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Impact of Care Bundle on Prevention of Ventilator Associated Pneumonia in an Adult Intensive Care Unit at a Rural Tertiary Teaching Hospital

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Abstract

Objectives: To evaluate the incidence of ventilator associated pneumonia (VAP) before and after implementation of VAP Care bundle and to correlate incidence of VAP with Care bundle compliance. *Methods:* This is a prospective study conducted in an adult intensive care unit (ICU) from August 2016 to July 2018. Active surveillance of VAP cases was carried out and incidence was calculated as per CDC definition. The VAP Care bundle with following elements was introduced after training; head end elevation by 30^0, Chlorhexidine mouth care 6^{th} hourly, daily sedation vacation and assessing readiness to wean from ventilator, peptic ulcer and DVT prophylaxis. To study the effect of Care bundle on incidence of VAP, 2 year retrospective data before Care bundle implementation was collected and analyzed. Care bundle compliance was assessed using a checklist for each intubated patient. *Results:* The incidence of VAP was 9.87 and 2.92 per 1000 ventilator days before and after implementation of Care bundle respectively. The reduction in average incidence of VAP rate before and after implementation of Care bundle is 6.95 per 1000 ventilator days with $p<0.005$ which is highly significant. The overall VAP bundle compliance rate was 80.33% with significant statistical correlation between the VAP rate and its bundle compliance ($p<0.005$). *Conclusion:* Significant reduction in the incidence of VAP rate can be achieved with strict adherence to VAP Care bundle, periodic training of health care workers with regard to infection control practices and active surveillance by the infection control team.

Keywords: VAP Care bundle; VAP incidence rate; bundle compliance.

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Introduction

Ventilator associated pneumonia (VAP) is the most common device associated infection in Intensive Care Unit (ICU) [1,2]. VAP is defined as the pneumonia that develops in a patient after 48 hours of mechanical ventilation [3,4]. Ventilator Care bundles have found their greatest application in the prevention of VAP [5].

Care bundle is a set of scientifically evidenced elements in patient care, that when implemented together, results in better patient outcome [6]. Formulating the Care bundle protocol, training of health care workers and strict adherence to the Care bundle practice in ICU are essential in reducing the incidence of VAP. The use of Care bundle has been reported to decrease the incidence of VAP [7]. Many hospitals in developing countries

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do not follow Care bundles and even if followed, the effectiveness of the bundle to prevent VAP has not been studied much [8,9].

The aim of this study is to evaluate the incidence rate of VAP before and after implementation of Care bundle and to correlate the incidence of VAP with Care bundle compliance rate.

Materials and Methods

This is a prospective study conducted in a 14 bedded Adult ICU from August 2016 to July 2018. Active surveillance of Ventilator associated Pneumonia cases was carried out regularly by the Hospital infection control team with the help of Intensivist and was validated based on Centre for Disease Control and Prevention (CDC) criteria. Incidence of VAP was calculated on monthly basis based on occurrences per 1000 ventilator days as per CDC definition [3,4] and was monitored throughout the study period.

Care bundle for VAP was implemented in a full-fledged manner in August 2016 after conducting training for Nurses, Postgraduates and Staff. The training emphasised on the consequences of VAP and the importance of implementation of Care bundle to prevent the incidence of VAP, thereby reducing morbidity and mortality in patients on ventilator. The VAP Care bundle included the following five elements; head end elevation by 30^0, Chlorhexidine (0.2%) mouth care 6^{th} hourly, daily sedation vacation for assessing readiness to wean from ventilator, peptic ulcer disease prophylaxis and deep venous thrombosis prophylaxis [6,7]. In addition, basic infection control measures were also applied to all patients which included hand hygiene and standard precautions.

Compliance with the bundle was assessed using a checklist covering all the Care bundle elements for each patient on ventilator. During the daily rounds, intensive care team would check and record the compliance for the five elements of the VAP bundle. The entire bundle was considered compliant only if all the five elements were executed. A bundle was considered noncompliant if any element was not performed. If there was any contraindication for a bundle element, then the patient was considered compliant with regard to that element of Care bundle. Compliance data was collected during the study period and the rate was calculated as a percentage.

To study the effect of Care bundle on VAP rates, two years retrospective data on the VAP rate from August 2014 to July 2016, before Care bundle implementation was collected by reviewing the records from the ICU and Hospital infection control surveillance data. VAP rates were compared before and after implementation.

Statistical analysis

Data was entered into microsoft excel and was analyzed with Statistical Package for Social Sciences (SPSS) version 22 (IBM SPSS Statistics, Somers NY, USA). To compare the difference in the VAP incidence rates before and after Care bundle implementation and to find out the statistical significance, 'Z' test was used. Compliance rate of Care bundle was calculated as a percentage.

Results

During the study period from August 2016 to July 2018, there were 1130 patients who were on mechanical ventilator, with 2731 ventilator days in ICU. The overall VAP incidence rate during this period was 2.92/1000 ventilator days. The incidence rate and trend of VAP from August 2016 to July 2018 is shown in Figure 1. The average incidence

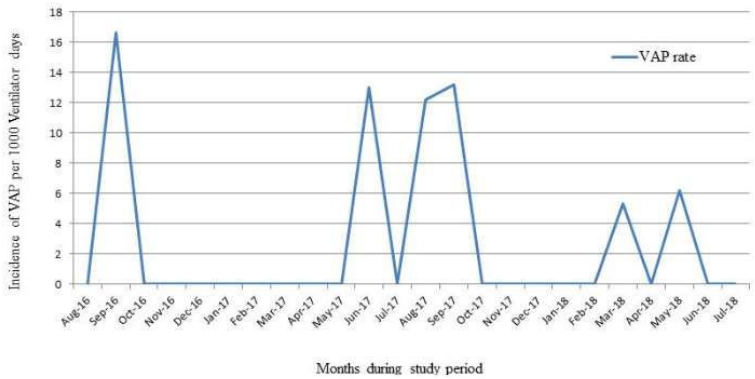

Fig. 1: Incidence of VAP after implementation of VAP Care bundle

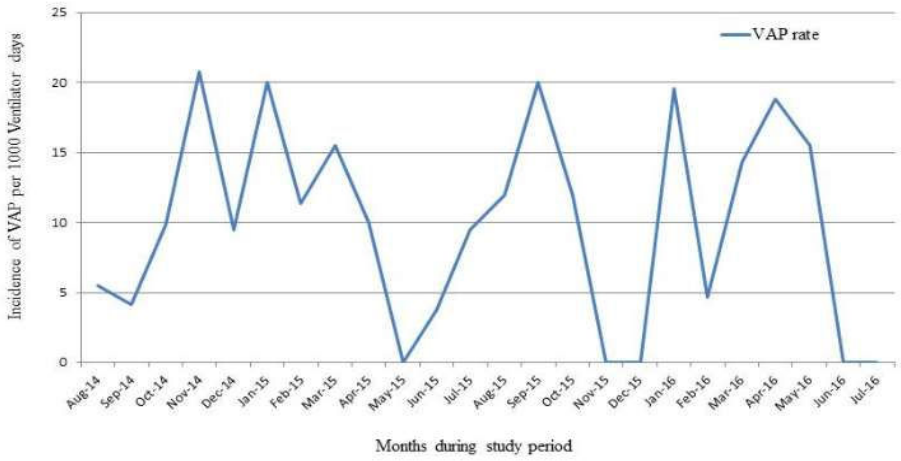

Fig. 2: Incidence of VAP before implementation of VAP Care bundle

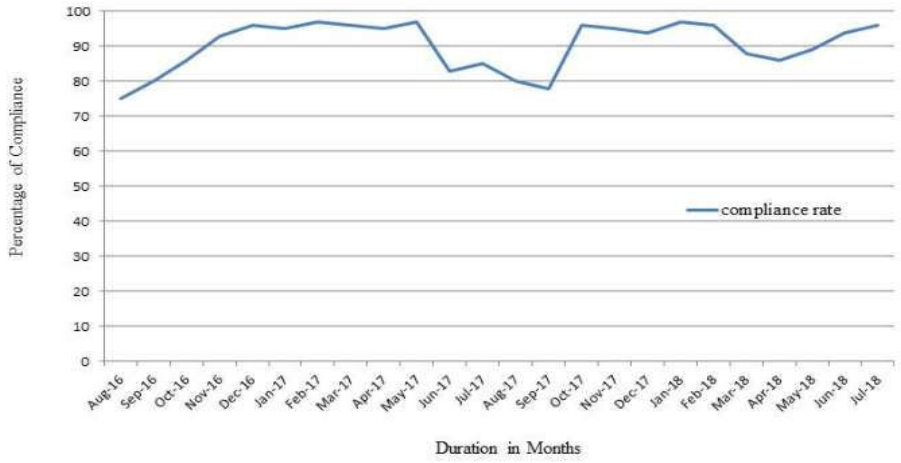

Fig. 3: VAP Care bundle compliance rate

rate of VAP from August 2014 to July 2016 before the implementation of Care bundle was 9.87/1000 ventilator days and is shown in Figure 2.

The reduction in average incidence of VAP rate after implementation of Care bundle was 6.95/1000 ventilator days. Statistical significance of difference in VAP rates before and after implementation of Care bundle by Z test at 95% confidence interval showed that the difference ranged from as low as 1.3 to as high as 13.2/1000 ventilator days with a p value of < 0.005 which is highly significant.

The overall VAP Care bundle compliance rate was found to be 80.33%. To begin with, the compliance rate was 75%, for which repeated education and training was conducted for health care workers. Later, the compliance rate reached 95%. The compliance rate of ventilator Care bundle is shown in Figure 3. There was significant statistical correlation between the VAP rate and its bundle compliance ($p < 0.005$).

The most frequent pathogens isolated were *Pseudomonas aeruginosa, Acinetobacter species and Klebsiella pneumoniae.*

Discussion

Ventilator associated pneumonia is the most common device associated infection in intensive care unit [2]. VAP leads to increased duration of mechanical ventilation and longer duration of stay in ICU, thereby, increasing the cost of healthcare and also associated with higher mortality [11-13]. The Study on Efficacy of Nosocomial infection control (SENIC) concluded that, with proper surveillance programs in place, 22% of nosocomial pneumonias are preventable [14].

Surveillance has been recognized as the major component of infection control programs. It has been proven that, there is a definite decrease in health care associated infection rates in the hospitals with established surveillance programs that are followed strictly over a period of time [14]. Studies have also shown that, by following evidence based strategies like VAP Care bundle, incidence of VAP can be decreased [10,15]. However, many health care organizations in developing countries like India have neither active surveillance programs nor incorporate VAP Care bundles to prevent VAP.

The VAP Care bundle was designed as a strategy to improve the care of mechanically ventilated patients [5]. Study done by Kamel Abd Elaziz Mohammed concluded that, VAP incidence rate was decreased from 34% to 18% after introducing VAP Care bundle and the VAP bundle compliance rate was > 80% during the study period [10]. Another study done by Syed Z. Bukhari et al., showed that, VAP rate was decreased from 3.39 to 1.98 per 1000 ventilator days after introducing VAP Care bundle and the VAP bundle compliance reached 100% after few months of implementation of VAP bundle [15].

The present study also showed that, there was a significant reduction of VAP rate from 9.87 to 2.92 per 1000 ventilator days after introducing VAP Care bundle. It was observed that the reduction in the incidence of VAP correlates well with the increase in bundle compliance rate. The bundle compliance rate increased to more than 95% after few months of introduction of Care bundle. The higher bundle compliance rate could be achieved and sustained in most of the months during study period due to effective and repeated training of health care workers. In our study, we were able to achieve VAP rate of zero in many months except for a few spikes after introducing the bundle. Root cause analysis was done to find out the reason for rise in VAP rate after implementing Care bundle. The root cause for the initial spike was attributed to lesser VAP bundle compliance rate (about 70%) during the initial few months of VAP bundle introduction. The second spike was observed between May 2017 and October 2017 and the root cause analysis concluded that, the rise of VAP rate was due to admission of newer post graduates and appointment of newer nursing staff in ICU who were unaware of the Care bundle and infection control practices, thereby leading to decreased bundle compliance. Few other studies also complimented our root cause analysis by concluding that, VAP bundle compliance rate was indirectly proportional to VAP incidence rate [15,16,17].

In addition to VAP bundle care components, our health care workers were also well compliant with hand hygiene practices and using appropriate personal protective equipments like goggles, cap, mask, gloves, gowns, plastic aprons and shoe covers when required during patient care.

Continued surveillance, re-education and reinforcement should be a part of strong infection prevention program [18]. In this regard our hospital infection control team ensured that, there was strict surveillance of infection control practices in the hospital and periodic infection control training programs were organized to educate and re-educate all the health care workers involved in patient care. In addition, regular monthly audits were done with regard to health care associated infections and would discuss the root cause analysis, preventive and corrective actions to be taken following hospital acquired infections.

Conclusion

In conclusion, significant reduction in the incidence of VAP rate can be achieved with strict adherence to VAP Care bundle, periodic training of health care workers with regard to infection control practices and active surveillance by the infection control team. This study would also help in strengthening the infection control practices to prevent VAP in critical care unit, especially in resource limited settings.

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