledge and attitude regarding nursing care of patients with MVs among nursing students?

Is there an effect of an education program regarding nursing care of patients with MVs among nursing students?

Is there an association between demographic variables and post-test KA scores regarding patients with MVs among nursing students?

2. Methodology

This study used a quasi-experimental one-group pre-test post-test design. Undergraduate nursing students in the fourth year of their education at NG Institute of Paramedical Sciences were the target population. Nursing students enrolled in the fourth-year education that proposed the final bachelor's degree was fifty students. The inclusion criteria were students registered in the fourth academic year aged 21 and older available during data collection, and willing to participate in the study. Students registered in the first, second, and third academic year who were not willing to participate were excluded from participating.

The tool comprised two parts; part one included demographical variables of participants such as; age, sex, religion, previous knowledge regarding care of the patient in MVs, sources of information, and duration of critical care course posting in the acute care. The survey tool had three parts. The second part had knowledge items (thirty) of the multiple-choice questionnaire (score 1-30), and the third part had attitude items (score 1-40). The knowledge scores were adequate at 21-30, moderate at 11-20, and inadequate 1-10. Ten attitude items adopted the Likert assessment scale with four points ranging from Strongly Agree (score 4) to disagree Strongly (score 1). The total scores on the attitude scale were 40. The interpretation was 0-13 as poor, 14-26 as moderate, and 27-40 as a good attitude. The content validity was performed by submitting the tool with the specialty guide, field experts of the medical-surgical department, and statisticians. Experts' suggestions and recommendations were considered for modifying the tool.

The tool with a closed-ended questionnaire was distributed to student nurses after testing their credibility. A test-re-test method was adopted to prove the credibility with a value was $r = 0.88$. The structured tool was found to be reliable. The observational checklist reliability was done by adopting inter rated method, and the score was $r = 0.85$.

The pilot study was conducted at the NG Institute of Paramedical Sciences in Coimbatore, and the students enrolled were about 10% of the calculated sample size. A structured teaching program on MVs Knowledge was organized on the same day. After seven days same structured questionnaire was adopted to evaluate participants' KA post-score. Some questions were modified based on the test results, and the same participants were excluded from the main study.

Ethical approval has been obtained from the NG Institute of Paramedical Sciences chairperson, Coimbatore. Data was collected from the participants before and after the Computer-assisted teaching program. Students were consented to be the study participants after getting their consent.

The updated statistical version of SPSS was used for descriptive and inferential statistics. Demographic characteristics of the study sample were presented in table format as frequency and percentage. Knowledge and attitude levels were compared

with participants' demographic data to determine the correlation using Karl Pearson correlation and presented in table format as frequency and percentage. Paired t-test was used to compare the knowledge and attitude of participants' mean of pre and post-test data. P-value <0.05 was used to cut off the significance of the results.

3. Results and Discussion

Table 1: Description: Demographic information

Demographic Variables		<i>f</i> (N)	Participants' Percentage (%)
Students' Gender	Male Students	15	30
	Female Students	35	70
	Total	50	100
Age in Years	21 - 22 years	46	92
	Above 22 years	4	8
	Total	50	100
Religion	Hindu	30	60
	Muslim	5	10
	Christian	15	30
	Total	50	100
Previous knowledge regarding the care of patients in mechanical ventilators	Yes	35	70
	No	15	30
	Total	50	100
Sources of information	Workshop and Conferences	20	40
	Colleagues	5	10
	Journals	10	20
	Mass Media	15	30
	Total	50	100
Duration of clinical posting in the critical care unit	Less than three months	10	20
	More than three months	40	80
	Total	50	100

Table 1 showed that the total number of participants was fifty, 35 (70%) were females, and 15(30%) were males. The majority of subjects 46 (92%) were 21–22 years old, and 4 (8%) were over 22 years. About 30 (60%) were Hindus, 5 (10%) were Muslims, and 15 (30) were Christians. Regarding pre-test knowledge, the majority of them, 35 (70%), knew few details about the care of patients on mechanical ventilators, and 15 (30%) hadn't had prior knowledge. Regarding the source of information, 20 (40%) have attended workshops and conferences, 5 (10%) students acquired an outline through colleagues, 10 (20%) had an opportunity to browse journals, and 15 (30%) happened to hear about it by mass media.

Table .2: Participants' Knowledge and Attitude (n=50)

Level of Knowledge and attitude		Pre-test Scores	Post-test Scores
Knowledge	Inadequate	37(74%)	4(8.0)
	Moderately Adequate	13(26%)	24(48.0%)
	Adequate	0 (0.0%)	22(44.0%)
Attitude	Poor	44(88.%)	0(0.0%)
	Average	6(12.0%)	18(36.0%)
	Good	0(0.0%)	32(64.0%)

The table reflected students' pre and post-scores on knowledge and attitude related to patients on mechanical ventilator care. During the pre-test, 74% of the nursing students were deficient in knowledge, and 26% were moderately adequate. None of them have scores above twenty-one out of thirty scores. In contrast, 22(44%) students were adequate knowledge in the post-test. This table also showed that students had a poor attitude related to patients on mechanical ventilator care in the pre-test. At the same time, they demonstrated a 32 (64.0%) score of favorable score in the post-test, followed by an 18 (36.0%) average score.

Table .3: Students' pre- post-test scores Knowledge and Attitude. (n=50)

Levels	Pre-test Mean± SD	Post-test Mean± SD	Paired 't ' test value	Tablevalue	Level of significance
Knowledge	8.58 ±3	19.18±5	13	2.001	P < 0.005 significant
Attitude	12.64 ±5.99	32.38±3.7	19	2.001	P < 0.005 significant

Legend p-value less than 0.005 (p < 0.005) Highly significant

Based on the Paired t-test, the above table showed the benefits of an education program in increasing the kA student nurses in providing care for mechanically ventilated patients.

Table 4: Association demographic variables with post-test Knowledge scores (n=50)

Participants' information	Knowledge Score			Significant
	Adequate	Moderate adequate	Inadequate	
Age in years				$\chi^2=1.8119$ df=4 P>0.05 Not Significant
21 - 22 years	33	10	3	
Above 22 years	2	2	0	
Gender				$\chi^2 = 2.0941$ Df = 2 P > 0.05 Not Significant
Male	10	3	2	
Female	25	9	1	
Religion				$\chi^2 = 1.185$ Df = 4 P > 0.05 Not Significant
Hindu	19	9	2	
Muslim	3	2	0	
Christian	11	3	1	
Previous knowledge regarding the care of patients in mechanical ventilators				$\chi^2 = 2.06$ Df = 2 P > 0.05 Not Significant
Yes	20	12	3	
No	11	2	2	
Sources of information				$\chi^2 = 3.00$ Df = 6 P>0.05 Not Significant
Workshop and Conferences	17	3	0	
Colleagues	4	0	1	
Journals	9	1	0	
Mass Media	13	2	0	
Duration of clinical posting in the critical care unit				$\chi^2 = 1.96$ Df = 2 P > 0.05 Not Significant
Less than three months	6	2	2	
More than three months	30	5	5	

Students' demographic data, such as age, gender, religion, location of residence, education, sources of information, and the hospital unit, was reflected in table 4. According to Chi-square values, post-test knowledge scores regarding mechanical ventilators and demographic characteristics did not have any statistically significant correlation.

Table 5. Association demographic variables and Post-test attitude scores. (n=50)

Demographic information	Attitude Score		Significant
	good	Average	
Age in years			$\chi^2 = 0.2071$ df=2 P>0.05 NS
21 - 22 years	35	11	
Above 22 years	3	1	
Gender			$\chi^2 = 1.1514$ df=1 P>0.05 NS
Male	10	5	
Female	28	7	
Religion			$\chi^2 = 0.862$ df=2 P>0.05 NS
Hindu	24	6	
Muslim	4	1	
Christian	13	2	
Previous knowledge regarding the care of patients in mechanical ventilator			$\chi^2 = 1.6266$ df=2 P>0.05 NS
Yes	32	3	
No	6	12	
Sources of information			$\chi^2 = 4.361$ df=3 P>0.05 NS
Workshop and Conferences	18	2	
Colleagues	8	2	
Journals	9	1	
Mass Media	14	1	
Duration of clinical posting in the critical care unit			$\chi^2 = 1.6337$ df=2 P>0.05 NS
Less than three months	8	2	
More than three months	30	10	

Table 5 depicts the association between post-test attitude scores of student nurses with their demographic variables. It revealed no statistically significant association between post-test scores and demographic variables, as reflected by the Chi-square values.

Table 6: Pre and post-test scores of knowledge (n=50)

Knowledge and Attitude	Scores	Pre-test			Post-test		
		Mean	Standard Deviation	%	Mean	Standard Deviation	%
knowledge	50	8.58	3	17	19.18	5	38
Attitude	40	12.64	5.99	25	32.38	3.7	64

The table reflected the mean and mean percentage of knowledge questions and attitude scale. The pre-test score was 8.58 (17%) \pm 3SD at a mean rate of 17, and the post-test score was 19.18 (38%) \pm 5SD at a mean rate of 38.

DISCUSSION

The research was conducted to explore student nurses' knowledge and attitude (KA) toward caring for patients with mechanical ventilators among student nurses studying in a nursing college in Tamilnadu. The KA education program regarding the patient's mechanical ventilators care was delivered after assessing participants' baseline KA. A post-test supported the researchers to identify the significant difference in KA scores between pre and post-test to authenticate the effectiveness of an education program. Student nurses are developing the required KA while undergoing critical nursing courses theoretical lectures; however, there would be the possibility of failure in recognizing the clinical deterioration of patients connected with ventilators when they are placed for hospital training.

[13]. Above fifty percent of health care providers lack knowledge, especially about weaning criteria [14] and low skills in the physical assessment of a patient with ventilators [15]. Our results concerning students' knowledge and attitudes discovered that more than seventy percent of students exhibited inadequate mechanical ventilator patient care knowledge in the pre-test. Literature suggests that knowledge deficiency is one of the core factors for delivering low-quality care for severely ill patients in ICU [16]. A study highlighted the lack of KA among nurses regarding the professional care practices of critical patients. It is a massive challenge for healthcare providers to render efficient services without reliable measurement with meager studies in Intensive care units [14].

Of the participants in our study, 35 (70%) were female, and 15 (30%) were males. The majority of subjects were aged between 21 and 22. Forty percent of the participants acquired details about caring for patients with ventilators from workshops and conferences. A recent study during covid-19 insisted that sophisticated training is mandatory to care for patients with mechanical ventilators to enhance productive patient outcomes [17]. A pre-test survey on KA identified majority of the student nurses had inadequate knowledge with unfavorable attitudes. Out of fifty student nurses, above three fourth of them did not have the appropriate knowledge to deliver acute nursing care. Surprisingly, the literature review provided subtle data among student nurses working in ICUs with mechanical ventilators.

Regarding the dependent variable of knowledge about ventilators, being females (71.4%), nurses' understanding of the care of patients increased by one-third percentage compared with males. Hence it can be assumed that male students have more barriers in rendering the necessary care than females. Despite being trained in theory as part of their curriculum, preclinical critical care training with simulation is essential to all student nurses [18]. Another study revealed that ICU is a field that requires expertise in several attributes to prevent patients from potential health risks. Hence prevention is a vital strategy that an education protocol can provide to deliver comprehensive care to patients with MV [19].

Our study showed a statistical difference between pre and post-test knowledge and attitude scores ($p < 0.05$). Hence the gap between theory and practice may be due to the inability to adhere to the new guidelines and hospital instructions [20]. Perhaps students need an adaptation period to learn the current changes that the hospital has amended [21]. Student nurses who implement evidence-based practice take decisions wisely, provide higher quality care, less hospital stay, less cost, and improved care [20]. Our study showed a significant impact of education on MV to revamp their sound knowledge and attitude. The critical care unit is the core and pivotal hospital health care setting team. Due to the acute conditions of MV

patients hospitalized in ICUs, nurses must have profound scientific knowledge and enhanced experience. Besides, high-quality professional care, a high understanding of technical devices, more clinical competencies, and broader abilities in team decision-making is expected to develop critically ill patients' outcomes.

As a patient with MV-supported is more likely to get complications, student nurses who have clinical placement in the ICU must keep abreast of evidence-based and institution protocol-based knowledge to enhance their clinical competencies in daily practice [22,23]. The findings of this will be helpful to healthcare institutions to adopt simulation procedures to bridge the gap between theoretical knowledge into clinical practice. Further research is needed to study additional educational programs related to MV and KA. Additional training can also be mandatory about hospital guidelines, bundles, and instruments to manage hospital-acquired infections.

Even though the study has shown the impact of education programs, the limitation was that the study had a small sample size, which does not meet the standards in the generalization of the finding. The second limitation was that the intervention program was given within a short training session.

4. Conclusion

Nursing administrators could play an essential role in a clinical setting in improving nursing students' professional knowledge, attitude, and skills to prevent complications of mechanically ventilated patients through an appropriate simulation training program before hospital training. We advocated strengthening the understanding and practice of nursing students working in the intensive care unit through the courses, training, workshop, and curriculums.

Acknowledgment: Herewith I wish to express my sincere gratitude to my professional colleague, who has supported me to collect data with ethical approval from the concerned institution.

References

1. Zhu Y, Zhang J, Wang G, Yao R, Ren C, Chen G, Jin X, Guo J, Liu S, Zheng H, Chen Y, Guo Q, Li L, Du B, Xi X, Li W, Huang H, Li Y, Yu Q. Machine Learning Prediction Models for Mechanically Ventilated Patients: Analyses of the MIMIC-III Database. *Frontier Medicine; Intensive Care Medicine and Anesthesiology*. 2021 July; 8: 662340. <https://doi.org/10.3389/fmed.2021.662340>
- 2. Kara G, Temiz G. Evaluation of nursing care requirements in mechanically ventilated patients. *JOURNAL OF CLINICAL MEDICINE OF KAZAKHSTAN*. 2022;19(1):706 <https://doi.org/10.23950/jcmk/11736>
3. Wei W, Niu Y, Ge X. "Core competencies for nurses in Chinese intensive care units: a cross-sectional study." *Nursing in critical care*. 2019;24(5): 276-282. <https://doi.org/10.1111/nicc.12398>
4. Cvach MM, Stokes JE, Manzoor SH, Brooks PO, Burger TS, Gottschalk A, Pustavoitau A. Ventilator Alarms in Intensive Care Units: Frequency, Duration, Priority, and Relationship to Ventilator Parameters. *Anesthesia and Analgesia*. 2020 Jan;130(1): e9-e13 <https://doi.org/10.1213/ANE.0000000000003801>
5. Rafiei H, Rahimi S, Shafaei M, Ommatmohammadi M. Emergency nurses' knowledge about ventilator-associated pneumonia. *International Emergency Nursing*. 2020 Jan; 48:100783. <https://doi.org/10.1016/j.ienj.2019.06.006>. Epub 2019 Jul 23
6. Jeong YG, Jihyun K, and Sook KH. Development and Effects of a Mechanical Ventilation Education Program with Blended Learning for Nursing Students, *Journal Korean Academy of Fundamentals of Nursing*. 2021;28(3): 361-371 <https://doi.org/10.7739/jkafn.2021.28.3.361>
7. Al-Sayaghi, Khaled M. "Critical care nurses' compliance and barriers toward ventilator-associated pneumonia prevention guidelines: cross-sectional survey." *Journal of Taibah University Medical Sciences*. 2020 Dec; 16(2): 274-282.

<https://10.1016/j.jtumed.2020.12.001>

8. Madhuvu A, Endacott R, Plummer V, Morphet J. Nurses' knowledge, experience and self-reported adherence to evidence-based guidelines for prevention of ventilator-associated events: A national online survey. *Intensive Critical Care Nursing*. 2020 Aug;59: 102827.

<https://10.1016/j.iccn.2020.102827>

9. Aloush SM, Al-Rawajfa OM. Prevention of ventilator-associated pneumonia in intensive care units: Barriers and compliance. *International Journal of Nursing Practice*. 2020Oct;26(5): e12838.

<https://10.1111/ijn.12838..>

10. Schroedl CJ, Frogameni A, Barsuk JH, Cohen ER, Sivarajan L, Wayne DB. Impact of Simulation-based Mastery Learning on Resident Skill Managing Mechanical Ventilators. *ATS Sch*. 2020 Dec 23;2(1):34-48. <https://10.34197/ats-scholar.2020-0023OC>

11. Reper P, Van der Brempt I, Haelterman M. The national Australian survey about nurses' knowledge of evidence based guidelines for ventilated patients: and the Belgian national bundle campaign? *Intensive Critical Care Nursing*. 2020 Dec;61: 102914.

<https://10.1016/j.iccn.2020.102914>

12. Winning, L, Lundy FT, Blackwood B. Oral health care for the critically ill: a narrative review. *Critical Care*. 2021; 25(353)

<https://doi.org/10.1186/s13054-021-03765-5>

13. Simin Jahani, Tayebbeh Poursangbor. Survey of knowledge, attitude and performance of Intensive Care Unit nurses regarding oral care of patients under mechanical ventilation in educational hospitals of Ahvaz, 2017. *Journal of Advanced Pharmacology Education and Research*. 2019;9(S2): 130-135.

<https://10.22122/johoe.v8i1.410>

14. Jhou HJ, Chen PH, Ou-Yang LJ, Lin C, Tang SE, Lee CH “Methods of Weaning From Mechanical Ventilation in Adult: A Network Meta-Analysis.” *Frontiers in medicine*. 2021 Oct; 8(752984)

<https://10.3389/fmed.2021.752984>

15. Yuan, X., Lu, X., Chao, Y. et al. Neurally adjusted ventilatory assist as a weaning mode for adults with invasive mechanical ventilation: a systematic review and meta-analysis. *Critical Care*. 2021; 25(222)

<https://doi.org/10.1186/s13054-021-03644-z>

16. de Haro C, Ochagavia A, López-Aguilar J, Fernandez-Gonzalo S, Navarra-Ventura G, Magrans R, Montanyà J, Blanch L. Patient-ventilator asynchronies during mechanical ventilation: current knowledge and research priorities. *Intensive Care Medicinal Experimental*. 2019 Jul;7(Suppl 1):43.

<https://10.1186/s40635-019-0234-5>

17. Williams LM, Sharma S. Ventilator Safety. [Updated 2021 Aug 11]. In: StatPearls [Internet]. Treasure Island (FL): Stat Pearls Publishing; 2022 Jul.

<https://www.ncbi.nlm.nih.gov/books/NBK526044/>

18. Shahrzad Y, Marzieh M, Soroor P, Noushin M. Intensive care unit nurses's perception of the barriers to effective in-service education: A qualitative study. 2020;7(4): 241-247.

https://10.4103/JNMS.JNMS_27_20

19. Al-Busaidi, Ibrahim Saleh et al. "Nurses' Knowledge, Attitudes, and Implementation of Evidence-based Practice in Oman: A Multi-institutional, Cross-sectional Study." *Oman medical journal*. 2019; 34(6): 521-527.

<https://10.5001/omj.2019.95>

20. Bankanie, V., Outwater, A.H., Wan, L. et al. Assessment of knowledge and compliance to evidence-based guidelines for VAP prevention among ICU nurses in Tanzania. *BMC Nursing*. 2021; 20: 209.

<https://doi.org/10.1186/s12912-021-00735-8>

21. Selamat NAB, Aung KT, Soe MK. Critical Care Nurses' Knowledge and Practices on Ventilator-Associated Pneumonia. *International Archives of Nursing and Health Care*. 2021 Jul;7: 163.

<https://10.23937/2469-5823/1510163>

22. Keller JM, Claar D, Ferreira JC, Chu DC, Hossain T, Carlos WG, Gold JA, Nonas SA, Seam N. Mechanical ventilation training during graduate medical education: perspectives and review of the literature. *Journal of Graduate Medical Education*. 2019 Aug;11: 389–401

<https://10.4300/JGME-D-18-00828.1>