



ORIGINAL

Demographic, clinical and therapeutic characterization of the cases of hospital-acquired non-ventilator associated pneumonia

Caracterização demográfica, clínica e terapêutica dos casos de pneumonia hospitalar não associada à ventilação mecânica

Caracterización demográfica, clínica y terapéutica de los casos de neumonía hospitalaria no asociada a ventilación mecánica

Maria Eduarda Cardoso Silva¹

[ID https://orcid.org/0000-0002-2145-3100](https://orcid.org/0000-0002-2145-3100)

Rafaella Gomes¹

[ID https://orcid.org/0000-0002-8992-3068](https://orcid.org/0000-0002-8992-3068)

Amanda Caroliny Gomilde¹

[ID https://orcid.org/0000-0002-9255-4128](https://orcid.org/0000-0002-9255-4128)

João Victor Rodrigues Cardoso¹

[ID https://orcid.org/0000-0002-6505-7302](https://orcid.org/0000-0002-6505-7302)

Natacha Bolorino¹

[ID https://orcid.org/0000-0002-3039-2987](https://orcid.org/0000-0002-3039-2987)

Flávia Meneguetti Pieri¹

[ID https://orcid.org/0000-0003-1239-2550](https://orcid.org/0000-0003-1239-2550)

¹Universidade Estadual de Londrina. Londrina, Paraná, Brasil.

ABSTRACT

Objective: To characterize the hospitalized adult individuals that developed hospital-acquired non-ventilator associated pneumonia, according to demographic, clinical and therapeutic variables. **Methods:** A cross-sectional and descriptive study, carried out at a tertiary-level hospital in northern Paraná; considering the notification forms of Healthcare-Associated Infections from the Hospital Infection Control Commission in patients aged at least 18 years old, admitted from January 2017 to December 2018. **Results:** There was similarity in relation to gender, with higher prevalence in patients over 60 years old and with prolonged hospitalization time; the clinical variables resulted in 50.6% of patients with negative blood cultures associated with pneumonia, with 53.6% of them evolving to death. Regarding the tracheal secretion cultures, a higher index of *Acinetobacter baumannii* was obtained, with use of the *piperacillin sodium + tazobactam sodium* antimicrobial. **Conclusion:** The cases of hospital-acquired non-ventilator associated pneumonia occurred in the same proportion between the genders, with prevalence in older adults and evolution of death in more than half of the individuals. The clinical profile of the tracheal secretions and *Staphylo spp* blood cultures reveals that the *Acinetobacter baumannii* microorganism was the most prevalent, with the cephalosporins class as the antimicrobial therapeutic choice.

Descriptors: Pneumonia. Cross Infection. Health-Care Associated Pneumonia. Nursing.

RESUMO

Objetivo: Caracterizar os indivíduos adultos internados que desenvolveram Pneumonia Hospitalar Não Associada à Ventilação Mecânica, segundo variáveis demográficas, clínicas e terapêuticas. **Métodos:** Estudo transversal e descritivo, realizado em hospital terciário do norte do Paraná; considerando as fichas de notificação das Infecções Relacionadas à Assistência à Saúde da Comissão de Controle de Infecção Hospitalar, com idade maior ou igual a 18 anos, internados no período de janeiro de 2017 a dezembro de 2018. **Resultados:** Em relação ao sexo houve similaridade, com maior prevalência em pacientes acima de 60 anos e com o tempo de permanência prolongado; as variáveis clínicas resultaram em 50,6% de pacientes com hemocultura associada à pneumonia negativa, destes, 53,6% evoluíram a óbito. Quanto às culturas de secreção traqueal, obteve-se maior índice de *Acinetobacter baumannii*, com a utilização do antimicrobiano *piperacilina sódica + tazobactam sódico*. **Conclusão:** Os casos de Pneumonia Hospitalar Não Associada à Ventilação Mecânica ocorreram na mesma proporção entre os sexos, com prevalência em idosos e evolução de óbito de mais da metade dos indivíduos. O perfil clínico das secreções traqueais, hemocultura de *Staphylo spp*, revela que o microrganismo *Acinetobacter baumannii* foi o mais prevalente, tendo como escolha terapêutica de antimicrobiano a classe das cefalosporinas.

Descritores: Pneumonia. Infecção Hospitalar. Pneumonia Associada à Assistência à Saúde. Enfermagem.

RESUMÉN

Objetivo: Caracterizar a los adultos internados que desarrollaron neumonía hospitalaria no asociada a ventilación mecánica, según variables demográficas, clínicas y terapéuticas. **Métodos:** Estudio transversal y descriptivo, realizado en un hospital de nivel terciario del norte de Paraná; considerando los formularios de notificación de Infecciones Relacionadas con la Atención de la Salud de la Comisión de Control de Infecciones Hospitalarias, de pacientes de al menos 18 años de edad internados entre enero de 2017 y diciembre de 2018. **Resultados:** Hubo similitud en relación con el sexo, con mayor prevalencia en pacientes de más de 60 años y con internaciones prolongadas en el tiempo; las variables clínicas arrojaron un resultado de 50,6% de pacientes con hemocultivo asociada a neumonía negativa; de ellos, el 53,6% falleció. En relación a los cultivos de secreción traqueal, se obtuvo un mayor índice de *Acinetobacter baumannii*, con utilización del antimicrobiano *piperacilina sódica + tazobactam sódico*. **Conclusión:** Se registraron casos de neumonía hospitalaria no asociada a ventilación mecánica en la misma proporción entre los sexos, con prevalencia en adultos mayores y fallecimiento como desenlace en más de la mitad de las personas. El perfil clínico de las secreciones traqueales y hemocultivo de *Staphylo spp* revela que el microrganismo *Acinetobacter baumannii* fue el más prevalente, escogiéndose la clase de las cefalosporinas como opción terapéutica de antimicrobianos.

Descriptores: Neumonía. Infección Hospitalaria. Neumonía Asociada a la Atención Médica. Enfermería.

INTRODUCTION

Pneumonia is considered an acute inflammatory disease of an infectious nature, in which structures of the respiratory system are affected by bacteria, microbacteria, fungi and viruses. They are classified into four types: Community-Acquired Pneumonia (CAP), Health-Care-Associated Pneumonia (HCAP), Hospital-Acquired Pneumonia (HAP), Non-Ventilator-Associated Pneumonia (NVAP), and Ventilator-Associated Pneumonia (VAP).⁽¹⁻²⁾

The hospital environment is configured as a complex environment, which assists patients with severe and unstable diseases, in which invasive procedures are performed for life maintenance. Such procedures can favor acquisition of Healthcare-Associated Infections (HAIs), such as VAP and HAP, among others.⁽³⁾

HAP corresponds to the type that occurs 48 hours after hospital admission, usually treated in the hospitalization unit, not related to orotracheal intubation or to Mechanical Ventilation (MV). Due to etiological, therapeutic and prognostic implications, HAP has been classified according to the time elapsed from admission until its onset, which can be early (occurring until the fourth hospitalization day) or late (starting after five hospitalization days).⁽⁴⁾ In turn, the remaining infections were attributed to those not related to invasive devices, including NVAP.⁽⁵⁾

The dispersion of cases across the hospital units, the failures and difficulties in surveillance, the possibility of occurrence after hospital discharge, and the difficulty performing invasive techniques to identify the etiologic agents, make the existing data non-comparable and very different from each other, thus causing difficulties establishing the density of NVAP incidence.

In Brazil, upper respiratory tract infections remain as the third leading cause of death throughout the years. The Northeast region recorded numbers above 15 million, occupying the second place among the Brazilian regions, only behind the Southeast region; according to data from the Unified Health System (*Sistema Único de Saúde*, SUS), pneumonia was the second reason for hospitalizations in 2017, accounting for 14% of all hospitalizations.⁽⁶⁻⁷⁾

As a coping strategy against this scenario, Nursing can promote rethinking of actions and favor participation in decision-making through Permanent Education in Health (PEH), which incorporates the act of learning and teaching into the health organizations' daily routine.⁽⁸⁾

In 2003, the Secretariat of Labor Management and Education in Health (*Secretaria de Gestão do Trabalho e da Educação na Saúde*, SGTES) was created within the Ministry of Health (*Ministério da Saúde*, MS), with the responsibility of inducing formulation of policies for training and development of health professionals and workers and conducting inclusion of the permanent education policy in the health services. Creation of the SGTES made possible a significant advance for the field of professional education in health and, in 2004, the MS instituted the National Policy on Permanent Education in Health

METHODS

A cross-sectional and descriptive study with a quantitative approach, following the precepts set for in the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) checklist.⁽¹⁰⁾

The study was conducted in the University Hospital of the State University of Londrina (*Hospital Universitário-Universidade Estadual de Londrina*, HU-UEL). It is a tertiary-level hospital, currently considered a reference for the other 20 cities belonging to the 17th Health Regional Office of Paraná (RS/PR), subsidized by the SUS and providing provides assistance to approximately 250 cities in PR and more than 100 cities from other states in several Brazilian regions, especially São Paulo, Mato Grosso, Mato Grosso do Sul and Rondônia. It has a total of 300 beds distributed in Inpatient Units (IUs), Emergency Room (ER), Intensive Care Units (ICUs) for adults, Burns Treatment Center or Burns Intensive Care Unit (BTC/BICU), Pediatric ICU (ICU/PED) and Neonatal ICU (ICU/NEO). In 2016, it recorded nearly 25,003 ER cases and 11,714 hospitalizations.⁽¹¹⁾

The research data were obtained from the HAI notification forms made available by the Hospital Infection Control Commission (*Comissão de Controle de Infecção Hospitalar*, CCIH) of HU-UEL, and were collected between January and March 2020 in the CCIH room, once a week, in the afternoon period and by two researchers trained by the research coordinator. It is worth noting that this form was already in use before the data collection period, being considered as complete by the CCIH regarding the data related to HAIs.

All the NVAP cases in adults aged at least 18 years old, notified by the CCIH and admitted to the ER, IU, ICU for adults or BTC/BICU in the period between January 2017 and December 2018 were included in the research. The NVAP diagnoses were made by the CCIH physician, according to the International Classification of Diseases (ICD-10) and to the definition proposed by the National Health Surveillance Agency (*Agência Nacional de Vigilância Sanitária*, ANVISA). The exclusion criteria corresponded to notified cases in which the forms had incomplete data or even NVAP cases coming from another health service.

Identification of the patients was performed by means of an active search, considering those with prescription of at least one antimicrobial. In the hospital where the study was conducted, antibiotic therapy is initiated only after CCIH clearance. Consequently, given the work performed by this commission, it is possible to identify all those

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patients that had antimicrobials prescribed. After identifying the patients with some type of infection, an HAI suspicion form is opened; and, for confirmed cases, the HAI notification form is used.

The HAI notification form was prepared by the CCIH team according to the criteria established by ANVISA⁽¹²⁾ containing the clinical, laboratory and imaging items. Filling out is carried out by undergraduate volunteers/interns of the CCIH, trained by the nurse, PhD in Education and responsible for the sector, during the patient's hospitalization, that is, the interns monitor and update the diverse information, from notification to discharge or death.

The data collection stage was conducted from January to March 2020 by two researchers duly trained by the supervising researcher in charge. Data collection took place in the CCIH room, once a week and in the afternoon period. All the data from the HAI notification form were collected by typing them into an Excel spreadsheet. It is worth noting that this form was already in use before the data collection period and was considered as complete by the CCIH regarding the data related to HAIs.

The following variables were collected and categorized as follows: gender (male, female); age (from 18 to 59 years old and 60 years old or more); hospitalization days until NVAP diagnosis (up to 14 days and 15 days or more); unit associated with NVAP (IU, ER, ICU for adults, BTC, BICU and Maternity ward); blood culture associated with NVAP (positive, negative and not collected); type of microorganism; number of antimicrobials administered per patient (up to 3, 4 or more), admission diagnosis and death (yes and no).

It is worth stating that age was calculated from the subtraction between the "date of admission" and "date of birth" variables. The number of hospitalization days until the NVAP diagnosis was calculated from the subtraction between "date of the NVAP diagnosis" and "date of admission".

The diagnostic cultures were performed as requested by the physician in charge of the patient, considering clinical (hyperthermia, change in tracheal secretion characteristics), laboratory (leukogram results), and imaging (X-ray) aspects.

Tracheal secretion was collected by aspiration of the airways using a catheter. The blood culture was performed from two peripheral vein or artery punctures and blood was collected in aerobic and anaerobic blood culture tubes. After collection, the material was sent to the HU/UEL clinical analysis laboratory for incubation analysis of the tracheal secretion and blood culture by the Bactec™ automated system.

The data were typed into an Excel spreadsheet and analyzed in the *Statistical Package for the Social Sciences* – SPSS®, version 20.0. A descriptive analysis was performed for the sociodemographic, clinical and therapeutic variables by means of absolute and relative frequencies.

The research project was approved by the Research Ethics Committee of the State University of Londrina (*Comitê de Ética em Pesquisa/Universidade Estadual de Londrina, CEP/UEL*), according to the

Regulatory Guidelines and Standards for Research in Human Beings, Resolution 499/2012 of the National Health Council under Certificate of Presentation for Ethical Appreciation (*Certificado de Apresentação para Apreciação Ética, CAAE*) No. 00745218.0.0000.5231, Opinion No. 2,978,943, issued on October 24th, 2018.

RESULTS

In the period analyzed, 573 HAP and 168 NVAP cases were reported, totaling 746, with all cases notified due to NVAP comprising the sample of this study.

Of the NVAP cases, the analysis found that the frequency of female and male subjects was similar (50.6% and 49.4% respectively), prevalent in those aged at least 60 years old with n=111 (66.1%); in addition to that, the patients who were hospitalized for at least 15 days developed NVAP (n=124; 73.8%) and were diagnosed on the 14th hospitalization day (n=144; 85.7%).

In relation to the units associated with NVAP, the IU stood out (n=80; 47.6%) with the highest number of infected individuals, followed by the ER with 29.8% (n=50). As for the clinical variables, it was found that 50.6% (n=85) of the patients presented negative blood cultures associated with pneumonia, 61.9% (n=104) of the patients used up to three different types of antimicrobials, and 53.6% evolved to death (Table 1).

In relation to the type of microorganisms with positive results in the blood cultures, the most prevalent were the following: *Staphylo spp.* and *Gram-positive cocci* with 7.7%, *Enterobacter* with 1.8%, and *Enterococcus* and *Coagulase-Negative Staphylococcus* (CNS) with 1.2% each.

The data analysis also portrays the main microorganisms that were identified from the 75 tracheal secretion cultures that presented positive result linked to NVAP; in this way, the result obtained was that 44.0% of the patients presented *Acinetobacter baumannii*, 30.7% *Staphylococcus spp* and 28.0% *Klebsiella pneumoniae* (Figure 1).

Regarding the main antimicrobials used to treat the NVAP cases in adults, we can see that the most prevalent choices in the institution were Tazocin (58.0%) followed by Vancomycin (56.0%), and that the third most administered medication was Meropenem (50.6%) (Figure 2).

In relation to the main admission diagnoses recorded, it is an evident predominance of stroke with 13.1% of the cases and of fracture in 11.9% of the cases, according to Figure 3.

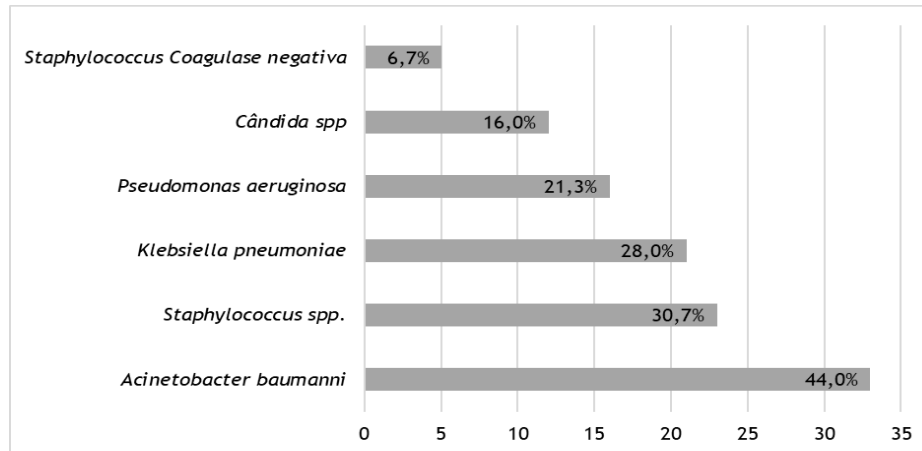
Table 1. Distribution of the demographic, clinical and therapeutic profile of the 168 NVAP cases in adults. Londrina, Paraná, Brazil, 2020.

Variables	n	%
Gender		
Female	85	50.6
Male	83	49.4
Age group		
18-59	57	33.9
60+	111	66.1
Hospitalization days		
Up to 14	44	26.2
≥15	124	73.8
Hospitalization days until the HANVAP diagnosis		
Up to 14	144	85.7
≥15	24	14.3
Unit associated with HANVAP		
Hospitalization unit	80	47.6
ER*	50	29.8
ICU**	24	14.3
BTU/BTC***	13	7.7
Maternity ward	1	0.6
Blood culture associated with HANVAP		
Positive	27	16.1
Negative	85	50.6
Not collected	56	33.3
Tracheal secretion culture associated with pneumonia		
Positive	75	44.6
Negative	9	5.4
Not collected	84	50.0
Number of antimicrobials administered		
Up to 3	104	61.9
4+	64	38.1
Death		
Yes	90	53.6
No	78	46.4

*ER – Emergency Care; **ICU – Intensive Care Unit; ***BTU/BTC – Burns Treatment Unit/Burns Treatment Center

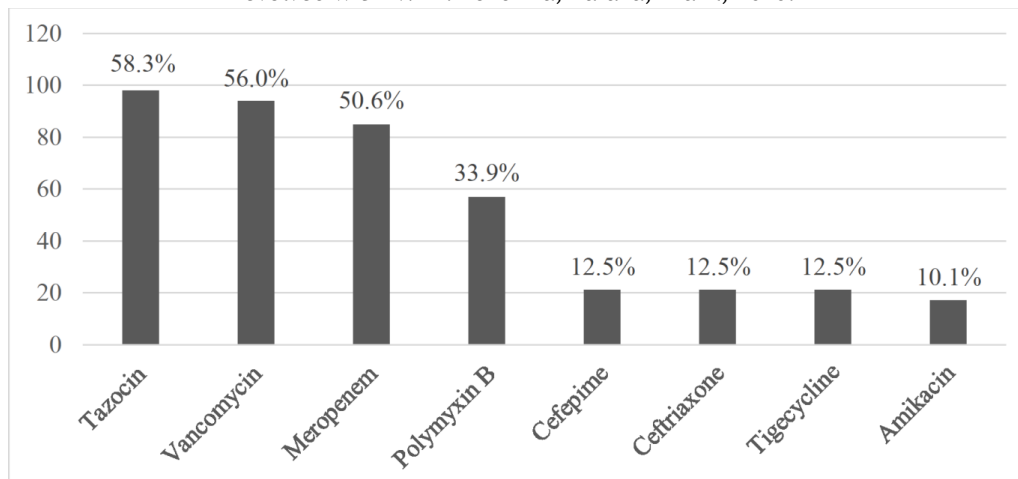
Source: Prepared by the authors (2022).

Figure 1. Relative and absolute distribution of the main microorganisms identified in the 75 positive tracheal secretion cultures, associated with NVAP in adults. Londrina, Paraná, Brazil, 2020.



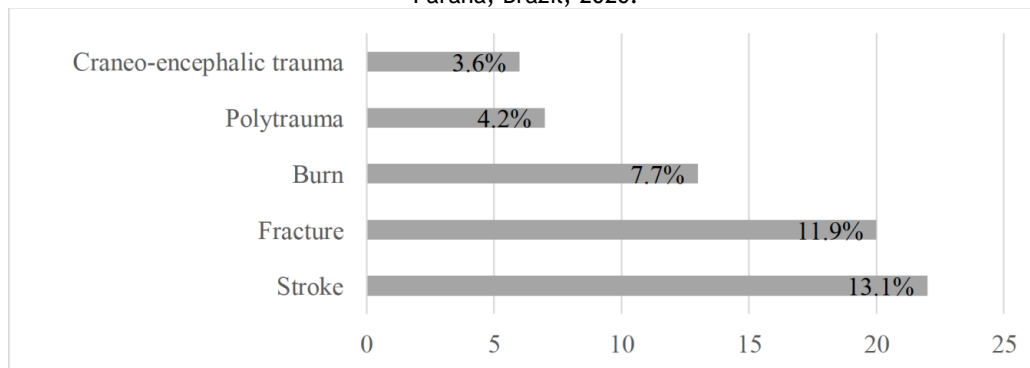
Source: Prepared by the authors (2022).

Figure 2. Relative and absolute distribution of the main antimicrobials prescribed to 168 hospitalized adult patients that evolved with NVAP. Londrina, Paraná, Brazil, 2020.



Source: Prepared by the authors (2022).

Figure 3. Relative and absolute distribution of the main admission diagnoses associated with the NVAP cases. Londrina, Paraná, Brazil, 2020.



Source: Prepared by the authors (2022).

DISCUSSION

The current study shows the characterization of adult inpatients that developed NVAP, according to demographic, clinical and therapeutic variables.

In relation to age, in this study it was evident that patients older than 60 years old had a higher incidence than those aged up to 59 years old; this can be related to the vulnerability of older adults. With age, many physiological changes occur, caused by the age group itself, leaving the patient more susceptible to contracting/developing pneumonia. Some of the changes that are conducive to acquiring pneumonia are the compromised immune system and constant accumulation of secretion derived from impaired mucociliary transport and loss of the glottic and cough reflex.⁽¹³⁾

A significant part of the literature is focused on VAP, with an emphasis on individuals over 60 years old, mostly hospitalized in ICUs. In contrast, the data of this research evidenced that the hospitalization unit presented higher incidence in relation to the others (n=80; 47.6%), followed by ER (n=50; 29.8%) and by the ICU (n=24; 14.3%). This result can be explained since the ER is the service's gateway and because, after hospitalization, most of the patients are transferred to these units, where they remain hospitalized and often intubated, which can result in HAP which, most of the times, occurs outside the ICU environment.⁽¹⁴⁾

Protocols can be used to prevent HAIs, such as the bundle, created by the Institute for Healthcare Improvement (IHI) for the prevention of VAP, which consists of a small grouping of key evidence-based multidisciplinary practices to be used in a multidisciplinary manner primarily in the ICU.⁽¹⁵⁻¹⁶⁻¹⁷⁾ When applied together, the preventive measures will result in better outcomes than when implemented individually. However, when there is some medical contraindication to apply certain preventive measure present in the bundle, it should be considered as accomplished and not as a failure to apply the protocol, thus considering the bundle as complete.⁽¹⁸⁻¹⁹⁾

For the prevention of pneumonia, the bundle encompasses essential recommendations: weaning from sedation; care with aspiration of tracheal secretions; hand hygiene by the health professionals; oral hygiene with 0.12% chlorhexidine; headboard elevated from 30° to 45°; and cuff pressure between 20 and 30 cm H₂O in case of mechanical ventilation. A number of studies highlighted that, although it is

not a measure for NVAP, application of the bundle reduces the VAP rates.⁽²⁰⁻²¹⁾

Another issue to be discussed is the prevalence of the microorganisms found in the tracheal secretion. A study carried out at several hospitals in the city of Uberlândia - Minas Gerais, with the objective of evaluating the results of positive tracheal secretion cultures, presented convergence with the current study in relation to the *Acinetobacter baumannii* microorganism. A possible explanation refers to the study locus, as *A. baumannii* adapts very well to hot and humid climates, which may or may not be related to the pneumonia-associated unit being air-conditioned or not, as this microorganism is viable in extremes temperatures.⁽²²⁻²³⁾

The *Staphylococcus spp* microorganism was identified as the second most prevalent, which is expected given that the literature corroborates that bacteria of genus *Staphylococcus* are the leading cause of HAIs and also the main etiologic agents of a number of hospital-acquired infectious processes.⁽²⁴⁾

Regarding the result obtained in the blood cultures, Gram-positive microorganisms prevailed, with the highest frequency in *Staphylococcus spp.* and *Gram-positive cocci* with 7.7% each, followed by *Enterococcus* as the second most frequent (1.8%). This is consistent with a study conducted in Pernambuco that evaluated the bacteriological profile of blood cultures performed in a University Hospital, where Gram-positive bacteria predominated in 61.0% of the cases in the first year of analysis.⁽²⁵⁾

In healthy adults, the predominant organism in the oral cavity is *Streptococcus viridans*, but the oral flora in critically-ill patients changes and becomes predominantly Gram-negative organisms, constituting a more aggressive flora. This flora can consist of *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Acinetobacter baumannii*, *Haemophilus influenza* and *Pseudomonas aeruginosa*.⁽²⁶⁻²⁷⁻²⁸⁾

Eight types of antimicrobials were prescribed for all 168 adult patients with NVAP. The most frequent class of antimicrobial in the prescriptions analyzed was cephalosporins, in 83.3%, where the most frequent was *Piperacillin sodium + Tazobactam sodium* with 58.3% (n=334.05). A descriptive, retrospective and cross-sectional study⁽²⁹⁾ corroborates the same result (cephalosporins as first choice) and justifies the indication as first choice according to the protocol of the hospital in question, which indicates it for the management of respiratory infections and sepsis.

The second most used antimicrobial was vancomycin. It was prescribed for 56.0% (n=320.88) of the cases and, according to one study, this can be a reflection of the prevalence of bacterium *Staphylococcus spp*, which is configured as the first choice in the treatment of infections caused by this microorganism.⁽³⁰⁾ In contrast, a study states that certain microorganisms such as enterococci, which have been found with a higher frequency, show resistance to vancomycin, especially in ICUs.⁽³¹⁾

Meropenem comes in next (n=85; 50.6%), which is a broad-spectrum antimicrobial but has a short and rapid half-life, that is, its administration is time-dependent, requiring frequent administration for optimization.⁽³²⁾

Also in relation to antimicrobials, a study presented data on resistance and sensitivity of the antimicrobials tested in Gram-negative microorganisms: *Piperacillin sodium + Tazobactam* showed sensitivity in 42.8% of the cases tested while Meropenem only did so in 29.5%. In the cases where there is still no microbiological confirmation of the infection and the treatment with antimicrobials was made presumptively, the scenario becomes more complex, as the broader the spectrum of the antimicrobial (advantageous because it saves time), the greater the disadvantage because of the harms to the normal microbiota.⁽³³⁻³⁴⁾

Regarding mortality, it was found that more than half of the patients evolved to death. An analysis conducted at a General Hospital of the University of Caxias do Sul pointed out that, although Pneumococcal Pneumonia (PP) mainly affects patients with comorbidities, the study found no difference in the mortality rate between patients aged < 65 years old and those aged ≥ 65 years old.⁽³⁵⁾

As a study limitation, we point out non-evaluation of the patients' comorbidities and the Nursing care provided, which could be described in the HAI notification forms, which would result in the analysis of other variables associated with healthcare-associated pneumonia. The *Hawthorne* Effect can also be cited, due to non-implementation of the preventive bundle by the health professionals in the aforementioned institution analyzed for cases at risk of developing NVAP.

The findings of this study contribute to the implementation of measures for NVAP prevention, through a continued assessment on its occurrence and such outcomes, with the possibility of implementing a bundle for prevention, thus contributing to reducing the incidence of NVAP, promotion of care quality and safety in the assistance provided to hospitalized patients.

CONCLUSION

In this study it was possible to verify that the characterization of adult inpatients that developed NVAP is both female and male, with similarly distribution, aged more than 60 years old and with prolonged hospitalization times (15 or more hospitalization days). As for the place of stay during hospitalization, the inpatient unit and the ER stood out. It was also noticed that more than half of the patients with NVAP evolved to death, with the

Acinetobacter baumannii microorganism in tracheal secretion, blood culture with *Staphylo spp.*, *Gram-positive cocci* and use of cephalosporins as the antimicrobial of choice.

It is suggested that studies addressing the association of demographic, clinical and therapeutic variables with deaths and studies regarding implementation of bundles by Nursing for NVAP be conducted, in addition to an evaluation of the Nursing care provided for NVAP prevention.

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Corresponding author:

Maria Eduarda Cardoso Silva

E-mail: Maria.eduarda.cardoso@uel.br

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