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Mechanical fans used in patients with COVID-19: challenges in safe disassembly

Ventiladores mecânicos utilizados em pacientes com COVID-19: retos del desmontaje seguro**Ventiladores mecânicos usados em pacientes com COVID-19: desafios na desmontagem segura****ABSTRACT**

Objective: To describe the nurses' feelings regarding the safe disassembly of mechanical ventilators used in patients with Covid-19 inside the intensive care unit. **Method:** This is a descriptive and exploratory study, with a qualitative approach. Data were collected between March and June 2020, through semi-structured individual interviews, with a sample of 13 nurses. The data were submitted to lexical analysis in the IRAMUTEQ Software and analyzed using the Descending Hierarchical Classification (CHD) and Similitude Analysis. **Results:** The speeches showed the insecurity and disagreement of nurses working in the ICU for patients with COVID-19, exposing professionals to the risk of contamination. **Conclusion:** Upon describing the feelings of the interviewed nurses, there was unanimous agreement that decentralization in the processing of these contaminated articles increases the risk of spreading the disease and leaves workers more susceptible to the risk of illness.

DESCRIPTORS: Nursing; Coronavirus; Occupational risks.

RESUMEN

Objetivo: Describir el sentimiento de las enfermeras sobre el desmontaje seguro de los ventiladores mecánicos utilizados en pacientes con Covid-19 dentro de la unidad de cuidados intensivos. **Método:** Se trata de un estudio descriptivo y exploratorio, con enfoque cualitativo. Los datos se recolectaron entre marzo y junio de 2020, mediante entrevistas individuales semiestructuradas, con una muestra de 13 enfermeras. Los datos se sometieron a análisis léxico en el software IRAMUTEQ y se analizaron utilizando la Clasificación Jerárquica Descendente (CHD) y el Análisis de Similitud. **Resultados:** Los discursos mostraron la inseguridad y el desacuerdo de los enfermeros que trabajan en la UCI para pacientes con COVID-19, exponiendo a los profesionales al riesgo de contaminación. **Conclusión:** Al describir los sentimientos de los enfermeros entrevistados, hubo acuerdo unánime en que la descentralización en el procesamiento de estos artículos contaminados aumenta el riesgo de propagación de la enfermedad y deja a los trabajadores más susceptibles al riesgo de enfermedad.

DESCRIPTORES: Enfermería; Coronavirus; Riesgos laborales.

RESUMO

Objetivo: Descrever os sentimentos dos enfermeiros frente à desmontagem segura dos ventiladores mecânicos usados em pacientes com Covid-19 dentro da unidade de terapia intensiva. **Método:** Trata-se de um estudo descritivo e exploratório, com abordagem qualitativa. Os dados foram coletados entre março e junho de 2020, por meio de entrevista individual semiestructurada, com uma amostra composta por 13 enfermeiros. Os dados foram submetidos à análise lexical no Software IRAMUTEQ e analisados por meio da Classificação Hierárquica Descendente (CHD) e Análise de Similitude. **Resultados:** Os discursos apresentaram a insegurança e a discordância dos enfermeiros que atuam na UTI destinada à pacientes com COVID-19, expondo os profissionais ao risco de contaminação. **Conclusão:** Mediante a descrição de sentimentos dos enfermeiros entrevistados, foi unânime a concordância de que a descentralização no processamento desses artigos contaminados aumenta o risco de disseminação da doença e deixa os trabalhadores mais susceptíveis ao risco de adoecimento.

DESCRITORES: Enfermagem; Coronavirus; Riscos ocupacionais.

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INTRODUCTION

COVID-19 has a high rate of dissemination and this is worrisome, given the great impacts that the disease has been causing worldwide. Evidence of the potential contamination of health professionals in viral pandemics is well elucidated, especially in aerosol-generating procedures (AGPs).¹

In view of the contagious nature of covid-19, professionals working on the front line must consider all aspects relevant to a safe airway approach, both to avoid possible errors and to reduce the risk of contamination of these professionals. It is recommended to participate in the procedure a doctor, a nurse and/or a physiotherapist, in addition to a circulator.²

The person responsible for intubation must be the most experienced member in the management of the airways of critically ill patients, preferably using a negative pressure environment and a Hepa³ filter. In the absence of these conditions, the patient should be placed in a room with closed doors, open windows and restrict the number of professionals during these procedures.¹

In the care setting, among the health professionals most vulnerable to this infection, there are nurses, technicians and nursing assistants, as they represent the majority in health services and in the other 24 hours providing assistance to the patient affected by the disease.⁴

Acting on the front line and providing assistance to intubated patients, it was noticed a routine of opening the closed system of the mechanical ventilator circuits after use by the patient with covid-19 inside the unit itself. The pieces were disassembled and packed in black bags to be sent to the Material and Sterilization Center (MSC). Therefore, a question arose about the risk that the professionals would be exposed with the manipulation of these contaminated circuits.

Thus, the objective was to describe the nurses' feelings regarding the safe disassembly of mechanical ventilators used in patients with Covid-19 inside the intensive care unit.

METHOD

This is a descriptive and exploratory study, with a qualitative approach, deve-

loped in an intensive care unit of a public hospital of reference in highly complex procedures, located in the capital of the state of Ceará, linked to the Unified Health System.

The individuals were invited to participate in the investigation according to the following inclusion criteria: being a nurse and working in the intensive care unit for patients diagnosed with Covid-19. Professionals on health leave or on vacation were excluded. The sample closure was due to saturation, that is, when there was no new information in the testimonies, 13 nurses participated in the investigation.

Data were collected from March to June 2020, through a semi-structured individual interview, prepared and validated by the researchers themselves, consisting of three guiding questions, covering subjects such as: disassembly and pre-cleaning of the mechanical ventilator after use. in the patient with COVID-19 within the unit, organization of the disassembly flow and sending it to the Material and Sterilization Center (MSC) and feelings experienced about the safety of carrying out this disassembly.

The interviews were conducted in a private place, without interruptions. The testimonies were recorded and transcribed in an exhaustive way in an attempt to generate qualitative and quantitative indicators. It is necessary to characterize the classes and, subsequently, to analyze the content of all speeches.⁵ To guarantee anonymity, nurses were identified by the letter E, followed by Arabic numerals in the order of the interviews (E1, E2, E3 ...).

The data were analyzed using the IRAMUTEQ (Interface de R pour les Analyses Multimensionnelles de Textes et de Questionnaires) software (SOUZA et al 2018).⁶ Classical lexicographic analyzes were performed at Iramuteq to

understand statistical data and quantify evocations and forms. Descending Hierarchical Classification (DHC) was obtained to measure the data of the dendrogram according to the generated classes, considering the words with $X^2 > 3.84$ ($p < 0,05$). Subsequently, the Similitude Analysis was performed, which based on the theory of graphs was able to identify the occurrences between words and their connection.

The study was submitted to the appreciation of the ethics and research committee (CEP - comitê de ética e pesquisa) of the Hospital Geral de Fortaleza, which received approval with number 4.049.919, under CAAE 31452620.5.0000.5040. The study res-

pected all stages of the guidelines and research standards involving human beings of Resolution 466/12 of the National Health Council. Nurses were required to read and sign the Informed Consent Form (ICF).

RESULTS

The general corpus consisted of 13 texts, separated into 25 text segments (TS), with the use of 19 TSs (76,00%). 673 occurrences (words, forms or words) emerged, with 214 distinct words and 112 with a single occurrence. The analyzed content was categorized into three classes: Class 1 - "Risk of contamination", with 06 ST (31,58%); Class 2 - "Exposure in handling the contaminated mechanical ventilator", with 05 ST (26,32%) and Class 3 - "Incorrect flow to CME when transporting the mechanical ventilator", with 08 ST (42,11%) (see figure 1).

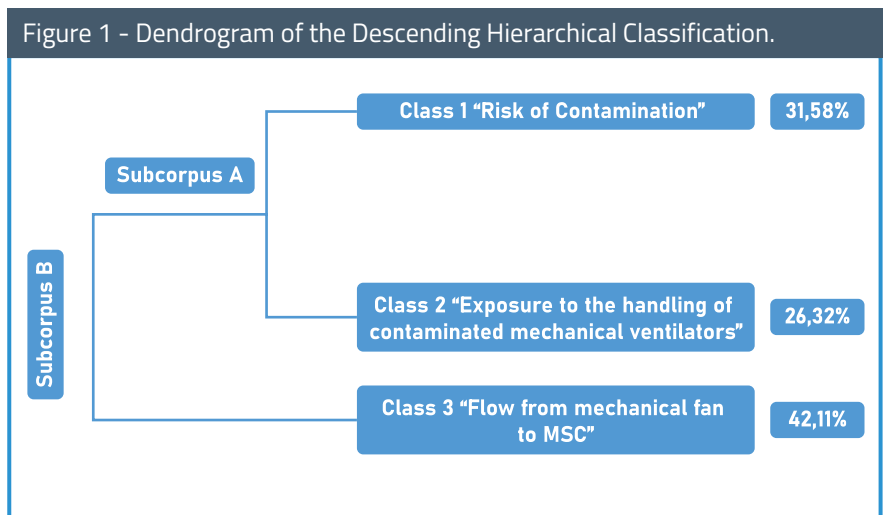
In order to better illustrate the words in the textual corpus in their respective classes, a class diagram was organized with examples of words from each class evaluated using the chi-square test (X^2). In it, evocations emerge that present vocabulary similar to each other and vocabulary different from other classes. Then, each of these classes found through the analysis of Descending Hierarchical Classification will be presented, operationalized and exemplified (see figure 2).

Class 1 - "Risk of contamination"

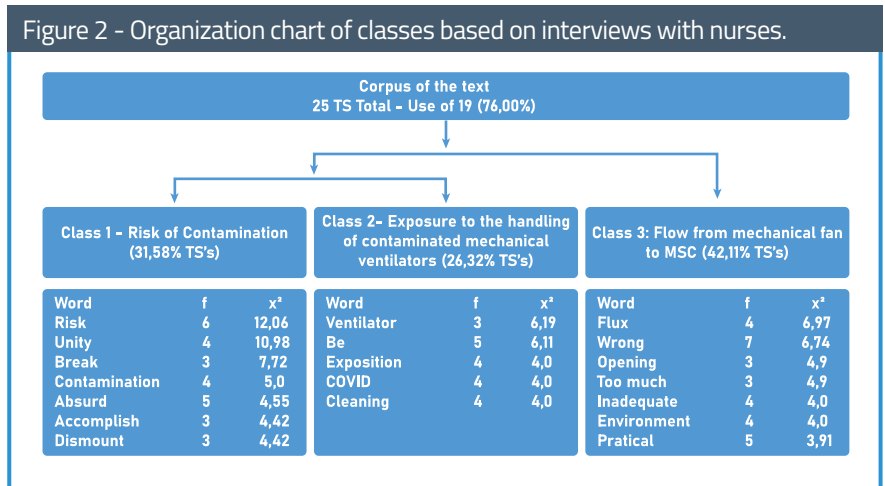
It comprises 31,58% ($f = 06$ ST) of the total analyzed corpus. Consists of words and radicals in the range between $x^2 = 4,05$ (No) and $x^2 = 12,06$ (Risk).

This class refers to the perception of the nurses interviewed, after assuming such an assignment. They report that it is a conduct that goes against the safety recommendations recommended by the competent health agencies.

It was observed that many professionals did not receive technical training to perform the dismantling of the fans, thus being more exposed to contamination and spread of the disease.



Source: Iramuteq software, version: 0.7 alpha2.



Source: Own elaboration.

[...] I do not agree! Absurd, the risk of contamination will increase... our safety... we will break the seal of the contaminated tracheas in the unit. (E4)

This dismantling is absurd, it is being carried out by untrained nursing professionals. Hurts biosafety increasing risks, there is no security [...]. (E7)

[...] without security, many professionals are not trained and end up doing it anyway exposing themselves to infection. (E10)

The disassembly of the mechanical fan and pre-cleaning must not be carried out in the unit itself, this manipulation is absurd because of the exposure and risk to the professional [...]. (E11)

Class 2 - "Exposure in the handling of contaminated mechanical ventilators"

It comprises 26,32% (f = 05 ST) of the total analyzed corpus. It consists of words and radicals in the range between $x^2 = 4,0$ (Cleaning) and $x^2 = 6,19$ (Fan).

This class brings questions related to nurses' perception regarding exposure to the handling of contaminated mechanical ventilators within the intensive care unit itself. They report concern and discontent with such activity, showing themselves to be insecure.

There is unanimous agreement that this practice goes against the sanitary recommendations in force in the country. They also state that this exposure is an unnecessary risk that professionals are exposed to, as according to the interviewees, the entire cleaning process must be carried out in a specific environment, citing the MSC as responsible.

I do not see the need to dismantle this ventilator in the ICU and put the professional on greater exposure. It is wrong, all cleaning must be done at MSC. (E2)

This practice only increases the

professional's exposure to the virus. It's wrong, we studied in college, all cleaning must be done at MSC [...]. (E3)

It was absurd, disgusting to dismantle the contaminated ventilator used in a patient with Covid in an ICU. (E13)

Class 3 - "Flow from mechanical fan to MSC"

It comprises 42,11% (f = 08 ST) of the total analyzed corpus. It consists of words and radicals in the interval between $x^2 = 3,91$ (Practical) and $x^2 = 6,97$ (Flow).

This class addresses aspects related to the flow of contaminated materials performed incorrectly within the ICUs. The feeling of insecurity and dissatisfaction is evident in the speeches of the nurses interviewed. They report that such a practice is totally inadequate. The interviewed professionals stated that since college they learned that this type of service is the responsibility of the MSC, it must be carried out in an environment prepared and equipped for such action.

The intensive care unit is not a safe environment for the disassembly of contaminated mechanical ventilators, given that COVID-19 infection is a disease that is easily spread and highly transmissible. Everyone recognizes the risk to which they are exposed, in addition

to defending that all the processing of the contaminated material must be done centrally at the MSC.

[...] high degree of transmissibility, this practice is wrong, these flows are disrespectful and not acceptable because they expose us even more. (E9)

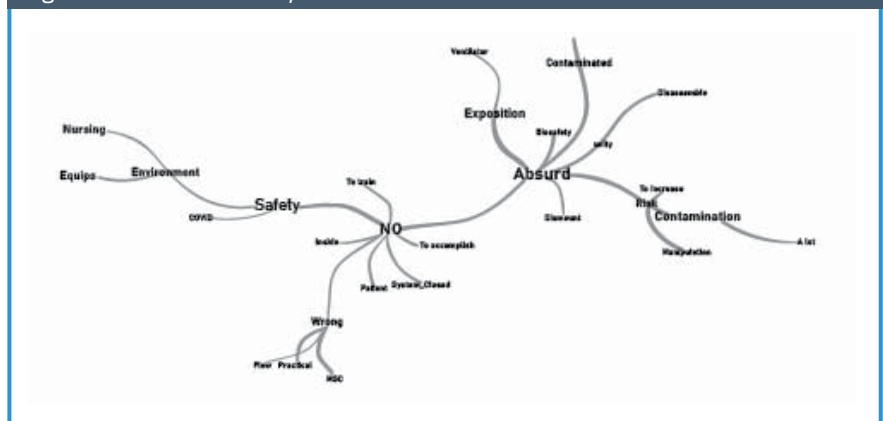
[...] there is no security, the environment is inadequate, the team has not been trained, wrong practice with inadequate flow. (E11)
A totally wrong flow, handling in this way is wrong, because we are going to open the closed system very contaminated in the patients' environment (E13)

The similarity analysis is based on the theory of graphs, in which it is possible to identify the occurrences between the words and the indications of the connectedness between the words, helping to identify the structure of the content of a textual corpus. It is observed that the word "No" and "Absurd" are at the center of the reports, and they are strongly linked with "Security", "Exposure" and "Risk" and from these arise several other ramifications that underlie all textual discourse (see figure 3).

DISCUSSION

The Unified Health System has bio-

Figure 3 - Similitude analysis.



Source: Iramuteq software, version: 0.7 alpha2.

safety laws and regulations that guide care practices in public and private health services across the country.⁷ Sometimes, these rules and regulations are not followed according to the determinations, and professionals are faced with circumstances where they are obliged not to do what is recommended, putting their integrity and that of everyone involved in the assistance process at risk.⁸

In the current scenario, the impacts of this pandemic that the world has been facing are immeasurable, in the field of health, the main deficiencies of the system are the lack of adequate structure, lack of inputs and unskilled labor, thus generating an overload in the system leaving it about to collapse.⁹

Health professionals working on the front lines to fight covid-19 are more vulnerable to infection.¹⁰ This whole context in which workers are inserted and given the limitations they have to face on a daily basis, results in physical damage and damage to their mental health.⁹

Health care services must be performed under the premise of maximum safety, always seeking to reduce the occurrence of errors to a minimum.¹¹ However, on a daily basis there are events and circumstances that expose professionals to occupational risks. In this study, the processing of articles for health in ventilatory care stands out, where nursing professionals are responsible for this entire dismantling process within the intensive care unit and are more exposed to situations that cause damage to their health.¹²

The hospital environment is considered unhealthy because it contains various types of diseases of a contagious nature and for carrying out various procedures that offer occupational risks capable of causing harm to the health of workers.¹² In order for these risks to be minimized, it is necessary that all professionals who work on the front line in the fight against infectious diseases receive permanent training and qualifications.¹³

The flow of contaminated material must be unidirectional, with physical

and / or technical barriers between the areas. The responsible professional must have registration with his class council proving his technical capacity to perform the designated function and must also be

Health professionals working on the front lines to fight covid-19 are more vulnerable to infection. This whole context in which workers are inserted and given the limitations they have to face on a daily basis, results in physical damage and damage to their mental health.

part of a permanent education program.⁷ The MSC has a fundamental role in the processing of articles for health care that currently work centrally following the safety recommendations established by health authorities.¹⁴

Through the testimonies collected, it is evident that it is not easy for professionals who work on the front line in assisting patients infected with covid-19, to perform new work routines without the proper conditions. We can see how much they are being exposed to the disease, putting their lives at risk and further increasing the risk of spreading the disease.¹⁵

The health sanitary agencies create protocols and recommend that each institution providing care implement it during assistance. In the case of assistance related to mechanical ventilation, it is necessary to adopt a sequence of steps when processing the articles, ranging from the removal of the patient's equipment and forwarding for processing until its reuse. In view of the testimonies collected in this study, it is clear that the decentralization of this service can generate loss of aerosols and inadequate handling, thus increasing the risk of contamination of the professionals involved.

Therefore, it is the duty of each institution to promote an adequate and safe environment during the entire process of managing contaminated ventilatory assistance items, in order to guarantee safety for the entire team.¹⁶

It is the nurse's responsibility and duty to provide assistance to the person, family and community free of damages resulting from malpractice, negligence or recklessness and that nursing must guarantee assistance safely.¹⁷ For this reason, it is necessary that this routine of dismantling contaminated respirators be reviewed, readjusted and this activity can be performed in a safe environment.

In this context, the similarity analysis emphasizes that the presence of professionals in hospital institutions in the context of COVID-19, in which the main

preventive measure is distance, the risk of contamination related to work activity increases considerably, due to the magnitude spread of this virus, which strongly confirms the context of the risk that these workers are exposed within a scenario of new care routines.¹⁸

CONCLUSION

By describing the feelings of the nurses interviewed, it was possible to perceive great dissatisfaction, fear and insecurity regarding the handling, disassembly and transport of contaminated mechanical

ventilators within the intensive care unit after use by patients with COVID-19.

There was unanimous agreement that decentralization in the processing of these contaminated articles increases the risk of spreading the disease and leaves workers more susceptible to the risk of illness. ■

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