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ADHERENCE TO GOOD PRACTICES IN THE PREVENTION OF VENTILATOR-ASSOCIATED PNEUMONIA: A CROSS-SECTIONAL STUDY

ADESÃO ÀS BOAS PRÁTICAS NA PREVENÇÃO DE PNEUMONIA ASSOCIADA À VENTILAÇÃO MECÂNICA: ESTUDO TRANSVERSAL

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RESUMO

Objetivo: avaliar as boas práticas para prevenção de pneumonia associada à ventilação mecânica, nos pacientes em ventilação mecânica invasiva, internados na terapia intensiva. **Método:** trata-se de estudo transversal, prospectivo com abordagem quantitativa, através da adesão dos profissionais a três itens que compõem o pacote de prevenção da pneumonia associada à ventilação. A análise descritiva foi baseada em distribuições de frequências, absolutas e relativas, e cálculo de estatísticas descritivas para variáveis quantitativas. **Resultado:** o item com maior adesão foi a manutenção da cabeceira elevada, com 68,85% de conformidade, seguido pela manutenção da pressurização do *cuff* entre 25 e 30 mmHg, com 55,74% de conformidade. A higiene oral apresentou a menor adesão, com 32,79%. No que diz respeito à totalidade do *bundle*, a taxa de conformidade foi de 21,31%. **Conclusão:** a maior taxa de adesão foi observada para a elevação da cabeceira, seguida pelo monitoramento da pressão do *cuff*, enquanto a higiene oral apresentou a menor adesão. Constatou-se que a manutenção da pressão do *cuff* dentro dos valores recomendados esteve associada à redução desse risco. Ademais, a adesão integral ao *bundle* resultou em diminuição significativa na incidência de pneumonia associada à ventilação mecânica.

Descritores: Pneumonia Associada à Ventilação Mecânica; Terapia Intensiva; Higiene Oral; Segurança do Paciente.

ABSTRACT

Objective: to evaluate best practices for preventing ventilator-associated pneumonia in patients on invasive mechanical ventilation admitted to intensive care. **Method:** this is a cross-sectional, prospective study with a quantitative approach, assessing professionals' adherence to three items that comprise the ventilator-associated pneumonia prevention bundle. Descriptive analysis was based on absolute and relative frequency distributions and calculation of descriptive statistics for quantitative variables. **Results:** the item with the highest adherence was maintaining the head of the bed elevated, with 68.85% compliance, followed by maintaining cuff pressure between 25 and 30 mmHg, with 55.74%. Oral hygiene had the lowest adherence, with 32.79%. Regarding the entire bundle, the compliance rate was 21.31%. **Conclusion:** The highest adherence rate was observed for elevating the head of the bed, followed by monitoring cuff pressure, while oral hygiene had the lowest adherence. Maintaining cuff pressure within recommended values was associated with a reduced risk. Furthermore, full adherence to the bundle resulted in a significant reduction in the incidence of ventilator-associated pneumonia.

Descriptors: Ventilator-Associated Pneumonia; Intensive Care; Oral Hygiene; Patient Safety.

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INTRODUCTION

In the intensive care unit (ICU), one of the main therapeutic interventions is invasive mechanical ventilation, which can be implemented through an endotracheal tube (orotracheal or nasotracheal) or a tracheostomy. However, the use of these devices increases the risk of respiratory infections, with ventilator-associated pneumonia (VAP) being one of the most frequent complications[1].

This severe infection affects the lung parenchyma and compromises gas exchange essential for oxygenation, particularly in patients who remain intubated for more than 48 hours. The predisposition to VAP arises from the fact that the use of ventilatory prostheses in patients receiving invasive mechanical ventilation interferes with the body's natural defense mechanisms, thereby increasing vulnerability to microbial invasion of the respiratory system. These microorganisms can pass through the space between the trachea and the tube, reaching the lower respiratory tract[2–3]. VAP is among the most common healthcare-associated infections, with a national incidence of 12.51 cases per 1,000 days of mechanical ventilation and 11.09 cases in the state of Rio de Janeiro. It is also associated with prolonged hospitalization, increased healthcare costs, and, most critically, high mortality rates ranging from 24% to 76%, reflecting heterogeneity among patients and intensive care settings[1,4-5].

In response to this problem, the Brazilian Health Regulatory Agency (ANVISA), following the guidelines of the Institute for Healthcare Improvement (IHI)—an organization recognized worldwide for promoting excellence in healthcare—developed a set of strategies aimed at addressing modifiable risk factors to reduce the occurrence of VAP. Although these measures may seem simple, they have proven effective in decreasing the incidence of VAP when applied in a coordinated and integrated manner[4-7].

These strategies include elevating the head of the bed to an angle between 30° and 45°, performing daily assessments for sedation interruption, regular subglottic suctioning, and maintaining oral hygiene with a 0.12% chlorhexidine solution. In addition, other recommendations, which are not part of the IHI guidelines but are included in ANVISA's protocols, involve monitoring cuff pressure, judicious use of neuromuscular blocking agents, and appropriate care of the ventilator circuit, among others[4-7].

However, although this set of measures has demonstrated its effectiveness in preventing VAP, a significant disparity is often observed between the recommended ideals and the actions actually implemented[6].

Although several studies address the prevention of VAP and the consequent reduction in its incidence, there is a scarcity of research examining this issue from the perspective of nursing care, especially in light of recently published guidelines, and exploring its association with clinical outcomes.

Based on this premise, the present study aims to evaluate best practices for preventing ventilator-associated pneumonia in patients on invasive mechanical ventilation admitted to intensive care.

METHOD

This is an observational, cross-sectional study with a quantitative approach, following the 22 steps of the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) recommendations. It assessed healthcare professionals' adherence to three items that comprise the VAP prevention package: elevated headboard, oral hygiene, and cuff pressure assessment[7].

The study was conducted in two intensive care units of a university hospital in Rio de Janeiro between March and July 2024. Neither unit had a pre-established care protocol for VAP prevention. The care provided to 65 patients was analyzed according to the inclusion and exclusion criteria of this study. The inclusion criteria were: Adult patients admitted to intensive care using invasive mechanical ventilation via orotracheal tube or tracheostomy for more than 48 hours. Pregnant patients and those undergoing neurosurgical procedures were excluded from the study, as the duration of invasive mechanical ventilation in this population is generally less than 48 hours.

To assess adherence, three components of the VAP prevention bundle were directly observed: oral hygiene, cuff pressurization, and headboard elevation. These items were selected because they are specific nursing interventions, unlike daily wake-up calls and thrombosis prophylaxis, which require a physician's prescription.

Regarding oral hygiene, the presence or absence of soiling was assessed. Cuff values between 20 and 30 mmHg were considered, and the measurement was performed using the cuffometer available in both units. Regarding the headboard, the elevation was verified between 30 and 45 degrees, using the leveler located on the side of the bed, available in all beds. Data collection was performed by a single researcher between 10:00 a.m. and 12:00 p.m. on random days.

Data collection was performed using an electronic instrument integrated with the patient's electronic medical record, called the Epimed Monitor UTI System. This instrument includes patient characteristics, demographic data (age, gender, and race), and clinical data (primary and secondary diagnoses, comorbidities, functional capacity, severity according to the Simplified Acute Physiology Score 3 (SAPS 3), and ventilatory parameters. The data obtained were extracted into an Excel spreadsheet format from the Epimed Monitor UTI System and statistically analyzed.

The descriptive analysis was based on absolute and relative frequency distributions and calculation of descriptive statistics for quantitative variables (minimum, maximum, mean, median, standard deviation, and coefficient of variation). Initially, the sample normality test was used. Subsequently, the chi-square test and Fisher's exact test were used to determine the association between oral hygiene compliance and the following outcomes: duration of MV and occurrence of VAP, with $p < 0.05$ as the standard of significance.

Ethical issues of research

The research was approved by the Research Ethics Committee of the State University of Rio de Janeiro under Opinion No. 5,997,457 and Certificate of Presentation of Ethical Appreciation (CAAE): 26827219.8.0000.5259, in accordance with Resolution No. 466/12 of the National Health Council. The research is linked to a broad-scope project entitled "Healthcare-Related Infection Indicators: Tools for Nursing Care." The Informed Consent Form (ICF) was applied to the patients' guardians for direct observation and consultation of patient records. Furthermore, all data were anonymized and coded in accordance with the Law for Gen-

eral Data Protection (LGPD).

RESULTS

Sixty-one patients participated in the study. Among these, there was a predominance of females (55.74%) and a diagnosis of infection/sepsis (57.38%). The mean age of the participants was 60.37 (±11.47) years. Of the total, 72.73% of the participants died, as shown in Table 1.

Table 2 presents the characterization of the items in the VAP prevention bundle. The most frequently completed item was elevating the head of the bed (68.85%), followed by maintaining cuff pressure within the target range (55.74%). The prevalence of VAP was 50.82%.

Table 1 – Sociodemographic and clinical characterization of participants (n=61). Rio de Janeiro, RJ, Brazil, 2024

Variables	N	%
Gender		
Female	34	55.74
Male	27	44.26
Readmission		
Yes	7	11.48
No	54	88.52
Readmission >24 hours		
No	61	100.0
Outcome in the unit[I]		
Discharge	15	28.3
Death	38	71.7
Hospital outcome[†]		
Discharge	15	27.27
Death	40	72.73
Patient orgin		
Ward/Room	23	37.7
Surgical center/hemodynamics	19	31.15
Transfer from another hospital/institution	15	24.59
Semi-intensive Unit	1	1.64
Another ICU/ICU in your hospital	3	4.92
Diagnostic category		
Infection/sepsis	35	57.38
Tumors and oncological complications	10	16.39
Neurological / psychiatric	6	9.84
Liver. Bile Ducts. Spleen and Pancreas	3	4.92
Respiratory (except sepsis/infection)	3	4.92
Abdominal/retroperitoneal surgeries	1	1.64
Endocrine/metabolic	1	1.64
Cardiopulmonary arrest	1	1.64
Renal	1	1.64

Variables	Mean (±SD)	Median (IIQ)	Minimum/maximum
Age	60.37 years (11.47)	62 years old (38)	36/ 80
Length of stay in the ICU	25.16 days (14.43)	22 days (52)	5/ 65
Length of stay in hospital	37.07 days (28.25)	30 days (78)	8/ 110
Duration time in VM	14.54 days (7.27)	14 days (20)	4/ 36

[I]N=53. [†] N = 50.

Table 2 – Characterization of ventilator-associated pneumonia prevention bundle items and the occurrence of VAP. (n=61). Rio de Janeiro, RJ, Brazil, 2024

Variables	N	%
Raised headboard		
Yes	42	68.85
No	19	31.15
Cuff pressure within the target		
Yes	34	55.74
No	27	44.26
Oral hygiene protocol with chlorhexidine		
Yes	20	32.79
No	41	67.21
Full compliance with the MVAP prevention bundle		
Yes	13	21.31
No	48	78.69
VAP		
Yes	31	50.82
No	30	49.18

Table 3 presents the associations between sociodemographic and clinical characteristics and the occurrence of VAP. Patient origin, age group, length of ICU stay, and cuff pressure within the target range were associated with the occurrence of VAP. Being 60 years of age or older increases the chance of VAP by 3.91 times (95% CI 1.29; 11.84). Patients whose cuff pressure is within the target range have an 84% lower chance of VAP (95% CI 0.05; 0.51). Full compliance with the three-item bundle (headboard, cuff, and hygiene) showed a 79% reduction in the chance of VAP (95% CI 95% to 23%).

Table 3 – Association between sociodemographic and clinical characteristics and occurrence of VAP. (n=61). Rio de Janeiro, RJ, Brazil, 2024

Variables	Occurrence of VAP				OR	CI95%	p-value
	Yes		No				
	N	%	N	%			
Gender							0.091†
Female	14	41.18	20	58.82	0.41	0.14; 1.16	
Male	17	62.96	10	37.04	1	-	
Age range							0.013†
36 to 59 years old	7	30.43	16	69.57	1	-	
60 years old or more	24	63.16	14	36.84	3.91	1.29; 11.84	
Patient origin							0.021‡
Ward/ Room	15	65.22	8	34.78	1	-	
Others	9	47.37	10	52.63	0.48	0.13; 1.66	
Transfer from another hospital/ Institution	3	20.0	12	80.0	0.13	0.02; 0.61	
Semi-intensive Unit	1	100.0	0	0	-	-	
Another ICU/ICU in your hospital	3	100.0	0	0	-	-	
Diagnostic category							0.152†
Infection/sepsis	15	42.86	20	57.14	0.46	0.16; 1.32	
Others	16	61.54	10	38.46	1	-	
Length of stay in the ICU							0.008†
One to 10 days	6	85.71	1	14.29	1	-	
11 to 20 days	14	66.67	7	33.33	0.33	0.03; 3.33	
21 days or more	11	33.33	22	66.67	0.08	0.01; 0.78	
Duration time in VM							0.454†
One to 10 days	13	61.9	8	38.1	1	-	
11 to 20 days	10	45.45	12	54.55	0.51	0.15; 1.73	
21 days or more	8	44.44	10	55.56	0.49	0.13; 1.77	
Raised headboard							0.064†
Yes	18	42.86	24	57.14	0.34	0.11; 1.08	
No	13	68.42	6	31.58	1	-	
Cuff pressure within the target							0.001†
Yes	11	32.35	23	67.65	0.16	0.05; 0.51	
No	20	74.07	7	25.93	1	-	
Oral hygiene protocol with chlorhexidine							0.525†
Yes	9	45.0	11	55.0	0.70	0.24; 2.06	
No	22	53.66	19	46.34	1	-	
Full compliance with the bundle							0.024
Yes	3	23.08	10	76.92	0.21	0.05; 0.87	
No	28	58.33	20	41.67	1	-	

† Chi-square test. ‡ Fisher's exact test. 95% CI = 95% Confidence Interval.

Table 4 shows the associations between sociodemographic and clinical characteristics and clinical outcome (discharge or death) of participants in the unit. Gender, age range, diagnostic category, length of stay in the ICU, head-of-bed elevation, cuff pressure within the target range, and oral hygiene protocol with chlorhexidine were associated with the clinical outcome of participants. The variables associated with the outcome were: age with the highest mortality rate and full compliance with the bundle with the best clinical outcome.

DISCUSSION

The most widely adopted practice in this study was head-of-bed elevation, with a 68.85% adherence rate. This rate is higher than that observed in a study conducted in Rio Grande do Sul, which recorded an adherence rate of 34.5%. However, it is still considered low when compared to studies conducted in other regions of the Southeast in 2019, where adherence rates were considerably higher, reaching 88.7% and 90.05%, respectively[9-11].

Table 4 – Association between sociodemographic and clinical characteristics and clinical outcome of participants in the unit (discharge or death) (n=61). Rio de Janeiro, RJ, Brazil, 2024

Variables	Clinic outcome				OR	CI95%	p-value
	Discharge		Death				
	N	%	N	%			
Gender							0.020†
Female	12	41.38	17	58.62	0.20	0.04; 0.83	
Male	3	12.5	21	87.5	1	-	
Age range							<0.001‡
36 to 59 years	14	73.68	5	26.32	1	-	
60 years old or more	1	2.94	33	97.06	92.4	9.87; 864.64	
Patient origin							0.260‡
Ward/ Room	5	29.41	12	70.59	1	-	
Surgical center	2	10.53	17	89.47	3.54	0.59; 21.39	
Transfer from another hospital/ Institution	7	53.85	6	46.15	0.35	0.07; 1.61	
Semi-intensive Unit	1	100.0	0	0	-	-	
Another ICU/ICU in your hospital	0	0	3	100.0	-	-	
Diagnostic category							0.023‡
Infection/Sepsis	13	40.63	19	59.37	0.15	0.03; 0.77	
Other	0	0	9	100.0	1	-	
ICU Length of Stay							0.002‡
One to 10 Days	0	0	7	100.0	-	-	
11 to 20 Days	2	10.0	18	90.0	1	-	
21 Days or More	13	50.0	13	50.0	0.05	0.01; 0.47	
MV Length of Stay							0.104†
One to 10 Days	3	15.0	17	85.0	1	-	
11 to 20 Days	6	28.57	15	71.43	0.44	0.09; 2.07	
21 Days or More	6	50.0	6	50.0	0.17	0.03; 0.93	
Raised headboard							0.019‡
Yes	14	37.84	23	62.16	0.10	0.01; 0.92	
No	1	6.25	15	93.75	1	-	
Cuff pressure within the target							0.003†
Yes	13	44.83	16	55.17	0.11	0.02; 0.56	
No	2	8.33	22	91.67	1	-	
Oral hygiene protocol with chlorhexidine							0.001†
Yes	10	58.82	7	41.18	0.11	0.02; 0.43	
No	5	13.89	31	86.11	1	-	
Full compliance with the bundle							<0.001
Yes	8	72.73	3	27.27	0.075	0.01; 0.35	
No	7	16.67	35	83.33	1	-	

† Chi-square test. ‡ Fisher's exact test. 95% CI = 95% Confidence Interval.

Head-of-bed elevation is an easy-to-apply, low-cost measure that helps improve respiratory patterns by increasing tidal volume. It also helps reduce the risk of bronchoaspiration of contents from the upper airways and gastrointestinal tract, thus becoming an important ally in preventing VAP[11-12].

Despite being the item with the highest adherence rate in the study, due to its low cost and ease of implementation, adherence rates were expected to be higher than those observed. This leads us to question the reasons for this rate. One possibility is that the headboard is manipulated by different professionals during their activities, which may have contributed to the variation in adherence. Furthermore, there may be a tendency to elevate the headboard and believe the level is adequate, without checking the bedside leveler, which was available at all beds.

In the present study, 62.96% of patients who developed VAP were male. Of the 61 patients analyzed, 50.82% acquired VAP during their hospitalization, and the majority were 60 years of age or older. These data are in line with the literature, which indicates that male gender and age over 60, among other factors, constitute risk factors for the development of VAP[3].

The rate of adequate cuff pressurization was 55.74%, the second highest among the patients analyzed. This result, exceeding 50%, is attributed to the ongoing training offered to nursing residents, the practical application of this knowledge in in-person training sessions with the entire team, and the theoretical-practical coordination established between medical, nursing, and physical therapy residents. In a study conducted in Santa Catarina, this rate was even higher, reaching 61.8%[12-13]. In a study conducted in Rio de Janeiro, the researcher identified variations in cuff pressurization after nursing care, such as bed baths, tracheal suctioning, and position changes. These variations may be some of the reasons for the lower-than-expected observed numbers[14].

When properly pressurized, the cuff plays a crucial role in ensuring airway sealing. This prevents the migration of contaminated secretions from the upper to the lower airways, acting as an effective barrier between the space between the tube and the tracheal wall. It is worth noting that the Brazilian consensus on mechanical ventilation proposed by AMIB recommends that nurses monitor cuff pressure, ensuring safe levels before and after oral hygiene[15].

Aqueous chlorhexidine 0.12% is the recommended antiseptic solution for patients on mechanical ventilation, as it helps reduce bacterial plaque and the occurrence of VAP. Furthermore, some studies suggest that its effect is enhanced when preceded by mechanical biofilm removal. However, there is moderate evidence suggesting that daily toothbrushing without chlorhexidine may be effective. Other studies indicate that chlorhexidine may not have a significant impact on reducing the incidence of VAP, duration of mechanical ventilation, or hospital stay, and its exclusion did not result in significant differences in these metrics or in mortality rates[15-16].

Regarding oral hygiene, it was the item with the lowest adherence rate in our study, with compliance of only 32.79% of the patients evaluated, lower than a study conducted in the Northeast, which recorded a compliance rate of 48.86%, and a study in São Paulo, which recorded a compliance rate of 50%[17-18]. It is important to highlight that the evaluation models used in previously published studies differ from the one adopted in this study, as the former used chlorhexidine as a parameter, while the latter considered the presence of tongue coating. It is believed that some patients' difficulty relaxing their oral cavity muscles may have limited the effectiveness of hygiene.

It is also noteworthy that the unit did not have a dental professional to contribute to the effectiveness of care, and that, according to the current care plan, the oral hygiene routine was performed twice a day. Based on the findings of this study, the frequency was increased to four times a day. It is worth noting that the Brazilian Consensus on Mechanical Ventilation does not establish the frequency of oral hygiene, but recommends that it include mechanical removal of biofilm through brushing or manual cleaning[15].

However, the importance of training that demonstrates the correct way to perform this practice is also highlighted, which should be further emphasized. It is essential not only to use antiseptic, but also to make an effective effort to remove dirt and plaque, as this is what will truly yield results. In a survey conducted in a hospital in Brasília, 19.4% of nurses reported facing difficulties in implementing this practice, making it the second most difficult item reported[2].

Finally, in this study, only 21.31% of patients had the bundle fully implemented, a result significantly lower than the average observed in other studies, such as the one in Porto Alegre, which achieved a rate of 92.7%. However, this figure is quite similar to that of the study conducted in São Paulo, which recorded a 21.7% compliance rate[10-21].

In this context, the most recent systematic review with meta-analysis, published in 2023, included 36 studies involving 116,873 participants focusing on adherence to the VAP prevention bundle. The results showed wide variation in self-reported adherence (38.5% and 100%). Despite this heterogeneity, a significant reduction in the occurrence of VAP was observed among patients in whom the bundle was implemented, compared to those who did not receive the care bundle (OR = 0.42; 95% CI: 0.33–0.54)[16].

That said, it's essential to understand that no single measure can prevent microorganisms from reaching the lungs. This justifies the need for comprehensive compliance with the bundle, as the study in question demonstrated a 79% reduction in the risk of VAP when all interventions were implemented together.

As a limitation, it's worth noting that the study was conducted in only two intensive care units, despite the healthcare institution having five units. Furthermore, no stratification was performed into subgroups of patients undergoing mechanical ventilation via tracheostomy and orotracheal or nasotracheal tubes, which could have provided more detailed and comparative analyses across patients.

CONCLUSION

Analysis of the bundle components revealed that the highest adherence rate was observed for head-of-bed elevation, followed by cuff pressure monitoring, while oral hygiene showed the lowest adherence. Being 60 years old or older increased the likelihood of VAP, while maintaining cuff pressure within recommended values was associated with a reduced risk. Furthermore, full adherence to the bundle resulted in a significant decrease in the incidence of VAP. These findings highlight the importance of periodic training on the care of patients on mechanical ventilation and continuous nursing supervision in care practice, both considered essential elements for improving the quality of care and consolidating evidence-based practices.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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