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## BUNDLE TO PREVENT VENTILATOR-ASSOCIATED PNEUMONIA: A COLLECTIVE CONSTRUCTION

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**ABSTRACT:** This article reports on a qualitative convergent care research, which was aimed at the collective construction of a bundle to prevent ventilator-associated pneumonia by nursing and physiotherapy professionals at the intensive care unit of a public teaching hospital in Santa Catarina. The data collection occurred from May to December 2011 and included individual interviews and discussion groups, with the participation of 25 and 14 professionals, respectively. For the data analysis, Morse and Field's reference framework was adopted. The construction of the bundle was guided by the evidence-based practice criteria and consists of four preventive care acts: oral hygiene with 0.12% chlorhexidine; headboard elevated (30-45°); endotracheal cuff pressure between 20-30 cmH<sub>2</sub>O; and care with the aspiration of tracheal secretions. The implementation of these recommendations can support healthcare practice, contributing to reduce ventilator-associated pneumonia rates.

**DESCRIPTORS:** Intensive care units. Ventilator-associated pneumonia. Nursing care. Nursing assessment.

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## BUNDLE DE PREVENÇÃO DA PNEUMONIA ASSOCIADA À VENTILAÇÃO MECÂNICA: UMA CONSTRUÇÃO COLETIVA

**RESUMO:** Trata-se de uma pesquisa qualitativa do tipo convergente-assistencial, que objetivou a construção coletiva de um *bundle* de prevenção da pneumonia associada à ventilação mecânica, por profissionais de enfermagem e fisioterapia da Unidade de Terapia Intensiva de um hospital público de Santa Catarina. A coleta dos dados ocorreu de maio a dezembro de 2011, por meio de entrevistas individuais e grupos de discussão, e contou com a participação de 25 e 14 profissionais, respectivamente. Para análise dos dados adotou-se o referencial de Morse e Field. A construção do *bundle* foi norteada pelos critérios da prática baseada em evidências e composto por quatro cuidados de prevenção: higiene oral com clorexidina 0,12%; cabeceira elevada (30-45°); pressão do *cuff* entre 20-30 cmH<sub>2</sub>O; e cuidados com aspiração das secreções. Acredita-se que a implementação dessas recomendações possa auxiliar a prática assistencial, contribuindo para redução das taxas de pneumonia associada à ventilação mecânica.

**DESCRIPTORIOS:** Unidades de terapia intensiva. Pneumonia associada à ventilação mecânica. Cuidados de enfermagem. Avaliação de enfermagem.

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## BUNDLE DE PREVENCIÓN DE NEUMONÍA ASOCIADA A VENTILACIÓN MECÁNICA: UNA CONSTRUCCIÓN COLECTIVA

**RESUMEN:** Se trata de un estudio cualitativo de tipo convergente asistencial, que tuvo por objetivo construir colectivamente un *bundle* para evitar la neumonía asociada a ventilación mecánica por profesionales de enfermería y fisioterapia en la unidad de cuidados intensivos de un hospital público de enseñanza en Santa Catarina. La recolección de datos tuvo lugar entre mayo y diciembre de 2011 por medio de entrevistas individuales y grupos de discusión, que incluyeron la participación de 25 y 14 profesionales respectivamente. Para el análisis de los datos se utilizó el referencial de Morse y Field. La construcción del *bundle* se guió por los criterios de Práctica Basada en la Evidencia y compuesto por cuatro cuidados preventivos: higiene oral con clorexidina 0,12%, alta cabecera (30-45°); presión del *cuff* endotraqueal entre 20-30 cm H<sub>2</sub>O; y el cuidado con la aspiración de secreciones traqueales. Se cree que la aplicación de estas recomendaciones puede ayudar a la práctica asistencial, contribuyendo a la reducción de las tasas del neumonía asociada a ventilación mecánica.

**DESCRIPTORIOS:** Unidades de cuidados intensivos. Neumonía asociada a ventilación mecánica. Cuidados de enfermería. Evaluación de enfermería.

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## INTRODUCTION

Ventilator-Associated Pneumonia (VAP) is an infectious process of the pulmonary parenchyma that affects patients submitted to endotracheal intubation and Mechanical Ventilation (MV) for more than 48-72h and for whom infection was not the reason to start the ventilation.<sup>1-3</sup>

Considered as the most recurrent Healthcare Related Infection (HCRI) at Intensive Care Units (ICUs), VAP plays a considerable role in morbidity and mortality rates and entails potential health damage for individuals affected by this complication. In addition, its occurrence leads to a significant increase in hospitalization times and care costs for health institutions.<sup>4</sup>

Risk factors for VAP are diverse and "can vary depending on the hospital, type of ICU and study population".<sup>5,39</sup> This indicates the need for continuing local surveillance and specific conducts to prevent and control these adverse events.

A strategy that has been adopted successfully to prevent VAP is the creation of protocols in ICUs, applied in a multidisciplinary form and audited by Hospital Infection Control Services.<sup>3</sup>

Applying protocols in care practice represents a challenge though. Studies suggest that these should be dynamic and put in practice together with the health team, so that all stakeholders are motivated, permitting the continuous assessment of care delivery and the creation of clear therapeutic measures.<sup>6-8</sup> Nowadays, Care Bundles have been frequently used, which join a small group of interventions that, when implemented jointly, result in substantial healthcare improvements.<sup>2</sup>

Differently from conventional protocols, in care bundles, not all possible therapeutic strategies need to be included, as this model does not serve as a comprehensive reference framework of the available therapeutic arsenal, but as a small and simple set of evidence-based practices that, when executed jointly, improve the outcomes for the patients. The choice of what interventions to include in a bundle should consider cost, ease of implementation and adherence to these measures. The bundle approach is aimed at the joint execution of all elements in an "all or nothing" strategy. With a view to a successful implementation, there cannot be any "more or less", there is not partial credit for doing some of the steps. Results are

only effective if all care actions are accomplished at all times.<sup>2</sup>

In this perspective, with a view to effective actions for the control and reduction of these HCRI, we sought an answer to the following question: what care do nursing and physiotherapy professionals consider relevant for inclusion in a bundle to prevent ventilator-associated pneumonia?

To answer this inquiry, the collective construction, with nursing and physiotherapy professionals, of a prevention bundle for ventilator-associated pneumonia was set as the study objective, with a view to promoting care that is based on the safety and quality of healthcare delivery to patients under artificial ventilation.

## METHOD

A qualitative Convergent-Care Research (CCR) was undertaken, whose main characteristics are: subjects' active participation, intentional solution and/or minimization of problems and introduction of innovations in care practice.<sup>9</sup>

The research was developed at the general ICU of a public hospital in Santa Catarina and involved 25 health professionals, 21 from the nursing team and four from the physiotherapy team. The nursing and physiotherapy staff at the ICU under study consists of 82 professionals, including 17 nurses, 59 nursing technicians and six physiotherapists. The research universe comprised all professionals who agreed to participate in the research in advance and complied with the following inclusion criteria: being a nursing or physiotherapy professional, working at the sector for at least six months, authorizing the use of a recorder and permitting the dissemination of results, with the preservation of anonymity. To determine the end of data collection, the information saturation principle was used. All participants signed the Informed Consent Form.

The research received approval from the Ethics Committee for Research Involving Human Beings at *Universidade Federal de Santa Catarina* (Process 1922/11), in compliance with the recommendations of National Health Council Resolution 196/96.<sup>10</sup>

Data were collected between May and December 2011 in two phases. The first included semistructured individual interviews, held in a

private room at the ICU. To guarantee reliability, the information was registered on a micro-recorder, with the interviewees' consent, and then fully transcribed. The second phase involved discussion groups. All professionals who participated in the interviews were invited to the meetings. Three groups were organized, each including different members, based on the participants' preferred times and availability. The mean duration of each group meeting was 60 minutes.

To analyze and interpret the data, the reference framework by Morse and Field<sup>11</sup> was adopted, suggested by the authors of the CCR method,<sup>9</sup> which consists of four phases: apprehension, synthesis, theorization and recontextualization. The apprehension phase included information collection and organization, based on the careful reading of each interview, with a view to getting familiar with what the participants expressed. The synthesis phase involves the study of the collected information, analyzing associations and variations. Seventeen care actions to prevent VAP emerged from this phase, which were grouped in five categories, and then analyzed in the light of Evidence-Based Practice (EBP), which corresponded to the initial phase of theorization. In EBP, evidence levels are organized according to classification system, which in general "are characterized hierarchically, depending on the research design".<sup>12:5</sup>

Most classifications are designed in few items, about three or four. In this study, the classification of the American Thoracic Society<sup>4</sup> was adopted, which organizes evidence levels into: level I (high): well-conducted evidence, randomized clinical trials; level II (moderate): well-conceived evidence, controlled trials without randomization (including cohort, patient series and case-control studies). This level also includes any large sample in which systematical analysis and reports on new therapies were not collected in a randomized manner; and level III (low): evidence from case studies and expert opinions.

After ranking the care actions' evidence levels, this were taken to group discussions to socialize the results obtained in the interviews and jointly selecting the care actions for inclusion in the VAP prevention bundles, taking into account the professionals' opinions, care-related evidence and the feasibility of applying these practices in the care context.

The final VAP prevention bundles, which comprised the final phase of theorization, resulted

from the combination of the care actions chosen by the professionals who participated in the three group meetings. During the meetings that followed on the first group, participants received no information on what care actions the preceding group had selected, so as to avoid bias and/or induced answers, thus permitting the authenticity of each group.

## RESULTS AND DISCUSSION

In the first research phase, which involved individual interviews, 25 professionals participated, eight of whom were nurses, 13 nursing technicians and four physiotherapists. Nineteen of the participants were women.

Fourteen professionals participated in the group meetings, 13 of whom were women. The first group included six members (two nurses, one physiotherapist and three nursing technicians), the second group four (two physiotherapists and two nursing technicians) and, in the third group, four professionals participated (one nurse, one physiotherapist and two nursing technicians).

Ages ranged from 26 to 56 years and average professional experience at the ICU varied between seven months and 26 years. Regarding education, seven out of eight nurses are ICU specialists, one of whom holds an M.Sc. degree, four are taking a Master's program and one a Ph.D. program. Out of 13 secondary-level professionals, five hold an undergraduate nursing degree, three are undergraduate nursing students and two Master's students. As for the four physiotherapists, three are ICU specialists, three hold a Master's degree and one is a Ph.D. candidate.

Variation is observed in the participants' age and professional experience at the unit. This fact is probably due to the admission of new professionals in the last public competitive examination held at the hospital approximately one year earlier. The participants' degrees also reveal their search for professional qualification. It is important to register that the institution that the institution offers a professional Master's program and also stimulates employees to take an academic Master's and Ph.D. program.

The 17 VAP prevention care actions, grouped in five categories and organized with their respective evidence levels, are summarized in figure 1.

**Figure 1 - Categories, care related to the prevention of ventilator-associated pneumonia and evidence level of the care actions. Florianópolis-SC, 2011**

Categories	VAP prevention care	Evidence level of care actions
Oral and hand hygiene to prevent VAP	Strict hand washing, independently of glove use.	Level I
	Oral hygiene with 0.12% Chlorhexidine.	Level I
Prevention of bronchial aspiration of secretions	Elevation of the head of the bed between 30-45°, if there is no contra-indication, mainly when receiving tube feeding.	Level I
	Preferring orogastric to nasogastric tube due to the risk of sinusitis.	Level II
	Pausing the diet when lowering the headrest of the bed.	(URI*)
	Effective control of endotracheal tube cuff pressure; maintaining between 20 and 30 cm H <sub>2</sub> O.	Level II
Care with aspiration of secretion and ventilation circuit	Airway aspiration only when necessary, including preliminary pulmonary auscultation and avoid infusing 0.9% physiological saline solution or any other type.	Level II
	Take all necessary care so as to avoid contamination at this moment.	Level I
	Preferring a closed and/or open aspiration system to prevent VAP.	(URI*)
	When using a closed aspiration system, assessing catheter conditions and aspiration ability early, as that is what determines the change intervals.	(URI*)
	Using subglottic aspiration tubes to prevent VAP.	Level I
	No routine change of ventilation circuit. Only change in cases of failure, dirt or when the patient is discharged.	Level I
	Maintaining the ventilator circuit free from accumulated water or condensation. When these are present, they should be discarded.	Level II
Daily assessment of possible extubation	Avoid unnecessary sedation.	Level II
	Prevent and anticipate ventilator weaning and extubation.	Level II
	Perform tracheotomy early to prevent VAP.	(URI*)
Continuing education of the team	Offer continuing education to the team about all care involved in the prevention of VAP and other infections.	Level I

\* Unresolved Issue: refers to practices without proven evidence or without a consensus on their efficacy.<sup>13</sup>

The interview results were presented in the discussion groups, after which the professionals who participated in the study collective chose four care actions for inclusion in the bundle. The professionals' choice of the care actions was based on evidence that proved their efficacy and on the feasibility of application at the ICU under analysis. Thus, the bundle comprised evidence level I and II care actions, which were: oral hygiene using 0.12% chlorhexidine; elevation of the head of the bed between 30 and 45°; cuff pressure

between 20-30 cm H<sub>2</sub>O; and care with the aspiration of secretions.

Strong evidence was found on the effectiveness of these four care actions to prevent VAP, besides others taken from the interviews. To potentiate the effects of each of these elements, however, the importance of commitment was highlighted in the simultaneous accomplishment of all bundle items. Next, based on the literature, the care the professionals chose for inclusion in the VAP prevention bundle is discussed.

## Oral hygiene using 0.12% chlorhexidine

Appropriate oral hygiene for patients submitted to MV is fundamental as, in these cases, saliva production decreases and chewing is impossible, favoring the appearance of dental biofilm, which can be an important reservoir for pathogens that, in case of bronchial aspiration, can cause VAP.<sup>2</sup>

Studies recommend the use of the antiseptic 0.12% Chlorhexidine Gluconate for oral hygiene (OH) of MV patients, due to its antibacterial potential against gram-positive and gram-negative organisms, including resistant ones.<sup>2,4,14</sup>

No consistent recommendations were found in the literature to determine the ideal oral hygiene technique for MV patients. In a randomized controlled clinical trial, the effects of mechanical hygiene (brushing), pharmacological hygiene (oral chlorhexidine) and the combination of both methods (brushing + chlorhexidine) were assessed for the prevention of VAP. The study results showed that, although mechanical brushing removes dental biofilm, it does not prevent VAP. Pharmacological hygiene using oral chlorhexidine significantly reduced the incidence of pneumonia associated with MV. The combination between brushing and oral chlorhexidine, then, showed the same effects as chlorhexidine used without brushing. These results suggest that VAP prevention is associated with the use of oral chlorhexidine and not necessarily with brushing the patient's teeth.<sup>14</sup>

In those cases when brushing associated with chlorhexidine is the preferred oral hygiene technique, some caution is due. The toothpastes generally used for brushing contain a substance that is responsible for the formation of foam, which is Sodium Lauryl Sulphate. Studies have shown that this component produces ionic attraction, which reduces the chlorhexidine action, and consequently its activity, recommending an interval of approximately 30 minutes between the brushing and the oral chlorhexidine application with a view to reducing dental plaque.<sup>15</sup>

In view of disagreements on the most appropriate oral hygiene method, the professionals who participated in the construction of the ventilation bundle developed in this study suggested the following oral hygiene technique: use of the oral hygiene technique, containing a curved Kelly forceps, gauze and a round tub, with swabs drenched in 0.12% chlorhexidine for hygiene. These criteria should be followed in the technique: check

whether the headrest is raised at 30-45°; aspirate oral secretions; check cuff pressure and maintain 20-30 cm of H<sub>2</sub>O; and perform oral hygiene of the entire oral cavity, teeth and tongue, using swabs drenched in 0.12% chlorhexidine.

This process should be applied three times per day. The professionals justify that this care sequence should be chosen to avoid the migration of oral secretions to lower airways. In addition, the participants suggest that OH precedes bodily hygiene as, during the bed bath, the headrest tends to be lowered.

## Elevation of the head of the bed between 30-45°

Maintaining the head of the bed at 30-45° is one of the main recommendations to avoid bronchial aspiration, mainly in patients who are on enteral nutrition. Besides preventing bronchial aspiration, and consequently VAP, this measure contributes to an improvement in the tidal ventilation volume and even reduces cases of atelectasis.<sup>1-2,4,13</sup>

A meta-analysis of randomized and controlled studies suggests that, between the angles of 30° and 45°, the latter should be preferred, in view of signs that VAP incidence rates are significantly lower when the head of the bed has been elevated to an angle of 45° when compared with an angle of 30° or less.<sup>16</sup> Nevertheless, some studies reveal some sources of resistance against elevating the head of the bed in clinical practice, justifying that the patient slides from the bed, entailing a risk of injuries in patients with impaired skin integrity, besides the fact that patients may feel uncomfortable in this position.<sup>2</sup>

As an alternative to the elevated head, a pioneering study has shown that the lateral Trendelenburg position can contribute to prevent VAP, in view of observations that this position does not only avoid pulmonary aspiration, but also contributes to clean mucus in intubated patients. Further research is necessary though to recommend this measure.<sup>17</sup>

In view of the recommendations described in the literature, in the bundle, elevating the head of the bed between 30-45° was defined for all patients under MV without contraindications for this position.

The professionals' suggestions were as follows: putting in practice a mechanism to check whether the head of the bed is elevated at the appropriate angle (30-45°), like a mark on the

bed or a line on the wall to certify this; lowering the headrest when necessary only, when moving the patient to change position, for body hygiene and physiotherapy, after which the head of the bed should be returned to the 30-45° angle; and verifying that the cuff has been insufflated with appropriate pressure levels before lowering the headrest.

### Cuff pressure between 20-30 cm H<sub>2</sub>O

Effective control of endotracheal tube cuff pressure is an important measure to prevent VAP.<sup>1,4</sup> Preserving appropriate cuff pressure is aimed at guaranteeing the closing of the trachea to prevent microaspiration of subglottic secretion into the lower respiratory tract, which can cause VAP. At the same time, pressure should not be raised to avoid tracheal perfusion problems, as hyperinflation can cause local ischemia, which can evolve to stenosis, fistulae and tracheomalacia.<sup>18-19</sup>

In general, cuff pressure levels ranging between 20 and 30 cm H<sub>2</sub>O are recommended. Maintaining these pressure levels represents a challenge though, as many factors influence the pressure, including patient positioning, aspiration of secretions, central temperature and some anesthetic agents.<sup>19</sup> In the attempt to maintain pressure levels in the ideal range, studies have shown strategies for the continuous monitoring of cuff pressure. Despite the ability to maintain pressure at appropriate levels, however, these studies only presented favorable results with regard to tracheal damage risks, without showing benefits for VAP prevention.<sup>19-20</sup>

In the prevention bundle, the professionals defined the following care for cuff pressure verification: check the cuff three times per day and in case of signs that air is escaping. Pressure levels should be maintained between 20-30 cmH<sub>2</sub>O; certify that the head of the bed is elevated between 30-45° when verifying the cuff; aspirate the oral cavity before checking cuff pressure to avoid the migration of secretions to the lower respiratory tract during the verification; and verify cuff pressure before oral hygiene.

### Care with aspiration of secretion

When patients are submitted to MV, they are exposed to risk factors of catching an infection, as they lose the natural barrier between the oropharynx and the trachea and, if sedated, lose their cough reflex, accumulating secretion above

the endotracheal tube cuff, which furthers greater colonization of the tracheobronchial tree, predisposing to the migration of this secretion to the lower airways.<sup>21</sup>

Endotracheal aspiration is an important care action to reduce the accumulation of this secretion, maintain permeable airways and reduce the risk of consolidation and atelectasis, which can lead to inadequate ventilation. Removing this secretion is fundamental, but this should be done with caution and guided by specific care actions, so as not to harm the patients.<sup>1,13,21</sup>

For many years, tracheal aspiration was part of routine practice every 1-2 hours, with a view to removing secretion and preventing endotracheal tube occlusion. Due to contamination risks, however, aspiration is only recommended when necessary today.<sup>22</sup>

A group of nurses undertook a study to describe the best evidence available on aspiration techniques and care actions for secretion. The recommendations included: hand washing and use of clean but not necessarily sterile gloves; use of a catheter that occludes less than half of the internal lumen of the endotracheal tube and is introduced no further than 2cm above the Carina; suction pressure between 80-120 mmHg to reduce the risk of atelectasis and tracheal mucosa damage; avoid saline solution instillation, due to greater infection risks; duration of aspiration no longer than 15 seconds, with pre-oxygenation for at least 30 seconds to prevent desaturation; and aspiration if necessary only, in case of cough, visible or audible secretion, desaturation or increased respiratory effort.<sup>22</sup>

Two types of endotracheal aspiration systems exist: the open system and the closed system. The first demands detachment of the mechanical ventilator from the endotracheal cannula to introduce the aspiration catheter, which should be sterile and disposable.<sup>13,23</sup> "In the closed system, the catheter is for multiple use, protected by a plastic cuff and connected between the tracheal tube and the ventilation circuit, so that disconnection of ventilation support is unnecessary".<sup>23:107</sup>

Some studies compared the effectiveness of these two systems with regard to VAP prevention, but no evidence exists yet to support the superiority of one system over the other in terms of infection prevention.<sup>1,13,22-24</sup>

Based on these recommendations, the following care actions were elected for the bundle with regard to the aspiration of secretions: airway

aspiration when necessary only, including previous pulmonary auscultation and avoiding the instillation of 0.9% saline solution, or any other type of solution; hand washing before the procedure and use of sterile globes in case of open aspiration and clean gloves in closed aspiration systems; and use of a sterile aspiration technique, taking all care due to avoid contaminations.

## CONCLUSION

The VAP prevention bundles, collectively constructed by nursing and physiotherapy professionals, included four recommendations: oral hygiene using 0.12% chlorhexidine; elevation of the head of the bed between 30-45°; cuff pressure between 20-30 cm H<sub>2</sub>O; and care with aspiration of tracheal secretion. The choice of these elements was based on their evidence level, as well as the feasibility of their application and ease of adherence.

As observed, the professionals who participated in the study possess knowledge about VAP prevention care, and scientific evidence exists to use most of the care mentioned. This fact may be related to their instruction level. Education level alone does not guarantee knowledge use in care routine though, but also demands the awareness and accountability of clinical professionals.

The elaboration method of the bundle, which involved professionals throughout the process, can be a favorable aspect with a view to its implementation, as the professionals served not only as informants, but also as actors of this construction. The easy applicability of this bundle is also highlighted, due to the simplicity of the care actions, which do not demand an increased workload from the professionals or additional costs for the institution, thus permitting its application at any ICU.

The researchers hope that the use of the bundle can contribute to reduce VAP rates and promote high-quality and safe care delivery to patients under invasive ventilation.

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