Original article

Prevention of pneumonia associated with neonatal mechanical ventilation: knowledge and practice of nursing professionals

Prevenção da pneumonia associada à ventilação mecânica neonatal: conhecimento e prática de profissionais de enfermagem

Paula Isis Nascimento Silva[1]
João Vitor Gomes Guilherme[2]
Louziane Karina Tavares de Sousa Teixeira[3]
Brenda Naya Carlos Ferreira[4]
Elisângela Franco de Oliveira Cavalcante[5]

[5]Corresponding author. Universidade Federal do Rio Grande do Norte (Natal). Rio Grande do Norte, Brazil. elisangelafranco2@gmail.com
[1-4]Universidade Federal do Rio Grande do Norte (Natal). Rio Grande do Norte, Brazil

ABSTRACT | INTRODUCTION: Analyzing the knowledge and practices of nursing professionals about the prevention of Mechanical Ventilator-Associated Pneumonia in neonates. **METHODOLOGY:** Descriptive exploratory research, with a quantitative approach. Participants were 19 nurses and 39 nursing technicians working in a Neonatal Intensive Care Unit of a teaching maternity hospital, a reference in a state in the northeast region. Data collection took place through the application of a questionnaire between December 2019 and February 2020. For data analysis, descriptive statistics was used. **RESULTS**: It was found that 77.6% of professionals know about preventive measures that must be adopted. However, measures with robust scientific evidence are not performed, such as performing the hygiene of the oral cavity (52.2%), elevating the headboard (49%), humidifying and heating the air (44.3%), removing condensate from the circuit (28.7%) and sanitizing hands (12.9%). The reasons are factors intrinsic to management and work processes, such as lack of training (2.4%), supplies (4.8%), standardization of preventive measures (24.3%), in addition to work overload (24 .3%), inadequate staffing (29.2%) and patient complexity (4.8%). **FINAL CONSIDERATIONS:** Nursing professionals cannot fully carry out measures strongly recommended in the scientific literature for the prevention of Mechanical Ventilator-Associated Pneumonia, although they know their importance.

KEYWORDS: Ventilator-Associated Pneumonia. Newborn. Nursing Care. Neonatal Intensive Care Unit. Neonatology.

RESUMO | INTRODUÇÃO: Analisar os conhecimentos e as práticas dos profissionais de enfermagem sobre a prevenção da Pneumonia Associada à Ventilação Mecânica em neonatos. **MÉTODO**: Pesquisa descritiva exploratória, de abordagem quantitativa. Participaram 19 enfermeiros e 39 técnicos de enfermagem de uma Unidade de Terapia Intensiva Neonatal de uma maternidade escola, referência em um estado da região nordeste. A coleta de dados aconteceu por meio da aplicação de questionário entre dezembro de 2019 e fevereiro de 2020. Para análise dos dados, utilizou-se estatística descritiva. **RESULTADOS:** Verificou-se que 77,6% dos profissionais conhecem medidas de prevenção que devem ser adotadas. Todavia, medidas com evidência científica robusta não são realizadas, como higienizar cavidade oral (52,2%), elevar cabeceira (49%), umidificar e aquecer o ar (44,3%), retirar condensado do circuito (28,7%) e higienizar as mãos (12,9%). Os motivos são fatores intrínsecos a gestão e processos de trabalho, como falta de capacitação (2,4%), insumos (4,8%), padronização de medidas de prevenção (24,3%), além da sobrecarga de trabalho (24,3%), dimensionamento inadequado de pessoal (29,2%) e complexidade dos pacientes (4,8%). **CONSIDERAÇÕES FINAIS:** Profissionais de enfermagem não conseguem realizar, integralmente, medidas fortemente recomendadas na literatura científica para prevenção da Pneumonia Associada à Ventilação Mecânica, apesar de terem conhecimento de sua importância.

PALAVRAS-CHAVE: Pneumonia Associada à Ventilação Mecânica. Recém-nascido. Cuidados de Enfermagem. Unidades de Cuidado Intensivo Neonatal. Neonatologia.

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1. Introduction

Health Care-Associated Infections (HAIs) are adverse events that persist in healthcare services. These illnesses are responsible for the growth of healthcare costs, the length of hospital stay, and the increase in morbidity and mortality rates. In Brazil, specifically, HAIs became more relevant in the 1990s, a period in which new information and recommendations about the topic were published.[1]

In neonatology, except for placental-transmitted HAI, which is acquired transplacentally, with intrauterine involvement, the Pan American Health Organization (PAHO) considers all infections that take place in the neonatal period to be HAIs. They are classified as endogenous, when the infection is caused by microorganisms present in the body of the patient, especially in an immunosuppressed organism, and exogenous, when the patient is exposed to microorganisms from the external environment through invasive procedures and/or poorly executed aseptic techniques.[2]

The neonatal HAIs that are the focus of epidemiological surveillance are primary bloodstream infections, pneumonia, necrotizing enterocolitis, meningitis, urinary tract infections, and surgical site infections.[3,4]

Mechanical Ventilator-Associated Pneumonia (VAP) is described in the literature as one of the adverse events (AE) resulting from invasive ventilation therapy in neonates and is a leading cause of HAIs. According to the Agência Nacional de Vigilância Sanitária - ANVISA (Brazilian Health Surveillance Agency), VAP must be considered in newborns (NB) when they are on mechanical ventilation for a period of more than two calendar days (D1 being the day mechanical ventilation is installed) and when, on the date of infection, the newborn is using the device or if this device was removed the previous day.[5] This alteration consists of an infection generated by microorganisms that are disseminated to the lung parenchyma after 48 hours or more of orotracheal intubation in an ICU, causing local and systemic alterations.[6]

In recent years, mechanical ventilation (MV) has proved to be an important ally in terms of reducing the mortality of critically ill patients admitted to a neonatal intensive care unit (NICU). On the other hand, because it is an invasive procedure, MV can lead to some infectious complications, thus constituting a predisposing factor for the emergence of HAIs.[7-9]

Most studies found in the literature highlight the epidemiological aspects and risk factors of VAP in the neonatal population, as well as the need to apply specific protocols aimed at preventing VAP in this age group. However, there is a gap in terms of the structure and processes needed to achieve effective and desired results in terms of preventing VAP, as well as a lack of studies describing the preventive measures applied to the neonatal population in view of its peculiarities.[3,10]

Given the highlighted problem, the need to comply with preventive measures aimed at the safety of neonate patients must be systematically instituted with the nursing team members, as they are responsible for continuous care and many interventions. Therefore, regarding the time dedicated to caring for patients and the number of invasive procedures they carry out, nursing professionals play an important role in terms of ensuring safe care, also highlighting that they are also the professional category most cited in studies about the prevention of HAIs.[2,11]

In this setting, the research question is: what is the knowledge and practice of nursing professionals about the prevention of Mechanical Ventilator-Associated Pneumonia in neonates? The justification is to reinforce the importance of the nursing team as a great ally in terms of taking measures to prevent VAP in neonates, as well as gathering information about this topic, given the scarcity of studies about it.

This study aimed to analyze the knowledge and practices of nursing professionals about the prevention of Mechanical Ventilator-Associated Pneumonia in neonates.

2. Methodology

This is an exploratory, descriptive study with a quantitative approach aimed at diagnosing the knowledge and practices of nursing professionals. Data collection took place between December 2019 and February 2020 in a Maternity School located in a capital city in northeastern Brazil.

This study was attended by 19 nurses and 39 nursing technicians of the NICU of the maternity hospital. The entire universe of nursing professionals working in that NICU was considered as the study population, which, during the collection period, consisted of 24 nurses and 60 nursing technicians. Nurses and nursing technicians working in the NICU who were involved in the direct care of the neonate were included in the study, while those who were absent from the sector due to leave, doctor's note, or vacations were excluded.

The data collection tool used was a questionnaire based on a literature review that identified scientific evidence with recommendations in terms of preventing VAP in neonates. From this review, ANVISA and PAHO manuals, as well as national and international publications, were chosen as the theoretical reference, adopting the preventive measures recommended in these materials as criteria. The questionnaire provided information about professional practice related to the prevention of VAP in neonates, namely: knowledge of preventive measures; which of these measures were carried out; the reasons for not complying with these measures; and the characterization of the professionals who took part in the study. The data was tabulated using Microsoft Excel 2013® software and analyzed using descriptive statistics.

The data was categorized and analyzed descriptively using absolute and relative frequencies. The research was approved by the Research Ethics Committee through Consubstantiated Opinion nº 3.474.820/CAAE: 17590719.4.0000.5537.

3. Results

Fifty-eight nursing professionals participated in this study, 96.6% (n=56) of whom were females, 77.4% (n=43) predominantly aged up to 39 years old. As for the positions held in the NICU, 67.2% (n=39) were nursing technicians and 32.8% (n=19) nurses. There was no standardization of care aimed at preventing VAP.

As the questionnaire was made up of open and closed questions, in some cases, the professionals refrained from answering and were included in the count as "Did not answer". The analytical dimensions in terms of the knowledge and practices of interest to this study are introduced below.

3.1 Professional knowledge

Regarding measures to prevent VAP, 77.6% (n=45, 17 nurses and 28 nursing technicians) said they knew about them, while 22.2% (n=13, 2 nurses and 11 nursing technicians) said they did not know.

Those who answered positively about their knowledge in relation to these measures highlighted the following open answers, which were distributed according to the concept presented and the professional category, as displayed in Table 1.

Table 1. VAP prevention measures known by the nursing team. Natal/RN, 2020

Preventive measures cited by them	Nurses		Nursing Technicians		Total	
	n	%	n	%	n	%
Aspirating with an aseptic technique	11	57.8	20	51.3	31	53.4
Sanitizing hands	9	47.4	20	51.3	29	50.0
Performing the hygiene of the oral cavity	9	47.4	17	43.5	26	44.8
Removing condensate from the circuit	6	31.5	14	35.8	20	34.5
Humidifying supplied air	6	31.5	10	25.6	16	27.6
Handling materials adequately	9	10.5	6	15.4	15	25.9
Elevating headboard	4	21.0	10	25.6	14	24.1
Minimizing MVI* time	6	31.5	3	7.7	9	15.5
Heating supplied air	2	10.5	5	12.8	7	12.0
Changing aspiration bottle and latex	-	-	5	12.8	5	8.6
Aspirating with a closed system	2	10.5	3	7.7	5	8.6
Changing position	1	5.2	3	7.7	4	6.9
Observing OGP** and regurgitation	-	-	3	7.7	3	5.8
Avoiding accidental extubation	1	5.2	1	2.6	2	3.4
Performing physiotherapy	2	10.5	-	-	2	3.4
Adopting safety measures for invasive procedures	2	10.5	-	-	2	3.4
Changing humidification bottles	-	-	2	5.1	2	3.4
Not using 0.9% SS*** routinely during aspiration	-	-	1	2.6	1	1.7
Avoiding using PPV****	-	-	1	2.6	1	1.7
Extubating early	1	5,2	-	-	1	1.7
Antibiotic therapy	-	-	1	2.6	1	1.7
Using Bundles	-	-	1	2.6	1	1.7

*Invasive mechanical ventilation
** Orogastric tube
*** Saline solution
****Positive pressure ventilation
Source: the authors (2020).

Regarding the measures known by professionals but that are not actually carried out, the following answers were reported, as displayed in Table 2.

Table 2. Description of the measures known by professionals and that are not fully carried out. Natal/RN, 2020

Non-performed activities	Nurses		Nursing Technicians		Total	
	n	%	n	%	n	%
Elevating headboard	3	15.7	13	33.3	16	27.6
Changing aspiration bottles and humidifiers	1	5.2	3	7.7	14	24.1
Performing the hygiene of the oral cavity	7	36.8	6	15.4	13	22.4
Humidifying and heating supplied air	5	26.3	7	18.0	12	20.7
Removing condensate from the ventilation circuit	4	21.0	3	7.7	7	12.0
Observing the ventilation circuit	2	10.5	5	12.8	7	12.0
Sanitizing hands	1	5.2	3	7.7	4	6.9
Aspirating OTT* and UAS**	-	-	2	5.1	2	3.4
Avoiding accidental extubation	1	5.2	-	-	1	1.7
Reducing intubation time	1	5.2	-	-	1	1.7
Aspirating with a closed system	-	-	1	2.6	1	1.7
Controlling temperature provided in ventilation	-	-	1	2.6	1	1.7
Not using 0.9% SS routinely during aspiration	-	-	1	2.6	1	1.7
Installing nasal CPAP***	-	-	1	2.6	1	1.7

* Orotracheal tube
** Upper airway
*** Continuous positive airways pressure
Source: the authors (2020).

As for the reasons given for not carrying out VAP prevention measures, as displayed in Table 2, 41 professionals gave their answers. Of these, 29.2% (n=12) gave poor staffing levels as the reason for not taking measures to prevent VAP. In turn, 24.3% (n=10) reported work overload, 2.4% (n=1) lack of knowledge, 2.4% (n=1) lack of training and incentives, 4.8% (n=2) lack of supplies, and 2.4% (n=1) lack of standardized preventive measures, such as complying with a protocol or Standard Operating Procedure (SOP).

In addition, 9.7% (n=4) reported that aspiration and changing the ventilation circuit are not the responsibility of the nursing technician; the lack of an aspiration bottle to perform the change and the lack of a physiotherapist on the night shift accounted for 7.3% (n=3) of the reports each; both the limitation of material/supplies and the complexity of patients were cited by 4.8% (n=2) of professionals. Finally, the fact of not being able to sanitize hands and stop dieting in emergencies and intercurrences, the fact of thinking that intubation is a medical competence, and lack of knowledge of the five moments of hand hygiene corresponded to 2.4% (n=1) of the analyzed reports each.

3.2 Professional nursing practice in the prevention of neonatal VAP

An important fact is that 37 professionals did not answer about changing the aspiration system and the bottle. Regarding the hygiene of the oral cavity of the newborn, the study showed that this is done according to the assistance provided by the professional, that is, before the diet (n=11), before or after bathing (n=16), after aspiration (n=27) or only if there is dirt (n=24). Two participants reported that they had never performed the hygiene of the oral cavity. It is important to underline that the 58 professionals answered this question with the possibility of selecting more than one option. Therefore, relative percentage numbers were not included in these results.

When it comes to changing the circuit, it was found that this is most often done in the event of dirt (n=16) or malfunction (n=16). In this survey, 24 participants said they did not know this practice, while three said they practiced it routinely. As for secretion aspiration, most professionals said they only do it if needed (n=45), five professionals do it at pre-established times, and three of them do not know this measure.

4. Discussion

Aspiration of the airways using an aseptic technique was the most reported measure. As a known measure to prevent VAP in neonates and based on the assumption that good handling of the artificial airways is essential to avoid complications, aspiration of the orotracheal tube must only be carried out when needed, with an aseptic technique, using sterile and disposable material.[1,11,12] Of the surveyed nurses, 63.2% (n=11) reported that aspiration was their responsibility and that they were able to carry out the procedure fully.

Aspiration in the NICU setting takes place in accordance with the Resolution of the Conselho Federal de Enfermagem – COFEN (Brazilian Federal Nursing Council) nº 557/2017. The document recognizes that critically ill patients undergoing orotracheal intubation or tracheostomy must have their airways privately aspirated by a professional nurse.[13]

When it comes to hand hygiene, 7.7% of nurses (n=3) and 5.2% of nursing technicians (n=1) said they were unable to perform this technique, which is the simplest and most effective strategy in terms of preventing HAIs, and its non-performance is a risk factor for patients.[14-16] In view of the lack of hand hygiene, strategies to improve this practice must be implemented, with a view to improving the quality of the technical and humanized care offered to the neonatal population.[17]

Most complications caused by HAIs are classified as avoidable and can be prevented through interventions held by the multidisciplinary team.[11,18]

The use, whenever possible, of non-invasive ventilation was not cited by any of the professional categories as a measure to prevent VAP. In turn, minimizing the time mechanical ventilation is used whenever possible was cited by 31.5% (n=6) of nurses and 7.7% (n=3) of nursing technicians. Avoiding accidental extubation was mentioned by 5.2% (n=1) of nurses and 2.6% (n=1) of nursing technicians. Nurses also mentioned less traumatic tracheal intubation techniques and aseptic aspiration, and these were included in the topic of adopting safety measures for invasive procedures, which received 10.5% (n=2) of mentions. Carrying out these preventive measures has been shown to be effective in terms of reducing VAP, as well as monitoring unplanned extubation procedures.[1]

As for the care in relation to mechanical ventilation equipment and its accessories, changing the aspiration bottle and latex was only reported by nursing technicians, with 12.8% (n=5) of answers; changing humidification bottles was also only mentioned by nursing technicians, with 5.1% (n=2) of answers; removing condensate from the circuit was mentioned by 31.5% (n=6) of nurses and 35.8% (n=14) of nursing technicians; heating the supplied air was mentioned by 10.5% (n=2) of nurses and 12.8% (n=5) of nursing technicians; and humidifying the supplied air was mentioned by 31.5% (n=6) of nurses and 25.6% (n=10) of nursing technicians. According to the pertinent literature, in patients undergoing mechanical ventilation and humidification with heated water, condensed water can accumulate in the ventilator circuit, and this water can, through careless handling, penetrate the trachea of the patient.[4] In order to prevent this event, the health team must be aware of the correct handling of MV equipment and accessories.

Concerning gastric tube care and enteral feeding, VAP prevention measures include avoiding gastric distension and keeping the headboard elevated between 15° and 30° to prevent gastric aspiration and bronchoaspiration.[1] This was reported by 21% (n=4) of nurses and 25.6% (n=10) of nursing technicians. In turn, changing the gastric tube within the recommended time, which in the studied institution is 72 hours, had 5% (n=2) of mentions by nursing technicians, even though they knew that this control and change must be carried out by nurses. Keeping the neonate ventilated in a medial and lateral position allows oral secretions to accumulate on the lateral oral mucosa, thus reducing the chances of accumulation in the subglottic area around the endotracheal tube without a cuff.[5]

Changing ventilator circuits was mentioned by 2.5% (n=1) of nursing technicians, but it must not be carried out at intervals of less than 48 hours, as this practice has no impact on reducing MV-associated pneumonia.[1] Currently, the recommendation is to change the circuit only when it is visibly dirty or with malfunction.[6,7]

Hygiene of the oral cavity was mentioned by 47.4% (n=9) of nurses and 43.5% (n=17) of nursing technicians. Oral hygiene, which must be carried out with sterile gauze soaked in distilled water before orotracheal aspiration[7-13], is presented as a measure that should be held by these professionals, but only 41% (n=17) of nursing technicians carry it out during health care.

It is worth emphasizing that this is a VAP prevention measure that, when carried out effectively by the nursing team, not only promotes patient comfort but can also be associated with a reduced risk of infection.[19]

In patients undergoing MV, there is a reduction in the cleaning conditions of the oral cavity through chewing, which is reduced, likewise the movement of the cheeks and tongue, due to the absence of speech.[20] In addition, the use of antibiotics or corticosteroids and a reduction in salivary flow contribute to an alteration in oral homeostasis, favoring the formation of biofilm. Under these conditions, when the contents of the oral cavity are aspirated, the numerous pathogens that colonize it can be transported to the respiratory tract via the oropharynx, favoring the emergence of VAP and culminating in a worsening of the clinical condition of the patient.[21]

Measures known by the researched professionals were identified, but they are unable to fully implement them in their practice. In this case, they were asked to justify the reason for not carrying out the actions, where poor staffing levels and work overload stood out as the answers. It was found an increase in the number of HAIs when there is an inadequate ratio of patients/nurses in neonatal units.[3,18] Adequate staffing levels were considered by the study's participants to be an important measure, but one that does not fall within their competencies.

At the time of the research, there was a disproportion between hospital beds and nursing technicians, so that only one professional was responsible for caring for, on average, four NBs simultaneously, which exceeded the requirements of Ordinance nº 930, dated May 10, 2012.[22]

Regarding the standardization of preventive measures, the adoption of protocols in daily life is a positive component, generating safe care, according to established technical-scientific parameters, although adherence and training by the multidisciplinary team are needed.[18,23]

In this study, 59.6% (n=27) of professionals admitted that they found it difficult to follow protocols, citing inadequate staffing levels, work overload, and a lack of supplies as justifications. The provision of materials is essential for the continuity of care, but it is their management that ensures that they are available in quantity and quality for harm-free care.[18,24]

Participation in educational activities is an important strategy in terms of transforming the practices carried out by professionals.[18,22,25]

Regarding the limitations of this study, in addition to using a research tool that has not yet been validated, it was also not possible to carry it out in other locations, thus constituting a considerably small sample. Therefore, the results may not reflect the reality of other NICUs.

5. Conclusion

The conclusion is that nursing professionals are unable to fully implement measures with robust scientific evidence for the prevention of Mechanical Ventilator-Associated Pneumonia, even though they are known. These include performing the hygiene of the oral cavity, elevating the headboard, humidifying and heating the air, removing condensate from the circuit, and sanitizing hands. The failure to carry out these measures is due to factors such as a lack of knowledge, training, incentives, supplies and cooperation between professionals, standardization of preventive measures, as well as work overload and inadequate staffing levels.

This study contributes to the quality and safety of nursing care and neonatology services as it reveals the misalignment among theory, professional knowledge, and practice, the latter being what they actually manage to achieve. It also reveals the need for multifaceted interventions in the context of care within neonatal intensive care units, with a view to achieving effectively safe care.

In the case of the neonatal population, the problem is exacerbated by the scarcity of studies and theoretical references on the topic. Research is needed to expand knowledge about the possible causes of VAP in the NICU setting and, above all, about how to prevent this type of infection through healthcare technologies, such as protocols and packages of measures, as well as educational interventions, adequate provision of materials, personnel management, among others, which can optimize the quality of care and, consequently, increase the survival rates.

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Authors' contributions

Silva PIN participated in the conception of the research question, methodological design, search and statistical analysis of the research data, interpretation of the results, and writing of the scientific article. Guilherme JVG participated in the collection and interpretation of the data and writing of the scientific article. Teixeira LKTS and Ferreira BNC participated in the collection and interpretation of the data. Cavalcante EFO participated in the conception of the research question, methodological design, statistical analysis of the research data, interpretation of the results, and writing of the scientific article. All the authors have reviewed and approved the final version and agreed to its publication.

Conflicts of interest

No financial, legal, or political conflicts involving third parties (government, private companies and foundations, etc.) have been declared for any aspect of the submitted paper (including, but not limited to, grants and financing, advisory board membership, study design, manuscript preparation, statistical analysis, etc.).

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References

1. Araújo BT, Pereira DCR. Policies for control Health Care-Related Infections (IRAS) in Brazil, 2017. Com Ciências Saúde [Internet]. 2017;28(3/4):333-42. Available from: https://www.arca.fiocruz.br/handle/icict/40729

2. Wachholtz MA, Costa AEK, Pissaia LF. Knowledge of nurses in an intensive therapy unit on health care-infected infections. Res Soc Dev. 2019;8(10):e378101397. https://doi.org/10.33448/rsd-v8i10.1397

3. Ceparano M, Sciurti A, Isonne C, Baccolini V, Migliara G, Marzuillo C, et al. Incidence of Healthcare-Associated Infections in a Neonatal Intensive Care Unit before and during the COVID-19 Pandemic: A Four-Year Retrospective Cohort Study. J Clin Med. 2023;12(7):2621. https://doi.org/10.3390/jcm12072621

4. Freitas FTM. Impacto das infecções relacionadas à assistência à saúde em um serviço de neonatologia de referência do Distrito Federal [dissertação] [Internet]. Brasília: Universidade de Brasília; 2017. Available from: https://repositorio.unb.br/handle/10482/25265

5. Agência Nacional de Vigilância Sanitária. Critérios Diagnósticos de Infecção Associada à Assistência à Saúde Neonatologia [Internet]. 2nd. ed. Brasília: ANVISA; 2017. Available from: https://www.gov.br/anvisa/pt-br/centraisdeconteudo/publicacoes/servicosdesaude/publicacoes/caderno-3-criterios-diagnosticos-de-infeccao-associada-a-assistencia-a-saude-neonatologia.pdf/view

6. Weber CD. Applying Adult Ventilator-associated Pneumonia Bundle Evidence to the Ventilated Neonate. Adv Neonatal Care. 2016;16(3):178-90. https://doi.org/10.1097/anc.0000000000000276

7. Fan Y, Gao F, Wu Y, Zhang J, Zhu M, Xiong L. Does ventilator-associated event surveillance detect ventilator-associated pneumonia in intensive care units? A systematic review and meta-analysis. Crit Care. 2016;20(1):338. https://doi.org/10.1186/s13054-016-1506-z

8. Centers for Disease Control and Prevention. Pneumonia (Ventilator-associated [VAP] and non-ventilator-associated Pneumonia [PNEU]) Event: Patient Safety Component Manual [Internet]. 2023. Available from: https://www.cdc.gov/nhsn/pdfs/pscmanual/6pscvapcurrent.pdf

9. Lamotte GV, Vicente CM. Neumonía adquirida en el hospital. Protoc diagn ter pediatr [Internet]. 2017;1:147-56. Available from: https://www.aeped.es/sites/default/files/documentos/10_neumonia_adquirida_en_el_hospital.pdf

10. Tan B, Zhang F, Zhang X, Huang YL, Gao YS, Liu X, et al. Risk factors for ventilator-associated pneumonia in the neonatal intensive care unit: a meta-analysis of observational studies. Eur J Pediatr. 2014;173(4):427-34. https://doi.org/10.1007/s00431-014-2278-6

11. Alecrim RX, Taminato M, Belasco A, Longo MCB, Kusahara DM, Fram D. Strategies for preventing ventilator-associated pneumonia: an integrative review. Rev Bras Enferm. 2019;72(2):521-30. https://doi.org/10.1590/0034-7167-2018-0473

12. Busanello J, Härter J, Bittencourt CM, Cabral TS, Silveira NP. Best practices for airway aspiration of intensive care patients. J Nurs Health. 2021; 11(1):e2111119127. https://doi.org/10.15210/jonah.v11i1.19127

13. Resolução COFEN nº 557/2017 (Brasil). Normatiza a atuação da equipe de enfermagem no procedimento de aspiração de vias aéreas. Diário Oficial da União. 2017 set. 5. http://www.cofen.gov.br/resolucao-cofen-no-05572017_54939.html

14. Contreiro KS, Jantsch LB, Arrué AM, Oliveira DC, Bandeira D. Adhesion to the hand hygienization of health professionals in a neonatal intensive care unit. Rev Enf Contemp. 2020;10(1):25-32. https://doi.org/10.17267/2317-3378rec.v10i1.3094

15. Santos CG, Brandão ES, Sanchez MCO, Azevedo SL. Strategies for adherence to hand hygiene. Ver Enferm UFPE on line. 2019;13(3):763-72. https://doi.org/10.5205/1981-8963-v13i3a238374p763-772-2019

16. Zottele C, Magnago TSBS, Dullius AIS, Kolankiewicz ACB, Ongaro JD Hand hygiene compliance of healthcare professionals in an emergency department. Rev Esc Enferm USP. 2017;51:e03242. https://doi.org/10.1590/S1980-220X2016027303242

17. Gouvêa NS, Demogalski JT, Pomini MC, Pedroso CM, Weinert MCC, Alves FBT. The multidisciplinary workof the resident in neonatal hospital dentistry inthe Brazilian Healthcare System: an experience report. Rev ABENO. 2018;18(4):48-57. https://doi.org/10.30979/rev.abeno.v18i4.597

18. Alhumaid S, Al Mutair A, Al Alawi Z, Alsuliman M, Ahmed GY, Rabaan AA, et al. Knowledge of infection prevention and control among healthcare workers and factors influencing compliance: a systematic review. Antimicrob Resist Infect Control. 2021;10(1):86. https://doi.org/10.1186/s13756-021-00957-0

19. Silveira SC, Cruz ICF. The importance of oral hygiene in patients submitted to mechanical ventilation in ICU: systematic review of the literature. J Special Nurs Care [Internet]. 2017;9(1). Available from: http://www.jsncare.uff.br/index.php/jsncare/article/view/2904/725

20. Silva Junior AC, Xavier IP, Silveira LM, Stabile AM, Cárnio EC, Gusmão JL, et al. Oral hygiene: performance of the nursing team in a hospital environment. Rev Enf Ref [Internet]. 2020;5(1):e19099. Available from: https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1115136

21. Rangelova VR, Raycheva RD, Kevorkyan AK, Krasteva MB, Kalchev YI. Ventilator-Associated Pneumonia in Neonates Admitted to a Tertiary Care NICU in Bulgaria. Front Pediatr. 2022;10:909217. https://doi.org/10.3389%2Ffped.2022.909217

22. Portaria nº 930, de 10 de maio de 2012 (Brasil). Define as diretrizes e objetivos para a organização da atenção integral e humanizada ao recém-nascido grave ou potencialmente grave e os critérios de classificação e habilitação de leitos de Unidade Neonatal no âmbito do Sistema Único de Saúde (SUS) [Internet]. Diário oficial da União. 2012 maio 12. Available from: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2012/prt0930_10_05_2012.html

23. Chicayban LM, Terra ELVS, Ribela JS, Barbosa PF. Bundles de prevenção de pneumonia associada à ventilação mecânica: a importância da multidisciplinaridade. Persp Online Biol Saúde. 2017;7(25):25-35. https://doi.org/10.25242/886872520171200

24. Nascimento ACST, Morais AC, Amorim RC, Santos DV. The care provided by the family to the premature newborn: analysis under Leininger's Transcultural Theory. Rev Bras Enferm. 2020;73(suppl 4):e20190644. https://doi.org/10.1590/0034-7167-2019-0644

25. Oliveira AIB, Wernet M, Facio BC, Dias PLM, Fabbro MRC. Motivation for vocational training: significance to nurses in neonatal intensive care. Rev Bras Enferm. 2021;74(1):e20190793. https://doi.org/10.1590/0034-7167-2019-0793