

# Knowledge of Ventilator Care Bundles among Registered Nurses in the Intensive Care Unit at Sarawak General Hospital, Malaysia

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## ABSTRACT

**INTRODUCTION:** Ventilator Care Bundles (VCB) is a group of evidence-based high-impact interventions for mechanically ventilated patients. The study aims to identify the knowledge of VCB among Intensive Care Unit (ICU) nurses at the local hospital in Sarawak, Malaysia. **MATERIALS AND METHODS:** A quantitative cross-sectional survey was conducted among 30 nurses who worked in the ICU at Sarawak General Hospital, Malaysia. A modified questionnaire with 20 items was used to measure the level of knowledge. Data analysis was performed using the Statistical Package for the Social Sciences Statistics 26.0 for Windows with  $p < 0.05$  was considered statistically significant. **RESULTS:** The results revealed that 86.7% ( $n=30$ ) of respondents had a high-level knowledge of the VCB. There is a significant relationship between the level of knowledge of VCB and qualification as a Registered Nurse ( $p=0.03$ ), ICU post-basic qualification ( $p=0.02$ ), and level of nursing education ( $p<0.001$ ). The level of knowledge was significantly related to the level of education ( $r=0.71$ ;  $p<0.001$ ), the number of years qualified as a registered nurse ( $r=0.38$ ;  $p=0.03$ ), and post-basic qualification ( $r=0.42$ ;  $p=0.02$ ). **CONCLUSION:** The good level of knowledge regarding VCB implementation among registered nurses indicates that they are well-equipped with the proper knowledge for caring for mechanically ventilated patients.

### Keywords

Ventilator Care Bundle, Knowledge, Intensive Care, Nurses

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## INTRODUCTION

One of the life-saving interventions in critical care units for patients with respiratory failure is mechanical ventilation. The use of a ventilators can unquestionably save lives, but in some patients who are not expected to survive, this kind of treatment may only serve to delay death. Other patients treated with mechanical ventilation may survive but do not improve to the point where they can become ventilator-independent. Unsurprisingly, mechanical ventilation frequently exposes patients to ventilator-associated pneumonia (VAP) when assisting patients with respiratory failure. A previous study reported that ventilator-associated pneumonia occurs in 10% to 20% of patients who receive mechanical ventilation for more than 48 hours, prolonging their hospitalization<sup>1</sup>. Of

particular concern is that ventilator-associated pneumonia was highlighted as the second-worst hospital-transmitted infection, significantly increasing the morbidity and mortality rate among patients with mechanical ventilation<sup>2</sup>.

Worldwide, the prevalence of VAP is 12.6%; in the United States of America, it is 13.5%; in Europe, 19.4%; in Latin America, 13.8%; and in South Asia, it is 16%<sup>2</sup>. In Malaysia, the incidence of VAP varies from 9% to 27%<sup>3</sup>. In addition, recent data from the Malaysian Registry<sup>4</sup> reported that the rate of VAP was 1.6 per 1000 ventilator days. Thus, there is an urgent need to address strategies to help lower the rate of VAP and its complications.

One of the most significant current discussions is the impact of ventilator care bundles (VCB) and VAP. Previous research has established that VCB is of the utmost importance for adequate ventilation and preventing complications of mechanical ventilation<sup>5,6,7</sup>. The VCB protocol, as described by Wolfensberger et al. (2020), entails several different steps, some of which are: elevating the head of the bed by 30–45 degrees, taking a break from sedation once per day, preventing pressure ulcers and deep vein thrombosis, and performing daily oral hygiene<sup>8</sup>. Consequently, nurses are in the best position to practice VCB interventions because, most of the time, they are at the bedside of intubated patients<sup>8,9</sup>.

Previous studies found a significant relationship between knowledge and compliance with VCB among nurses<sup>10,11</sup>. Alotaibi (2016) showed that a nurse with sufficient knowledge will have a positive attitude toward VCB, especially in the oral care of the patients<sup>12</sup>. Compliance with VCB was also associated with working shifts, consistent training, and years of experience, especially in the Intensive Care Unit (ICU).<sup>10,11</sup> However, according to some studies, nurses working in the ICU have poor knowledge of VCB.<sup>2,13,14</sup> Of particular concern is that their practices did not meet the standard of procedure on VCB.<sup>2,5</sup> The main barriers in this regard are a lack of education and time to follow up on institutional protocols and policies and a staff shortage<sup>2,13,14,15</sup>. Dipanjali et al. (2020) highlighted that a lack of knowledge of VAP is the main reason the nurses could not adhere to and translate evidence-based findings into consistently delivered patient care.<sup>13</sup>

A key issue is that poor knowledge may have been associated with poor practice of VCB by the nurses. Knowledge of nurses about using the ventilator bundle to prevent VAP significantly affected subsequent clinical practices.<sup>16</sup> It is believed that with proper implementation of VCB, ventilator-related complication prevention can be achieved.<sup>13,17</sup> Thus, serious attention needs to be taken into accounts based on the knowledge of VCB among nurses to enhance quality patient care outcomes. Nonetheless, the results of previous studies prove that the situation is uncertain and debate continues about the

best strategies for managing VCB. Indeed, very little is currently known about the knowledge on VCB among nurses in Sarawak, Malaysia. Therefore, this survey was conducted to identify the knowledge of ICU nurses related to VCB at Sarawak General Hospital. The findings should make an important contribution to the field of nursing practices in order to enhance knowledge of VCB.

## **MATERIALS AND METHODS**

### **Study Design and Participants**

This quantitative cross-sectional study is aimed to identify the level of knowledge on VCB and investigate its association with sociodemographic variables among 30 ICU nurses working in the hospital. This study design was chosen because it gives information that fits each method used to get more meaningful information about the VCB<sup>18</sup>. Additionally, research participants in this study were selected using the cluster probability sampling technique. The exclusion criteria included nurses on maternity or long leave during data collection.

### **Research Tool**

All the data was obtained through questionnaires, allowing respondents to complete the questionnaire independently. Before collecting the data, the participants were briefly informed about the study. Most respondents needed about 20 to 30 minutes to complete the questionnaires, and they had to return them to the researcher in person or by mail.

The level of knowledge of VCB was measured using the questionnaire developed by Said (2012). The questionnaire consisted of 20 items in English and was translated into Bahasa Malaysia. The original instrument had good internal reliability with a Cronbach alpha of 0.78<sup>19</sup>. Meanwhile, the translated version has internal reliability consistent with Cronbach's coefficient of 0.75, indicating an acceptable reliability level. The total scores for this instrument ranged between 0 and 60. Scores below 30 showed a low knowledge of VCB, while scores between 31 and 60 showed high knowledge of VCB.

## Ethics, consent, and permission

This research study was based on the ethical principles of autonomy, beneficence, confidentiality, and anonymity used to protect people's rights. The research ethics committee approved the study prior to conducting the study. All participants provided written informed consent before participation.

## Data Analysis

Data was analyzed using IBM Statistical Package for the Social Sciences (SPSS) Statistics 26.0 for Windows. This study included both descriptive and inferential analysis. The significance level is set at  $p < 0.05$ .

## RESULTS

### Data Socio-demographic

The response rate in this study was 100%. In addition, the result of as shown in the Table 1. The majority of respondents were qualified as nurses within five to ten years (70%), were diploma holders (90.0%), and did not have post-basic critical care (60%). The findings also revealed that 66.7% of the respondents had experience working in the ICU for five to ten years.

**Table I:** Sociodemographic data (n=30)

|  | Frequencies | %     |
|--|-------------|-------|
| <b>Qualification as a Registered Nurse</b> |             |       |
| < 5 years                                  | 9           | 30.0  |
| 5 - 10 years                               | 21          | 70.0  |
| <b>Level of Nursing Education</b>          |             |       |
| Diploma                                    | 27          | 90.0  |
| Bachelor Degree                            | 3           | 10.0  |
| <b>Post basic qualification</b>            |             |       |
| No   | 18          | 60.00 |
| Yes  | 12          | 40.00 |
| <b>Length of Service in ICU</b>            |             |       |
| <5 years                                   | 10          | 33.3  |
| 5 -10 years                                | 20          | 66.7  |

### Knowledge of the Ventilator Care Bundles

In this study, 29 respondents strongly agreed with the statements "frequency and percentage of responses on disposal of suction catheter", "endotracheal insertion of the suction catheter", and "range of head of the bed elevation". Furthermore, 90% of respondents strongly disagreed with the following statements: "the frequency of

ETT suctioning should be done to a patient," "the influence of early weaning on the risk for VAP," and "the role of maintaining adequate cuff pressure during ventilated patient care". 26.7% of respondents chose to disagree because of the maintenance of a high nurse-to-patient ratio in a critical care setting. Table II details the knowledge on the VCB among the respondents.

**Table II:** Knowledge on the Ventilator Care Bundle among respondents (n=30)

| No | Response   | Strongly disagree | Disagree | Agree    | Strongly agree |
|----|--|-------------------|----------|----------|----------------|
| 1  | The best recommended route when intubating a patient.  | 6(20.0)           | 1(3.3)   | 0        | 23(76.7)       |
| 2  | Response Frequency and percentage of response on the reason for best recommended route when intubating a patient | 3(10.0)           | 0        | 1(3.3)   | 26(86.7)       |
| 3  | Frequency and percentage of response on disposal of suction catheter.  | 0                 | 0        | 1(3.3)   | 29(96.7)       |
| 4  | The feedback regarding the frequency recommended to change humidifiers.  | 0                 | 1(3.3)   | 4(13.3)  | 25(83.4)       |
| 5  | Endotracheal Insertion of the Suction Catheter.  | 0                 | 0        | 1(3.3)   | 29(96.7)       |
| 6  | Response on dusting of respiratory and bedside equipment with antiseptic.  | 0                 | 0        | 2(6.7)   | 28 (93.3)      |
| 7  | Range of Head of the Bed Elevation.  | 0                 | 0        | 1(3.3)   | 29( 96.7)      |
| 8  | The respondent as to when be the time the nurse caring a ventilated patient is required to wear sterile gloves.  | 19(63.4)          | 0        | 1(3.3)   | 10 (33.3)      |
| 9  | The time a nurse caring a ventilated patient is required to wash hands.  | 18(60.0)          | 0        | 1(3.3)   | 11 (36.7)      |
| 10 | Response on using swab moistened with mouth was and water to perform oral care.                                  | 23(76.7)          | 0        | 0        | 7(23.3)        |
| 11 | The prolonged use of stress ulcer prophylaxis to a ventilated patient.   | 5(16.7)           | 1(3.3)   | 11(36.7) | 13 (43.3)      |
| 12 | The reason of maintenance of a high nurse to patient ratio in critical care setting.                             | 6(20.0)           | 8(26.7)  | 3(10.0)  | 13 (43.3)      |
| 13 | The reason of continuous education to ICU nurses on prevention of nosocomial infection.                          | 4(13.3)           | 5(16.7)  | 2(6.7)   | 19 (63.3)      |
| 14 | The influence of adjustable or non-adjustable bed has upon the risk for VAP.                                     | 22(73.3)          | 0        | 0        | 8(26.7)        |
| 15 | The influence of adjustable or non-adjustable bed has upon the risk for VAP.                                     | 4(13.3)           | 0        | 4(13.3)  | 22(73.4)       |
| 16 | The frequency of ETT suctioning should be done to patient.   | 27(90.0)          | 0        | 0        | 3 (10.0)       |
| 17 | The influence of early weaning to the risk for VAP.  | 27(90.0)          | 0        | 0        | 3(10.0)        |
| 18 | The association of over feeding a ventilated patient with risk for VAP.  | 5(16.7)           | 7(23.3)  | 3(10.0)  | 15 (50.0)      |
| 19 | The role of maintaining adequate cuff pressure during the care of ventilated patient.                            | 27(90.0)          | 0        | 0        | 3 (10.0)       |
| 20 | Association of unplanned extubation with increased risk of aspiration.   | 4(13.3)           | 2(6.7)   | 1(3.3)   | 23(76.7)       |

Furthermore, the level of knowledge on the Ventilator Care Bundle was divided into low and high (Table III). Results reported that 86.7% of respondents had a high-level knowledge of Ventilator Care Bundle implementation.

**Table III** Level knowledge on Ventilator Care Bundle implementation (n=30)

| Level of Knowledge | Frequency | Percentage (%) | Mean (Std. Deviation) |
|--------------------|-----------|----------------|-----------------------|
| Low knowledge      | 4         | 13.3           | 0.87 ( $\pm$ 0.35)    |
| High knowledge     | 26        | 86.7           |                       |

### Relationship between Socio-demographic and Knowledge of Ventilator Care Bundle

The results in this study indicated that respondents who had high knowledge of VCB were among nurses who qualified for five to ten years (50.0%), had a bachelor's degree (76.67%), and had an Intensive Care post-basic (53.34%). Likewise, the results of the chi-square analysis showed a significant relationship between the level of knowledge of VCB and qualification as a registered nurse ( $\chi^2=4.62$ ;  $p=0.03$ ), intensive care post-basic qualification ( $\chi^2=5.28$ ;  $p=0.02$ ), and level of nursing education ( $\chi^2=15.17$ ;  $p<0.001$ ). The results of this study are in Table IV.

**Table IV:** Relationship between socio-demographic and knowledge of VCB (n=30)

| Socio-Demographic Characteristics              | Level of Knowledge |            | $\chi^2$ | p-value |
|--|--------------------|------------|----------|---------|
|  | Low                | High       |          |         |
| <b>Qualification as a Registered Nurse</b>     |                    |            | 4.62     | 0.03    |
| < 5 years                                      | 4 (13.33)          | 11 (36.67) |          |         |
| 5 - 10 years                                   | 0(0.00)            | 15 (50.00) |          |         |
| <b>Level of Nursing Education</b>              |                    |            | 15.17    | <0.001  |
| Bachelor Degree                                | 4 (13.33)          | 3(10.00)   |          |         |
| Diploma  | 0 (0.00)           | 23(76.67)  |          |         |
| <b>Length of Service in ICU</b>                |                    |            | 3.53     | 0.06    |
| <5 years                                       | 4 (13.33)          | 13 (43.34) |          |         |
| 5 -10 years                                    | 0 (0.00)           | 13 (43.33) |          |         |
| <b>Intensive care Post basic qualification</b> |                    |            | 5.28     | 0.02    |
| No   | 4(13.33)           | 10(33.33)  |          |         |
| Yes  | 0 (0.00)           | 16(53.34)  |          |         |

*df=1; P>0.05*

### Association between Socio-demographic Factors and Knowledge of VCB

The association between socio-demographic and knowledge of VCB among the ICU nurses was determined using Spearman's rho correlation coefficient analysis. Based on the findings (Table IV), it was revealed that the level of knowledge of VCB is strongly positively associated with the level of nursing education ( $r=0.71$ ;  $p<0.001$ ). Moreover, the level of knowledge of VCB was

also associated positively with moderate strength with the number of years qualified as a registered nurse ( $r=0.39$ ;  $p=0.003$ ) and Intensive Care post-basic ( $r=0.42$ ;  $p=0.02$ ). The results implied that, as the respondents experienced more as registered nurses or had a higher level of education, they tended to have higher knowledge regarding VCB implementation.

**Table IV:** correlation between socio-demographic and knowledge of VCB (n=30)

| Variables                               | 1              | 2                | 3               | 4              | 5 |
|---|----------------|------------------|-----------------|----------------|---|
| Qualification as a Registered Nurse     | +              |                  |                 |                |   |
| Education Level                         | 0.55**<br>0.02 | +                |                 |                |   |
| Length of Working in ICU                | 0.87**<br>0.00 | 0.48**<br>0.01   | +               |                |   |
| Intensive Care Post Basic Qualification | -0.40*<br>0.03 | 0.12<br>0.54     | -0.53**<br>0.03 | +              |   |
| Level of knowledge                      | 0.39*<br>0.03  | 0.71**<br><0.001 | 0.34<br>0.06    | 0.42**<br>0.02 | + |

*P<.005*

*\*\* Correlation is significant at the 0.01 level (2-tailed).*

*\* Correlation is significant at the 0.05 level (2-tailed).*

### DISCUSSION

This study aimed to identify the level of knowledge about VCB and to investigate its association with socio-demographic variables among 30 ICU nurses working in a Sarawak General Hospital, Malaysia. The level of knowledge of VCB was measured using the 20 items of the questionnaire developed by Said (2012). This study showed that most respondents were qualified registered nurses with experience working in the ICU for more than five years. Most of them were diploma holders and did not have specific post-basic training in critical care nursing. One interesting finding is that more than half of nurses in the ICU had a high level of knowledge regarding the VCB implementation. Nurses who qualified more than five years ago with a bachelor's degree or had post-basic intensive care training were the ones who had high knowledge of VCB.

Similar to the present results, previous studies have demonstrated that nurses had good knowledge of VCB.<sup>10,11,20,21,22</sup> Indeed, the nurses who had high knowledge of VCB were significantly more compliant with VCB guidelines.<sup>21,22,23</sup> Several studies, however, have reported that high VCB knowledge among nurses is primarily due to frequent training on the job and the impact of continuing nursing education.<sup>11,24</sup> Branco et al.

(2020) found that nurses were more likely to follow the VAP bundle after continuing their education and that compliance went up right after they were taught about it.<sup>25</sup> Thus, the most important factor for a good outcome among patients is when the ICU nurses were educated on the VCB.<sup>26</sup>

Nevertheless, previous studies have reported that ICU nurses have poor knowledge of VCB. Contrary to expectations, the poor knowledge has influenced nurses' practice, which is unsatisfactory and does not meet the standard criteria.<sup>2</sup> However, according to Santos et al. (2021) and Alotaibi (2016), adherence to VCB and VAP interventions showed a reduction in utilization but no significant reduction in the VAP rate. This inconsistency may be due to a lack of policies and protocols, a shortage of resources and human resources, especially ICU nurses.<sup>5,13</sup> Some researchers, however, revealed that a lack of time and a failure to follow-up on institutional protocols are the causes of non-compliance with practices.<sup>2</sup> This is very important because it cannot prevent ventilator-associated pneumonia. Meanwhile, Dipanjali et al. (2020) highlighted that a lack of knowledge of VAP was why they could not adhere to and translate the evidence-based findings into consistently delivered care.

In our study, the knowledge of VCB is significantly associated with the level of nursing education, the number of years qualified as a registered nurse, and post-basic in ICU. These findings were consistent with Ab Manap and Jailani's study (2019), whose reported level of knowledge was associated significantly with years of experience in nursing and certificates in or post-basic Intensive Care Nursing. It showed that years of experience in nursing are similar to the number of years qualified as a registered nurse. A previous study reported that less experienced nurses reported significantly higher adherence than nurses with more ICU experience.<sup>27</sup> Indeed, lack of education becomes a significant barrier related to the low altitude in VCB. They identified that nurses with more experience and previous education on VAP reported higher compliance with the guidelines of the VCB than Aloush and Al-Rawaifa (2020). In contrast, Yeganeh et al. (2021) study in which they reported that there was no significant

relation between knowledge score among nurses and their work experience and level of education.<sup>28</sup> Indeed, the level of knowledge appears to be similar for both less and longer experienced in ICU.<sup>29</sup>

Excellent knowledge among ICU nurses is crucial for the critical care setting as part of the prevention strategies of the risk for VAP. This means they are well-equipped with the proper knowledge in caring for mechanically ventilated patients using the VCB approach. Our result showed that nurses' awareness of VAP prevention and VCB implementation is high and that they also have high level of knowledge of the theoretical practice. However, on individual item assessment, the majority of the nurses showed misconception on some of the VCB practice. ICU nurses have complete and fruitful knowledge about the VCB to protect patients from diseases. The most important for the excellent quality patient outcome is when the ICU nurses are educated on the VCB.<sup>26</sup>

Consequently, our findings may help the development of evidence-based for health education measures, particularly concerning issues of practicing VCB among ICU nurses in Malaysia. The ICU nurses need to be encouraged to translate their knowledge into practice. Indeed, the ICU nurses should be exposed to continuous education on implementing VCB and the risk of VAP in critical care. The emphasis should be placed on equipping themselves with up-to-date information and knowledge to ensure quality patient care. Furthermore, the learning should include proper handling and implementation of VCB. Moreover, these results can be used as baseline data in planning continuous nursing education to maintain the VCB practicing standards at the maximum point.

## STUDY LIMITATIONS

This research has limitations, such as the use of cross-sectional data from a particular point in time, which makes it more challenging to conclude cause and effect. Furthermore, our sample size was small, and the assessment of knowledge was based solely on a set of validated questionnaires. We also did not directly correlate VAP bundle adherence with VAP rates. As a result, our findings cannot be applied to other hospitals in Malaysia.

## CONCLUSIONS AND RECOMMENDATIONS

More than half of ICU nurses in hospitals in Sarawak had a high knowledge of VCB. Knowledge of VCB was significantly associated with factors such as level of education, length of time since becoming a registered nurse and had ICU post basic qualification. The high degree of VCB implementation knowledge among ICU nurses implies that they are well-versed in the care of mechanically ventilated patients. Several suggestions for improvement are made based on the results of this study, including other studies with different designs, comparison studies, and single intervention studies.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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