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Comparative study of remote and face-to-face teaching of mechanical ventilation: a website proposal

Estudo comparativo do ensino remoto e presencial de ventilação mecânica: uma proposta de *website*

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ABSTRACT

The Covid-19 pandemic has challenged health professionals who work on the front lines of this serious health situation, especially in terms of the ability to perform the Mechanical Ventilation (MV) technique in patients who need respiratory support. The handling and technique of a mechanical ventilator is one of the major concerns of these professionals in the Emergency Room (ER), Intensive Care Unit (ICU) and in urgency and emergency services. After graduation, several health professionals assume leadership positions in teams that work in areas of emergency care without having specific qualifications for MV, a situation that generates difficulties, anguish, stress and care deficiencies. In addition, there is a great demand for qualified professionals in times of pandemic and social distance, and thus there was an expansion of training and remote and/or online study activities using Digital Technologies tools connected to the internet. Thus, this study aimed to comparatively evaluate face-to-face and remote teaching, in the handling of MV for health professionals who are on the front lines of the Covid-19 pandemic. For this purpose, an Educational Product (EP) was developed in the form of a website, questionnaires and video class with theoretical content and practical demonstrations of the techniques. The material was developed for health professionals and used to assess the quality of face-to-face and remote teaching with participants who answered knowledge survey questionnaires on the subject before training, and also a final questionnaire after attending the class. 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 it was 4.62, considering a disparity in the data. This result shows that in an average above 4, half of the participants got 4 questions right. In the post-test, there is 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 remote teaching post-test there was a decrease in correct answers. These differences evidenced in the remote group for the pre-test and the post-test had a significance of 0.030. Conclusion: 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. 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. Remote teaching can be an immediate response to demands with the Basic Mechanical Ventilation theme, especially in periods of social isolation. However, future studies will still be necessary to affirm if there is an improvement in distance learning when compared to the face-to-face methodology.

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

1 INTRODUCTION

Faced with the pandemic caused by the SARS-CoV-2 virus, etiological agent of Covid-19, the health professional, who is on the front line in facing this health crisis, has the need to know about Mechanical Ventilation (MV). MV is a support method for the treatment of patients with acute or acute chronic respiratory failure (CARVALHO; TOUFEN JUNIOR; FRANCA, 2007).

Despite being widely used in the hospital environment, the technique is still a challenge and a major concern for professionals working in Emergency Departments (ER), Intensive Care Units (ICUs), and in urgencies and emergencies. The challenge becomes even greater in more severe situations and in patients with comorbidities. Even so, if the team is well prepared to deal with mechanical ventilators, part of the problems arising from intensive care can be alleviated with the acquisition of mechanical ventilation.

After graduation, many health professionals assume the role of leaders in teams that work in urgency and emergency services, emergency room and intensive care. However, it is evident that some of these professionals still do not have a specific qualification related to IMV (Invasive Mechanical Ventilation), thus arising the difficulties, anguishes, stress, and consequently, the deficits in patient care. The lack of knowledge/training by these professionals can turn the application of the technique into a stressful factor for the whole team of the sector.

According to Smeltzer and Bare (2002), caring for a patient under MV has become an integral part of nursing care in Intensive Care Units (ICUs), in general clinical-surgical units, in intermediate care units, and even in the home.

For this, it is necessary the understanding of both the principles of MV and the patient's care needs; as well as an effective communication between the whole health team together with the objectives and therapeutic plan and adequate weaning planning, also considering the patient's tolerance regarding ventilatory parameter changes.

Leite (2005) emphasizes that nursing professionals who work in ICUs are expected to have a refined scientific knowledge, to follow technological changes and to be highly specialized. However, for Zuñiga (2004), ventilatory assistance is a challenge for the nursing team, due to the complexity of the equipment, which requires specific theoretical and practical knowledge, often not addressed in their training.

Nevertheless, physicians and nurses were the professionals most affected by the COVID-19 scenario (ARAGÃO *et al*., 2021; FERNANDEZ *et al*., 2021; FIOCRUZ, 2021).

With the high demand for health professionals during the pandemic, remote training and study activities have become accessible and flexible, reconfiguring the teaching and learning process. Through the *internet*, several tools of Digital Information and Communication Technologies (DTICs), such as *notebooks*, *smartphone* cell phones and *tablets*, have been essential for remote teaching assisting in the approach of content, research, exercises, assessments, among others (OLIVEIRA, SIQUEIRA, 2017).

With the worsening of the pandemic scenario, 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 (BRITO *et al*. 2020). In particular, the application of the Didactic Simulator of Mechanical Ventilation on the *web* as a teaching tool in the context of the pandemic (GIRARDI *et al*., 2020; GIRARDI; GIRARDI; MARQUES, 2020).

The use of mobile devices or *m-learning* with *internet* access enables the creation of learning environments without geographical barriers between students and teachers and the development of didactic strategies. Valente; Hildebrand; Mèdina (2014) point out that such methodology is much more focused on the learner, the time and the situation in which he is. The use of ICTs associated with *internet* access has allowed students to follow the content according to their availability.

According to Landeiro *et al*. (2015), the use of information technology by nurses was once considered a challenge, but the skill has been increasingly developed through the implementation of innovative educational processes that impact the professional career and the care services offered to patients and their families. From an educational point of view, the insertion of digital technologies in pedagogical practices not being a rule, becomes 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 in *online* platforms (GOMES; RODRIGUES, 2019).

During the pandemic, the teaching process was reconfigured to ensure the social distance and the non-interruption of classes, being implemented the remote classes through the use of ICTs. Consequently, there was an expansion in the adoption of these tools through the *Internet*, such as: videos, podcasts, simple virtual reality, digital educational games and computer simulations (ARRUDA, 2020; GOH; SANDARS, 2020; ROSE, 2020; GIRARDI *et al*., 2020). *Lives* have also been considered important tools to operationalize permanent health education, especially in a pandemic context. However, Neves *et al*. (2021) points out that there is also an exclusion factor

for users of the public health system with greater social vulnerability, who do not have access to the *internet*.

Considering that the nursing staff, physicians and physical therapists are directly involved in the care of patients requiring MV, training in skills laboratories with realistic simulation (artificial lung and MV apparatus), either in person or through distance learning (DLT), is essential for professional development. Thus, the present research aimed to comparatively evaluate face-to-face and remote learning in the management of MV for health care professionals who are on the front lines of the Covid-19 pandemic.

The objective of this study was to create an Educational Product (EP) in video lesson format for the in-person and remote teaching and training of health care professionals who are on the front line in the fight against coronavirus, and are directly involved with the MV technique.

Additionally, the effectiveness of the EP in both teaching modalities was analyzed based on the participants' previous knowledge and the knowledge acquired after participating in the application. The *link to* access the theoretical content and the didactic-pedagogical video are available on the *website* of the University Hospital of Maringá - HUM, for everyone who wants to improve the practice of MV.

2 LITERATURE REVIEW

The current health scenario in Brazil has been marked by several global changes, such as the epidemiological, demographic, and technological transitions, besides other factors inherent to the Brazilian culture and society. One of the areas that faces challenges that are difficult to overcome and recognize is health care. Despite the shared responsibilities in all spheres of government, as well as the principles and guidelines related to the services offered in Primary Care (BRASIL, 2017).

The insertion in the global economic context, as well as the pressure of regional competition, has been imposing pressures on health sector organizations in Brazil (BRASIL, 2017). According to the studies of Severo *et al*. (2010), strategies to overcome crises tend to modify the health system in order to give it greater management flexibility and greater financial stability. The economic vision of the sector focuses on a service-producing company, a resource-transforming entity that uses the technological, physical, and human resources at its disposal to produce health services that, in turn, are delivered to the population, either for free or through payment (SEVERO, 2010).

In a critical essay on health management, Sodré (2020) reconstructs the actions of the federal government in confronting the Covid-19 pandemic, highlighting the precariousness of the labor contracts of health professionals. According to the author's review, as several workers became ill in the services, the replacement of these workers did not happen immediately as, in theory, was intended to happen. The sick professionals left several health services, at the same time, depleted of labor force. This professional, now sick, is the front-line worker in many services - something common among health workers who have multiple jobs and work in several services to supplement their income from multiple shifts.

For the future, Aveni (2020) reaffirms that it will be necessary for health systems to work on disease prevention, innovation, and the use of new Industry 4.0 technologies in the health sector, and also to rethink the relationship between the current system and a system that is more focused on people, health education, and training professionals for research.

In the following topics (1.3.1 and 1.3.2) the concepts and technique of MV are presented, and the main relationships between the use of MV during the Covid-19 pandemic and the practice of remote teaching as a means of qualifying health care professionals involved with the practice are discussed.

3 THE PRACTICE OF MECHANICAL VENTILATION AND THE COVID-19 PANDEMIC

MV or IMV is the process of support or replacement of spontaneous breathing for the treatment of patients with acute respiratory failure (ARF) or acute chronic (CARVALHO; TOUFEN JUNIOR; FRANCA, 2007). ARF is a common cause of admission to the ICU and in severe conditions, IMV is required. The Brazilian Consensus on Mechanical Ventilation defines it as follows: *"Method of Ventilatory Support for the treatment of patients with Acute or Chronic Acute Respiratory Failure"* (CARVALHO; TOUFEN JUNIOR; FRANCA, 2007).

This method aims to maintain oxygenation and/or ventilation in patients with ARF, in an invasive or noninvasive artificial way, until they can assume it spontaneously. MV is indicated to maintain gas exchange, i.e., to correct severe hypoxemia and respiratory acidosis associated with hypercapnia; to reduce the work of the respiratory muscles which, in acute situations of high metabolic demand, is high; to reverse or prevent fatigue of the respiratory muscles; to reduce oxygen consumption, thus reducing respiratory distress; and to allow the application of specific therapies (CICARELLI; GONÇALVES, 2005; SOUZA *et al.*, 2021).

MV is also an important tool in the support of patients who evolve to ARDS (Acute Respiratory Distress Syndrome) and SARS-COV-2 (SILVA; MELLO; RAMOS, 2021). The disease caused by the Sars-Cov-2 virus leads to ARDS in 5% of those affected. Diagnosed patients may evolve to Severe Respiratory Syndrome (SARS-CoV), with complications by shock and multiple organ failure (ZHANG *et al*., 2020, WORLD HEALTH ORGANIZATION, 2020). Greater complications are expressive in elderly patients or those with comorbidities, such as diabetes *mellitus,* asthma, hypertension, obesity, chronic obstructive pulmonary disease, among others. When severe damage to the respiratory system occurs, which is common among vulnerable groups, there is a need for ICU assistance and MV as respiratory support (ZHANG *et al*., 2020; SOUZA *et al*., 2021)

IMV occurs through a ventilator, which provides airflow to the patient's lungs (CARVALHO; TOUFEN JUNIOR; FRANCA, 2007; FIALKOW *et al*., 2016). Ventilatory support is done through the use of devices that intermittently inflate the airways with volumes of air (tidal volume - VT). The movement of gas into the lungs occurs due to the generation of a pressure gradient between the upper airways and the alveolus, which can be achieved by equipment that decreases alveolar pressure (negative pressure ventilation) or increases the pressure of the proximal airway (positive pressure ventilation).

Due to its greater application in clinical practice, only the aspects related to positive pressure ventilation, both invasive and noninvasive, will be commented on. In this air, the O2 concentration (FIO2) necessary to obtain an adequate arterial oxygen rate (partial pressure of oxygen in arterial blood - PaO2) is controlled.

There are several causes and factors that may lead to the indication of mechanical ventilation, as well as to its weaning, and the patient submitted to such treatment is usually sedated, in a state of inability to communicate, associated to the loss of physical, psychic and emotional control, requiring from the professional who assists him, both a more accurate knowledge of the signs and symptoms of respiratory insufficiency, as well as of the alterations indicated by the machine (ventilator). The constant technological evolutions with modern ventilators also require from the professional a constant renewal of knowledge.

According to the Brazilian mechanical ventilation guideline (2013), the criteria for applying MV vary according to the objectives to be achieved. In emergency situations, especially when the risk of life does not allow good evaluation of respiratory function, the clinical impression is the most important point in the indication of MV, aided by some laboratory parameters (Table 1). The main indications to start ventilatory support are:

- Resuscitation due to cardiac arrest;
- Hypoventilation and apnea: The elevation in PaCO2 (with respiratory acidosis) indicates that alveolar hypoventilation is occurring, either acutely, as in patients with injuries to the respiratory center, intoxication or drug abuse and in pulmonary embolism, or chronically in patients with diseases with chronic airflow limitation in acute phase and in morbid obesity;
- Respiratory failure due to intrinsic lung disease and hypoxemia. Decreased PaO2 resulting from ventilation/perfusion changes (up to its most severe expression, the intrapulmonary *shunt*). Hemoglobin (Hb) concentration, cardiac output (CO), arterial oxygen content (CaO2), and blood pH variations are some factors that must be considered when assessing arterial oxygenation status and its influence on tissue oxygenation;
- Mechanical failure of the respiratory system: muscle weakness/ neuromuscular diseases/ paralysis; and unstable respiratory command (head trauma, stroke, exogenous intoxication, and drug abuse).

Cicarelli and Gonçalves (2005) point out that MV has contributed greatly to increase survival in various clinical situations, but despite the great advance, when used inappropriately, it can contribute by increasing the morbidity and mortality rate. The impact of MV on the mortality of patients affected by Covid-19 was investigated by Souza *et al.* (2021). The authors reviewed scientific articles published on the topic (2018-2020), showing that among 2634 patients evaluated with Covid-19, 12.2% needed to undergo MV. Of these, 88.1% did not survive, or only 11.9% of survived. The death rate of Covid-19 patients who required invasive MV was higher compared to patients with lung cancer, indicating that the technique increases the likelihood of intensive care mortality.

According to the Chinese guide developed by Peng *et al.* (2020), Covid-19 disease can be classified according to its severity: mild, moderate, severe and its critical state, in which each one presents a different clinical picture and management, and ventilatory support is necessary from the severe phase of the disease, characterized by respiratory distress (PENG *et al*., 2020).

The Brazilian Ministry of Health guidelines for the treatment of Covid-19 suggest endotracheal intubation for critically ill patients who have not achieved symptom relief (persistent respiratory distress and/or hypoxemia) after standard oxygen therapy, patients whose symptoms (respiratory distress, respiratory rate >30/min, PaO2/FiO2 oxygenation index<150 mmHg) persist

or exacerbate after high-flow nasal oxygenation (HFNO) or noninvasive ventilation for 2 hours (BARBOSA; ZANATTA; CAMPIOLO, 2020).

In addition to the numerous challenges imposed on health services due to the pandemic, the training of human resources was also configured as one of the greatest obstacles to be overcome to ensure the safety of care to critically ill patients. The search for qualification to meet a growing demand for critical care demanded the need to diversify teaching-learning techniques. The invasive MV technique became in evidence with the outbreak of Covid-19, which attacks, preferentially, the respiratory system, making occasionally an affected patient need this resource (SOUZA *et al*., 2021), requiring a professional prepared to perform it.

In this context, it was observed that the training and development of health professionals should occur in a decentralized manner encompassing all locations and knowledge in order to provide the democratization of work spaces. The teaching-service learning methodology needs to consider the flexible and changing reality of health actions and services; the link between training and the composition of professional profiles; the introduction of mechanisms, spaces and themes that generate self-analysis, self-management, implication and change of pedagogical and institutional practices that provide problematization and experimentation processes (ALMEIDA, 2020).

In short, the healthcare team must understand each patient's specific pulmonary needs and work together to best serve them. This requires an understanding of the principles of MV and the patient's care needs, as well as open communication among health care team members about the goals of therapy, weaning planning, and the patient's tolerance for ventilator changes (SMELTZER; BARE, 2002).

3.1 REMOTE TEACHING AND THE QUALIFICATION OF HEALTH PROFESSIONALS

The TIDCs (Digital Information and Communication Technologies) have been changing the paradigm of teaching/learning and the relationships between the individual, work, and society as we know them today. On the one hand, computerization emerges as a foundation for a leap in the quality of care, management, and teaching, making every phase of the process interactive and dynamic. And the collective construction of knowledge can contribute to identifying better ways of doing things, making professionals aware, and improving the quality and efficiency of service delivery (ZEM-MASCARENHAS, 2004).

Recent trends in higher education in Brazil are expressed by the massive training of professionals by private Higher Education Institutions (HEI), whose graduates are destined to

precarious jobs, with low technical knowledge and subject to greater exploitation. There is also a strong trend towards differentiation of courses, institutions and education modalities, with emphasis on distance learning (EAD), and the expansion of post-graduation, with emphasis on the particularization of knowledge (MANCEBO ; VALE; MARTINS, 2015; MANCEBO; SILVA JUNIOR; SCHUGURENSKY, 2015).

Although the definition of ODL is quite polysemic, in general, it is conceptualized as an education modality in which teacher and student are geographically in different places. According to Decree 9.057 of the Official Gazette of the Union, 2017, it is situated prior to the advent of the *Internet,* beginning in the 18th century, through courses conducted by mail. Already *e-learning*, also defined in different ways in the literature, occurs when there is the use of *internet* technologies to promote student learning.

It can be synchronous, when performed at the same time, or asynchronous, when activities are recorded and broadcast to learners who can access them at any time. There are other terms related to the articulated composition between face-to-face and distance learning, considered hybrid (*blendedlearning* or *b-learning*), as well as terms related to the specificity of the remote devices used for learning (*mobile learning* or *m-learning*) (MOORE; DICKSON-DEANE; GALYEN, 2011; VALENTE; HILDEBRAND; MÈDINA, 2014).

Despite the terminological differences, Brazilian legislation defines DL as an educational modality mediated by the use of information and communication media and technologies, highlighting the need for qualified personnel and compatible access, monitoring, and evaluation policies. The recent decree of the Ministry of Education and Culture (MEC) No. 9,057 of 2017 also refers that the modality is related to educational activities between teachers and students in "different places and times," which allows the interpretation that the activities can be synchronous and asynchronous (BRASIL, 2017).

The National Policy for Continuing Education in Health (PNEPS) was established by Ordinance GM/MS No. 198 on February 13, 2004 (BRASIL, 2004), and had its implementation guidelines published in Ordinance GM/MS No. 1996 of August 20, 2007 (BRASIL, 2007). The Programa de Educação Permanente em Saúde (PEPS) instituted by Portaria GM/MS n° 278 of February 27, 2014 and the Programa Nacional de Segurança do Paciente (PNSP) (BRASIL, 2014) implemented by the Ministry of Health, as a public health policy in Brazil, also stand out.

In recent years, patient safety has become an object of study in different areas of knowledge and scientific expertise. In health care, especially in nursing, the topic has become a concern, as it is directly related to the quality of care provided by professionals in different care settings. The

permanent health education services (HPS) of health institutions should be aware of the fact that, despite facing a pandemic situation, new strategies are required to ensure in-service training and professional training, which will probably reduce the risk of compromising the safety of workers and patients.

Thus, the continuing education programs of health institutions need to find strategies capable of stimulating their professionals to act accurately, safely and consciously, aiming to achieve the re-signification of relationships and work processes. It is important to highlight that the actions carried out by the continuing education in health during the pandemic contributed to improve the care practice of nursing professionals, who are directly in the front line of Covid-19, thus strengthening the multiprofessional bond.

In the pandemic scenario, it is essential that all those involved in the care process are able to play their role with complete safety, that they are stimulated to safe practices, which provide a higher quality of care to the patient and ensure their own life and that of their families (AZEVEDO *et al*., 2021).

4 JUSTIFICATION

Given the need to qualify health professionals for the practice of mechanical ventilation, as well as the relevance of improving information and communication technologies remotely, this study aimed to contribute to the qualification of professionals on the issue of "Basic Mechanical Ventilation".

5 OBJECTIVES

5.1 GENERAL OBJECTIVE

The objective of this study was to create an Educational Product (EP) for in-person and remote training of health care professionals who are on the front line in the fight against coronavirus and who are directly involved with the handling and use of mechanical ventilation.

5.2 SPECIFIC GOALS

- To comparatively evaluate face-to-face and remote teaching in mechanical ventilation management for healthcare professionals who are on the front lines of the Covid-19 pandemic.
- Produce a video lesson on "Basic Mechanical Ventilation" and make it available on the *website* created from the research.

- To contribute to the professional qualification in health care and quality of care in the Covid-19 pandemic and other diseases that may require mechanical ventilation (MV).

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