Revista Contexto & Saúde
Editora Unijuí
Programa de Pós-Graduação em Atenção Integral à Saúde
ISSN 2176-7114 – v. 25, n. 50, 2025
http://dx.doi.org/10.21527/2176-7114.2025.50.15095
HOW TO CITE:
Luiz LP, Dell' Agnolo CM, Gurgel SJT, Gavioli A, Uema RTB, de Andrade L. Using the fundamentals of programmed instruction as a teaching method on mechanical ventilation for nurses. Rev. Contexto & Saúde. 2025;25(50):e15095.

ORIGINAL ARTICLE

USING THE FUNDAMENTALS OF PROGRAMMED INSTRUCTION AS A TEACHING METHOD ON MECHANICAL VENTILATION FOR NURSES

Luan Pereira Luiz[1], Cátia Millene Dell' Agnolo[2], Sanderland José Tavares Gurgel[3]
Aroldo Gavioli[4], Roberta Tognollo Borotta Uema[5], Luciano de Andrade[6]

Highlights:
(1) The need for nurses to manage mechanical ventilation during the pandemic.
(2) Mechanical ventilation training has positive effects and increases knowledge.
(3) The importance of regular training and continuing education.

ABSTRACT

Objective: To assess the effectiveness of mechanical ventilation training based on programmed instruction for nurses at a Regional University Hospital in northwest Paraná. *Method:* A quasi-experimental, before-and-after study, with pre- and post-intervention assessment of a single group, carried out between June and September 2022. Data was collected at three phases: pre-test, immediate post-test, and delayed post-test, the last of which took place three months after the training. The SPSS software was used for analysis, with the Friedman and Durbin-Conover Post-hoc tests. Cronbach's alpha coefficient was used to analyze the instrument. *Results:* In the pre-test, 51 nurses participated; in the immediate post-test, participation decreased to 45 nurses, and in the delayed post-test, 30 nurses remained involved in the study. The mean age was 42+7.56 years, 45% of the participants had double jobs, and 64% had never received training on mechanical ventilation. The pre-test had an average score of 8.73+2.21; the immediate post-test had an average score of 12.4+1.87, and the delayed post-test had an average score of 10.7+2.21. Friedman's test resulted in a p-value <0.01, and Cronbach's alpha showed that in the delayed post-test, there was better reliability of the questionnaire (value of 0.88). *Conclusion:* It can be concluded that the training was effective, but three months after it took place, there were still errors that theoretically shouldn't have been present, highlighting the need for the training to become periodic.

Keywords: nursing; mechanical ventilation; continuing education; Intensive Care Unit; programmed instruction.

[1] Universidade Estadual de Maringá – UEM. Maringá/PR, Brazil. https://orcid.org/0000-0001-5010-9619
[2] Universidade Estadual de Maringá – UEM. Maringá/PR, Brazil. https://orcid.org/0000-0002-7312-6451
[3] Universidade Estadual de Maringá – UEM. Maringá/PR, Brazil. https://orcid.org/0000-0002-8079-1724
[4] Universidade Estadual de Maringá – UEM. Maringá/PR, Brazil. https://orcid.org/0000-0003-1454-1652
[5] Universidade Estadual de Maringá – UEM. Maringá/PR, Brazil. https://orcid.org/0000-0002-8755-334X
[6] Universidade Estadual de Maringá – UEM. Maringá/PR, Brazil. https://orcid.org/0000-0003-2077-1518

INTRODUCTION

With the advent of the Sars-Cov-2 (Covid-19) pandemic, there was a strong need for the use of artificial respirators, given the severity of the patients who acquired the disease[1]. By definition, mechanical ventilation (MV) is an invasive procedure that provides life support by optimizing the cardiopulmonary system and improving gas exchange. It can be used with various ventilator models and strategies, and is directly related to the patient's state of health[2].

It is known that this therapy has risks. Therefore, it is necessary for the professionals involved in its management to receive adequate training in the installation, maintenance, and removal of the device[3].

In this context, the figure of the nursing professional stands out, especially the nurse. Since 2020, as a result of the Covid-19 pandemic, the Federal Nursing Council[4] has stated that the handling of MV is also the responsibility of nurses, especially when working with critically ill patients in the intensive care unit. It is of the utmost importance that nurses are trained in installation, maintenance, infection control, care related to the equipment itself, and preventing and minimizing damage and complications[5].

Despite official recommendations guaranteeing that nurses have adequate support in the management of MV, the practical application of knowledge regarding ventilator management, as well as its parameterization, alarms, and even its assembly, is still restricted, with these activities being focused on doctors and physiotherapists. In the vast majority of cases, it is up to nurses working in environments that receive highly complex patients to organize and maintain preventive care, such as measures to avoid bronchoaspiration and good oral hygiene[6].

A study carried out in a tertiary level hospital in the city of Fortaleza-CE, which sought to identify nurses' knowledge of complications arising from MV, showed that 77.52% of professionals still reported insecurity and lack of practice in ventilator management and care for patients using this technology[7].

It appears that the need to include nurses in addition to basic care related to MV is growing, and some countries have already made use of this practice by including training with nurses on the topic[8]. Some more advanced countries, such as South Korea, are looking for strategies to insert such situations using virtual reality at the undergraduate level[9].

Considering the relevance of the topic and the scarcity of studies related to MV in the nursing field, this study aimed to analyze the results of mechanical ventilation training for nurses using programmed instruction as a teaching method.

METHOD

This is a quasi-experimental, before-and-after study, with pre- and post-intervention evaluation of a single group[10] carried out at a Regional University Hospital in the northwest of Paraná. The hospital is large and is a reference point for the municipality of Maringá and 29 other municipalities that make up the 15th Regional Health Department. As a public organization, it exclusively serves the Unified Health System (*Sistema Único de Saúde*, SUS) and currently has 123 ward beds and a further 44 intensive care beds for adult, neonatal, and pediatric patients. The organization has approximately 1500 employees. In the nursing sector, there are around 590 professionals , including 60 nurses and 128 nursing technicians working under the statutory system. In addition, another 405 nursing professionals, including 120 nurses and 285 nursing technicians, are contracted on an accreditation basis.

Employee training was based on the assumptions of Programmed Instruction (PI)[11]. This technique can be used both as a process and as a final product. As a process, the method organizes content into units within a teaching program. As a product, PI is configured as self-instructional teaching material using the presentation of right or wrong answers that emerge from the learner's contact with the previously programmed material[12].

A purposive sample was used, and the inclusion criteria were: being a nurse and voluntarily agreeing to take part in the study. In the initial phase, the collaborators were invited to take part in the study and answered a pre-test (Phase I), which consisted of an instrument formulated by the researcher based on the guidelines of the Brazilian Society of Intensive Care Medicine[13] and the Brazilian Association of Respiratory Physical Therapy, Cardiovascular Physical Therapy, and Intensive Care Physical Therapy (*Associação Brasileira de Fisioterapia Respiratória, Fisioterapia Cardiovascular e Fisioterapia em Terapia Intensiva*)[14] in the researcher's practical experience, and in a study also carried out with nurses and PI, but on the subject of electrocardiograms[15]. This pre-test was previously assessed by three specialists (physiotherapists specializing in intensive care) before being applied to the research subjects.

The nurses were invited to take part in the study in person at the institution's premises, while the training registration form was sent electronically to the group of nurses via the WhatsApp application. The training was carried out in collaboration with the institution's Continuing Education Center and covered all the hospital's nurses, not just those working in sectors where patients specifically require mechanical ventilation. Even those nurses who were absent due to vacation or leave received invitations, although their participation was optional, not mandatory.

Of the 120 working nurses who were invited to take part in the study, only 51 took part in phase I, followed by 45 in phase II, and only 30 in phase III. This progressive decrease in the number of participants throughout the phases of the study was observed, despite the researcher's efforts to encourage attendance at the training and later to complete the delayed post-test. Data collection took place between April and September 2022.

The data collection instrument used was divided into two sections, comprising closed questions and one open question. The first section includes four questions that seek to understand the sociodemographic and occupational characterization of the participants, as well as their experiences in mechanical ventilation (MV) and in caring for highly complex patients. The second section contains 15 questions focused on parameterization, setting alarms, ventilation modalities, care of the orotracheal tube cuff, and ventilator assembly and calibration procedures. In addition, an open-ended question was included at the end of the instrument so that participants could express any doubts or comments on topics that were not covered during training.

Both sections were self-completed by the participants during the data collection phases. After this initial stage of completing the pre-test, the participants were given a training course consisting of an expository theoretical component followed by a practical simulation on the basic principles of mechanical ventilation, respirator assembly, parameterization, warning signals, and alarm programming.

The theoretical part and the practical training lasted approximately 30 minutes each, totaling 60 minutes of training. The training was carried out in groups of no more than five nurses on the institution's different shifts. Immediately after the end of the training and simulation, the participants were again asked to fill in the same instrument, but at this point it was renamed the immediate post-test (Phase 2). Some nurses had to be absent, which reduced the number of participants compared to the initial number. Three months after the training, as recommended in the PI[7], the participants answered a new instrument via Google Forms called the delayed post-test (Phase 3), using the same data collection instrument as the pre-test.

The completion of the pre- and post-test, as well as the training, was scheduled with the nurses during the off-shift, at a time that was most convenient for the employee, so as not to harm the institution. During the three months between the immediate post-test and delayed post-test, the nurses who took part in the study were able to ask questions and handle the ventilator during their work in the intensive care unit.

Sociodemographic data were initially analyzed using descriptive statistics. To test the main hypotheses (1) whether there was a significant increase in the nurses' performance immediately after the training compared to their initial performance, and (2) whether the gains in knowledge and skills were maintained or improved in a subsequent test, the Friedman test was applied. Although Friedman's test identified significant differences between the three moments assessed, it does not specify where exactly these differences occur. For this reason, the Post-hoc Durbin-Conover test[16] was used to detail these differences over the three moments assessed: before training, immediately after, and after a period. The significance level was set at $p<0.05$. The SPSS software was used to process and analyze the data, including calculating means, standard deviations, and percentages. The normality of the data was previously confirmed by the Shapiro-Wilk test[17].

The instrument's reliability was analyzed by calculating Cronbach's alpha, which was calculated again at three points: pre-test, immediate post-test, and delayed post-test. Alpha is a scale analysis carried out to assess the questionnaire concerning the sample of respondents[18]. The coefficient can provide a reasonable measure of reliability by performing a single test, so that it is not necessary to apply another test in parallel to estimate a similar value; it can be used in multiple-choice questionnaires and calculated using the most basic statistical principles[18].

The Permanent Ethics Committee for Research with Human Beings of the State University of Maringá approved the study with opinion No. 5.156.142 and Certificate of Presentation for Ethical Appreciation No. 53526021.1.0000.0104 on December 9, 2021.

RESULTS

All nurses were eligible to take part in the study (Figure 1). However, there was a reduction in the number of participants in each subsequent phase of the study. In Phase I, entitled pre-test, 51 nurses took part. In Phase II, called immediate post-test, 45 nurses took part, with a reduction of six participants who were excluded for not showing up to carry out this phase of the research. In Phase III, called the delayed post-test, despite prior communication and scheduling, only 30 nurses showed up (Figure 1). This reduction can be attributed to various factors, such as the availability of participants at the time of the subsequent phase and other professional or personal commitments that prevented continued participation in the study.

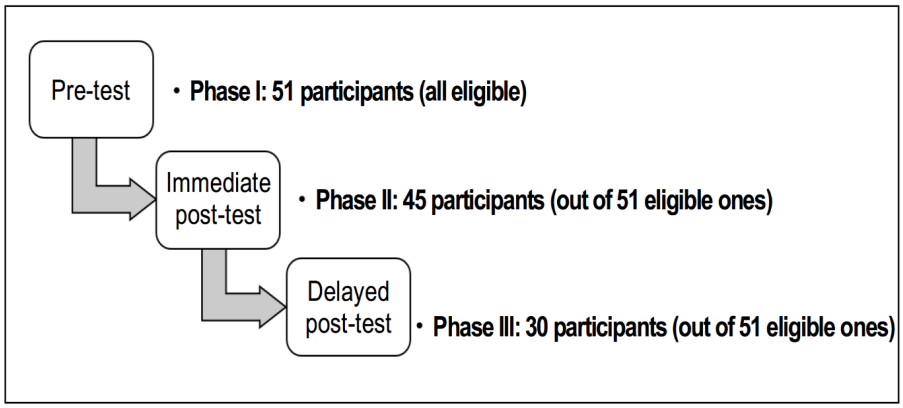

Figure 1 – Flow of participants throughout the study phases. Maringá/PR-BR, 2022 .

Among the participants, 69% were female, with an average age of 42. The median time working in the area was 14 years. In addition, 55% had only one job, and 64% had never taken part in training on the subject.

There were no responses to the open question at the end of the questionnaire. The results regarding the number of correct answers to the isolated questions can be seen in the table below (Table 1):

Table 1 – Frequency distribution of wrong answers to the questions that made up the mechanical ventilation training assessment tool for nurses, in the pre-test (n=51), immediate post-test (n=45), and delayed post-test (n=30) phases. Maringá/PR, 2024

Question	Pre-test	Immediate post-test	Delayed post-test
	n (%)	n (%)	n (%)
1) When not in use, the mechanical ventilator needs to be connected to an electrical power source?	1 (2.0)	3 (6.7)	0 (0.0)
2) Which bacterial filter has the function of protecting the patient?	5 (9.8)	4 (8.9)	7 (23.3)
3) When should the circuit test be carried out?	2 (3.9)	0 (0.0)	0 (0.0)
4) When the mechanical ventilator alarms: "Patient circuit disconnected", it means:	11 (21.6)	8 (17.8)	12 (40.0)
5) When the alarm is: "Airway pressure, high", it means:	18 (35.3)	8 (17.8)	12 (40.0)
6) Which conventional ventilation modalities are most commonly used in adults?	26 (51.0)	8 (17.8)	8 (26.7)
7) What are the basic parameters for placing the mechanical ventilator on admission?	24 (47.1)	23 (51.1)	14 (46.7)
8) Which alarms should be set initially?	1 (2.0)	3 (6.7)	0 (0.0)
9) Why should the orotracheal tube be clamped during intubation and patient disconnections in the Covid patient?	11 (21.6)	4 (8.9)	9 (30,0)
10) When transporting Covid patients on mechanical ventilation, what precautions should be taken?	12 (23.5)	5 (11.1)	7 (23.3)
11) Which of the conventional ventilation modes is recommended for programming the ventilator on admission?	2 (3.9)	2 (4.4)	0 (0.0)
12) After admitting the patient to mechanical ventilation, which laboratory test is requested to adjust the parameters?	12 (23.5)	0 (0.0)	7 (23.3)
13) How much is the ideal cuff pressure?	32 (62.7)	9 (20.0)	10 (33.3)
14) Which of the conventional ventilation modes is associated with an increase in mechanical ventilation withdrawal time?	22 (43.1)	13 (28.9)	10 (33.3)
15) What does it mean when the ventilator is set to "NIV PS or NIV PC" mode??	30 (58.8)	17 (37.8)	25 (83.3)
16) When assembling a ventilator, list the steps in the columns according to the order in which they are carried out:	27 (52.9)	16 (35.6)	23 (76.7)

n: absolute frequency, %: percentage frequency

When assessing the normality of the data using the Shapiro-Wilk test, a value of W = 0.93499 and a p-value = 0.01413 were identified, indicating that the data did not have a normal distribution. Analysis of each group separately using the Friedman method (Figure 2) showed that the pre-test had

an average of 8.73 correct answers with a standard deviation of 2.21; the immediate post-test had an average of 12.4 correct answers with a standard deviation of 1.87 and the delayed post-test had an average of 10.7 correct answers with a standard deviation of 2.21. As can be seen in Figure 2, the immediate post-test showed the best results, since it was more statistically significant with a p-value of less than 0.01, with a higher mean and standard deviation than the others.

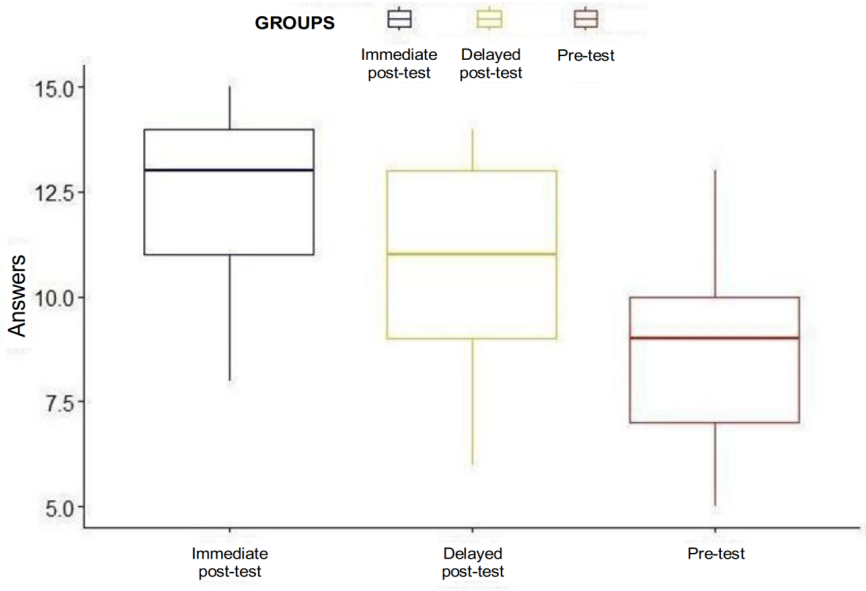

Figure 2 – Boxplot of the analysis comparing the responses at the three stages (Pre-test, Immediate post-test, and Delayed post-test) of a training course on mechanical ventilation for nurses, Maringá, 2022 .

In this way, there were statistically significant differences between the means of the evaluation tests, as demonstrated by the Durbin-Conover Post-hoc test (Table 2). The analysis revealed a statistically significant difference between the pre-test and the immediate post-test, with a magnitude of -2.99 and a p-value of less than 0.001, indicating a substantial improvement in the nurses' performance immediately after the training. Similarly, the comparison between the pre-test and the delayed post-test also showed a significant difference, with a magnitude of -4.95 and a p-value of less than 0.001, suggesting that knowledge gains were maintained, albeit reduced, after three months. However, the comparison between the immediate and delayed post-test results did not show a significant difference, evidenced by the absence of an expressive magnitude, reflecting a certain stability in the nurses' performance over time, despite the small decrease observed.

Table 2 – Summary of the Durbin-Canover paired comparisons test results of a test assessing nurses at a teaching hospital on relevant aspects of mechanical ventilation. Maringá/PR-BR, 2023

Test moments assessed		Significant difference	Direction of the difference	Magnitude	p
Pre-test	Immediate Post	Yes	Decrease	-2.99	< 0.001
Pre-test	Delayed Post	Yes	Decrease	-4.95	< 0.001
Immediate post	Delayed Post	No	-	-	-

p: statistical significance; α: 0.05

The results of the reliability test (internal validity) are detailed in Table 3. It was observed that at the time of the late post-test, the reliability of the questionnaire was higher, with a standardized Cronbach's α coefficient of 0.899, while it was lower at the time of the immediate post-test, which revealed a standardized Cronbach's α of 0.452 and a moderate standardized Cronbach's α of 0.672.

Table 3 – Statistical analysis of the reliability of the questionnaire applied at pre-test, immediate post-test, and delayed post-test phases. Maringá/PR, Brasil, 2023

	α	standardized α	number of items
Pre-test	0.672	0.642	15
Immediate post-test	0.452	0.409	15
Delayed post-test	0.870	0.899	15

α: Cronbach's alpha coefficient.

Thus, the results show that, although the team took part in the training and assessment activities, the participation in the delayed post-test was lower than in the pre-test; many participants had positive results, indicating that they had retained the information provided in the training. However, a considerable number of participants made mistakes on basic training questions, which reinforces the need for constant and periodic training.

DISCUSSION

Improving technical knowledge through programmed instruction proved to be a fundamental pillar in significantly reducing adverse events in hospital care. Higher average scores were observed in the immediate post-test compared to the pre-test. The three-month delayed post-test assessment showed a lower average than the immediate post-test period; however, even after the three months, the averages were higher than those seen at the pre-test moment. It can be inferred that the course was effective since the student had higher average scores on the post-tests and maintained this information for a moderate period, as seen in the six-month post-test, further reinforcing the need for serial courses, such as the delayed post-test moment for continuing education, to maintain the knowledge obtained.

It was observed that the training in mechanical ventilation for nurses using programmed instruction, with pre-test, immediate post-test, and delayed post-test, produced positive results, since the number of correct answers evolved positively from one moment to the next. However, it should be noted that many common doubts reappeared in the delayed phase, indicating the need for periodic training on the topic.

A study dealing specifically with the complications of mechanical ventilation and the role of nurses found that 100% of those interviewed would like to receive specific training on the topic to improve their knowledge and deepen their understanding of the topic[20], corroborating the findings of this study.

Still in this context, it is possible to observe that the limitations of nurses' knowledge on the topic of mechanical ventilation begin during their undergraduate studies, since the subject is little covered, causing many professionals to seek knowledge on their own after graduation, or when the institution finds this weakness and dedicates itself to providing training on the topic[19].

One of the difficulties raised during training sessions is the inadequate sizing of teams and the double job of nurses, which sometimes reduces the quality of care provided[6]. This study found that 45% of the participants had a double job, reported being tired and inattentive during the training, left early and didn't take advantage of the time to ask questions, claiming they were concerned about the other job, or that they had to rest for a few hours to go to work in the other period.

In this context, there is a need for a practice that can put the needs of employees on the agenda, so that they can perform their duties safely and at the same time be adequately trained to care for patients in the best possible way. Regarding mechanical ventilation, studies show that many nursing

professionals recognize that, as nurses, it is their job to understand, know how to assemble, calibrate, identify problems related to the ventilator itself and also with patients, as well as complications arising from the use of artificial ventilation. However, while they state that this is one of their roles, they don't know how to do it properly[20]

In the academic sphere, it is suggested that the topic of mechanical ventilation should be explored in greater depth to demonstrate that this should also be a concern for nursing professionals as leaders of the team working with critically ill patients. Therefore, the academy is responsible for their primary training in ventilatory support. Within the hospital environment, when these nurses are already practicing, it is suggested that the permanent education center identifies this need and acts to provide support and help minimize doubts and insecurities[6].

It is understood that the results presented refer to a local reality and cannot be generalized. As limitations, it was found that the initial pre-test was carried out during the off-shift and not during working hours. Considering that 45% of the participating professionals had double jobs, this may have hindered the progress of the data collection, since many either left early and didn't finish the training, or didn't have full attention during it.

As a limitation, I [11] was not used in a standard way. As described in the method, the methodology used for the training was based on the assumptions of PI, but it is known that, in this methodology, the training should ideally be repeated until 100% success is achieved, and, in this study, this was not the case because many nurses had double jobs and had to leave to start working at another institution. However, it should be noted that this study is a pioneer in training nurses in mechanical ventilation and that it can be used as a pilot study to support other studies on the same topic and/or population.

In an attempt to get around these situations, it should be noted that the training was not structured to be long and tiring, bearing in mind that many nursing professionals work double shifts and might not be able to complete all the steps. Added to this is the fact that the training was carried out several times during the day and over several subsequent days, with the researcher being available to answer questions or for people to finish filling in the questionnaire and handling the mechanical ventilator.

CONCLUSION

It was concluded that the training produced positive results, but it is important to emphasize the need for it to be carried out periodically, considering the number of errors present in the delayed phase, three months after the training. It is understood that the study is a pioneer in using this methodology associated with something as specific as MV, especially for nurses, but its results can help in the development of new research on the theme, as well as in the use of programmed instruction.

REFERENCES

[1] Holanda MA; Pinheiro BV. Pandemia por COVID-19 e ventilação mecânica: enfrentando o presente, desenhando o futuro. J Brasil. Pneum [Internet]. 2020 [cited 10 June 2023];46(4):e20200282. Available from: https://www.scielo.br/j/jbpneu/a/cCvkgszc66f66wHY4pwpd6P/?lang=pt&format= pdf

[2] Machado FD; Eder GL, Dullius CR. Ventilação mecânica: como iniciar. Acta méd. [Internet]. 2014 [cited 7 June 2023];35(8):1-8,. Available from: https://docs.bvsalud.org/biblioref/2018/04/882901/ventilacao-mecanica-como-iniciar.pdf

[3] David CM. Ventilação mecânica da fisiologia à prática clínica. Rio de Janeiro: Revinter; 2011.

[4] Conselho Federal de Enfermagem (Brasil). Resolução n° 639/2020. Dispõe sobre as competências do enfermeiro no cuidado aos pacientes em ventilação mecânica no ambiente extra e intrahospitalar. Ed. 87. [Access 10 June

2023]. Brasília: Cofen; 2020. Available from: http://www.cofen.gov.br/resolucao-cofenno-639-2020_79633.html

[5] Amorim MM, Gomes SR. Ações de enfermagem para prevenção de infecções associadas à ventilação mecânica na unidade de terapia intensiva neonatal. REINPEC [Internet] 2015 [cited 10 June 2023];2(1):72-82.

[6] Santos TR, Carvalho JFO, Pereira MWM. Atuação do enfermeiro frente ao paciente submetido à ventilação mecânica na emergência. Rev Nurs. [Interner]. 2022 [cited 22 Apr 2023]; 25(289). Available from: https://revistanursing.com.br/index.php/revistanursing/article/view/2320

[7] Martins LF, Sousa SMO, Alves ERB, Cavalcante KRG, Ferreira AKA, Façanha BDP. O enfermeiro está preparado frente às complicações ocasionadas pela ventilação mecânica? Rev. Nurs. [Internet]. 2019 [cited 24 Aug 2023];22(253):2956-2961. Available from: https://www.revistanursing.com.br/index.php/revistanursing/article/view/338/322

[8] Kramer M, Fultz J, Smoot B, Sutherlan S, Wells N, Monroe M, et al. Educating Nurses During a Pandemic to Manage Mechanically Ventilated Patients. Journal for Nurses in Professional Development. [Internet]. 2022 [cited 24 Aug 2023];38(5):E49-E54. Available from: https://journals.lww.com/jnsdonline/abstract/2022/09000/educating_nurses_during_a_pandemic_to_manage.17.aspx

[9] Lee H, Han JW. Development and evaluation of a virtual reality mechanical ventilation education program for nursing students. BMC Med Educ. [Internet]. 2022 [cited 24 Aug 2023];22:775. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9647745/

[10] Jacques JPB, Ribeiro RP, Sholze AR. Wellness room as a strategy to reduce occupational stress: quasi-experimental study. Reben. [Internet]. 2018 [cited 29 June 2023];7(1):483-489. Available from: https://www.scielo.br/j/reben/a/zxmkCDYRtmZFxwwCcYhM9HR/?format=pdf&lang= pt

[11] Agatti APR. Instrução Programada e sua Independência do Behaviorismo. Boletim de Psicologia; 1973;XXV(65):211-217.

[12] Souza JEJ. A autonomização do ensino no século XX: Crowder, Pressey, Skinner e a instrução programada; 2014. Manuscrito não publicado.

[13] Associação Brasileira de Medicina Intensiva. Diretrizes brasileiras de ventilação mecânica; 2013. [Acesso em: 9 July 2023]. Available from: https://www.amib.org.br/fileadmin/user_upload/amib/2018/junho/15/Diretrizes_B rasileiras_de_Ventilacao_Mecanica_2013_AMIB_SBPT_Arquivo_Eletronico_Of icial.pdf.

[14] Associação Brasileira de Fisioterapia Respiratória, Fisioterapia Cardiovascular e Fisioterapia em Terapia Intensiva. Indicação e uso da ventilação não-invasiva e da cânula nasal de alto fluxo, e orientações sobre manejo da ventilação mecânica invasiva no tratamento da insuficiência respiratória aguda na COVID-19. 2019. Available from: https://assobrafir.com.br/wp-content/uploads/2020/03/ASSOBRAFIR_COVID-19_VNI.pdf. Acesso em: 24 Aug. 2023.

[15] Andrade L, Melo AZ, Nihei OK, Pelloso SM, Carvalho MDB. Educação em enfermagem aplicada ao procedimento de eletrocardiograma. FIEP BULLETIN. 2012;82: Special Edition.

[16] Pires MC, Castro MB, Lieber ZM, Menezes TP, Aoki RYS. Estatística não paramétrica básica no software R: uma abordagem por resolução de problemas. Universidade Federal de Minas Gerais. Departamento de Estatística [Internet]. 2018 [cited 22 Aug 2023]. Available from: https://www.est.ufmg.br/portal/arquivos/rts/RTE_02_2018.pdf

[17] Razali NM, Yap BW. Power Comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling Tests. Journal Of Statistical Modeling And Analytics [Internet]. 2011;2(1);21-33.

[18] Landis RJ, Koch JJ. The Measurement of Observer Agreement for Categorical Data. Biometrics [Internet]. 1977. [cited 23 Aug 2023];33(1):159-174. Available from: https://www.jstor.org/stable/2529310?origin=crossref

[19] Bland JM, Altman DG. Cronbach's alpha. [Internet]. 1997 [cited 22 ago 2023]; 22;314(7080):572. Available from: https://pubmed.ncbi.nlm.nih.gov/9055718/

[20] Rafiei H; Rahimi S; Shafaei M. Emergency nurses' knowledge about ventilator-associated pneumonia. Int. Emerg. Nurs. 2020;48:100783. DOI: https://doi.org/10.1016/j.ienj.2019.06.006

Submitted: August 29, 2023
Accepted: November 28, 2024
Published: July 10, 2025

Authors' contributions:	
Luan Pereira Luiz:	Conceptualization, Data curation, Methodology, Visualization, Project administration, Writing – original draft.
Cátia Millene Dell' Agnolo:	Writing – review & editing.
Sanderland José Tavares Gurgel:	Writing – review & editing.
Aroldo Gavioli:	Validation, Writing – review & editing.
Roberta Tognollo Borotta Uema:	Writing – original draft, Writing – review & editing.
Luciano de Andrade:	Conceptualization, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing.
All the authors have approved the final version of the text.	
Conflict of interest:	There is no conflict of interest.
Funding:	There is no funding.
Corresponding author :	Luan Pereira Luiz Universidade Estadual de Maringá – UEM Av. Colombo, 5790 – Zona 7, Maringá/PR, Brasil. CEP 87020-900 fisioluanluiz@gmail.com
Editor:	Eliane Roseli Winkelmann. Ph.D
Editor-in-Chief:	Adriane Cristina Bernat Kolankiewicz. Ph.D