

RESEARCH ARTICLE

Knowledge and Practices Regarding Ventilator Care Bundle for Preventing Ventilator Acquired Pneumonia (VAP) Among Intensive Care Unit Registered Nurses

Maznah Ya'acob¹, Aini Ahmad², Annamma Kunjukunju³, Nurul Fariza Mohd Mustafa⁴, Norhanisah Chukari⁵

¹Undergraduate student, School of Nursing, KPJ Healthcare University College, Negeri Sembilan, Malaysia.

²Post Graduate Coordinator, School of Nursing, KPJ Healthcare University College, Negeri Sembilan, Malaysia.

³Senior Lecturer, School of Nursing, KPJ Healthcare University College, Negeri Sembilan, Malaysia.

⁴Dean, School of Nursing, KPJ Healthcare University, Negeri Sembilan, Malaysia.

⁵Lecturer, School of Nursing, KPJ Healthcare University College, Negeri Sembilan, Malaysia.

Received: 21 July 2023 Accepted: 01 August 2023 Published: 08 August 2023

Corresponding Author: Annamma K, Associate Professor, Senior Lecturer, School of Nursing, KPJ Healthcare University, Negeri Sembilan, Malaysia.

Abstract

Introduction: Mechanical ventilation is one of the major supportive modalities in the intensive care Unit (ICU), but it carries many risks and complications; the most common one is Ventilator Associated with Pneumonia (VAP). VAP is a global problem in intensive care units, contributing to increased morbidity and mortality rates in mechanically ventilated patients. VAP can happen within 48 to 72 hours in intubated ventilated patients. Preventing VAP is a major clinical challenge. ICU nurses' knowledge of ventilator care bundles and adherence to it would reduce the risk of VAP. The main bundle items used in the study were infection control measures, patient positioning, endotracheal suctioning care, peptic ulcer prevention, oral care, weaning & extubation trials and other ventilator care measures. The study aimed to determine the level of knowledge and practices on ventilator care bundles for preventing VAP among ICU Registered Nurses.

Methodology: This study used a cross-sectional survey design. A purposive sampling was done among Registered Nurses working in ICU at all eight KPJ Klang Valley hospitals. Data was collected using a questionnaire consisting of 3 parts: demographic data, single-response questions and an observation checklist. A total of 93 respondents were involved in the survey. Data were analysed using the IBM Social Packages for the Social Sciences (SPSS) software version 26 using descriptive and inferential statistical analysis methods.

Results: The finding shows that 95.7% of the respondents have excellent knowledge of VAP prevention. The compliance practices on the ventilator care bundle showed that ninety-two (98.9%) respondents have good compliance.

Conclusion: The study reveals that most ICU registered nurses at selected Klang Valley hospitals have good knowledge and practice compliance regarding care bundle items to prevent VAP. The nurse's leadership must continue supporting evidence-based clinical practice, and continuous monitoring will ensure adherence to VAP prevention practices.

Keywords: Ventilator-Associated Pneumonia, Ventilator Care Bundle, Intensive Care Units, prevention, pneumonia, Critical Care Nurses.

1. Introduction

Ventilator-associated pneumonia (VAP) is a type of pneumonia in a patient receiving mechanical

ventilation that was not present at admission to the hospital or that occurs 48 hours after intubation and mechanical ventilation (Said, 2012). VAP has the

Citation: Maznah Ya'acob, Aini Ahmad, Annamma Kunjukunju, *et al.* Knowledge and Practices Regarding Ventilator Care Bundle for Preventing Ventilator Acquired Pneumonia (VAP) Among Intensive Care Unit Registered Nurses. Open Access Journal of Nursing. 2023;6(2):01-08.

©The Author(s) 2023. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

highest mortality rate of up to 60% among all hospital-acquired infections worldwide (Soh, 2012). Recent data suggest that the care bundles in VAP prevention and clinical practice guidelines can improve patient outcomes (Sulaiman et al., 2020). as well as clinical practice guideline can improve patients' outcomes.

On the other hand, VAP represents a large percentage of ICU-acquired infections and increases antibiotics utilisation and morbidity, mortality and cost among critically ill patients (Wip & Napolitano, 2009). Prevention of VAP should be a priority for all ICUs in the world.

Bird et al.,(2010) highlighted (5.2 VAP cases/1000 ventilator days in the Surgical ICU and 10.2 VAP cases/ 1000 ventilator days in Trauma ICU and incurred a high cost of treatment. Another study in General Intensive Care Unit (GICU) of Hospital Kuala Lumpur reported 59.5% of the respondents had poor knowledge of VAP prevention (Norazlin & Norzakira, 2019). The study also showed that age, experience in nursing, certificate and participation in infection control programs tend to influence the respondent's knowledge (Norazlin & Norzakira, 2019). Therefore, if the nurses have inadequate knowledge and skills, they need guidance and should be supervised. For the patients, VAP will cause long stay hospitalisation with extra costs that need to be borne by the patients. However, healthcare providers may still amend some improvements to produce the best quality patient outcomes. This study focuses on the level of knowledge and practices on ventilator care bundles for preventing VAP among ICU Registered Nurses.

2. Methodology

2.1 Design and Sampling

A quantitative cross-sectional survey is used in this study to determine the knowledge and practice compliance among the Registered Nurses working in ICU regarding care bundle compliance on preventing VAP. This cross-sectional study was conducted in selected private hospitals in Klang Valley, Selangor. The study participants (N=140) included all the confirmed Registered Nurses working in ICU. Non-probability purposive sampling was used for the study. Due to the COVID-19 pandemic, the data was collected using an online survey, and the link was shared using a mobile phone.

2.2 Study Tools

The self-administered questionnaire was adapted

from a previous study (Aziz et al., 2020; Sulaiman et al., 2020), which consisted of 3 parts.

2.3 Methods and Materials

Section 1 consisted of social demographic (Age, gender, working hospital, and qualification, including post-basic and working experience). Section 2 assessed knowledge level, consisting of 15 multiple-choice questions with a single response. The knowledge is graded into four categories according to the score, which are excellent (81-100), good (61-80), average (41-60) and poor (0-40). Section 3 covered practice compliance of care bundles with 5 dichotomous questions (yes/no). If the nurses performed was rated as 'Yes', and if the nurses did not perform was considered noncompliance and was recorded as 'No'. Permission, explanation and informed consent were stated in the Google form. The questionnaires were distributed through mobile phones after obtaining the participant's consent. Researchers sought assistance from the ICU Unit Manager from each hospital for the list of staff names and for circulating the questionnaire. All questionnaires were presented in English because English is the principal language used in hospitals and communication for nurses in the clinical context. The Cronbach's Alpha value for this study was 0.7, which indicates an acceptable level of reliability obtained from 10% of the population, equal to 10 respondents. The data were analysed by using SPSS software version 26. The analysis included descriptive statistics such as frequencies, percentages, means and standard deviation. Kruskal Wallis test was used to analyse relationships between level of knowledge and practices with socio-demographics, including age, gender, working area, years of service, years of experience, qualification and hospital where there are working.

3. Ethical Considerations

Ethical clearance is sought from the university affiliation's Research Management Committee (RMC). The proposal for this study was reviewed and approved by RMC. The purpose of the study, informed consent, and the respondent criteria regarding privacy and confidentiality are attached and briefly explained in the Google form. Permission from the author for the adopted questionnaire was received via email on September 2021 (Miss Zunaira Aziz), and approval from the Clinical & Research Ethics Committee of the Headquarters before data collection was received on November 2021.

4. Results

The respondents of this study were 93 Registered nurses employed in the ICU settings. The response

rate of this study was 100%. No respondents refused to answer the questionnaires, and no samples were rejected due to incomplete responses.

Table 1. Demographic characteristics of the sample (n=93).

Characteristic	Frequency (n)	Percentage (%)
Gender		
Male	1	1.1
Female	92	98.9
Age		
21-30	37	39.8
31-40	43	46.2
41-50	12	12.9
>50	1	1.1
Ethnicity		
Malay	73	78.5
Chinese	2	2.2
Indian	11	11.8
Others	7	7.5
Qualification		
Diploma	81	87.1
Degree	12	12.9
Working Experience		
<1 year – 3 years	17	18
4 – 6 years	21	23
7 – 9 years	13	14
10 years and above	42	45
Post Basic		
Critical Care Nursing	55	59
Midwifery	2	2.2
Anaesthesia	1	1.1
Cardio	2	2.2
Neuro	2	2.2
No post basic	31	33.3

Table 1 shows the distribution of demographic data that has been collected. The majority of respondents were Malay females (98.9%). The majority (46.2%) were from the age of 31 to 40 years, followed by 39.8% (37) from the age of 21 to 30 years. Analysis of the education level showed 81 (87.1%) of the

respondents qualified with a diploma in nursing, and 12.9% of respondents are qualified with a degree in nursing. The majority had post-basic training (59%) in Critical Care Nursing. Most respondents had more than ten years of working experience (45%), followed by 21 respondents (23%) with 4-6 years of experience.

Table 2. Analysis of the level of knowledge on care bundle items with scoring level (n=93)

Level of Knowledge/Score	Frequency	Percentage
Excellent (81-100%)	89	95.7
Good (61-80)	2	2.1
Average (41-60)	1	1.1
Poor (0-40)	1	1.1

Table 2 shows the level of knowledge related to VAP prevention. As highlighted in Table 2, most respondents had excellent knowledge (95.7%)

regarding bundle care for preventing VAP among ventilated patients; poor knowledge is reported in only one respondent.

Table 3. Level of knowledge regarding VAP Prevention (n=93)

Variables	True		False	
	n	%	n	%
1. Ventilator Care Bundle (VCB) is a checklist used as a protocol for preventing VAP.	92	98.9	1	1.1
2. Non-compliance to VCB is associated with high mortality in mechanically ventilated patients.	70	75.5	23	24.7
3. Component not included in the VCB for preventing VAP: Antibiotic.	80	86.0	12	14.0
4. VAP would occur in patients who have received mechanical ventilators for 48hours	92	98.9	1	1.1
5. Semi-recumbent position is recommended for a ventilator patient to prevent VAP.	70	75.3	23	24.7
6. Head of the bed elevation should range from 30-45 degrees.	80	86.0	12	14.0
7. Effect of kinetic beds for preventing VAP: No effect.	73	78.5	20	21.5
8. Oral route is best for intubating a patient.	75	80.6	18	19.4
9. Evidence-based guidelines for changing ventilator circuits: Every new patient.	23	24.7	70	75.3
10. A Nurse caring for a ventilated patient is required to wash hands before & after.	91	97.8	2	2.2
11. Perform oral care using a swab moistened with chlorhexidine 1% every 4-6 hours.	63	67.7	30	32.3
12. One of the components of VCB is sedation interruption.	85	91.4	8	8.6
13. Early weaning to reduce VAP.	85	91.4	8	8.6
15. What is your opinion regarding respiratory physiotherapy for preventing VAP: Highly recommended.	84	90.3	9	9.7
16. Contraindications for DVT prophylaxis include thrombocytopenia, active bleeding, and confirmed clots in the lower extremity.	45	48.4	48	51.6

Table 3 shows the details of the 15 items used for assessing the knowledge of registered nurses regarding VAP prevention bundle care. Based on the results, item 1 (Ventilator Care Bundle is a checklist used as a protocol for preventing VAP) and item 4

(VAP would occur in patients who have received mechanical ventilator for 48 hours) had 98.9% of the respondents answered correctly. Item 9 (Evidence-based guidelines for changing ventilator circuits: Every new patient) had the least correct answers (24.7%).

Table 4. Analysis of practices compliance on care bundle items (n=93)

Variables		Frequency	Percentage
Practices on care bundle	Good	92	98.9
	Poor	1	1.1

As highlighted in Table 4, most respondents (98.9%) complied well with the VAP prevention care bundle.

Table 5. Compliance practices in care bundle on preventing VAP among the ICU registered nurse (n=93)

Variables		Frequency (n)	Percentage (%)
1. Elevation head of the bed 30-45 degrees unless contraindicated.	Yes	89	95.7
	No	4	4.3
2. Oral care (mouthwash) using an oral kit (Chlorhexidine 1% solution).	Yes	88	94.6
	No	5	5.4
3. Use of appropriate sedation interruption protocol.	Yes	92	98.9
	No	1	1.1
4. GI prophylaxis and avoidance of abdominal distension.	Yes	90	96.8
	No	3	3.2
5. Carries out orders for Deep Vein Thrombosis (DVT) prophylaxis.	Yes	90	96.8
	No	3	3.2

Table 5 highlights the practice compliance with VAP prevention bundle care across five items. Using

appropriate sedation interruption protocol had the highest agreement on practice among registered nurses.

Table 6. Relationship for level of knowledge and practices with socio-demographic and between levels of knowledge with practices

Variable	Variable	P-value
Level of knowledge	Age	0.0.10*
	Gender	0.356**
	Working hospital	0.111*
	Post basic	0.576*
	Qualification	0.003**
	Working experience	0.476*
Practices on care bundle	Age	0.771*
	Gender	0.715**
	Working hospital	0.667*
	Post basic	0.566*
	Qualification	0.736**
	Working experience	0.864*

Kruskal Wallis * Mann Whitney test**

Table 6 shows the relationship between socio-demographic data and the level of knowledge and practices on ventilator care bundles for preventing VAP. The resulting p-value of the relationship between the levels of knowledge with socio-demographics showed that all the variables had no relation, as the p-value was more than 0.05 except for age (p=0.010) and qualification (0.003). There were no associations in the relationship between practices on care bundle with socio-demographics as all the p-value were more than 0.05. The relationship between knowledge and practices in the care bundle also showed no association, as the p-value was more than 0.05, which is 0.770.

5. Discussion

5.1 The Level of Knowledge on Using Care Bundles for Preventing VAP

In a similar study, researchers found that the knowledge of using care bundles to prevent VAP among ICU registered nurses was good. The highest correct answer, scored above 90%, was the meaning of a care bundle, early weaning and respiratory physiotherapy for preventing VAP. The lowest score was regarding evidence-based guidelines about changing the ventilator circuit. Al-Rawajfah, Hweidi, Alkhalaileh, Khader and Alshboul, (2013).

A similar study in Kuantan, Malaysia, reported that nurses have good knowledge and practice in preventing ventilator-associated pneumonia (Nurul Aqilah Bt, Khin Thandar & May Khin, 2021). In another study, more than half (56.7%) of the staff nurses had excellent knowledge regarding ventilator care bundles, and 43.3% had good knowledge

regarding ventilator care bundles (Dumbre, 2019). VAP is a problem in intensive care units worldwide and dramatically increases morbidity and mortality rates on mechanically ventilated patients. It is the most common infectious complication among patients admitted to intensive care unit. Knowledge of nurses on ventilator care bundle for the prevention of VAP and adherence to them would reduce the risk of occurrence of VAP and decrease morbidity and mortality of mechanically ventilated patients in the ICU. Nursing care is growing rapidly in conjunction with technology and it is catching up with developed countries guidelines and standards of care. Nursing shortage, however, is a burden and intensive care nurses are in huge demand. The few intensive care nurses still practicing need to constantly update themselves with current knowledge and scientific evidence on many issues existent in the ICU, including VAP. The three primary recommended practices includes: elevating the head of the bed to 30 degrees, sedation vacations, oral care with chlorohexidine. The findings also show that knowledge and compliance of staff nurses regarding ventilator care bundles were found to have a significant association. However, the hospital must regularly monitor the healthcare personnel regarding the adherence to VAP guidelines to prevent hospital-acquired infection (Nurul Aqilah Bt et al., 2021).

Sulaiman et al., 2020 reported that the ICU nurses at Lahore tertiary care hospitals had poor knowledge of ventilator bundles. Also, Shaaban (2013) stated that the ICU nurses at Cairo University Hospital had inadequate knowledge regarding VAP bundles. They did not implement the latest evidenced VAP bundle practices in their current practice, and the study illustrated an absence of a uniform protocol for preventing VAP.

5.2 VAP Prevention Care Bundle Practices

The majority of the respondents had good practice with 98.9% complying with the bundle items during the care of ventilated patients. This is because the Unit Manager regularly observed the nurses applying all the care bundles checklist while managing the patient.

The result was similar to study findings among ICU nurses working at the two hospitals in Kuantan (Nurul Aqilah Bt et al., 2021). The study revealed that the ICU nurses had good practices related to VAP prevention protocol. The findings also recommended that it is very important for the Hospital management to regularly monitor the adherence to the ventilator care bundles checklist to prevent VAP-(Dumbre, 2019)

Nursing care is growing rapidly in conjunction with technology and it is catching up with developed countries guidelines and standards of care. Nursing shortage, however, is a burden and intensive care nurses are in huge demand. The intensive care nurses need to constantly update themselves with current knowledge and scientific evidence on many issues existent in the ICU, including VAP. The three primary recommended practices includes: elevating the head of the bed to 30 degrees, sedation vacations, oral care with chlorohexidine (CHG).

However, there were different outcomes from a study that Said (2012) conducted in Tanzania, which identified that the ICU nurses had adequate knowledge but did not reflect it in practice. Therefore, the ICU nurses' knowledge of VAP preventive strategies does not necessarily reflect adequate practical skills. However, knowledge remains the first step toward implementing the VAP preventive strategies.

5.3 Relationship between Levels of Knowledge for Prevention of VAP With Social Demographic Variables

The relationship between the demographic data and the level of knowledge for the prevention of VAP was well discussed in a few previous studies, as evidenced to support the result from this study. The socio-demographic data that were used in the study are gender, working hospital, and qualification, including post-basic and working experience.

5.3.1 Level of Knowledge and Age

In this study, the researcher finds a significant relationship between the level of knowledge with age. It could be said that the respondent's age

influenced the level of knowledge. In this study, most respondents were 31 - 40 years old. They have experienced registered nurses that work in ICU. In line with the study conducted by (Nurul Aqilah Bt et al., 2021) on the ICU nurses at Kuantan Hospital, 51% of the respondents were 31 – 40 years old. The P-value was 0.010.

5.3.2 Level of Knowledge and Gender

The majority of the respondents are female, and only one respondent is male. It is statistically not a significant relationship between the levels of knowledge with gender value 0.356

5.3.3 Level of Knowledge and Working Hospital

Researchers did a study from eight hospitals at KPJ Klang Valley: From the statistical analysis, working hospitals did not have a significant relationship with the level of knowledge. The variable was tested using Kruskal Wallis to identify the significance of the relationship. The p-value is 0.111, where $p > 0.05$. There is statistically not a significant relationship between the levels of knowledge with working hospitals.

5.3.4 Level of Knowledge and Qualification, Including Post Basic

Results from this study showed that most of the respondents had undergone post-basic. Only 33% are not qualified for any post-basic. Out of 67% of respondents with post-basic, 59% were qualified in critical care nursing. The studies showed a significant relationship between the levels of knowledge with qualification and post-basic. The P-value is 0.576.

5.3.5 Level of Knowledge and Working Experience

Total years of working experience might affect the knowledge level of the ICU registered nurses on the care bundle for preventing VAP. In this study, the relationship between working experience and level of knowledge was analysed. The finding showed that most respondents are more than ten years old, which is 45.2%, equal to 42 respondents. However, the relationship between working experience and knowledge level was insignificant. P-value is 0.476.

The relationship between demographic data and compliance practices for the prevention of VAP was well discussed in a few previous studies, as evidenced to support the result from this study. The socio-demographic data that would be discussed was the age, gender, working hospital, and qualification, including post-basic and working experience. Through the

analysis, there is no significant association between all the variables for demographic data and practices compliance on preventing VAP. The null hypothesis was accepted as the p-value for all the variables was more than 0.05.

Said (2012) showed no significant difference in practice between ICU nurses with different ICU training and years of working experience. However, a significant difference in practice is found between ICU nurses with different education levels.

6. Limitation and Recommendation

The limitation is defined as impacting or influencing the interpretation of the findings from the research. They are the shortcomings, conditions or influences that cannot be controlled by the researcher that place restrictions on the methodology and conclusions. In addition, the data collection method had changed from a hard copy questionnaire to a Google form (electronic) questionnaire due to the pandemic COVID19. Hence, the researcher could not monitor the progress of respondents who answered the questionnaire, and it depended on the respondent's trustworthiness. There could be bias in the knowledge of care bundle on preventing VAP as respondents might discuss or refer to other sources such as the internet. In completing this study, the researcher had difficulty collecting the respondent response, especially on practice compliance, as each unit manager was busy managing the services. However, after all the reminders and explanations, the questionnaire was done accordingly.

The result of this study achieved the study aim and found that an ICU Registered Nurse at KPJ Klang valley hospitals had good knowledge and practice on ventilator care bundle in preventing ventilator-acquired pneumonia. However, the hospital needs to monitor all the ICU regularly registered nurses to adhere to VAP guidelines to prevent VAP (Nurul Aqilah Bt et al., 2021).

There would be a few recommendations for future research if other researchers were planning to conduct the same study, such as selecting an equal sample size to conduct the study between all the organisations selected for better comparison of data and, therefore, the population value has an effect in the future study (Anderson, Kelley & Maxwell, 2017). There is a suggestion to increase the number of statements in the questionnaire of the knowledge section to assess the nurses' knowledge in a more in-depth manner and a longer time frame for this research to assess the

participants' knowledge and practices while providing care to patients that intubated and ventilated.

Besides that, the Unit Manager must emphasise the guidelines and policy of care bundle items, especially on changing the ventilator circuit. Updated guidelines are important in ensuring the latest management is applied to patients to prevent complications. A regular audit is recommended to evaluate the knowledge and practice compliance among the ICU Registered Nurses on the care bundle for preventing VAP. Awareness of the importance of ventilator care bundles helps sustain staff knowledge and include in the privileging topic, which will help continuously monitor compliance, especially for the new Registered Nurse.

7. Conclusion

The study reveals that most ICU registered nurses at KPJ Klang valley hospital have good knowledge of care bundle items to prevent VAP. Besides that, this study also proved that most ICU registered nurses at KPJ Klang valley hospital had good compliance with care bundle practices to prevent VAP.

For the socio-demographic data, there was no significant effect on the level of knowledge of care bundles for the prevention of VAP. Gender, ethnicity, working hospital, working experience and specialised certificate do not influence the level of knowledge on preventing VAP. However, there is a significant relationship between age and qualification with the level of knowledge on care bundles for the prevention of VAP.

For the practice's compliance on care bundle for prevention of VAP with socio-demographic data such as age, gender, ethnicity, working hospital, working experience, specialised certificate and qualification has no significant relationship at all.

These initial results concentrated on education based on a need assessment of nurses, leadership support to encourage clinical practice and continuous monitoring and educating the nurses by evaluating using a competency checklist. This confirms that infection prevention policy and procedure are agreed upon and correctly implemented.

Acknowledgement

The researcher is grateful to all the ICU Registered Nurses in this research project. The researcher is very thankful to the author for the permit to use the questionnaire to be conducted.

8. Reference

1. Al-Rawajfah, O.M., Hweidi, I.M., Alkhalaileh, M., Khader, Y.S. and Alshboul, S.A. (2013). Compliance of Jordanian registered nurses with infection control guidelines: A national population-based study. *American Journal of Infection Control* 41(11): 1065–1068. <https://doi.org/10.1016/j.ajic.2013.05.008>.
2. Aziz, Z., Kausar, S., Zahid, S., Farooqi, S., Aziz, Z. and Ahmad, R.A. (2020). Knowledge and practice of ventilator care bundle for preventing ventilator associated pneumonia by ICU nurses of tertiary care hospitals of Lahore. *Anaesthesia, Pain and Intensive Care* 24(4): 426–434. <https://doi.org/10.35975/apic.v24i4.1315>.
3. Bird, D., Zambuto, A., O'Donnell, C., Silva, J., Korn, C., Burke, R., Burke, P. and Agarwal, S. (2010). Adherence to ventilator-associated pneumonia bundle and incidence of ventilator-associated pneumonia in the surgical intensive care unit. *Archives of Surgery* 145(5): 465–470. <https://doi.org/10.1001/archsurg.2010.69>.
4. Dumbre, D.U. (2019). A study to assess the knowledge and compliance of critical care nurses regarding ventilator care bundle in prevention of ventilator associated pneumonia. *Medico-Legal Update* 19(1): 176–178. <https://doi.org/10.5958/0974-1283.2019.00035.5>.
5. Norazlin, A.M. and Norzakira, J. (2019). Critical Care Nurses Knowledge in Prevention of Ventilator-Associated Pneumonia. *ILKKM Journal Medical and Health Sciences* 1(1): 25–30. <http://rig.ilkkm.org.my/journal>.
6. Nurul Aqilah Bt, S., Khin Thandar, A. and May Khin, S. (2021). Critical Care Nurses' Knowledge and Practices on Ventilator-Associated Pneumonia. *International Archives of Nursing and Health Care* 7(3): 1–5. <https://doi.org/10.23937/2469-5823/1510163>.
7. Shaaban, N. (2013). Critical Care Nurses' Knowledge and Compliance with Ventilator Associated Pneumonia Bundle at Cairo University Hospitals 4(15): 66–78.
8. Soh, K.. (2012). Improving health outcomes by preventing intensive care related infection in Malaysia Intensive Care Unit (INVEST study)(January): 56–58.
9. Sulaiman, H., Salihah, A., Mazhar, A., Abdul Aziz, M.H., Hasan, M.S., Hairi, F., Mat Nor, B., Kamarulzaman, A. and Roberts, J. (2020). Knowledge and practice survey of clinicians on the management of ventilator-associated pneumonia (VAP) in Malaysia. *International Journal of Infectious Diseases* 101: 96. <https://doi.org/10.1016/j.ijid.2020.09.274>.
10. Wip, C. and Napolitano, L. (2009). Bundles to prevent ventilator-associated pneumonia: How valuable are they? *Current Opinion in Infectious Diseases* 22(2): 159–166. <https://doi.org/10.1097/QCO.0b013e3283295e7b>.