



## Comparative study of remote and presential teaching of mechanical ventilation

### Estudo comparativo do ensino remoto e presencial de ventilação mecânica

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#### ABSTRACT

The Covid-19 pandemic has challenged health professionals working on the front lines of this serious health situation, especially the ability to perform the mechanical ventilation technique on patients who need respiratory support. The handling and technique of a mechanical ventilator is one of the biggest concerns of these professionals in hospital, emergency and urgent health services. And improvement can occur through theoretical-practical training, in person or remotely. Thus, this study aims to evaluate the efficiency of face-to-face and remote teaching of mechanical ventilation for health professionals. To achieve our objective, an Educational Product (EP) was developed in the form of a website, questionnaires and video classes with theoretical content and practical demonstrations of the technique. Through the present research, a gap in pre-existing knowledge was observed in some professionals who already worked directly with the subject before training. After remote teaching, a significant number of participating health professionals correctly answered the post-test questions. It is suggested that this small deficiency in knowledge about MV can be carried out with training with newly trained professionals who will go to the job market. Although remote teaching participants showed lower performance in the post-test when compared to the pre-test, this group got more questions right than professionals who received the training in person.

**Keywords:** Mechanical ventilation, Remote teaching, Hybrid teaching, Covid-19.

#### 1 INTRODUCTION

Facing the pandemic caused by the SARS-CoV-2 virus: etiologic agent of Covid-19, the health teams that work in the front line to face the health crisis need to know the Mechanical



Ventilation (MV). Mechanical ventilation, or as we would better call it, ventilatory support, is a support method for the treatment of patients with acute or acute chronic respiratory failure<sup>1</sup>.

With the high demand for health professionals during the pandemic, remote training and study activities have become more accessible and flexible, speeding up the teaching and learning process. Through the *Internet*, several tools of Digital Information and Communication Technologies (ICTs), such as *notebooks*, cell phones, *smartphones*, and *tablets*, have been essential for remote teaching and can assist in the approach of content, research, exercises, assessments, among others<sup>2</sup>.

From an educational point of view, the insertion of digital technologies in pedagogical practices provides a fertile field of didactic possibilities to make the content more enjoyable and interesting. The use is focused on learning with images, videos, discussions, reviews, texts, and research on *online* platforms<sup>3</sup>.

As the pandemic scenario worsened, the need arose to train and qualify health professionals to deal with this disease. Scientific studies have addressed aspects related to the origin, etiology, clinical manifestations, diagnosis, and treatment against the SARS-CoV-2 virus<sup>4</sup>. In particular, the application of the Didactic Simulator of Mechanical Ventilation on the *web* as a teaching tool in the context of the pandemic.<sup>5,6</sup>

Considering that the team of nurses, physicians and physical therapists are directly involved in the care of patients requiring MV, training in skills laboratories (use of dummy, artificial lung and MV apparatus), either in person or distance learning (remote online), are essential for professional development. Thus, the aim of this study was to analyze and compare the efficiency of theoretical and practical training of MV, in person and remote, for health professionals working in a private hospital in the city of Paranavaí, Paraná, Brazil.

## 2 METHOD

This research was carried out with the approval of the Human Research Committee (COPEP) of the University Hospital of the State University of Maringá and identified by the Certificate of Ethical Appraisal - CAAE number 33698820.2.0000.0104. This study has a quantitative approach, with two distinct moments (starting with a questionnaire about the suitability of MV use and in a second moment, after remote training/teaching as a learning aid, handling of mechanical ventilators). To perform a comparative analysis of the efficiency of teaching methodologies for MV, two groups of health professionals were separately evaluated, N

= 13 in the face-to-face teaching (control group) and N = 21 in the remote teaching (experimental group).

The normality of the data was verified by the Shapiro-Wilk test, showing that the number of correct answers in both the pre-test (p-value<0.0001) and the post-test (p-value=0.0072) do not follow a normal distribution, making it impossible to use the t-test.

The Mann-Whitney non-parametric test was used to verify the significance between the number of correct answers. This test is applied when a small sample is available and the numerical variable is not known to present a normal variation, as is the case of the variable under analysis, number of correct answers. Unlike the t-test, which tests for equality of the means, the Mann-Whitney (U) test tests for equality of the medians.

## 2.1 ELABORATION AND DATA COLLECTION OF THE QUESTIONNAIRES MADE AVAILABLE

The healthcare professionals who participated in this research work on the front line of the Covid-19 pandemic in a private hospital in the city of Paranavaí-PR.

With the consent form from the management of the private hospital and the informed consent form, made available before starting the questionnaires, available on the free and accessible SurveyMonkey application, in an easy and agile way for the participants to handle.

The data collected from the participants' answers were extracted and organized in a spreadsheet for later statistical analysis. Figure 1 shows the initial page of the site and/or application.

Figure 1. Surveymonkey.com website



Source: Surveymonkey.com

## 2.2 SURVEY METHODOLOGY

The content and elaboration of the questionnaire had as main reference the "Brazilian Guidelines on Mechanical Ventilation 2013".

### *Initial Questionnaire - Survey*

Application of an initial questionnaire to assess the pre-existing knowledge on the topic of VM by health professionals, through 5 closed questions, with a score of 2 points for each question, totaling a maximum score of 10 points (APPENDIX I). The data from the scores were extracted into a spreadsheet for further analysis (methodology detailed in topic 2.6.6).

### *Final Questionnaire - Evaluation after face-to-face and remote training*

At the end of the training sessions, the participants answered a questionnaire prepared with questions after the theoretical-practical in-person or remote training, including video classes and in-person practice (Appendix II). The questionnaire was prepared with 5 questions to verify the level of learning retained, 2 points each, totaling a maximum score of 10 points. The data from the scores were extracted into a spreadsheet for later analysis (methodology detailed in topic 2.6.6).

With the analysis of the relative data collected, it was possible to evaluate the level of understanding and knowledge obtained with the different types of teaching, thus allowing more effective results to be obtained with the objective pursued.

## 2.3 CHARACTERIZATION OF THE RESEARCH PARTICIPANTS

The population for the study was selected as a random sample from a private hospital in the city of Paranaíba-PR. Health professionals working as nurses, physicians, and physical therapists who are active or not on the front line of the Covid-19 pandemic.

In total, 13 healthcare professional employees attended the face-to-face training (Figure 2).

Figure 2. Graph of the face-to-face group.

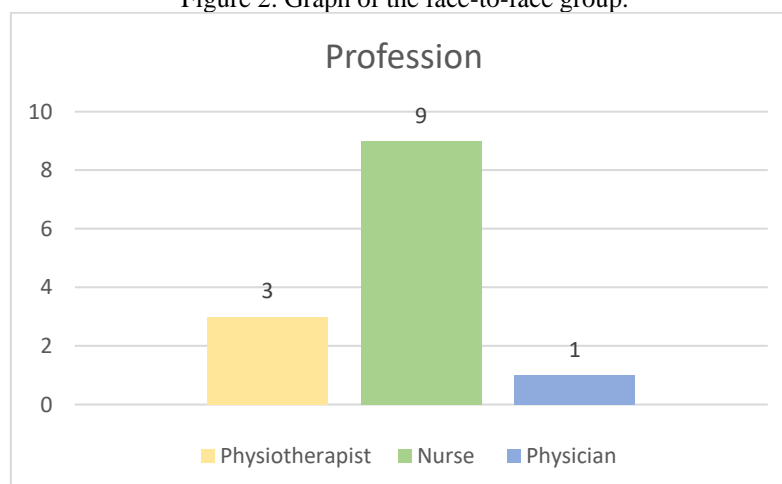


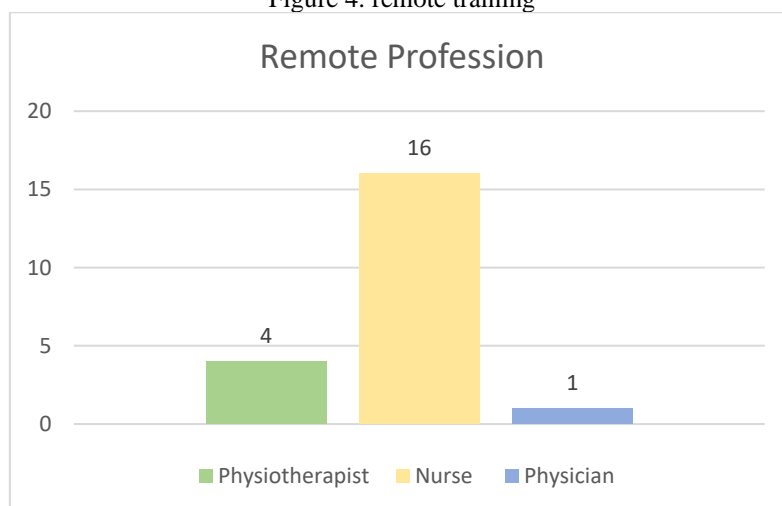
Figure 3: Live training



Source: author.

As remote training takes place through a digital tool with *internet* access, remote training participants benefited from the easy access, which favored the participation of 21 professionals (Figure 4).

Figure 4. remote training

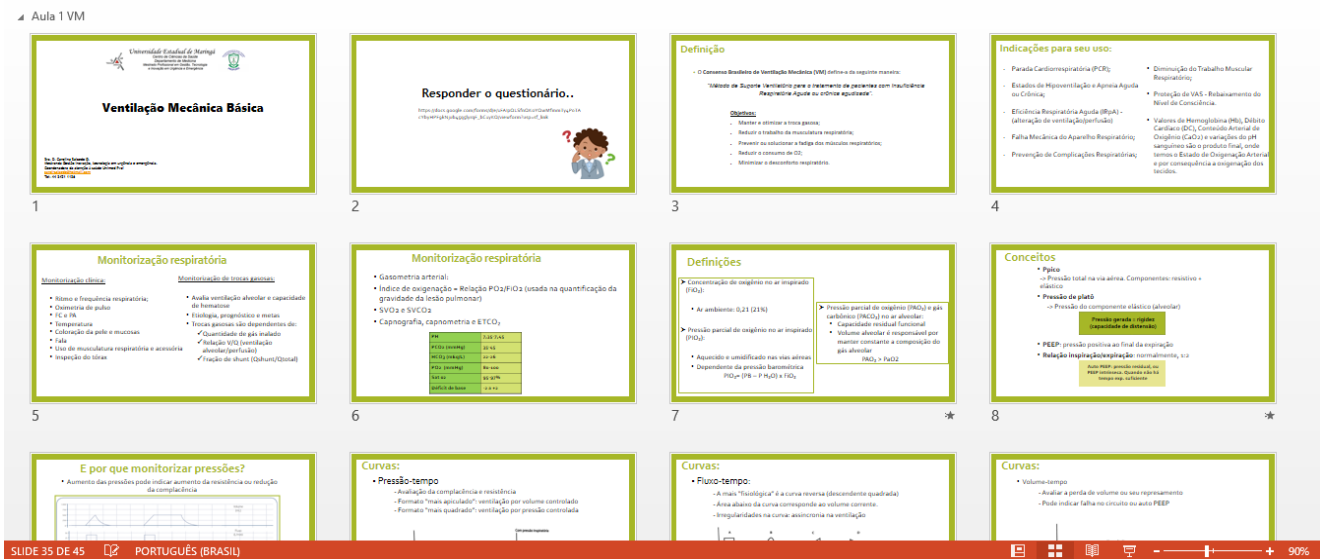


Source: author.

## 2.4 DIDACTIC MATERIAL AND CONTENT PRESENTED

The didactic material used for the theoretical presentation was produced in the *Microsoft Power Point* program for creating, editing and displaying graphics and descriptions. The material contains 45 dynamic *slides*, with basic and main themes such as: definitions, indications for use, monitoring, ventilation curves and modes, recruitment maneuvers and optimal parameter calculations. Questions and discussions about the theme were used (Figure 5).

Figure 5: Picture of teaching material in Microsoft Power Point



Source: author.

## 2.5 TRAINING, ORIENTATION, DISCUSSION OF MECHANICAL VENTILATION

The on-site training took place in the auditorium located in the city of Paranavaí, Paraná, Brazil. The participants answered the attendance list, and then watched the theoretical presentation developed in *Microsoft Power Point*, with descriptions of the theme, general definitions, tables, and other practical and easy-to-understand graphics.

Aiming at teaching the correct handling of the mechanical ventilator, by means of video classes and on-site practice, on this occasion, it was used the *CMOS DRAKE* mechanical ventilator model *RUAH* - advanced ventilator (Figure 6). The use of a mechanical ventilator is essential for learning, allowing professionals to have more proximity to devices that assist in artificial respiration.

Figure 6. DRAKE CMOS model RUAH



Source: <https://cmosdrake.com.br/produto/ventilador-pulmonar-ruah/>

## 2.6 DATA ANALYSIS

The tests and data analysis were verified by the Shapiro-Wilk test, showing that the number of correct answers in both the pre-test ( $p\text{-value} < 0.0001$ ) and the post-test ( $p\text{-value} = 0.0072$ ) do not follow a normal distribution, making it impossible to use the t-test.

Thus, the Mann-Whitney non-parametric test was used to verify the significance between the number of correct answers. This test is applied when a small sample is available and the numerical variable is not known to present a normal variation, as is the case of the variable under analysis, number of hits. Unlike the t-test, which tests for equality of the means, the Mann-Whitney (U) test tests for equality of the medians.

The data were collected after the completion of the training with the questionnaires answered in the pre- and post-training, these were conducted in person and remotely with the participants. Through the structured questionnaire, the data were compiled in a *Microsoft Excel* spreadsheet, version 2010, with subsequent quantitative analysis of the frequency of responses.

## 3 RESULTS

As described above, the population for the study obtained with a random sample from a private hospital in the city of Paranavaí-PR were health professionals such as nurses, physicians, and physical therapists who do or do not work on the front lines of the Covid-19 pandemic.

In total, 13 healthcare professional employees attended the face-to-face training (control group). And 21 healthcare professionals who underwent remote training (experimental group).

By performing the comparison of two means and results, the indicators of knowledge, learning and outcome of the effectiveness of remote teaching of MV for health professionals were investigated. The normality of the data was verified by the Shapiro-Wilk test, showing that the number of correct answers in both the pre-test ( $p\text{-value} < 0.0001$ ) and the post-test ( $p\text{-value} = 0.0072$ )



do not follow a normal distribution, making it impossible to use the t-test. In this test the null hypothesis is that the data follow a normal distribution, as the p-value was less than 0.05, this hypothesis is rejected, discarding the normality of the variable number of correct answers.

Thus, to verify the significance between the number of correct answers, we used the nonparametric Mann-Whitney test, which is applied when there is a small sample and the numeric variable is not known to present a normal variation, as is the case of the variable under analysis, number of correct answers. Unlike the t-test, which tests the equality of means, the Mann-Whitney (U) test tests the equality of medians. Its purpose is to verify whether the two distributions are similar as to the equality of the median. Thus, table 1 identifies the type of test (pre- and post-test) performed in the in-person and remote teaching groups with the objective of verifying if there was a difference in the teaching. The dependent variable in this way is the type of test that was applied.

Table 1. Type of test by education group

Test Type	Group						P-value
	Pre-test			Post-test			
	Average	DP	Median	Average	DP	Median	
Presencial	3,00	1,00	3,00	3,10	0,70	3,00	0,610
Remote	4,62	1,89	4,00	3,24	1,34	3,00	0,030

In the pre-test, it was possible to verify that the average presented in the face-to-face group was 3.00, while in the remote teaching was 4.62, considering a disparity of data. This result shows that in an average above 4 its is possible to notice that half of the participants got 4 questions right. The post-test, on the other hand, shows a parity of means with values of 3.10 for the face-to-face group and 3.24 for the remote group.

In turn, it was possible to verify that in the post-test of the remote teaching there was a decrease in the correct answers. These differences evidenced in the remote group for the pre-test and the post-test showed a significance of 0.030.

According to Melo and Silva<sup>7</sup> educational technology is important and necessary, and should not be used superficially, since its main function is to produce and disseminate information and knowledge to transform society. In the present study, remote teaching proved to be an efficient teaching methodology, given the objective achieved in this research.

In Table 2, the dependent variable of the types of teaching was considered, remote or face-to-face, in order to verify if there was a difference between the pre-test and the post-test. The analyses returned the mean between the pre-test (x:3.00) and the post-test (3.10) for face-to-face



teaching. In remote teaching, there was a significant difference (p-value = 0.026) between the mean obtained in the pre-test (x:4.62) and the post-test (X:3.24).

Table 2. Type of tests applied in the face-to-face and remote groups

Group	Test Type						P-value
	Presencial			Remote			
	Average	DP	Median	Average	DP	Median	
Pre-test	3,00	1,00	3,00	4,62	1,89	4,00	0,026
Post-test	3,10	0,70	3,00	3,24	1,34	3,00	0,714

Figure 6 shows the distribution of the numbers of hits in blocks in the remote teaching indicated in the red box. The lower box contains the minimum number of correct answers, which are 2 questions in the post-test questionnaire. In the upper box we get the maximum hits of the participants in the post-test totaling 4 questions. And in the line of greater proportion the median. In the blue box, representing the pre-test, the lower limit identifies 2 questions, but the number of correct answers remained concentrated in the number of correct answers of 3 questions in the pre-test, being the maximum of correct answers of 4 questions.

Figure 7: Distribution of hit numbers in blocks in remote teaching

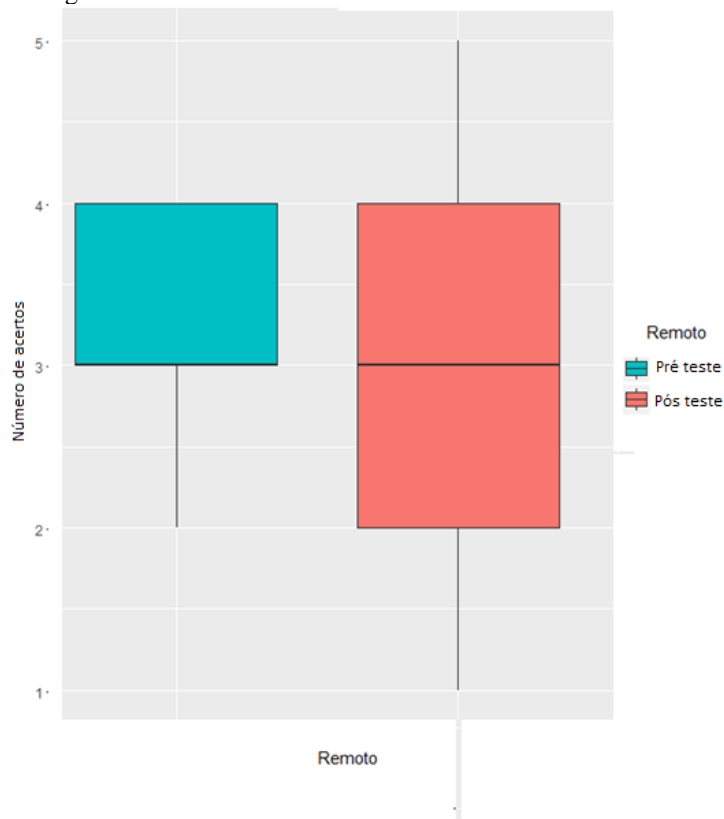
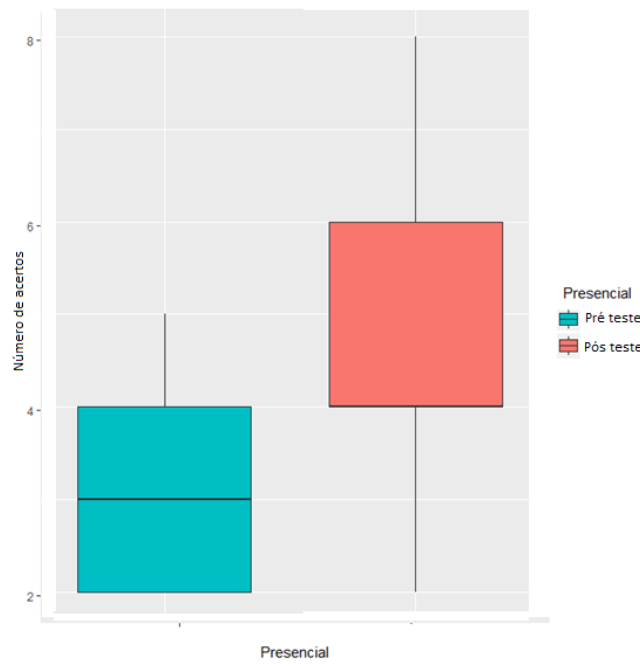


Figure 8: Distribution of the numbers of hits in blocks in face-to-face teaching



The in-person group in the pre-test got an average of 4 correct answers, and in the post-test this number increased to 6 (Figure 7). Considering that the post-test helped in the number of correct answers in the face-to-face group.

#### 4 DISCUSSION

With this study it was detected that health professionals such as physicians, nurses, and physical therapists had a better performance after the training and clarifications on the proposed theme, as well as on the ventilatory modes to which the patient can be submitted.

When comparing the difference and effectiveness of remote and face-to-face teaching on the topic of VM, the results indicate that remote teaching can be an alternative for the training of health professionals. The development of a low-cost EP and the training carried out through a digital tool connected to the Internet brings more convenience and flexibility to the participants, who can adjust according to their availability and professional life.

We observed that remote teaching or distance education has enabled new forms of inclusive education to be opened. The research of Kenski<sup>8</sup> and of Dantas and Medeiros<sup>9</sup>, collaborates with the findings of this research, in the valorization of technology as a form of learning for remote teaching.

According to the World Health Organization (WHO), one way to combat the spread of the Covid-19 virus is social isolation and, as a result of the adoption of this measure, most educational



institutions have adopted distance learning, also called remote learning. Even if remote teaching is the current scenario, and assuming that it is the only possibility of continuing the classes, one should be aware of the importance of humanization in the teaching and learning process, so no technology replaces the human being.

In this sense, Oliveira, Queiroz and Souza Júnior<sup>2</sup>, mention that: "Technologies are very important and have contributed to some changes in teaching and learning. But they, by themselves, have not changed our model of schools. If we lose the human sense of education, we lose everything. [...]". One can see, then, the importance of the teacher being inspiring and not repetitive in the acquisition of knowledge, as well as the paramount importance of continuing education in the use of technologies.

Despite the great importance and contribution of technologies applied to education, the human sense needs to remain because the "essence" of education would be lost. Therefore, it is necessary that educational institutions and teachers seek tools that do not minimize the importance of the human being and continue to provide dialogue and the exchange of experiences<sup>2</sup>.

The results obtained show that the participants in the remote training had a higher achievement in relation to their performance, configuring the significant difference compared to the face-to-face group. This situation can be explained by the different forms of interventions to which the participants in the in-person and remote training were submitted. Possibly, the remote teaching group used Internet tools to access information on the subject more quickly and easily, raising a hypothesis that the participants in this group accessed websites as a way to help them build their own learning and answer the questionnaire.

## 5 CONCLUSIONS

Through this research, a gap in knowledge was observed in some professionals who already worked directly with the theme and practice of MV mechanical ventilation before the training. This deficiency detected in the knowledge about MV can be overcome by applying the EP developed in this study for the training of newly graduated professionals who will go to the labor market.

After the remote learning, a significant number of the participating healthcare professionals answered the post-test questions correctly. Although the remote teaching participants performed less well on the post-test when compared to the pre-test, this group got more questions right than the professionals who received the face-to-face training.



The remote teaching methodology can be considered an alternative to training through state-of-the-art technology, is innovative, and allows more flexibility to access knowledge. Remote teaching may be an immediate response to the demands with the subject Basic Mechanical Ventilation, especially in periods of social isolation. However, future studies are still needed to determine if there is an improvement in distance learning when compared to face-to-face methodology.



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