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ORIGINAL ARTICLE

Ventilator-associated pneumonia in adult patients: development and validity of a bundle and a checklist

Pneumonia associada à ventilação mecânica no paciente adulto: elaboração e validação da aparência de bundle e checklist

Neumonía asociada a la ventilación mecánica en pacientes adultos: elaboración y validación de la apariencia del paquete y de la lista de verificación

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ABSTRACT

Background and Objectives: Ventilator-associated pneumonia is a lung infection that occurs 48 hours after the start of orotracheal intubation and invasive mechanical ventilation and is a common infection in intensive care. In the quest for higher quality care and patient safety, the objective of this study was to develop and validate the appearance of the bundle and checklist for the prevention of ventilator-associated pneumonia with professionals from the Adult Intensive Care Unit. **Methods:** methodological and quantitative study, which took place from January 2023 to November 2024, and was organized in two stages: (1) construction of the bundle and checklist; (2) validation of the instruments. The population consisted of 15 professionals in the field, who consented electronically to participate in the research. The data collection instrument was hosted on Google Forms®, with support from the WhatsApp® social network and email. The criteria of clarity and relevance were evaluated using the Suitability Assessment of Materials to measure the appearance of the bundle and checklist. Each item that obtained more than 80% agreement was considered valid. **Results:** Fifteen responses were obtained: 57.1% female; average age of 32 years; mostly professional nurses (42.9%). None of the validation criteria required changes, due to agreement greater than 0.80 on all items. Both instruments have internal consistency of 0.949, considered excellent. **Conclusion:** the bundle and checklist were

evaluated as adequate, clear, and relevant tools, and their incorporation into practice can contribute significantly to the prevention of ventilator-associated pneumonia.

Keywords: *Pneumonia, Ventilator-Associated. Critical Care. Checklist. Patient Care Bundles. Validation Study.*

RESUMO

Justificativa e Objetivos: a pneumonia associada à ventilação mecânica é uma infecção pulmonar que ocorre 48 horas após o início da intubação orotraqueal e ventilação mecânica invasiva, sendo uma infecção comum em terapia intensiva. Na busca por maior qualidade assistencial e segurança do paciente, o objetivo do estudo foi elaborar e validar a aparência do *bundle* e do *checklist* para prevenção da pneumonia associada à ventilação mecânica com profissionais de Unidade de Terapia Intensiva Adulto. **Métodos:** estudo metodológico e quantitativo, que ocorreu no período de janeiro de 2023 a novembro de 2024, e foi organizado em duas etapas: (1) construção do *bundle* e do *checklist*; (2) validação dos instrumentos. A população foi composta por 15 profissionais na temática, que consentiram eletronicamente em participar da pesquisa. O instrumento para coleta dos dados foi hospedado no *Google Forms®,* com apoio da rede social *WhatsApp®* e *e-mail.* Realizou-se a avaliação dos critérios de clareza e relevância, aplicando-se o *Suitability Assessment of Materials* para mensuração a aparência do *bundle* e *checklist.* Considerou-se válido cada item que obteve concordância superior a 80%. **Resultados:** obtiveram-se 15 respostas: 57,1% do sexo feminino; com média de faixa etária de 32 anos; majoritariamente profissionais enfermeiros (42,9%). Nenhum dos critérios de validação demandou alterações, devido à concordância superior a 0,80 em todos os itens. Ambos os instrumentos apresentam consistência interna de 0,949, considerada excelente. **Conclusão:** o *bundle* e o *checklist* foram avaliados como instrumentos adequados, claros e relevantes, e sua incorporação na prática pode contribuir significativa para prevenção da pneumonia associada à ventilação mecânica.

Descritores: *Pneumonia Associada à Ventilação Mecânica. Cuidados Críticos. Lista de Checagem. Pacotes de Assistência ao Paciente. Estudo de Validação.*

RESUMEN

Justificación y Objetivos: la neumonía asociada a la ventilación mecánica es una infección pulmonar que se produce 48 horas después del inicio de la intubación orotraqueal y la ventilación mecánica invasiva, y es una infección frecuente en cuidados intensivos. En la búsqueda de una mejor calidad asistencial y seguridad del paciente, el objetivo del estudio fue elaborar y validar la apariencia del paquete y la lista de verificación para la prevención de la neumonía asociada a la ventilación mecánica con profesionales de la Unidad de Terapia Intensiva para Adultos. **Métodos:** un estudio metodológico y cuantitativo, que se desarrolló de enero de 2023 a noviembre de 2024, y se organizó en dos etapas: (1) construcción del paquete y lista de verificación; (2) validación de los instrumentos. La población estuvo formada por 15 profesionales del sector que dieron su consentimiento electrónico para participar en la investigación. El instrumento de recogida de datos se alojó en *Google Forms®*, con el apoyo de la red social *WhatsApp®* y correo electrónico. Los criterios de claridad y relevancia se evaluaron mediante la *Suitability Assessment of Materials* para medir la apariencia del paquete y la lista de verificación. Cada elemento con un nivel de concordancia superior al 80% se consideró válido. **Resultados:** se obtuvieron 15 respuestas: el 57,1 % fueron mujeres, con una edad media de 32 años, y la mayoría eran enfermeras (42,9 %).

Ninguno de los criterios de validación requirió cambios, debido a una concordancia superior a 0,80 en todos los ítems. Ambos instrumentos presentan una consistencia interna de 0,949, considerada excelente. **Conclusión:** el paquete de medidas y la lista de verificación se evaluaron como instrumentos adecuados, claros y pertinentes, y su incorporación en la práctica puede contribuir significativamente a la prevención de la neumonía asociada a la ventilación mecánica.

Palabras Clave: *Neumonía Asociada al Ventilador. Cuidados Críticos. Lista de Verificación. Paquetes de Atención al Paciente. Estudio de Validación.*

INTRODUCTION

Pneumonia is an acute respiratory infection caused by germs, toxic products, or allergic reactions, affecting the pulmonary alveoli, bronchi, and interstitium.[1] It affects about one in every 100 patients overall and up to one in ten patients on invasive mechanical ventilation (IMV), with Streptococcus pneumoniae being the main causative agent, responsible for about 60% of cases of hospital-acquired pneumonia and one of the leading causes of morbidity and mortality in nosocomial infections.[2]

Ventilator-associated pneumonia (VAP) is a lung infection that occurs more than 48 hours after the start of orotracheal intubation and IMV, and is one of the most common infections in intensive care units (ICUs), with an incidence of 6 to 52%.[3-5] The mortality rate from VAP is 70% in high-risk patients globally.4 The incidence ranges from two to 16 episodes per 1,000 days of ventilation in the United States.[4-5] The estimated risk of VAP is 1.5% per day, decreasing to less than 0.5% per day after the 14th day of mechanical ventilation.[5] In Brazil, the incidence is 23.2 to 36.01%.[6] Mortality from VAP varies between 20 and 60%, resulting in hospital stays longer than 12 days and increased healthcare costs.[6]

The main factor for the development of pneumonia in the ICU is mechanical ventilation.[2-3] Endotracheal intubation, nasogastric tube feeding, malnutrition, and inadequate saliva flow, which lead to oropharyngeal colonization in patients, are other predisposing factors.[7] VAP increases oxygen demand and pulmonary secretion production, which can cause alveolar collapse and impair gas exchange.[7] Other consequences of VAP include prolonging the length of hospitalization and increasing the length of stay in the ICU, with a consequent increase in treatment costs, greater use of health resources, and continued IMV, thus causing high morbidity and mortality rates.[2]

The multidisciplinary ICU team is expected to play an important role in preventing VAP by using management tools such as care bundles and checklists.[8]

Awareness of the use of these tools can be effective in preventing VAP, potentially reducing its incidence significantly. To this end, it is up to ICU professionals to seek reliable scientific evidence for translation and implementation in practice.

In 2022, The Society for Healthcare Epidemiology of America (SHEA) published a guideline containing best practices for the prevention of VAP based on the opinion of international experts.[2] Based on this evidence, it is possible to translate this knowledge into the construction and evaluation of bundles and checklists for care.

Bundles and checklists are characterized as care management tools that present interventions with specific care that, when grouped together, improve practices with a view to patient safety. It should be noted that the success of these tools is related to the execution of all proposed items, without fragmentation of any stage.

The production of these management tools is a systematic strategy to improve care processes in complex care environments, seeking satisfactory results for the patient. Given the above, this study aimed to develop and validate the appearance of the bundle and checklist for the prevention of VAP with adult ICU professionals.

METHODS

Methodological and quantitative research. This type of research allows for the verification of methods for obtaining, organizing, and analyzing data, with the aim of developing, validating, and evaluating instruments for care practice.[10]

The research took place from January 2023 to November 2024 and was organized in two stages: (1) development of the bundle and checklist; (2) validation of the appearance with adult ICU professionals.

Development of the bundle and checklist

The products were developed based on the recommendations published by SHEA, containing clinical care for the prevention of VAP.[2] Brazilian resolutions from the Medical, Nursing, Physiotherapy, and Dentistry Councils were also consulted to identify the ethical and legal prerogatives of the practice of each area.

The bundle was structured with the following items: objectives; scope; acronyms; glossary; knowledge base; development; methodology; management indicator; and references. SHEA is an international professional society that improves public health by establishing infection prevention measures and supporting antibiotic stewardship among healthcare professionals. In the 2022 recommendations, the quality of the evidence was assessed using the Grades of Recommendation, Assessment,

Development, and Evaluation, characterizing the bundle for the prevention of VAP in the categories high, moderate, and low (Table 1).

Table 1. Categories of evidence quality from Grades of Recommendation, Assessment, Development, and Evaluation. Curitiba, Paraná, Brazil, 2025.

CATEGORY	DEFINITION
HIGH	Highly confident that it is true, the effect is close to the estimated size and direction of the effect. Evidence is classified as "HIGH" quality when there is a wide range of studies without major limitations, there is little variation between studies, and the summary estimate has a narrow confidence interval.
MODERATE	The actual effect is likely to be close to the estimated size and direction of the effect, but there is a possibility that it could be substantially different. Evidence is classified as "MODERATE" quality when there are few studies and some have limitations, but no major flaws. In addition, there is some variation between studies, or the confidence interval of the summary estimate is wide.
LOW	The true effect may be substantially different from the estimated size and direction of the effect. Evidence is classified as "LOW" quality when supporting studies have major flaws, there is important variation between studies, the confidence interval of the summary estimate is very wide, or there are no rigorous studies.

The guideline verified the following items: avoid intubation and prevent reintubation; reduce sedation; maintain and improve physical conditioning; raise the head of the bed between 30° and 45°; perform oral care without the use of chlorhexidine; provide enteral nutrition in comparison with parenteral nutrition early on; change the ventilator circuit only when it is visibly dirty or damaged.

As for the checklist, three blocks were created, with the first containing identification data and clinical history, the second containing a description of essential practices for the prevention of VAP, containing nine items, and the third containing care referred to as additional approaches, with three items. A procedural representation was chosen to demonstrate simplicity and objectivity, helping to reduce care failures, organize processes with a focus on results, and promote higher quality care and safety for patients, family members, and professionals.

Appearance validation

The validation process, a quantitative stage, took place online in one round. The population consisted of 45 professionals specializing in the subject, selected intentionally and not probabilistically. The selection was made by searching the Lattes Platform for *résumés* from the National Council for Scientific and Technological

Development.[11] Invitations were sent via WhatsApp® groups linked to intensive care professional associations, through consultation with the LinkedIn platform (social media focused on business and employment), and by referral from specialists (snowball technique).

The professionals were classified based on their technical expertise (target audience with practical experience in the context for which the bundle and checklist are intended).[11] For selection, resumes were analyzed considering the following criteria in order of priority: having a degree in nursing, medicine, physical therapy, or dentistry; working in direct care for adult patients in intensive care, preferably for more than one year; having participated in courses/training on the study topic. The choice to invite professionals from the above-mentioned areas is justified by their involvement in the production of the guideline published by SHEA.[2]

The validation sample consisted of 15 professionals who met the pre-established criteria. We sought to establish a committee of between five and 27 professionals.[11] Participants were given a period of ten days to validate the documents. When there was a delay in response, reminders were sent to identify the need for assistance in completing the form, clarifying doubts, and/or extending the deadline. Professionals who did not return the bundle and checklist validation instrument by the end of the ten-day extension were excluded.

Considering the 15 selected participants, an invitation to participate was sent electronically (via email or WhatsApp®), containing a presentation of the research, its objectives, and a link to access the Free and Informed Consent Form on Google Forms®. If accepted, the evaluator was directed to the document validation stage, with instructions for the validation process.

The data collection instrument, hosted on Google Forms®, was organized into three stages: 1) characterization of the evaluators; 2) analysis of the relevance of the bundle and checklist content in terms of clarity and relevance; 3) assessment of the appearance of the bundle and checklist based on the items in the Suitability Assessment of Materials (SAM), which are divided into the following domains: content; language; illustrations; layout; motivation; and usability.[10] For the evaluation of each item, the options “inappropriate,” “somewhat inappropriate,” “appropriate,” or “totally appropriate” were considered.[12] At the end of the survey, space was provided for “comments or suggestions for improvements to the bundle and checklist.” The time to complete the forms varied between 25 and 30 minutes.

Subsequently, to complete the validation, professionals were asked to answer an open question: 1) Comments, suggestions, rewriting of any of the items and/or domains of the bundle and checklist?

The data were analyzed using descriptive statistics (absolute and relative frequencies, minimum, maximum, mean, median, and standard deviation). To validate the content and appearance of the bundle and checklist, the scores assigned to each item in the participants' evaluations were verified, considering the psychometric criteria and SAM criteria.[10,12]

The clarity and relevance of the items were calculated using the Content Validation Coefficient (CVC).[13] The CVC was calculated for each criterion (clarity and relevance/pertinence) and for each domain of the SAM, as well as the total CVC of the bundle and checklist. Items with more than 80% agreement among professionals (evaluated as adequate) and a CVC > 0.80 were considered valid.

Ethical aspects were respected, and the study was approved by the Research Ethics Committee on April 6, 2023, as stated in Opinion No. 5,988,955 and Certificate of Ethical Presentation and Appraisal No. 67399323.7.0000.5668.

The study was conducted in accordance with the Guidelines for Reporting Reliability and Agreement Studies.

RESULTS

Fifteen professionals participated in the appearance validation, predominantly nurses (47%). Regarding gender, 53.3% were female. Their ages ranged from 21 to 60 years. Regarding professional practice, 80% are involved in direct patient care, with 53% coming from public institutions. Regarding qualifications, 80% have specialization (Table 2).

Table 2. Characterization of the sample of evaluators of the bundle and checklist for the prevention of ventilator-associated pneumonia. Curitiba, Paraná, Brazil, 2025.

Variables	N (%)
Age (years) – mean ± SD	32.5 ± 12.7
Gender	
Male	7 (46.7)
Female	8 (53.3)
Profession	
Physician	4 (28.0)
Physical Therapist	3 (20.0)
Nurse	7 (47.0)
Dentist	1 (5.0)

Professional performance	
Assistance	12 (80.0)
Management	3 (20.0)
Institution that operates	
Public	8 (53.0)
Private	7 (47.0)
Length of practice (years) – median (P25 – P75)	2 (1 – 10)
Length of training (years) – median (P25 – P75)	4 (1 – 18)
Highest degree	
Specialization	12 (80.0)
Residency	3 (20.0)

Caption: SD – standard deviation.

The results correspond to the responses related to the items in the bundle and checklist regarding their clarity and relevance, as perceived by the participants (Table 3). The CVC analysis showed a high degree of agreement among professionals, exceeding 80%, which allowed both instruments to be considered valid.

Table 3. Validation with professionals regarding the clarity and relevance of the bundle and checklist. Curitiba, Paraná, Brazil, 2025.

Criteria evaluated	Bundle CVC	Checklist CVC
Clarity	0.93	0.93
Relevance	0.89	0.95
Average	0.91	0.94
Cronbach's alpha	0.950	0.896

Caption: CVC - Content Validation Coefficient.

The validation of the bundle and checklist appearance by professionals considered the instrument suitable for use in daily care. Validation was mediated by SAM, considering the analysis of content, language, layout, motivation, and usability. The items were evaluated with a CVC greater than 0.80, demonstrating that the products are clear and relevant tools for implementation in the clinical practice of adult ICU professionals (Table 4). Cronbach's alpha was evaluated at 0.949, indicating almost perfect reliability.

Table 4. Validation of the bundle's appearance and checklist with the target audience based on the Suitability Assessment of Materials. Curitiba, Paraná, Brazil, 2025.

Items evaluated	**Agreement (%)**			**CVC**
Content	**I**	**A**	**TA**	
1. Meets the proposed objectives	0 (0.0)	2 (13.0)	13 (87.0)	0.96
2. The content is divided coherently	2 (7.0)	3 (20.0)	11 (73.0)	0.91
3. Meets the needs of the target audience	0 (0.0)	3 (20.0)	12 (80.0)	0.95
4. There is logic in the sequence of information	4 (27.0)	11 (73.0)	0 (0.0)	0.93

5. It is relevant to inform the target audience	0 (0.0)	5 (33.0)	10 (77.0)	0.91
6. It is scientifically accurate	0 (0.0)	5 (33.0)	10 (77.0)	0.91
Language				
7. The writing style is appropriate for healthcare professionals.	0 (0.0)	5 (33.0)	10 (77.0)	0.91
8. The sentences are engaging and not tiresome.	1 (7.0)	6 (40.0)	8 (53.0)	0.86
9. The text is clear and objective.	0 (0.0)	5 (33.0)	10 (77.0)	0.91
Layout				
10. The font size and typeface make it easy to read	1 (6.0)	7 (47.0)	7 (47.0)	0.85
11. The colors used in the checklist make it easy to read	1 (6.0)	4 (27.0)	10 (67.0)	0.90
12. The items are arranged in an organized manner	0 (0.0)	4 (27.0)	11 (73.0)	0.93
13. The size of the checklist is consistent	0 (0.0)	5 (33.0)	10 (77.0)	0.91
14. The visual composition is attractive and well organized	2 (13.0)	5 (33.0)	8 (53.0)	0.85
Motivation				
15. The reader is encouraged to continue reading	2 (13.0)	5 (33.0)	8 (53.0)	0.85
16. The checklist is enlightening	0 (0.0)	5 (33.0)	10 (77.0)	0.91
Usability				
17. The checklist items highlight key aspects that should be reinforced	0 (0.0)	4 (27.0)	11 (73.0)	0.93
18. It is suitable for use by healthcare professionals in the care of critically ill adult patients	0 (0.0)	5 (33.0)	10 (77.0)	0.91
Cronbach's alpha		**0.949**		

Caption: CVC - Content Validation Coefficient.

After validating the bundle and checklist, the evaluators praised the instruments: clear and direct information; interesting and relevant; organized, facilitating the collection of information in an efficient and clear manner; tools that are easy to understand and useful for the ICU routine; complete, practical, and objective checklist. Based on the results, no structural adjustments to modify, include, or exclude content were made, so as not to compromise the instrument. Thus, the final version of the checklist is structured into four domains: Domain 1 - Patient identification; Domain 2 - Clinical identification; Domain 3 - Essential practices; and Domain 4 - Additional approaches (Figure 1).

PATIENT IDENTIFICATION								
Name:_____ **Date of birth:** ___/___/_____ **Bed n°.**_____								
CLINICAL IDENTIFICATION								
Date of admission to the ICU: ___/___/____ **Date and location of intubation:** ___/___/_____ **( ) ICU ( ) PS ( ) OTHERS:** _____ **( ) Reintubation:** ___/___/____ **( ) Extubation: ( ) Accidental ( ) Scheduled:**__/__/____ **( ) Tracheostomy:** ___/___/____ **( ) TOT Exchange** ___/___/____								
Verification of the intervention: (Y) YES; (N) NO; (NA) NOT APPLICABLE.								
ESSENTIAL PRACTICES	**DATE OF THE WEEK/TIME**							
Oxygen therapy was administered via high-flow nasal cannula.**								
Oxygen was administered via non-invasive positive pressure ventilation.**								
It presents measures to minimize accidental extubation and reintubation.***								
Minimize daily sedation in patients without contraindications.***								
Exercise and early mobilization were performed.***								
The head of the bed should be kept elevated between 30° and 45°, unless medically contraindicated.*								
Brushing instructions are provided, but without chlorhexidine.**								
Early enteral nutrition provided.***								
The ventilator circuit was replaced due to visible dirt, a defect, or in accordance with institutional protocol.***								
ADDITIONAL APPROACHES								
If intubation is required, endotracheal tubes with subglottic secretion drainage are used.**								
Considered early tracheostomy (if lower extremity intubation < 10 days).**								
Post-pyloric feeding tube insertion is considered for patients intolerant to gastric feeding and at high risk of aspiration.**								
Quality of Evidence measured using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) system: *High, **Moderate, ***Low								

Figure 1. Final version of the checklist for the prevention of ventilator-associated pneumonia. Curitiba, Paraná, Brazil, 2025.

DISCUSSION

The development and validation of the bundle and checklist for preventing VAP in adults represent a crucial step toward optimizing healthcare, as they provide a solid scientific basis for implementing evidence-based practices, promoting continuous improvement in healthcare processes and standardization of care.[15]

In the United States, the Centers for Disease Control and Prevention, located in Atlanta, conducted the Study on the Efficacy of Nosocomial Infection Control to

analyze the effectiveness of healthcare-associated infection (HAI) control programs implemented in the country. The findings of this study indicated that HAI result in an average increase of four days in hospital stays, in addition to generating significant additional treatment costs.[16-17] Thus, the strategy of creating bundles has been adopted, aiming to systematize actions to prevent adverse events in practices associated with IMV in patients.[18]

Hospitalized patients, especially those undergoing IMV, are at increased risk for pneumonia. Estimates indicate a mortality rate of approximately 33% for patients with this infection.[19] Thus, the implementation of VAP prevention measures is essential to reduce the morbidity and mortality associated with this complication, and the lack of standardization in care practices has limited the effectiveness of these interventions.[20]

The SHEA recommendations can be classified into two main categories. The first encompasses essential practices that have a positive impact on clinical outcomes, such as reducing the duration of mechanical ventilation, length of hospital stay, and mortality. The second category covers additional approaches that similarly have the potential to improve these outcomes, although they may be associated with additional risks.[20]

From this perspective, the development of a bundle and checklist based on up-to-date scientific evidence, capable of guiding professionals in the processes for preventing VAP, is a valuable tool for improving the quality of care and patient safety.[21] This approach allowed for the integration of the expertise of healthcare professionals and the knowledge of educators and researchers, resulting in a tool that shows great potential for improving the quality and safety of patient care in both educational and healthcare settings.

The evaluation of professionals allowed for the emergence of diverse opinions and approaches to VAP, minimizing the possibility that the topic would be based solely on the perception and interest of researchers. The instrument was validated by a multidisciplinary group, as it understands that the prevention of HAI is intrinsic to everyone.[22] However, nurses play a uniquely important role, with an indispensable role in all stages of care, from prevention to treatment and monitoring of infections. Their contribution is particularly notable in the training and education of teams, in the rigorous implementation of care protocols, and in the continuous supervision of surveillance practices, promoting quality of care and safety.

The checklist is an essential tool for ensuring that all stages of a given procedure are followed systematically. At the same time, it allows procedures to be performed in the required order, ensuring compliance with requirements and facilitating data collection for further analysis. Furthermore, it is an accessible and effective method for reducing risks arising from distractions or overconfidence, especially in standardized activities. To ensure the reliability of this instrument, making it safe, the validation process has become indispensable.[24]

This study used the patient's name, date of birth, and bed number as identifiers, considering that the patient identification protocol presented by the National Patient Safety Program recommends the use of at least two identifiers. The checklist begins with the correct identification of the patient, representing the first of the six International Patient Safety Goals. Correct identification is an extensive process, involving multiple professionals, which encompasses structural factors, work processes, professional practices, and the participation of the patient and their family members. When correctly implemented, it contributes to the prevention of errors related to care at different levels of healthcare.[25]

The second section of the study is dedicated to recommended practices for preventing intubation and reintubation. Scientific evidence supports the use of high-flow nasal oxygen or noninvasive positive pressure ventilation when safe and feasible. High-flow nasal oxygen has been shown to be effective in preventing intubation in patients with hypoxemic respiratory failure, in addition to reducing reintubation and nosocomial pneumonia in critically ill or postoperative patients, when compared to conventional oxygen. Noninvasive positive pressure ventilation has similar results and, when combined with high-flow nasal oxygen immediately after extubation, can further reduce the risk of reintubation in patients at high risk of failure.[2,6,22]

For the management of agitation in ventilated patients, a multimodal approach is recommended, avoiding the isolated use of benzodiazepines. Dexmedetomidine and propofol, in particular, have demonstrated superiority over benzodiazepines, reducing the duration of mechanical ventilation and length of stay in the ICU. Daily assessment of readiness for extubation in patients without contraindications is essential to minimize the duration of mechanical ventilation. Studies show that the use of specific protocols can accelerate extubation by up to one day, compared to the traditional approach.[2,6]

In addition to the preventive measures already discussed, promoting early mobilization emerges as a fundamental strategy to enhance the recovery of

mechanically ventilated patients, reducing the length of stay in the ICU, indicating lower rates of VAP, and promoting an increase in the rate of functional recovery independently.[2,22]

Although studies indicate a positive association between raising the head of the bed and reducing the incidence of VAP, the scientific literature has not yet conclusively demonstrated a significant impact on the duration of mechanical ventilation or mortality. The scarcity of data limits understanding of the full scope of the benefits of this intervention. However, considering its simplicity, low cost, and potential benefit in preventing VAP, raising the head of the bed remains a recommended practice.[2]

The scientific literature shows a consistent association between daily oral hygiene and a reduction in the incidence of VAP. However, the use of chlorhexidine solutions as an adjunct to oral hygiene has not been shown to be effective in reducing the duration of mechanical ventilation or the length of stay in the ICU. Meta-analyses of randomized studies and observational studies point to a possible association between the use of chlorhexidine and higher mortality, although this relationship is uncertain and requires further investigation. Considering the lack of solid evidence on the benefits of routine chlorhexidine use and the possibility of adverse events, its use is not recommended as standard practice in the oral care of intubated patients.[2,6]

Research shows that early enteral nutrition in critically ill patients, compared to parenteral nutrition, is associated with a reduced risk of nosocomial pneumonia. However, studies indicate that early parenteral nutrition, initiated within the first 48 hours of ICU admission, may be associated with increased mortality and risk of HAI when compared to late parenteral nutrition, initiated after the eighth day of admission.[6,8,22-23]

Thus, the guidelines recommend replacing the ventilator circuit only when it shows visible signs of dirt or damage. This practice, supported by high-quality evidence, aims to optimize resources and reduce costs without compromising patient safety. Routine replacement of the circuit at predetermined times has not shown any benefit in terms of preventing VAP or improving clinical outcomes.[2-8]

The third and final section is dedicated to discussing additional approaches to preventing VAP. The use of endotracheal tubes with subglottic secretion drainage is recommended to minimize the accumulation of secretions above the tracheostomy cuff in patients who may require intubation for more than 48-72 hours. This intervention is

only feasible for children over 10 years of age, due to the smallest available tube (size 6.0).

Clinical research confirms that the use of these tubes reduced VAP rates by 44%, but there was no relationship with the duration of IMV or length of hospital stay. Although initial studies suggested a possible impact on mortality, this association was not confirmed in subsequent analyses. The indication for endotracheal tubes with subglottic drainage is particularly relevant for patients requiring prolonged IMV. In these cases, the use of these tubes may contribute to a reduction in the duration of ventilation. Frequent tube changes through extubation and reintubation are not recommended.[2,6,8]

Although the quality of evidence is considered moderate, several clinical studies have shown that early tracheostomy (less than ten days) is associated with lower rates of VAP, shorter ICU stays, and shorter IMV duration when compared to late tracheostomy. In addition, observational studies suggest a possible reduction in mortality rates in patients undergoing early tracheostomy.[2,8,22]

Considering the position of the post-pyloric feeding tube in patients at high risk of aspiration is a clinical practice with moderate scientific evidence. Meta-analyses show mixed results on whether post-pyloric feeding reduces the length of stay on the ventilator or in the hospital. Furthermore, post-pyloric feeding is seen as less physiological compared to gastric feeding. This type of enteral nutrition should be reserved for patients who are intolerant to gastric feeding and those at high risk of aspiration, according to the guidelines of the nutrition society.[2,6,8]

The response rate obtained from the evaluators was satisfactory. The analysis of the level of agreement indicated that both instruments, the bundle and the checklist, exceeded the recommended indices, demonstrating their effectiveness as tools for implementation in adult ICUs. These findings corroborate the relevance of using validated instruments to evaluate care practices in this context. Therefore, it should be noted that none of the evaluation criteria required changes, since all items evaluated obtained a concordance index greater than 0.80.

One limitation is the representativeness of the sample, which is limited by the geographical concentration of evaluators, who come exclusively from the state of Paraná. This characteristic restricts the generalization of the results to a broader context, covering the other four regions of the country. To overcome the limitations encountered, it is necessary to continue expanding the evaluation process, which takes place over

time. As a future perspective, we suggest the development (construction, validation, and evaluation) of instruments for pediatric and neonatal contexts to complement the present study.

Based on the results of this research, it is believed that the bundle and checklist are potentially significant tools for incorporation into health services, with a view to reducing the incidence of VAP in adults, providing improvements in the quality of care and patient safety.

The results obtained in the study of the construction and evaluation of the VAP prevention bundle and checklist pointed to acceptable clarity and relevance for their incorporation and use in adult ICUs. The consensus of the professionals provided evidence for the reliability of the bundle and checklist.

It should be noted that this research contributes to the use of new care strategies, in order to translate scientific knowledge into clinical practice. This study presented an innovative instrument resulting from the adaptation of international recommendations.

The process of evaluating the content and appearance of the instruments points to their contribution to the prevention of VAP, contributing to patient safety and the continuous improvement of care processes.

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AUTHORS' CONTRIBUTIONS

Ana Carolina Pereira de Lima contributed to the literature review, writing of the abstract, introduction, methodology, discussion, interpretation and description of results, preparation of tables, conclusions, review, and statistics. **Cléton Salbego** contributed to the literature review, writing of the abstract, introduction, methodology, discussion, interpretation and description of results, preparation of tables, conclusions, review, and statistics. **Graciele Torezan** contributed to writing the abstract, methodology, interpretation of results, conclusions, review, and statistics. **Tierle Kosloski Ramos** contributed to the discussion, interpretation, and description of results, conclusions, review, and statistics. **Silvana Bastos Cogo** contributed to the discussion, interpretation, and description of results, conclusions, review, and statistics. **Jessika de Oliveira Cavalaro** contributed to the discussion, interpretation and description of results, conclusions, review, and statistics. **Robson Giovani Paes** contributed to the discussion, interpretation and description of results, conclusions, review, and statistics.

All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.