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Surveillance of preventive measures for ventilator associated pneumonia (VAP) and its rate in Makkah Region hospitals, Saudi Arabia

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Background/aim: The present study aimed to assess the VAP rate and to identify VAP prevention activities in public sector hospitals situated in the Makkah Region, Saudi Arabia (SA).

Materials and methods: In this cross-sectional study, the VAP data from 13 public sector hospitals were collected from January to December 2013 and analyzed using SPSS 16.

Results: The overall VAP rate in Makkah Region hospitals was 6.89 cases per 1000 ventilator-days. There was a significant difference in VAP rate among the hospitals of the Makkah Region ($P < 0.001$). There was no significant difference in the VAP rate among hospitals, which were using only one, two, or all three VAP preventive approaches ($P = 0.26$) accredited by the Joint Commission International (JCI) and Central Board for Accreditation of Health Care Institution (CBAHI) ($P = 0.12$), and using the form in intensive care units (ICUs) ($P = 0.85$). There was a significant difference in the VAP rate among hospitals having different bed capacities ($P < 0.001$), data regularly collected ($P = 0.03$), and had a team to supervise the VAP project ($P = 0.04$).

Conclusion: The VAP rate in Makkah Region hospitals is 6.89 cases per 1000 ventilator-days.

Key words: Ventilator-associated pneumonia, VAP rate, VAP bundles, Saudi Arabia

1. Introduction

Ventilator-associated pneumonia (VAP) is a very common type of infection in intensive care unit (ICU) patients with a high rate of mortality. It is linked with extended ICU and hospital stay, delay in recovery, and augmented health care expenses (1–3). Because of the grave consequences of VAP, its prevention has gained the attention of policy makers for developing patients' safety plans (4,5).

Studies have documented that the rate of VAP ranges from 13.2 to 51 cases per 1000 ventilator-days (6,7). VAP has serious consequences, and several studies have reported mortality rates of 20% to 76% (6,8). Berenholtz et al. (2011) emphasized that there is a vital need to adopt evidence-based recommendations for reducing severe public health consequences linked with VAP (9).

The treatment cost of VAP is high and so most hospitals focus on adoption of preventive strategies against VAP. The Institute for Healthcare Improvement (IHI) has promoted some interventions recognized as a 'ventilator bundle' containing interventional steps that can be used to prevent VAP and help in maintaining patients' safety during ventilator support (10,11).

One study reported the VAP rate as 16.8/1000 ventilation-days in the Kingdom of Saudi Arabia (KSA) (12). Another longitudinal epidemiologic surveillance study regarding VAP at a tertiary care intensive care

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unit in KSA revealed an overall VAP rate of 15.9 per 1000 ventilator-days from 2003 to 2009, with a decrease during the course of the study from 19.1 in 2003 to 6.3 in 2009 (13). Nevertheless, that study reported the results of a single hospital ICU in Riyadh, KSA, and therefore there was a need to carry out further comprehensive surveillance encompassing multiple hospitals' ICUs. Therefore, the present study was designed to assess the rate of VAP in public sector hospitals and to identify VAP prevention activities and its rates in all ICUs in Makkah Region hospitals, KSA. The present study reports the VAP rate with the objective to help policymakers provide data on the basis of that they could then plan VAP preventive strategies.

2. Materials and methods

2.1. Study design and hospital selection

This cross-sectional, analytical study was undertaken by the Department of Quality Management and Patient Safety, Directorate General of Health Affairs of Makkah Region, Ministry of Health. It evaluated the VAP rate per 1000 ventilator-days in 17 public sector hospitals of the Makkah Region, including the cities of Jeddah, Taif, Qunfudah, and Makkah. The VAP data from 17 hospitals were collected monthly from January to December 2013. A specially designed proforma was used to collect the VAP data and related information. All respondents were asked about VAP-related preventive measures, VAP-related educational activities, use of a form in the ICU for ensuring compliance with the VAP prevention intervention, and the availability of trained ICU staff. Additionally, we identified if they were accredited by the JCI and CBAHI, and had an implemented VAP prevention project or not. We also noted other characteristics such as hospital recognized for teaching and training or not, bed capacity, the number of trained staff in the ICU, compliance with preventive measures for VAP, and number and scope of ICUs (i.e. AICU, SICU, CCU, PICU, NICU).

In the detailed analysis, we included only 13 hospitals that had provided 12 months' complete VAP data and had calculated VAP cases per 1000 ventilator-days. A total of 26 ICUs from 13 hospitals were included in this VAP project. Out of these, 11 were adult intensive care units (AICU), 2 surgical ICUs, 3 coronary care units, 4 pediatric ICUs, and 8 neonatal ICUs. These ICUs reported complete data for 12 months from January to December 2013. The proforma was approved by the local and regional authorities of the Ministry of Health, and the study was performed according to the principles of the Helsinki Declaration.

2.2. Statistical analysis

The data were analyzed using SPSS version 16. Median with interquartile range and mean ± SD were given for quantitative variables, i.e. the rate of infection/1000 ventilator-days. The Shapiro–Wilk test was used to check the normality of data. The data were not normally distributed and so the Mann–Whitney U test and Kruskal–Wallis H test were used to compare the mean difference in the rate of infection with respect to location, data collection procedure, the size of the hospital, etc. A P-value < 0.05 was considered significant.

3. Results

Out of 13 hospitals, 5 were located in Makkah, 5 in Jeddah, 2 in Taif, and one in Qunfudah. Seven hospitals had teams to supervise the VAP project and were collecting data on a regular basis. Nine hospitals were using forms in the ICU to ensure compliance with the VAP prevention intervention. Four hospitals were recognized for undergraduate teaching and training and 6 for postgraduate training, while 3 were recognized for both. Seven hospitals were accredited by the JCI and CBAHI and 4 by the CBAHI only. Three hospitals have a bed capacity of less than 200, while 6 hospitals have 200–400 beds and 4 hospitals have >400 beds. As a VAP preventive measure, closed suction, subglottic aspiration, and chlorhexidine oral care approaches were used by the hospitals; two hospitals were using all three approaches, 7 were using two approaches, and 4 were using a single approach (Tables 1 and 2).

The overall VAP rate in Makkah Region hospitals was 6.89/1000 ventilation-days. The rate of VAP was highest in the Jeddah Region hospitals (8.79 cases per 1000 ventilator-days) followed by 6.41 in Makkah, 6.12 in Taif, and 4.41 in Qunfudah. There was a significant difference observed in the VAP rate among hospitals of the Makkah Region (P < 0.001) (Table 3).

Table 1. Location and some characteristics of the hospitals in the study.

Characteristics	Number of hospitals
Location	
- Makkah	5
- Jeddah	5
- Taif	2
- Qunfudah	1
Team present to supervise VAP project	7
Educational activities in hospital regarding VAP prevention	13
Recognized for undergraduate teaching and training	4
Recognized for postgraduate training	6

Table 2. Comparison of hospitals rate of VAP infection according to different variables.

Variables	Rate of infection/1000 ventilator-days		P-value
	Median (IQR)	Mean ± SD	
Data collection regularly			
Yes (7 hosp)	7.39 (4.60–10.38)	9.43 ± 8.10	0.03
No (6 hosp)	6.19 (2.05–9.64)	7.68 ± 8.16	
Have team to supervise VAP project			
Yes(8 hosp)	7.60 (3.67–12.93)	10.07 ± 9.54	0.04
No (5 hosp)	6.30 (3.37–8.23)	6.25 ± 4.18	
Accredited by*			
CBAHI (4 hosp)	8.03 (4.56–12.51)	10.04 ± 8.65	0.12
CBAHI & JCI (7 hosp)	6.56 (2.91–9.84)	8.42 ± 8.55	
Use of form to ensure compliance			
Yes (9 hosp)	6.81 (3.30–11.61)	9.34 ± 9.34	0.85
No (4 hosp)	7.02 (3.93–9.04)	7.02 ± 4.09	
Preventive measures for VAP A) Closed suction, B) Subglottic aspiration C) Chlorhexidine oral care			
Using all three approaches (2 hosp)	7.47 (5.91–9.25)	7.66 ± 3.68	0.26
Using any two approaches (7 hosp)	6.38 (2.64–9.18)	8.11 ± 8.48	
Using one approach (4 hosp)	7.71 (3.90–13.37)	10.00 ± 9.08	
No. of beds			
<200 (3 hosp)	7.33 (0.82–15.76)	10.28 ± 10.29	< 0.001
200–400 (6 hosp)	4.97 (2.58–7.78)	5.38 ± 3.67	
>400 (4 hosp)	8.84 (6.57–17. 43)	12.24 ± 9.39	

Using Mann–Whitney U test and Kruskal–Wallis H test
*Two hospitals did not provide these data

Table 3. Comparison of VAP rate among hospitals of four major cities.

Hospitals in	No. of hospitals	VAP rate/1000 ventilator-days		P-value
		Median (IQR)	Mean ± SD	
Makkah	5	6.41(3.23–8.23)	5.88 ± 3.24	<0.001
Jeddah	5	8.79 (4.61–20.15)	12.64 ± 11.13	
Taif	2	6.12 (3.59–11.61)	7.66 ± 4.97	
Qunfudah	1	4.41 (0.64–6.33)	4.16 ± 3.17	
Total	13	6.89 (3.57–10.27)	8.26 ± 8.15	

Using nonparametric Kruskal–Wallis H test.

There was no significant difference in the VAP rate among the hospitals that were using only one, two, or all three VAP preventive approaches (P = 0.26); were accredited by the JCI and CBAHI (P = 0.12); and were using the form in the ICU (P = 0.85). There was a significant difference in the VAP rate among hospitals

having different bed capacities ($P < 0.001$), data regularly collected ($P = 0.03$), and a team to supervise the VAP project ($P = 0.04$) (Table 2).

4. Discussion

There is vast diversity in the VAP rate in different developing countries ranging from 10 to 41.7 per 1000 ventilator-days (14). Multiple factors account for this large variation in VAP rates: effective implementation of infection control programs, the efficiency of the critical care facilities, the availability of trained ICU staff, and others (14). The present study found that the overall VAP rate in the Makkah Region is 6.89/1000 ventilator-days.

Our results are compatible with previous studies in this country (15,16) and lower than those from several other Asian countries (7,17–20).

A study in KSA reported an overall VAP rate of 15.9 per 1000 ventilator-days from 2003 to 2009 in the AICU, but they noted a decrease in the VAP rate from 19.1 in 2003 to 6.3 in 2009 (13) and our results confirm their findings. Their study was a single-center study conducted in an AICU in one of the best 900-bed tertiary care hospitals in the capital of KSA. However, we collected 1-year data from 26 ICUs from 13 different 50–500-bed hospitals having diversity in the available facilities and training of the staff and availability of ICU facilities.

Many studies have reported that by implementing a VAP prevention bundle approach, the VAP rate can be reduced significantly (21–24). Berenholtz et al. in their large collaborative intervention study for reducing the VAP rate suggested that most VAPs are avoidable, and they demonstrated in their study that VAP could be effectively prevented across a huge and various cohort of ICUs (9).

It is suggested that a VAP prevention policy must be implemented with full compliance, and this is the only way to reduce the mortality and morbidity caused by the deadly VAP. Marra et al. documented that high compliance with policies will inevitably reduce the VAP infection rates and that study observed a significant decrease (58%) in VAP rates when the hospital shifted from no compliance to full compliance (25).

The VAP rate of Jeddah Region hospitals was significantly higher compared to that of Makkah, Taif, and Quanfudah hospitals. One of the possible reasons may be the higher patient turnover in Jeddah hospitals; it is a cosmopolitan city and the second most populated city of KSA. We also suggest that by increasing the number of nurses in the ICU, patient care can be improved, which will directly reduce nosocomial infections. Several studies have recognized a relationship between higher nurse-staffing levels and improved patient outcomes, including a decline in hospital-acquired infections (26–28).

Despite the fact that the Makkah Region hospitals are organizing VAP-related educational activities, there remains room to improve and expedite those activities. Several studies have described the positive influence of educational programs on reducing the VAP rate (29,30). Therefore, VAP-related educational programs should be initiated on a large scale in every hospital with an expected outcome of reducing hospital-acquired infection by proper implementation of the protocol. Sometimes a hospital may have an approved standard protocol for the prevention of VAP, but a lack of knowledge may affect the implementation of the protocol (31).

Most of the studied hospitals were recognized by the JCI and CBAHI and involved in undergraduate and postgraduate teaching and training, having expert and qualified ICU staff that are regularly attending the CME activity. This could be one of the reasons why overall VAP rate was only 6.89/per 1000 ventilator-days in Makkah Region hospitals. However, full compliance with VAP prevention guidelines is needed to reduce the VAP rate further and in this regard individual hospitals and the Ministry of Health can play a pivotal role.

In the present study, we found no significant difference in the VAP rate among hospitals that were using only one, two, or all three VAP preventive approaches. However, several studies have recommended the use of subglottic secretions drainage and oral care with chlorhexidine to decrease the VAP rate (32,33). In order to eradicate VAP, it is necessary to understand the main risk factors, and therefore implementations of efficient preventive actions against VAP are possible (34).

There are several limitations to our study. Firstly, we did not collect data on antimicrobial treatment or recovery of the patient from VAP. Secondly, no detailed data regarding compliance to VAP preventive measures were collected. There is a need to decrease the VAP rate in KSA hospitals further to save precious lives, and, in this regard, imperative measures should be taken. We recommend that all hospitals implement evidence-based practices regarding VAP prevention and should organize more VAP-related educational activities such as specific lectures and workshops to increase staff awareness and motivation about VAP prevention.

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