

CONDUTAS DOS PROFISSIONAIS DE ENFERMAGEM FRENTE AOS ALARMES DOS VENTILADORES MECÂNICOS EM UMA UNIDADE DE TERAPIA INTENSIVA

CONDUCT OF NURSING PROFESSIONALS TO THE ALARMS OF MECHANICAL VENTILATORS IN AN INTENSIVE CARE UNIT

CONDUCTAS DE LOS PROFESIONALES DE ENFERMERÍA FRENTE A LAS ALARMAS DE LOS VENTILADORES MECÁNICOS EN UNA UNIDAD DE TERAPIA INTENSIVA

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RESUMO

Objetivos: caracterizar quais alarmes sonoros disparados por ventiladores mecânicos foram mais frequentes, descrever o tempo estímulo-resposta aos alarmes do ventilador mecânico e analisar as condutas dos profissionais de enfermagem diante dos alarmes ventilatórios. **Método:** pesquisa descritiva, quantitativa, realizada em uma unidade de terapia intensiva de um hospital universitário do Rio de Janeiro. Os dados foram tratados com estatística descritiva. **Resultados:** realizadas 60 horas de observação, nesse período, soaram 25 alarmes de ventiladores mecânicos, 20 alarmes foram atendidos e 5 pararam sem nenhuma intervenção. Os alarmes mais prevalentes foram volume minuto expirado baixo, e pressão de vias aéreas alta. O tempo mínimo para atendimento dos alarmes foi 10 segundos, o tempo máximo 3 minutos, e o tempo médio 38 segundos. As condutas mais realizadas pelos profissionais de enfermagem foram aspiração traqueal, reposicionamento do circuito e ausculta pulmonar. **Conclusão:** os achados da pesquisa apontaram que, nos alarmes mais prevalentes, as condutas dos profissionais de enfermagem, de acordo com a literatura, não foram suficientes para a resolatividade dos problemas apresentados.

Descritores: Enfermagem; Respiração artificial; Unidades de terapia intensiva; Alarmes clínicos.

ABSTRACT

Objectives: To characterize which alarms were activated by mechanical ventilators were more frequent, to describe the stimulus-response time to the mechanical ventilator alarms and to analyze the nursing professionals conducts before ventilatory alarms.

Method: descriptive, quantitative research performed in an intensive care unit of a university hospital in Rio de Janeiro. The data were treated with descriptive statistics. **Results:** 60 hours of observation were performed. During this period, 25 mechanical ventilator alarms sounded, 20 alarms were answered and 5 stopped without any intervention. The most prevalent alarms were low expired minute volume, and high airway pressure. The minimum time to answer the alarms was 10 seconds, the maximum time 3 minutes, and the average time 38 seconds. The most accomplished conducts by the nursing professionals were tracheal aspiration, circuit repositioning and pulmonary auscultation. **Conclusion:** the research findings pointed out that, in the most prevalent alarms, nursing professionals' conduct, according to the literature, was not enough to solve the problems presented.

Descriptors: Nursing; Respiration artificial; Intensive care units; Clinical alarms.

RESUMEN

Objetivos: caracterizar que alarmas sonoras disparadas por ventiladores mecânicos fueron más frecuentes, describir el tiempo estímulo-respuesta a las alarmas del ventilador mecánico y analizar las conductas de los profesionales de enfermería ante las alarmas ventilatorias. **Método:** investigación descriptiva, cuantitativa realizada en una unidad de terapia intensiva de un hospital universitario de Río de Janeiro. Los datos fueron tratados con estadística descriptiva. **Resultados:** realizadas 60 horas de observación, en ese período sonaron 25 alarmas de ventiladores mecânicos, 20 alarmas fueron atendidas y 5 pararon sin ninguna intervención. Las alarmas más prevalentes fueron el volumen minuto expirado bajo, y la presión de las vías aéreas alta. El tiempo mínimo para la atención de las alarmas fue 10 segundos, el tiempo máximo 3 minutos, y el tiempo promedio 38 segundos. Las conductas más realizadas por los profesionales de enfermería fueron aspiración traqueal, reposicionamiento del circuito y auscultación pulmonar. **Conclusión:** los hallazgos de la investigación apuntaron que, en las alarmas más prevalentes, las conductas de los profesionales de enfermería, de acuerdo con la literatura, no fueron suficientes para la resolución de los problemas presentados.

Descriptores: Enfermería; Respiración artificial; Unidades de cuidados intensivos; Alarmas clínicas.

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INTRODUCTION

This study has as theme the fatigue caused by the alarm of mechanical ventilators and the behavior of nursing professionals before them. The choice of this theme is based on the need for a greater discussion on the response to alarms and the preparation of professionals to meet the demands of patients requiring ventilatory support.

Mechanical ventilation (MV) totally or partially replaces spontaneous ventilation. It promotes improvement of gas exchange and reduction of respiratory work, and can be used in a non-invasive and invasive way, being of great importance in Intensive Care Units⁽¹⁾.

The *Emergency Care Research Institute (ECRI)* annually publishes a list of 10 (ten) topics of major interest in patient safety, some of them referring to the dangers involved in technologies used in health care (TOP 10). For a number of years, the list pointed to alarms as the main threat to patient safety in the health area, surpassing other care technologies. In the years 2012, 2013 and 2014, alarms ranked first, and in 2016, second in the list. In 2017, missed alarms that could cause damage to patients occupied the third place in the *ranking*⁽²⁾.

The development of monitoring technologies has accompanied the progress of intensive care. In order to provide safety for patients in severe states, monitors provide alarms for a variety of physiological variables. Thus, the team can be alerted when changes in vital parameters happen. Due to the increasing incorporation of technologies in intensive care units, the number of alarms has also increased and become a matter of concern among researchers and intensive care professionals⁽³⁾.

Professionals who work in sectors with a greater number of electromedical devices and, consequently, more alarms are more susceptible to alarm fatigue. Such fatigue, in turn, may often cause them to become indifferent to the sound of these alarms. The alarm fatigue phenomenon can be understood as the delay in the professionals' response time to them. The sounds may be inactivated, silenced or ignored, and the team may become insensitive to them, decreasing the alertness⁽⁴⁾.

The *ECRI* received in 2006 about 2200 reports related to technology, and the word "alarm" was present in the problem description

field in approximately 12% of them. Of this total, 39% were alarms from mechanical fans. The reports showed the occurrence of device failures, which put the patient at risk and that did not generate the necessary alarm to alert the professionals⁽⁵⁾.

The *Association of Medical Instrumentation - AAMI Foundation*, in March 2014, published a *Webinar* titled "*Current Challenges with Ventilator Alarms*", which lists a series of recommendations to improve the safety practices regarding ventilators and to deal with the issue of alarms triggered.

Studies show that alarms triggered by MV can account for 30 to 33% of all alarms in an intensive care unit, being alarms of increased respiratory rate and increased airway pressure the most prevalent. This fact should be a cause for concern because alarms may indicate problems in the ventilatory support to patients that, when ignored, predispose the patient's life to imminent risk⁽⁵⁻⁶⁾.

Over time, some functions in the intensive care sector related to mechanical ventilation are no longer attributed to nurses. A study showed that practices that used to be previously specific of nursing such as assembly of the mechanical ventilation system, definition of initial parameters, airway aspiration, gasometric follow-up, ventilatory weaning, among others, are now carried out by professionals from other areas⁽⁷⁾. As the care of mechanical ventilation is provided by other professional categories, a possible distancing of nurses from this care has been observed, even with respect to responding to alarms triggered by the ventilator. The nursing team has the largest number of workers in the intensive care setting, with the professionals being mostly involved in monitoring critical patients.

Among the professionals who work in Intensive Care Units (ICUs), nurses are responsible for the direct care of critical patients, according to Law 7498/86 of the Federal Nursing Council. They have numerous duties in their daily work and develop both care and management activities. It is imperative that these professionals be able to deal with the care of patients under mechanical ventilation. The Brazilian Guidelines on Mechanical Ventilation of 2013 describe as part of the nursing care to patients under MV the task of checking alarms and clinical parameters⁽¹⁾.

Despite advances related to investigating the alarm fatigue phenomenon, the results seem still incipient with regard to the attitudes of the nursing team towards sounds of alarms triggered by mechanical ventilators. In this context, this study had as object the attitude of nursing professionals before ventilator alarms. The research question was: What are the behaviors of nursing professionals before ventilator alarms?

The relevance of the study lies in the fact that MV used in intensive care are increasingly present in these units and represent complex technologies, adding a series of alarm systems that can compromise the alertness of the nursing team, the quality of care and patient safety.

The objectives of the research were: to characterize which alarms triggered by mechanical ventilators are more frequent in the unit, to describe the stimulus-response time to mechanical ventilator alarms, and to analyze the actions of nursing professionals before ventilator alarms.

METHODS

This is a descriptive research with a quantitative approach.

The research was developed in an ICU of a university hospital of the state public network in the city of Rio de Janeiro, which has 10 beds, among 9 common beds and one respiratory isolation bed. The physical space destined to the 10 beds and to the circulation of health professionals and relatives (at visit hours) occupies an area located on the 5th floor of the Institution. There is a nursing desk with a complete view of the MV of the beds 3,4,5,6,7,8 and partial view of the MV of the beds 1,2,9,10.

All beds of the unit are equipped with the SERVO-S[®] mechanical ventilator. This ventilator has 4 options of ventilatory modes: controlled volume (CV); pressure control (PC); supportive pressure (SP)/continuous positive airway pressure (CPAP), and synchronized intermittent mandatory ventilation (SIMV). It also has the following alarms: high respiratory rate (RR), low RR, low expired minute volume, high expired minute volume, reserve ventilation, battery running, high airway pressure, increased O₂, gas network problem, high positive end-expiratory pressure (PEEP), low PEEP, among others (VM Instruction Manual).

The unit has a multiprofessional team composed of physicians, nutritionists,

physiotherapists, speech therapists, psychologists and nursing staff that consists of 13 nurses, 39 nursing technicians, and 15 nursing residents in intensive care because this is a university hospital with a residence program. The service schedule has six teams divided between daytime and nighttime shifts. In the daytime care, the team consists of 1 nurse and 5 nursing technicians and, in the night, 2 nurses and 5 nursing technicians.

As inclusion criteria, all nursing professionals (nurses, nursing technicians and nursing residents) who attended the alarms sounded by mechanical ventilators were selected.

Participants that make up the nursing team but are not participate in the direct care to these patients professionals on vacations, on leave, and re-assigned from the ICU nursing professional staff to other sectors, were excluded from the study.

All nursing professionals who accepted to participate in the research signed an Informed Consent form to authorize observation during their work activities.

The norms of Resolution 466/2012 of the National Council on Ethics and Research, which rules research involving human beings, were observed, and the ethical principles of autonomy, beneficence, non-maleficence and justice were respected. The project was submitted for appreciation by the institution's Research and Ethics Committee (REC) and approved with Presentation Certificate for Ethical Appreciation (CAEE) 2,046,512.

Data collection was done with aid of an instrument filled out by the researcher during non-participatory observation, being performed at different times. All observations were done during daytime shifts, totaling 60 hours of observation and recording. The option of producing data only in daytime shifts was the researcher's option it was due to administrative and operational difficulties to access the study scenario at night.

The data collection instrument had the variables: bed, alarm, professional, time, actions and observations. A timer was used to measure the stimulus-response time and during the observation of the beds, a strategic point was selected in front of the beds.

Thus, at the moment when one of the alarms of the electromedical devices was triggered, the timer was triggered and the following information was recorded in the instrument of data collection: the bed that had

the MV device that produced the alarm; the professional who responded to the alarm; the stimulus-response time, and the actions of the professional who responded to the audible alarm.

In order to determine the stimulus-response time, the time interval between the alarm triggering and the professional's arrival at the patient's bedside was considered. The stimulus-response time was no longer timed when it reached 5 minutes, and was recorded as a non-responded, fatigued alarm.

The limit of 5 minutes was defined because in the case of a cardiorespiratory arrest (CRA), in situations of absolute emergency, common among critical patients, for example, the longer the response time to the alarm the greater is the delay to start cardiopulmonary resuscitation maneuvers, and the worse is the neurological outcome⁽⁸⁻¹⁰⁾.

In order to record the variable of the mechanical ventilator responsible for triggering the alarm, we used the information expressed in

the *interface* (main screen) of the mechanical ventilator.

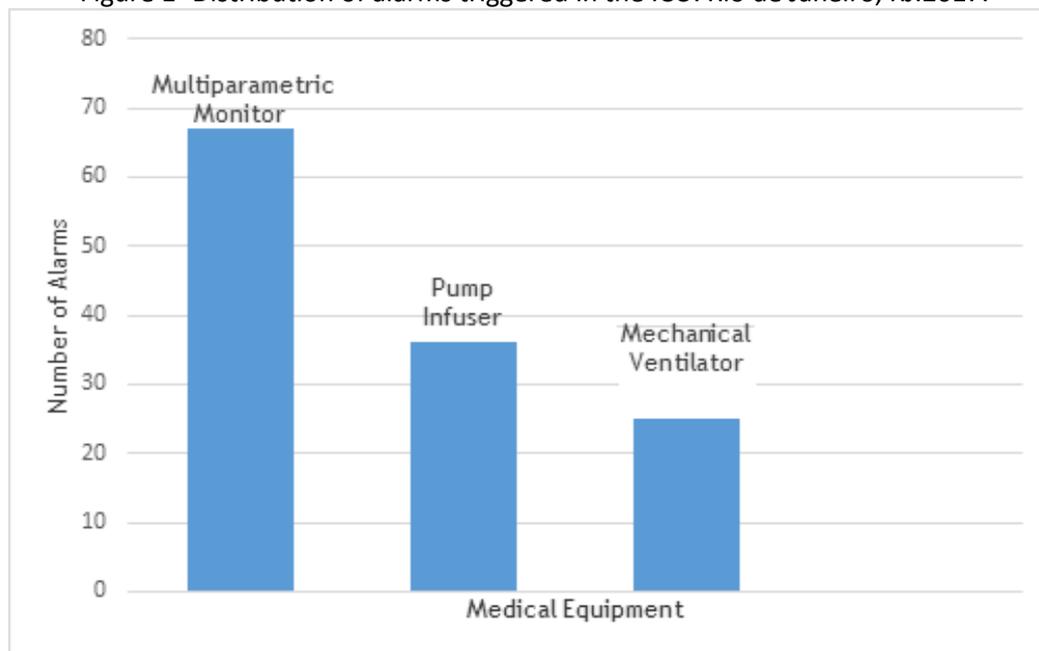
After the data were collected, they were coded and compiled in a computerized database in the program *Microsoft Office Excel 2007*. The data were treated with descriptive statistics. After observing the behavior of the professionals, they were described and confronted with pre-existent data in the literature.

RESULTS AND DISCUSSION

Sixty hours of activity were observed in 5 different moments of 12 hours (7 am to 7 pm), in the day shift. During the observation period, there was a significant reduction of professionals per shift in the unit.

In 60 hours of observation, a total of 128 alarms were triggered, approximately 2 alarms per hour. Of this total, 67 alarms were generated by the multiparametric monitor, 36 by infusion pumps and 25 by mechanical ventilators (Figure 1).

Figure 1- Distribution of alarms triggered in the ICU. Rio de Janeiro, RJ.2017.

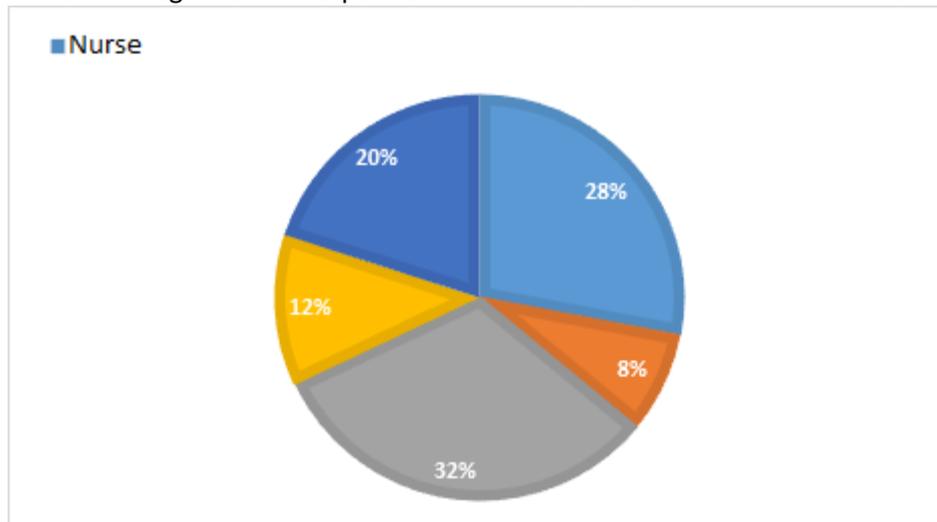


Source: Souza, 2017.

Regarding the 25 alarms generated the mechanical ventilators, 20 were attended and 5 ceased without any intervention after sounding for 5 seconds. Among the 20 professionals who

responded to these alarms, 28% were nurses, 32% were physiotherapists, 12% were physicians and 8% were nursing technicians (Figure 2).

Figure 2 - Professional categories that responded to mechanical ventilator alarms. Rio de Janeiro, RJ.2017.

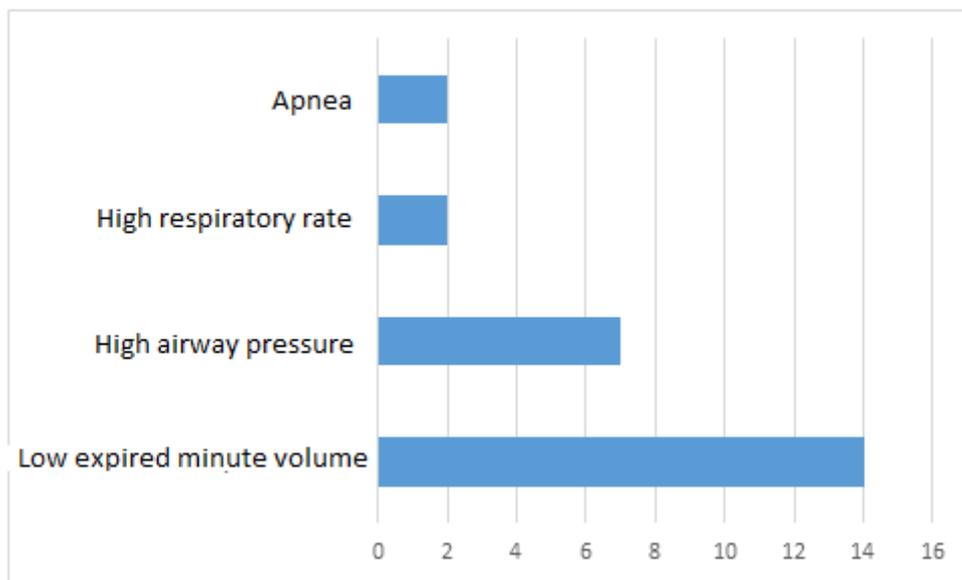


Source: Souza, 2017.

Among the alarms triggered by mechanical ventilators in the unit, the most prevalent were low expired minute volume (14), followed by high

airway pressure (7). There were also alarms caused by high respiratory rate (2) and apnea (2) (Figure 3).

Figure 3- Types of alarms triggered in the unit by mechanical ventilators. Rio de Janeiro, RJ.2017.



Source: Souza, 2017.

In this study, the stimulus-response time and conduct before mechanical ventilator alarms only of nursing professionals was considered. The minimum stimulus-response time for these alarms was 10 seconds.

This time is explained by the presence of professionals in the bed of the patient during the sound of the alarm, either at the moment of physical examination, or during bathing in the bed or when assisting diverse procedures.

The maximum stimulus-response time was 3 minutes. The mean stimulus-response time was 38 seconds and the standard deviation was 52.39

seconds. No alarm sounded for more than 5 minutes, time set in this study to consider alarm fatigue.

Although most of the alarms were responded by physiotherapy professionals, meeting one of the objectives of this work, actions of nursing professionals regarding the alarms triggered by mechanical ventilators in the ICU were observed and recorded. In the event of an alarm, all the conducts performed by the professional were taken into account, that is, more than one action was undertaken in the attendance of only one alarm; all actions were

counted. The most present action was tracheal aspiration (Table 1).

Table 1- Actions of nursing professionals in the response to mechanical ventilator alarms. Rio de Janeiro, RJ. 2017.

Actions	Number	Percentage
Tracheal aspiration	3	25%
Change of decubitus	1	8.3%
Repositioning of the circuit	2	16.6%
Auscultation	2	16.6%
Call the physiotherapist	2	16.6%
Mute the alarm	1	8.3%
Ignore	1	8.3%

Source: Souza, 2017.

The Resolution of ANVISA (National Health Surveillance Agency), Resolution of the Collegiate Board of Directors (RDC) n. 26 of May 11, 2012, describes that the number of nursing professionals in ICUs should be at least 1 nurse for every 10 beds or fraction at each shift; and of at least 1 nursing technician for every 2 beds at each shift⁽¹¹⁾.

Regarding the number of nursing professionals, the unit was not in agreement with this recommendation. Data collection was performed during a period of reduced number of professionals due to absenteeism in the unit. Therefore, there was a small number of nursing professionals in the unit, which could cause difficulties in responding to alarms triggered by electromedical devices. This reality can also incur greater physical and mental exhaustion of the professionals in the unit, increasing the levels of stress and collaborating for alarm fatigue.

The most frequent mechanical ventilator alarms in the unit were triggered by low expired minute volume and high airway pressure. Alarms were also triggered by high respiratory rate and apnea. Low expired minute volume may have as potential causes: leakage around the artificial airway; bronchopleural fistula; increased compliance; leakage in the circuit or expiratory valve; insufficient pressure in the gas networks; defective flow sensor; inadequate parameters (insufficient flow or inspiratory time, very low pressure limit or high minimum pressure value). The possible causes for high airway pressure alarm are: secretions, artificial airway obstruction or folding, selective intubation, cough, orotracheal tube (OTT) biting, decreased complacency, pneumothorax, bronchospasm, patient/ventilator asynchrony, circuit folding, water in the circuit, low limit value⁽¹²⁾.

The most frequent causes identified for the triggering of alarms in the case of low expired

minute volume and high airway pressure were the accumulation of secretion and leakage in the circuit. Increased secretions can cause airway obstruction, resulting in coughing and, consequently, an increase in intrapulmonary pressure, which, together with the preset pressure in the ventilator, decreased flow volume. Such situations cause the alarm due to high airway pressure and low pressure/minute volume to ring. Some studies are in line with this research, highlighting high airway pressure alarm as one of the most prevalent⁽⁵⁻⁶⁾.

The mean stimulus-response time in this study was 38 seconds, the shortest was 10 seconds and the longest was 3 minutes. Measuring the stimulus-response time is decisive to determine whether alarm fatigue is present or not. The longer the time for intervention, the greater the risk to the patient. Knowing how to interpret what was signaled by the alarm and understand the profile of clinical relevance that it represents for the patient also deserves attention of the team. For many health care professionals, alarms are often viewed as useless due to the high incidence of false positive alarms, i.e. those with no clinical relevance⁽⁴⁾.

The European Committee for Standardization (CEN) established a classification of alarms into three categories: high priority, indicating an emergent situation (which can immediately lead to a vital problem and requires an immediate response from the health team); medium priority, indicating a dangerous situation (team response is required); and low priority, indicating a warning situation (team attention is required). Regarding MV, the CEN study shows that high-priority alarms are those related to electrical or pneumatic failure, or high airway pressure. Alarms of disconnection, apnea, low expiratory minute volume, or high or low oxygen

concentration during inspiration are considered as a medium priority⁽¹³⁾.

It was observed that alarms indicating high airway pressure, classified as a high priority, were not responded by nursing professionals despite being the second most frequent in the unit. It was actually the most prevalent among the alarms that stopped spontaneously in up to 5 seconds. This phenomenon has been mentioned in other studies. It occurs when the mechanical ventilator returns to the pre-established parameters without any intervention, being this a characteristic only of this electromedical equipment⁽⁵⁻⁶⁾. Therefore, the assessment of the stimulus-response time specifically for this alarm was impaired. For the alarm for low expired minute volume, classified as medium priority, all were assisted in a timely manner, within up to 20 seconds.

The *Joint Commission*, since January 2014, has pointed out MV as one of the main responsible for triggering inconsistent alarms. MV generate a high number of audible alarms and many of these end up non-responded by professionals. In part, this is due to the short duration of these alarms, because they are automatically silenced even before they can be responded or even perceived by the professionals, as soon as the physiological parameters return to values considered acceptable⁽⁵⁾.

It is worth mentioning that, even if physiological variables return to acceptable values and the MV fails to trigger the alarm, it is essential that the health team assess what triggered the alarm and the patient/ventilator synchrony with the intention of predicting possible problems that may interfere with patient safety. By parameterizing the alarms according to the limits of each patient, inconsistent alarms can be minimized. It is essential that the nursing team be able to manage the use of technologies so as to reinforce the quality of care, to support the delivery of care in a highly complex clinical environment⁽¹⁴⁾. In this study, none of the 5 alarms under this condition received any attention from nursing professionals.

The nursing professionals adopted the following actions: tracheal aspiration, change of decubitus, repositioning of the MV circuit, pulmonary auscultation and informing the physiotherapist about the changes after actions that did not solve the situation. As causes of volume reduction that can be checked by nurses,

there are: disconnections or interruptions in the circuits; deflated or punctured *cuff*; worsening of compliance and increased resistance to air flow. These factors increase the risk of hypoventilation and hypoxemia for the patient. According to the literature, the nursing actions to solve this alarm are: checking the *cuff*, the position and size of the ventilator, performing auscultation (check ventilation), checking the connections and collectors (exchange defective parts), manually ventilating the patient if necessary, and checking the network and the need to change reducing valves⁽¹²⁾.

Concerning the increase of airway pressure, nurses are expected to identify or check some causes: wrong tracheal tube connection of the circuit with the patient, obstruction or folding of the circuit, selective intubation, bronchospasm, hypersecretion and mucous plugs (secretion stoppers); cough and orotracheal tube (OTT); biting; patient/ventilator asynchrony; presence of condensed water in the circuit and low limit value⁽¹²⁾. The measures that should be adopted are: aspiration of secretions, positioning of the orotracheal tube (OTT)/tracheostomy (TQT) (obstruction) or considering to change it, checking the pressure in the *cuff*, tranquilization of the patient and evaluation of the adjustment of his sedation, review of parameters with the physician (tidal volume, respiratory rate, flow, inspiratory/expiratory time), adjustment of sensitivity and alarms, correction of circuit folds, removal of condensed water from the circuit, and use of collectors⁽¹²⁾.

Regarding occurrences of alarms related to changes in respiratory rate (high respiratory rate), it is believed that nurses should identify or verify the following causes: neurological impairment of the patient, inadequate sedation, maladaptation to the ventilatory mode, pain or discomfort, and increased respiratory work (e.g. muscle fatigue in cases of ventilatory weaning), flow sensor defect, autocycling of the device, inadequate adjustment of sensitivity. Patients with persistent tachypnea may have a reduction of tidal volume due to decreased inspiratory time with consequent hypoventilation. In this case, the literature indicates that nurses can evaluate the cause, assess the need for sedation and/or analgesia, reassure the patient, verify sensitivity adjustment, verify patient saturation, check the patient's respiratory rate by another method and inform the physician⁽¹²⁾.

In this study, alarms generated by high respiratory rate and low expired minute volume were addressed by nursing professionals with the act of silencing the alarm. By interrupting, silencing, ignoring or delaying the time-response to alarms, health professionals also delay the time for the implementation of therapeutic approaches or significant changes in the patients, which may not be perceived and may hinder the safety of the follow-up of such patient. The incorrect use of the equipment, inoperative alarms, inadequate parameters and low volume are related to adverse events with electromedical equipment⁽¹⁵⁾. The assessment of MV must take into account the characteristics of the alarms and safety mechanisms.

Alarms caused by apnea indicate interruption or reduction of spontaneous ventilation and may have as possible causes: neurological impairment of the patient, inadequate sedation, inadequate adjustment of respiratory rate, sensitivity or time of apnea. In case of apnea alarms, the patient should be evaluated, ventilated in a controlled manner, and it must be checked if the MV detects the spontaneous ventilations of the patient, and review patient sedation⁽¹²⁾. The professionals of the unit who responded to this alarm informed the physiotherapist and together with this professional, they reassessed the ventilatory mode.

CONCLUSION

The findings indicated that the most frequent alarms were caused by: low expired minute volume and high airway pressure. The conducts adopted by nursing professionals, according to the literature, were not enough to solve the problems presented. The stimulus-response time of the professionals was on average 38 seconds, indicating that the alarms were responded timely.

The small size of the nursing team in the service schedule during the period of data collection was a limitation of the study, as well as the small number of patients under mechanical ventilation in the unit. It is understood that, with the greater number of patients in this condition, and a staff with adequate size, the record of alarms and the approaches adopted would present different numbers and characteristics. Another limitation of the study was the fact that it had only one researcher timing the time, and

this prevented the observation if two alarms sounded at the same time.

These results of this study are intended to contribute to the training of nursing professionals, so that they be able to provide care in a timely and safe way for patients using mechanical ventilators, as well as to adequate decision making, management and parameterization when these alarms are triggered.

REFERENCES

- 1- Barbas CSV, Ísola AM, Farias AMC. Diretrizes brasileiras de ventilação mecânica. São Paulo: AMIB; 2013.
- 2- ECRI Institute. Top 10 Health Technology Hazards for 2017 [Internet]. 2017[cited in 2017 Oct 8]. Available from: https://www.ecri.org/Resources/Whitepapers_and_reports/Haz17.pdf
- 3- Bridi AC, Silva RCL, Farias CCP, Franco AS, Santos VLQ. Tempo estímulo-resposta da equipe de saúde aos alarmes de monitorização na terapia intensiva: Implicações para a segurança do paciente grave. Rev Bras Ter intensiva 2014 jan/mar;26(1):28-35. DOI: [10.5935/0103-507X.20140005](https://doi.org/10.5935/0103-507X.20140005)
- 4- Graham KC, Cvach M. Monitor alarm fatigue: Standardizing use of physiological monitors and decreasing nuisance alarms. Am J Crit Care. 2010 Jan;19(1):28-37. DOI: [10.4037/ajcc2010651](https://doi.org/10.4037/ajcc2010651)
- 5- Passamani RF, Santos F, Schutz V, Silva CRL, Louro TQ, Silva RCL. Usabilidade de alarmes clínicos de ventiladores mecânicos em cuidados intensivos. Ciênc Cuid Saúde. 2016 abr/jun;15(2):220-6. DOI: [10.4025/ciencuidsaude.v15i2.29234](https://doi.org/10.4025/ciencuidsaude.v15i2.29234)
- 6- Santos F, Silva RCL, Ferrão PPSA, Ribeiro AS, Passamani RF. Fadiga de alarmes de equipamentos eletromédicos em terapia intensiva. Rev Enferm. 2014 mar;8 (3):687-94. DOI: [10.5205/reuol.5149-42141-1-SM.0803201425](https://doi.org/10.5205/reuol.5149-42141-1-SM.0803201425)
- 7- Barreiro Filho RD, Santiago LC, Silva RFA, Cunha KCS. O paciente submetido à ventilação mecânica e o cuidado de enfermagem que emerge da prática assistencial. In: Anais do 61º Congresso Brasileiro de Enfermagem, 2009; Fortaleza. Fortaleza: ABEn; 2009. p. 5012-26.
- 8- Gonzalez MM, Timerman S, Oliveira RG, Polastri TF, Dallan LAP, Araújo S, et al. I Diretriz de ressuscitação cardiopulmonar e cuidados cardiovasculares de emergência da sociedade brasileira de cardiologia: Resumo executivo. Arq

Bras Cardiol. 2013 fev;100(2):105-13. DOI: [10.5935/abc.20130022](https://doi.org/10.5935/abc.20130022)

9- Tallo FS, Moraes Junior R, Guimarães HP, Lopes RD, Lopes AC. Atualização em reanimação cardiopulmonar: Uma revisão para o clínico. Rev Soc Bras Clín Méd. [Internet]. 2012 [acesso em 2017 maio 5]; 10(3):194-200. Available in: <http://files.bvs.br/upload/S/1679-1010/2012/v10n3/a2891.pdf>

10- Vanheusden LMS, Santoro DC, Szpilman D, Batista CO, Correia LFB, Cruz Filho FES. Conceito fase-dependente na ressuscitação cardiopulmonar. Rev SOCERJ [Internet]. 2007 [acesso em 2017 mar 15];20(1):60-4. Available in: http://sociedades.cardiol.br/socerj/revista/2007_01/a2007_v20_n01_art09.pdf

11- Ministério da Saúde. Agência Nacional de Vigilância Sanitária. Resolução nº 26, de 11 de maio de 2012. Dispõe sobre a alteração da RDC 07 de 24 de fevereiro de 2010. Diário Oficial da União. 2010 maio.

12- Cintra EA, Nishide VM, Nunes WA. Assistência de enfermagem ao paciente gravemente enfermo. 2. ed. São Paulo: Atheneu; 2013.

13- European Committee for Standardization. Lung ventilators — Part 1: Particular requirements for critical care ventilators – NEN-EN 794-1:1997. British: British; 1997.

14- Gomes ATL, Assis YMS, Ferreira LL, Bezerril MS, Chiavone FBT, Santos VEP. Tecnologias aplicadas à segurança do paciente: Uma revisão bibliométrica. Rev Enferm Cent-Oeste Min. 2017 jul/dez;7:e1473. DOI: [10.19175/recom.v7i0.1473](https://doi.org/10.19175/recom.v7i0.1473)

15- Korniewicz DM, Clark T, David Y. A national online survey on the effectiveness of clinical alarms. Am J Crit Care [Internet]. 2008 [acesso em 2017 nov 10];17(1):36-41. Available in: <https://www.ncbi.nlm.nih.gov/pubmed/18158387>

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