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SHORT NOTE

TEMPORAL TRENDS OF VENTILATOR-ASSOCIATED PNEUMONIA IN ADULT INTENSIVE CARE UNITS IN THE MUNICIPALITY OF GOIÂNIA, GOIÁS, BRAZIL

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ABSTRACT

Given the potential for morbidity and mortality of ventilator-associated pneumonia (VAP), the profile of these infections in adult intensive care units was evaluated in the city of Goiânia. Data were collected from a secondary base in the Department of Prevention and Control of Infection in Health Services, of the Municipal Health Department of Goiânia, from 2014 to 2016, in private (82.7%), public (17.2%), and philanthropic (6.0%) health care services. The rate of use of mechanical ventilation did not change significantly over the three years (32.6%). However, there was a decrease in the mean of VAP incidence density, and in 2016 there was a reduction of 7% in the 90th percentile. These reductions highlight the benefit of the implementation and adherence to bundles by the multidisciplinary team.

KEY WORDS: Pneumonia; ventilator-associated; ventilators; mechanical; disease notification.

Intensive Care Units (ICUs) receive critically ill patients who are classified as at high risk for infection (Sousa et al., 2017), and ventilator-associated pneumonia (VAP) is a common healthcare-associated infection (HAI) in patients in these units (ANVISA, 2017a; Leal & Nunes, 2019).

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VAP is defined as a pneumonia in a mechanically ventilated patient for a period longer than two days when on the date of infection the patient was on the mechanical ventilator or this had been removed the day before (ANVISA, 2017a). This infection has significant clinical relevance due to its high frequency, associated mortality, costs and use of antimicrobials (Pombo et al., 2010; Rodrigues et al., 2016; Leal & Nunes, 2019). Historically, according to the Centers for Disease Control and Prevention, 10% to 20% of ventilated patients developed VAP (Klompas et al, 2014), and it is estimated that approximately 33% of patients with VAP die as a direct result of this infection (ANVISA, 2013; ANVISA, 2017b).

Epidemiological data on VAP in Brazilian hospitals are still imprecise. Data from the State of São Paulo, from 2015, showed that the mean incidence density of VAP was 9.87 cases per 1,000 days of mechanical ventilator use in an adult ICU (ANVISA, 2017b). In addition to all the cost and harm to the patient, VAP is a marker regarding quality of care, being a disease that signifies an adverse event (Nascimento et al., 2019).

Given that, and considering that HAI surveillance is an indispensable factor to understand, identify, implement actions and devise strategies aimed at reducing infection rates and providing patient safety, the profile of VAP infections was analysed in adult ICUs in the Municipality of Goiania, Goias, Brazil. The population in the study were adult inpatients in 41 ICUs from eight public (including two philanthropic) and 33 private hospitals. Data were obtained from a secondary database available at the Department of Prevention and Control of Infection in Health Services, of the Municipal Health Department of Goiânia, using the FormSUS form, from 2014 to 2016. All health care services that have ICU beds performed HAI notifications through the FormSUS form (ANVISA, 2018). The study was approved by a research ethics committee (opinion number: 1.269.485).

All VAP notifications from adult ICUs in the city of Goiânia were included, and all forms that were repeated, incomplete, presented errors or any inconsistent data were excluded. The rate of use of mechanical ventilation and VAP incidence density were obtained from the calculation of VAP prevalence for each indicator (ANVISA, 2017c). Statistical analysis were performed using the SPSS program (version 22). Descriptive analysis (absolute and relative frequency, mean, percentile and standard deviation) was performed according to the type of variable (categorical or continuous). Incidence density of VAP and the rate of use of ventilator-day were calculated, with 95% confidence intervals, and associations that obtained $p < 0.05$ were considered statistically significant.

A total of 1,988 HAI notification forms from 41 adult ICUs were analysed (this number varied due to the opening and closing of some units (Table), most of which were located in private health care facilities (82,7%), followed by public facilities (17.2%). Among these units, 28.6% were teaching

activity scenarios. Even with the increase in the number of health care services that notified VAP, mechanical ventilator use rate did not change significantly over the three years (32.6%). However, there was a decrease in the distribution of VAP incidence density (Table).

The use of mechanical ventilation is a prominent factor for the development of VAP (Mota et al., 2017; Kock & Maurici, 2018). In this study, despite the increase in the number of hospitals with ICU beds that reported VAP, reflecting what happened nationwide (ANVISA, 2017c), the rate of mechanical ventilator use in adult ICUs remained stable over the period evaluated (mean of three years). The incidence density of VAP decreased by 5.2%, and in 2016 there was a reduction of 7% in the 90th percentile. A cohort study performed on adults ICUs in the South region of Brazil with 120 patients showed the duration of mechanical ventilation as a risk factor for VAP ($p = 0.001$) and the mean duration of mechanical ventilation was 13.1 days (Kock & Maurici, 2018). Fortaleza et al. (2020) also reported the positive impact of implementing bundles for preventing VAP. These authors also noted that surveillance regarding adherence to the package of VAP prevention measures reduced the incidence of other HAIs.

The incidence density of VAP reduction evidenced in this study may be related to the use of bundles, packages of interventions for the prevention of HAI, and training of health care workers in caring for patients using mechanical ventilation (Hiil, 2016; Mota et al., 2017; Lourençone et al., 2019; Fortaleza et al., 2020). These preventive measures for VAP include, among others: judicious use of neuromuscular blockers, care with the ventilator circuit; indication and care of humidifiers; indication and care of the aspiration system; avoiding unscheduled (accidental) extubation and reintubation; cuff pressure monitoring; preference for orotracheal intubation; enteral tube in gastric or post-pyloric position; respiratory assistance product reprocessing. When these measures are applied simultaneously, the incidence rate of VAP is minimized, thus favouring patient safety (ANVISA, 2017a). A study performed in two medical-surgical ICUs in Brazil showed that the implementation of a bundle for preventing VAP, which had 53% of adherence, achieved a sustained trend towards reduction over time in overall HAI ($p = <0.001$), including VAP ($p = <0.001$) (Fortaleza et al., 2020).

Early and accurate VAP diagnosis is another relevant factor in assessing the rate of infection. Literature reviews about tests/criteria used to diagnose VAP evidenced the need for a standardised approach (Al-Omari et al., 2021), and possibly unnecessary antimicrobial utilization (Fernando et al., 2020), and a data-driven composite reference standard was suggested (Al-Omari et al., 2021).

Table. Mechanical ventilation (MV) utilization rate, incidence density (ID) of ventilator-associated pneumonia (VAP) and percentiles of the distribution of incidence densities of infections in intensive care units in Goiânia, between 2014 and 2016.

Year	Nº hospitals	Nº patient-day	Mean VAP	Mean MV-day	Utilization rate MV (mean)	ID VAP (mean)	Percentile				
							10%	25%	50%	75%	90%
2014	36	160006	28.2	1532.4	32.4	19.8	6.3	9.4	18.7	27.1	36.0
2015	39	155317	18.4	1397.1	32.7	15.8	4.0	8.7	13.4	22.8	30.0
2016	41	161670	18.6	1443.6	32.4	14.6	2.9	6.9	12.6	21.3	29.0

There was no statistically significant difference in the incidence density of VAP between public and private hospitals in this study. However, Rosenthal et al. (2011) reported a significant difference between academic and public hospitals (13.2 *versus* 2.4 VAP per thousand days of mechanical ventilation - $p< 0.001$), and academic and private hospitals (13.2 *versus* 4.9 VAP per thousand days of mechanical ventilation - $p < 0.001$) in 16 developing countries.

In conclusion, the rate of mechanical ventilator use in adult ICUs remained stable throughout the period evaluated, and there was a decrease in the mean incidence density of VAP. This infection reduction may be related to adherence to packages or bundles of measures by the multidisciplinary health care worker teams.

This study had limitations regarding the use of secondary and retrospective data, and some of the variables could not be controlled, such as diagnostic criteria, lack of surveillance, database inconsistencies, among others.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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