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RESEARCH

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## Prevention of pneumonia associated with mechanical ventilation under the optics of nursing academics

Prevenção da pneumonia associada à ventilação mecânica sob a ótica de acadêmicos de enfermagem

Prevención de la pneumonia asociada a la ventilación mecánica bajo la óptica de académicos de enfermeira

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### ABSTRACT

**Objective:** To describe the knowledge of the nursing undergraduate students about the prevention of Pneumonia associated with Mechanical Ventilation and to compare this knowledge among these students in the years of 2013 and 2016. **Method:** Quantitative research carried out with 59 graduate students of an institution of higher education, who answered a structured questionnaire. **Results:** The main assertive responses were hand hygiene (94.9%), patient sedation (89.8%), oral hygiene (86.4%) and nasogastric catheter position (83%). The Turma 2013 presented better knowledge regarding the Class of 2016 ( $p < 0.05$ ). **Conclusions:** It was concluded that students may be completing the course with a basic notion of care for the prevention of Pneumonia associated with Mechanical Ventilation, and some unobserved care are a necessary result of being reevaluated, requiring a curricular planning of the educational institutions that Facilitate the teaching-learning process.

**Descriptors:** Knowledge, Nursing, Pneumonia, Respiration artificial.

### RESUMO

**Objetivo:** Descrever o conhecimento dos acadêmicos concluintes do curso de Enfermagem sobre a prevenção de Pneumonia Associada à Ventilação Mecânica e comparar esse conhecimento entre esses acadêmicos nos anos de 2013 e 2016. **Método:** Pesquisa de natureza quantitativa, realizada com 59 acadêmicos concluintes de uma instituição pública de ensino superior, que responderam um questionário estruturado. **Resultados:** Observou-se que as principais respostas assertivas foram intervenções referentes à higienização das mãos (94,9%),

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sedação do paciente (89,8%), higiene oral (86,4%) e posição da sonda nasoentérica(83%). A Turma 2013 apresentou melhor conhecimentoem relação à Turma 2016( $p < 0,05$ ). **Conclusão:** Concluiu-se que os alunos podem estar completando o curso com noção básica dos cuidados para a prevenção da Pneumonia Associada à Ventilação Mecânica, e alguns cuidados inobservados constituem um resultado necessário de ser reavaliado, precisando de um planejamento curricular das instituições de ensino que facilite o processo de ensino-aprendizado.

**Descritores:** Conhecimento, Enfermagem, Pneumonia, Respiração artificial.

## RESUMEN

**Objetivo:** Describir el conocimiento de los académicos concluyentes del curso de Enfermería sobre la prevención de Neumonía asociada a la ventilación mecánica y comparar ese conocimiento entre estos académicos en los años 2013 y 2016. **Metodo:** Investigación de naturaleza cuantitativa, realizada con 59 académicos concluyentes de una institución Pública, que respondieron un cuestionario estructurado. **Resultados:** Se observó que las principales respuestas fueron intervenciones referentes a la higienización de las manos (94,9%), sedación del paciente (89,8%), higiene oral (86,4%) y posición de la sonda nasoentérica (83%). La clase 2013 presentó mejor conocimiento en relación a la Clase 2016 ( $p < 0,05$ ). **Conclusiones:** Se concluyó que los alumnos pueden estar completando el curso con noción básica de los cuidados para la prevención de la Neumonía asociada a la ventilación mecánica, y algunos cuidados inobservados constituyen resultado necesario de ser reevaluado, precisando de una planificación curricular de las instituciones que facilita el enseñanza-aprendizaje.

**Descriptor:** Conocimiento, Enfermería, Neumonía, Respiración Artificial.

## INTRODUCTION

The *Agência Nacional de Vigilância Sanitária (ANVISA)* [National Health Surveillance Agency], in partnership with the World Health Organization (WHO), has been devoting efforts to the implementation of health care security strategies. These include prevention and reduction of the occurrence and severity of Health Care Related Infections (HCRI).<sup>1</sup>

HCRI, especially those acquired in a hospital environment, are among the main causes of morbidity and mortality, and therefore, a considerable increase in patient care expenses. Most hospital infections can be prevented by implementing preventive measures, based on appropriate technical knowledge and administrative support.<sup>2</sup>

Pneumonia is the second most common hospital infection in ICUs, accounting for 15% of HCRI and approximately 25% of all infections acquired in ICUs. Its relevance is due to the increase in invasive procedures, the indiscriminate use of antimicrobials, and the increase in hospital admission.<sup>2-3</sup>

Therefore, the Ventilator-Associated Pneumonia (VAP) is a secondary pathology, intervening in the majority of cases of hospital infection in patients ventilated mechanically in ICUs. VAP is characterized as an infectious process of the pulmonary parenchyma, which occurs in patients undergoing endotracheal intubation and Mechanical Ventilation (MV) for more than 48 hours.<sup>4</sup>

VAP is considered a highly lethal pathology in ICUs, so it must be prevented through actions and interventions of the multidisciplinary team, which is known to be possible. The

training of nurses and the multiprofessional team is essential for the prevention of hospital infections, in other words, the prevention of secondary diseases acquired after entering the hospital environment.

The occurrence of VAP is related to several risk factors such as: age over 70 years old; adulterated level of consciousness; with the; gastric pH greater than 4; use of immunosuppressive drugs; tracheal intubation and re-intubation; immune conditions; disease severity; chronic obstructive pulmonary disease; mechanical ventilation greater than seven days; malnutrition; shock; exogenous contamination; antibiotic therapy as prophylaxis; microbial colonization; condensate aspirated from the fan circuits; prolonged surgeries; aspiration of contaminated secretions; colonization and aspiration.<sup>4</sup>

Therefore, the VAP has been seen as one of the most feared wicked effects in ICUs, resulting in serious damage and health problems for individuals afflicted by this serious complexity. Its clinical importance is due to its frequency, mortality, high costs related to the use of antimicrobials and the longer permanence in ICUs.<sup>5</sup>

Facing this health concern, it is necessary to apply interventions for the prevention of VAP, reducing the index of this infection through preventive measures. Research shows that there are a number of recommendations that can increase the quality of care and reduce health costs.<sup>6</sup>

A strategy that has been put into practice with regard to the prevention of VAP, in addition to the protocols instituted within ICUs, are the Bundles, which consists of packages of recommended procedures widely used by the care team, which result in considerable improvements in the health.<sup>7</sup>

In the light of the notes, it is evident the need for nurses to know how to act in the essential care that can prevent the occurrence and the aggravations from VAP, since a good evolution needs continuous care, that can identify problems that meet their needs.

For a quality care delivery, it is necessary that the nurses have a broad theoretical understanding of the principles of the MV, on the other hand, distance of the nursing professional in relation to this support may be present, either for lack of knowledge or for this care to be delegated to a professional from another area. It is noticed that many are not sufficiently prepared to act in a systematized manner and based on theoretical and practical knowledge of patients with MV in ICUs.<sup>8</sup> In this way, this study becomes important in view of the relevant role that the University has in the formation of quality of future health professionals. Based on this problematic, the question that permeates this research is as follows: What is knowledge level of nursing undergraduate students about essential care to prevent VAP?

Therefore, the study's goal was to describe the knowledge of the graduating students of the Nursing Graduation Course with regards to the VAP Prevention, and also to compare this knowledge among the graduating students of the Nursing Graduation Course in the years of 2013 and 2016.

## METHODS

It is a descriptive study with a quantitative approach. The study held 59 undergraduate students of the Nursing Graduation Course in 2013 and 2016, from a public institution of higher education located in the countryside of *Paraná* State.

The inclusion criteria established were, as follows: to be a final student, enrolled and attending the 4<sup>th</sup> year of the Nursing Graduation Course of a higher education public institution located in the countryside of *Paraná* State, during the years of 2013 and 2016, and consenting to participate in the study. In turn, the absence of the academic at the time of data collection constituted a criterion of exclusion.

The choice of the years 2013 and 2016 is due to the change in the curricular matrix of the course from the Higher Education Institution (HEI) during 2011. The theme "pneumonia" was contemplated in the Pedagogical Project of the Course in the discipline of Clinical Nursing (3<sup>rd</sup> grade). With this change, the curricular component Biosafety (1<sup>st</sup> grade) was included in the Course Pedagogical Project that addresses in the discipline syllabus and program content the preventive measures of hospital infections and nursing in the prevention of hospital pneumonia. Therefore, the pneumonia content was added in a further discipline to the graduating students of 2016, which suggests an advantage over the graduates of 2013.

Data collection was authorized through a permission statement addressed to the Nursing Department from the HEI investigated. It occurred in August of 2013 and May of 2016, in the class of the 4<sup>th</sup> grade, with the consent of the teachers who ministered the classes in those respective years. Of the 64 possible respondents, 59 participated in the survey, because five students were not present on the days of data collection. The academics answered a structured questionnaire prepared by the researchers.

The data collection instrument was elaborated through a literature review based on the recommendations of the Centers for Disease Control and Prevention (CDC) and ANVISA.<sup>2,8</sup> The instrument was composed of a structured questionnaire containing 15 closed questions, which included the technical-scientific knowledge about the measures aiming to prevent VAP.

The interpretation of the collected data was through the pre-analysis stages, consisting of reading and data organization and analysis through the classification and interpretation of the results found, being these presented in tables of distribution of absolute and relative frequency in the order of the variables of the study. The questions to evaluate the answers were based on the guidelines for prevention and control of hospital infections, considering the frequency of the assertive answers of the students on the subject.<sup>2,9</sup> A test of  $\chi^2$  was chosen, in which Fisher's exact test was chosen, and bivariate analysis using the Odds Ratio (OR), with a 95% Confidence Interval (CI) and a statistical significance level of 5%. For data analysis, the software program R was used.

The study was approved by the Research Ethics Committee involving human beings, then respecting all the ethical precepts

of the Resolution No. 466/12 of the National Health Council/Health Ministry, under the Legal Opinion No. 371.339.

## RESULTS AND DISCUSSION

59 students have participated of this study, where there was a predominance of females (81.08%) and individuals within the age group from 20 to 33 years old.

VAP is a serious health problem, with a high rate of morbidity and mortality. Faced with this complexity, it is necessary to perform actions and procedures to prevent this and other hospital infections. For this, the CDC in its categorization scheme classifies the recommendations of the prevention of the VAP.<sup>9</sup> Each recommendation is classified based on the scientific evidence, theoretical foundation, applicability, and potential of economic impact. They are, as follows: **Category IA:** strongly recommended for implementation and strongly supported by well-designed experimental, clinical or epidemiological; **Category IB:** strongly recommended for implementation and supported by some clinical or epidemiological studies and with strong theoretical foundation; **Category IC:** required for implementation as stipulated in a federal or state regulation or regulation; **Category II:** suggested for implementation and supported by suggestive clinical or epidemiological studies or by a strong theoretical foundation; **No recommendation and/or not resolved issue.**<sup>8</sup>

The main assertive answers of all the scholars about the care for the prevention of VAP were interventions related to hand hygiene (94.1%), patient sedation (89.9%), oral hygiene (86.4%) and position of Nasoenteral Catheter (NC) (83%). The responses with the lowest hit rate were related to strict analgesia in abdominal and thoracic surgeries (16.9%), tracheostomy recommendation (27.1%) and sterilization/disinfection of the internal machinery of the ventilator circuit (31.8%).

In this regard, the hands are the main routes of dissemination of infections transmitted to the contact and cross-transmission, since it is the nursing work tool and the multidisciplinary team.<sup>2</sup> It can be affirmed that hand hygiene is the initial method and used to reduce the migration of microorganisms to other sites, and if performed correctly and correctly, prevents hospital infections and reduces mortality associated with HCRI.<sup>10</sup>

Most of the nursing scholars, when asked about hand hygiene, were unanimous in corroborating the importance of this measure for the VAP prevention, and this action was considered the main measure of prevention and control of hospital infection.

An analogous result was found in a study carried out at the Adult Intensive Care Unit of the Regional Hospital of the Federal District, referring to nursing professionals' knowledge of the risk factors and the VAP prevention, in which 100% of the professionals interviewed said that hand washing may be considered as a preventive measure for VAP.<sup>11</sup>

Therefore, hand hygiene is classified as a strongly recommended (AI) measure.<sup>9</sup> The execution of hand antisepsis before and after handling patients is of paramount importance

and is an indispensable individual measure to prevent the spread of HCRI.

Regarding oral hygiene, studies have shown that the use of chlorhexidine (0.12% or 0.2%) considerably reduces the dissipation of VAP.<sup>1,3,5</sup> Many protocols recommend hygiene of the oral cavity with chlorhexidine, formulation of 0.12%, with a small sponge, avoiding lesions of the cavity, three to four times a day. The CDC considers it to be Category II; in other words, suggested for implementation and supported by clinical studies.

Regarding cuff pressure in the endotracheal tube, ANVISA recommends that it should be maintained between 20 and 30 cm H<sub>2</sub>O.<sup>11</sup> This pressure prevents endotracheal lesions and may contribute to preventing secretion of the subglottic region from draining around the cuff reaching the lung.

According to ANVISA, it is important to routinely check the position of CN, as aspiration of the gastroesophageal fluid contributes to the increased risk of VAP.<sup>5,12</sup> The CDC classifies the importance of the CN position in the prevention of VAP as IB, that is, is strongly recommended.<sup>9</sup>

With regards to bed decubitus, the elevation of the headboard at an inclination of 30° to 45° is a highly recommended care, except in cases where there is some contraindication, such as spinal cord trauma. This measure, in addition to preventing bronchoaspiration, contributes to an improvement in ventilatory tidal volume and decreases cases of atelectasis.<sup>2,11</sup> CDC considers this measure as Category II.<sup>9</sup>

A survey carried out in the General Intensive Care Unit of a public hospital in Santa Catarina State had as its main objective the collective construction of a bundle for the prevention of ventilator-associated pneumonia and defined that the head elevation should be between 30-45° in all MV patients who do not have a contraindication to this position.<sup>13</sup>

Allusive to tracheostomy, this constitutes an open doorway for the entry of pathogenic microorganisms into the lower respiratory tract, increasing the risk of infection.<sup>14</sup> Nonetheless, in the case of mechanical ventilation, ANVISA warns that late or early tracheostomy does not influence dissemination of the VAP, and the CDC corroborates that this technique does not prevent it, then classifying this preventive measure as not recommended.<sup>9</sup>

According to ANVISA<sup>12</sup> and CDC<sup>9</sup> the replacement of the respirator circuit should not be less than 48 hours, because of the shorter the interval of the exchanges, the greater the probability of contamination. The CDC qualifies this recommendation as Category II, which is suggested for implementation and supported by clinical or epidemiological studies.<sup>4,9</sup>

The CDC recommends that sterilization/disinfection of the internal machinery of the mechanical ventilator should not be performed. High-level sterilization/disinfection of the respirator circuit should be performed between each patient, and the condensed liquid should be discarded periodically as a means of preventing VAP.<sup>8</sup> The CDC recommends both recommendations as Category II, IB and IB respectively.<sup>4,9</sup>

Considering the pneumococcal vaccine, ANVISA recommends the practice of the vaccine so that the patient receiving MV receives antibodies that favor the reduction of

hospital infections, especially VAP.<sup>12</sup> The CDC recommends that vaccination should be performed for the purpose of is placed in Category IA.<sup>9</sup>

As for sedation of the patient, this should be decreased whenever possible. Although CDC<sup>5,9</sup> classify this issue as unresolved, daily discontinuation of sedation allows an adequate evaluation of the patient's respiratory pattern, verifying if it can be extubated, reducing the time of mechanical ventilation and consequently the incidence of VAP.<sup>15</sup>

Allergic to H2 blockers (antacids), CDC<sup>9</sup> advocates avoiding them, as their frequent use may increase the colonization of enteric bacteria, increasing the risk of hematological spread, which is the translocation of microorganisms from the stomach to the respiratory tract, or the retrograde migration of the enteric bacteria, leading to the lungs through the rise of capillarity by the nasogastric probe and nasoenteral probe, especially if the patient's decubitus remains below 30°. The CDC qualifies as Category II.<sup>9</sup>

As regards strict analgesia in abdominal and thoracic surgeries, there is a recommendation from ANVISA for compliance with this practice.<sup>12</sup> With this, patients lose glottal reflex (relaxation due to anesthesia), which serves as a slit that prevents the contents are bronchospastic. In turn, the patient with abdominal and thoracic pain also presents an inefficient respiratory process with superficial respiration, making it difficult to wean the respirator and increasing the risk of pulmonary infection,<sup>3,5</sup> the CDC classifies with IB.<sup>9</sup>

Concerning the use of antimicrobials, although there are no recommendations from CDC,<sup>9</sup> the same warns that antimicrobial prophylaxis should not be used, since the patient receiving these medications develops microbial resistance. According to ANVISA,<sup>16</sup> previous and prolonged administration of antibiotics has been associated with high risk due to the formation of multiresistant bacteria; therefore, the preventive administration of antibiotics is not recommended.

The results revealed that there were discrepancies between the two groups in most of the assertive answers. It was verified that the group 2013 presented better knowledge when comparing with the Class 2016 in three preventive care for VAP, being statistically significant the assertions referring to the cuff pressure of the endotracheal tube, the interval of the exchange of the respirator circuit and the prophylactic antibiotic therapy. Although the Class 2016 presents supposed advantage over the Class 2013, due to the addition of one more discipline that deals with the theme Pneumonia, it revealed that the best performance of one class over another in those questions, is not imperiously attributed to the change of the matrix curricular activities (**Table 1**).

It is believed that the recommendations of the CDC and ANVISA are probably not being considered in the program content. Both disciplines include the topic Pneumonia, prevention, and nursing care, but do not present the references of the CDC and ANVISA in the basic and complementary bibliographies. Therefore, the weaknesses presented in the apprehension of the knowledge about VAP might be a reflection of the difficulty of adaptation to the new menus

of theory and clinical practices in the areas of nursing in intensive care unit, whose area is considered as a specialty to be complemented in a Postgraduate Course.

It was also verified that, although for some answers no statistically significant differences were evidenced, two of them approached the double of assertions of the Class 2016 in relation to the Class 2013. On this occasion, the variables 6 and 9 were included. And for the variables 3, 11, 12 and 14 the homogeneity was calculated in the proportion of assertions between the two classes (**Table 1**).

**Table 1** - Bivariate analysis of the nursing undergraduate students achievements in 2013 and 2016 with regards to the prevention of ventilator-associated pneumonia. *Paranavaí, PR, Brazil, 2016*

Variables	Class 2013 (n=37)	Class 2016 (n=22)	OR	CI	p*
1. It is necessary for the professional to sanitize the hands	34 (91.9%)	22 (100%)	0	(0.0-3.86)	0.2863
2. Oral hygiene should be performed with chlorhexidine	34 (91.9%)	17 (77.2%)	3.33	(0.59-20.47)	0.135
3. It is necessary to check the position of the nasoenteral tube routinely	30 (81%)	19 (86.3%)	0.95	(0.16-5.37)	1,000
4. Maintain endotracheal tube cuff pressure between 20 and 30 cm H <sub>2</sub> O	26 (70.2%)	10 (45.4%)	3.47	(0.98-12.7)	0.0474
5. The patient under mechanical ventilation should lie down in an angle from 30° to 45°	27 (72.9%)	17 (77.2%)	0.88	(0.21-3.59)	1,000
6. Tracheostomy is not recommended as a preventive measure for Ventilator-Associated Pneumonia	7 (19.9%)	9 (40.9%)	1.26	(0.28-5.84)	0.7486
7. The replacement of the respirator circuit should be within 48 hours	23 (62.1%)	7(31.8%)	3.52	(1.01-12.62)	0.0326
8. High-level sterilization/disinfection of the respirator circuit between each patient should be performed	27(72.9%)	10 (45.4%)	3.24	(0.94-11.50)	0.0515
9. Do not sterilize/disinfect internal mechanical fan machinery	9(24.3%)	9 (40.9%)	0.42	(0.12-1.49)	0.2166
10. The condensed liquid in the respirator circuit should be discarded periodically	26(70.2%)	17 (77.2%)	0.7	(0.17-2.72)	0.7631
11. A pneumococcal vaccine should be performed in at-risk patients	22 (59.4%)	13 (59%)	1.02	(0.30-3.39)	1,000
12. It is necessary to evaluate daily the sedation of the patient and to reduce whenever possible	33(89.1%)	20 (90.9%)	0.82	(0.09-6.02)	1,000
13. The use of H2 blockers does not prevent Ventilator-Associated Pneumonia	28(75.6%)	15 (68.1%)	1.45	(0.39-5.45)	0.5579
14. Strict analgesia in abdominal and thoracic surgeries prevents Ventilator-Associated Pneumonia	6 (16.2%)	4 (18.1%)	0.87	(0.18-4.33)	1,000
15. Should not administer antibiotics as prophylaxis to Ventilator-Associated Pneumonia	22(59.4%)	3 (13.6%)	9.29	(2.05-48.17)	0.0009

\* Fisher's exact test.

Given this context, the faculty must be prepared to exercise the principles of curricular nursing guidelines, especially when it states that the professional profile includes a generalist, technical, scientific and humanistic education, with a critical and reflexive capacity, emphasizing the perspective of integrality of assistance.<sup>17</sup>

Considering the various preventive measures of the VAP, it is known that nursing has the main function to perform care for the promotion, prevention, and recovery of the patient's health. For this, it is essential that the nurses know the recommendations of ANVISA and the CDC and follow protocols of the institution regarding the prevention and dissemination of contagious diseases.

It is highlighted as a limitation of this study that the present analysis focused on the description and comparison of the knowledge of nursing academics about the prevention of the specific VAP of an HEI. Hence, these results reveal the problematic of a local reality and, therefore, by virtue of the sample and performance in a single institution, the data are not generalizable.

These are important aspects to be considered in future national research that may encourage HEIs to adopt similar paths that support the decision-making process based on evidence-based practice, in order to qualify the praxis of care based on technical-scientific knowledge.

## FINAL CONSIDERATIONS

The main assertive answers of the students were interventions related to hand hygiene, sedation of the patient and position of the NC, which denotes an understanding of the subject studied. This understanding suggests that students are leaving university to the market place with the basic notion of care for the prevention of hospital infection sites, especially VAP.

Some unobserved care by students for the prevention of VAP, such as rigorous analgesia in abdominal and thoracic surgeries, recommendation of the tracheostomy, and sterilization/disinfection of the internal machinery of the circuit respirator, as well as the better knowledge of the Class 2013 in relation to 2016 in three variables constitute a worrying and necessary result to be re-evaluated and discussed between the Structuring Teaching Core and the professors of the disciplines from the studied institution, in order to allow the planning of strategies that facilitate the teaching-learning process, given the high morbidity and mortality that this hospital infection presents.

The VAP, although it is an infection, it can be avoided by the nursing care based on the best scientific evidence, thus, it is suggested that the HEIs emphasize in the curricular components the recommendations of the CDC and ANVISA regarding the forms of VAP prevention, as well as concerning the other topographies of hospital infections, then developing in the student all the nursing care and interventions necessary towards the patients under risk.

This study suggests that new researches should be performed in other HEIs, with both different and similar curricula, and then based on this approach promote a wider evaluation of the matter.

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