

## ORIGINAL ARTICLE

# Compliance and Association of Ventilator Associated Pneumonia Bundle Strategy With Ventilator Associated Pneumonia rate: A Saudi Experience

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### ABSTRACT:

**Objectives:** To evaluate the effectiveness and compliance of Ventilator Associated Pneumonia(VAP) care bundle in local setting at Erfan & Bagedo General hospital, Jeddah, KSA.

**Materials and Methods:** The study was a Quasi experimental before and after observation type of study, in which VAP care bundle was implemented to the ventilated patients without any control group. It was conducted from February 2010 to January 2011.

**Results:** Out of a total of 3011 patient ventilator days, 18 patient developed VAP. Number of VAP care bundle implementation increased from 42 (17.36%) in February 2010 to 315 (91.8%) in October 2010. However the implementation rate was 100% during November, December 2010 and January 2011. VAP rate dropped from 8.85/1000 ventilator days in February 2010 to 3.15 in January 2011.

**Conclusion:** There was a strong negative correlation between proportion of implementation of VAP care bundle and VAP rate ( $r = -0.534$  p value=0.037 for one tailed test). Adopting VAP care bundle approach may help in reducing the morbidity and mortality in the ventilated patients.

**Keywords:** Ventilator Associated Pneumonia, Compliance, Infection, VAP care bundle, Saudi Arabia

### INTRODUCTION:

Ventilator Associated Pneumonia (VAP), one of Healthcare Acquired Infections (HAIs) associated with intensive care units (ICU) of hospitals is a major challenge for health professionals these days. It is one of the most common hospital infections among the ventilated patients<sup>1, 2, 3</sup>. It has serious implication as it continues to pose potentially fatal complication of ventilation care<sup>4</sup>. It results in load on health resources associated with increase morbidity and mortality.<sup>5,6,7,8,9</sup> VAP is further divided into two; early-onset pneumonia (That occurs within 48-72 hours) and late-onset pneumonia (72 hours or more after intubation). Incidence of pneumonia varies from 9% to 68%<sup>9</sup> and 90% of all HAIs in mechanically ventilated patients are attributed to VAP.<sup>10</sup> Increase prevalence of VAP is associated with the following risk factors identified by various studies. Most common microorganisms include Streptococcus pneumoniae, Haemophilus influenzae, and Moraxella catarrhalis. Late-onset VAP occurs 5 or more days after intubation. Staphylococcus aureus, Acinetobacter baumannii, Pseudomonas aeruginosa, Klebsiella pneumoniae, and Enterobacter are some of the most prevalent microorganisms reported for late-onset VAP.

Common risk factors for VAP include; supine position, endotracheal, nasogastric and enteral feeding tubes, sedation, impaired mental status, poor oral hygiene, gastric alkalization, inadequate hand washing, period of mechanical ventilation, prolonged antibiotic use,

preexisting comorbidities, invasive procedure, hospital environment and contact with other.<sup>11</sup>

There were various strategies applied for the prevention of VAP but no single strategy was effective in reducing VAP significantly. Hence a number of strategies identified to be implemented. Grap and Munro 1997 demonstrated that a supine position instead of elevation of head of bed (HOB) increased the chances of VAP.<sup>12</sup>

Evidence based guidelines for the prevention of VAP have been developed in North America by CDC.<sup>13</sup>

This ventilator care bundle included four elements;

1. Elevation of head of bed to 30-45°

2. Daily Sedation hold.

3. Deep vein thrombosis (DVT) prophylaxis.

4. Gastric ulcer (GU) prophylaxis.

This care bundle was updated in July 2007 and now includes some more strategies like appropriate humidification of inspired gases and tubing management. Various studies have been conducted in the western countries to evaluate the compliance and effectiveness of VAP care bundle<sup>14,15,16,17</sup> but only one such study conducted in this part of world, having different, geopolitical, social and health environment at the time of initiating of project<sup>18</sup>. This study was designed in order to evaluate the effectiveness and compliance of VAP care bundle in local setting at Erfan & Bagedo General hospital, Jeddah, KSA and to compare the VAP rate with compliance rate.

### MATERIALS AND METHODS:

This is a Quasi experimental before and after observation type of study, in which VAP care bundle was implemented to the ventilated patients without any control group. It was conducted in Erfan & Bagedo General Hospital, Jeddah, which is a long term chronic care hospital consisting of 22 ICU beds with patient/Nurse ratio as 2-3 to 1. All the patients who were kept on ventilator for more than 24 hours were included in the study. Following steps were taken to ensure the reliability and validity

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Received: August 2, 2013

Revised: November 21, 2013

Accepted: December 5, 2013

1. CDC definition of VAP was used to define the case.
2. Implementation of standard template for VAP care bundle.
3. Daily compliance monitoring by the principal investigator.
4. Training of involved staff.
5. Pilot study was done to find out the difficulty in VAP care bundle implementation and factors that could increase compliance.

**Method of data collection:**

A meeting was held with the head of ICU and ICU head nurse to discuss the implementation of VAP bundle and explore the role of physicians and nurses (formation of VAP care bundle team).

- Principal Investigator himself trained all the nurses working in the ICU of hospital, regarding HII strategy.
- VAP care bundle elements were selected by infection control team, based on extensive literature review and consisting of the following elements:

1. Elevation of the Head of The bed between 30-40 degrees.
2. Daily Sedation vacations of assessment of readiness to extubate.
3. PUD prophylaxis.
4. DVT prophylaxis.
5. Proper subglottic suction.
6. Optimal oral care with chlorhexidine.

VAP care bundle lecture was given to the ICU staff (physicians & nurses). Introduction was done, the care bundle elements were explained and questions answered. Date to start implementing the VAP bundle was proposed after getting the approval from the infection control committee and ethical committee of the hospital. Revision of the implementation of the care bundle to be done after six month or when required. It was decided to assess the effect of the VAP care bundle implementation on the reduction of VAP rate to be looked at after 12 months.

**Statistical analysis:**

SPSS software ver. 13 was used to analyze the data. Confidence interval was set at 95% and a p value < 0.05 was considered as statistically significant. The VAP rate was compared with CDC National Health Care Safety Network (NHSN) data which was reported as 0.6/1000 ventilator days<sup>19</sup>.

**RESULTS:**

Out of a total of 3011 patient ventilator days, 18 patient developed VAP. Some of the patients were readmitted more than once. The range of age was from 16 to 95 years with Mean as 63.5, Mode 70, Median 66 and standard deviation as 18.9. Twelve (66.6%) of them were male. Most common co-morbidities were hypertension and diabetes and the most common organisms found were *Acinetobacterbaumannii* and *Pseudomonas aeruginosa* (Table 1).

Regarding VAP care bundle observations, the range included minimum of 161 and maximum of 343 from February 2010 to January 2011 (Table 2).

Number of VAP care bundle implementation increased from 42 (17.36%) in the month of February 2010 to 315 (91.8%) in the month of October 2010. However the implementation rate was 100% for the months of November, December 2010 and January 2011. VAP rate dropped from 8.85/1000 ventilator days in the month of February 2010 to 3.15 in January 2011 (Fig 1).

**DISCUSSION:**

The ventilator Associated Pneumonia Care Bundle (VAP care bundle) strategy was designed to reduce the VAP rate and improve the health care of the ventilated patient. The current strategy demonstrates that VAP care bundle approach has shown strong association with the VAP rate. There was significant negative correlation between percentage of application of VAP care bundle and VAP rate. In the present study, the mean age of the patients was 63.5± 18.9. Male: Female ratio was 2:1. The total ventilation days were 3011. Most of the studies did not report demographic characteristics of studied population. However Bukhari has documented a total ventilation days during their one year study period as equal to 27 47<sup>18</sup>. We had a total of 18 patients identified during the study period. Some of the patients were admitted more than once. Most common co-morbidities identified were hypertension and diabetes. Most common organisms identified in this study were *Acinetobacterbaumannii* (28.6%) and *Pseudomonas aeruginosa* (25.0%). Allan<sup>2</sup> found the same two pathogens as the leading isolates with *Pseudomonas aeruginosa* as 29% and *Acinetobacterbaumannii* as 27%. Bukhari also found the same two organisms as the two most frequent isolates *Pseudomonas aeruginosa* 30.8% and *Acinetobacterbaumannii* as 27.7% respectively. Regarding VAP care bundle compliance rate, it started with 17.36% and reached to 100% within 9 months. Bukhari has reported 100% compliance within 6 months, probably because of the reason that they started with 30% compliance rate right from the start of study. In the current study the VAP rate at the beginning of the study was 8.85/1000 ventilator days which decreased to 3.15 at the end of study with a mean rate of 5.36/1000. Thus a reduction of 5.7 per 1000 (64.4%) was observed in this study Bukhari found a decrease of 1.41/1000 ventilator days. However the percentage reduction was less (41.6%) than our result. They started their study with a lower baseline VAP rate of 3.39 and achieved a rate of 1.98/1000 after one year implementation of VAP care bundle.<sup>18,19</sup>

Youngquist had similar findings for Maxcy Hospital where VAP rate dropped from 6.1/1000 to 2.7 per 1000 ventilator days. A reduction of 4.3/1000 (70.5%) ventilator

**Table 1**

No.	Age (years)	Gender	Associated Co-morbid Diseases	Microorganisms (sputum)
1	41	F	Metastatic Breast cancer, DM and Acute Renal Failure	Acinetobacterbaumannii
2	37	M	Morbid Obesity, hyperlipidemia, DM and HTN	Staph. Aureus
3	67	F	Pulmonary hypertension and Atrial Fibrillation	Acinetobacterbaumannii
4	50	M	Frontal Craniotomy, DM and HTN	Enterobacter cloacae
5	70	F	Obesity, DM, HTN and CABG	Pseudomonas aeruginosa
6	68	M	HTN, DM and old CVA	Pseudomonas aeruginosa
7	69	M	DM, HTN, Congestive Heart Failure and hyperlipidemia	Pseudomonas aeruginosaAcinetobacterbaumannii
8	95	M	HTN, DM, heart failure and old CVA	Acinetobacter species & E. coli
9	63	M	Non-Hodgkin lymphoma & respiratory failure	Acinetobacterbaumannii
10	70	F	DM, HTN, Respiratory Failure & exertional angina	Pseudomonas aeruginosa&Acinetobacterbaumannii
11	65	M	DM, HTN and Congestive Heart Failure	Pseudomonas aeruginosa& candida albicans
12	87	M	CHF, Dementia and Parkinsonism	Acinetobacter species, Staph. aureus& E. coli
13	90	M	Right lower lobe pneumonia, DM and Chronic Renal Failure	Klebsiella pneumonia
14	16	M	Cerebral Palsy and Pulmonary TB	Klebsiella pneumonia & Pseudomonas aeruginosa
15	60	M	DM, HTN, CVA and DKA	Acinetobacter species, Proteus maribilis & E. coli
16	63	M	DM, HTN and Pulmonary Embolism	Klebsiella pneumonia
17	70	F	CRF, COPD and old Pulmonary TB	Klebsiella pneumonia& Pseudomonas aeruginosa
18	62	F	Glioblastoma and Atrial Fibrillation	E. coli

Demography, associated co-morbid diseases and microorganisms for study population

Gender: M=male; F= female

days.<sup>20</sup>Resor reported a decrease in VAP rate from 6.6 to 2.7/1000. The percentage of reduction observed was 59.1%.<sup>21</sup> Allan observed a decrease of VAP rate from 3.8 to 1.67 case per thousand (a 56% decrease in VAP rate).<sup>2</sup> More recent studies also showed a decrease of more than 50 % in the VAP rate after successful implementation of VAP care bundle strategy <sup>22,23,24,25,26</sup>. It was estimated that each VAP case was responsible for 10 hospital days with a mean cost of \$ 40000. 15 A decrease of 5.7 per thousand days will save a sum of \$ 228000 and for 3011 days it will be \$ 686508. There was a strong negative correlation between proportion of

implementation of VAP care bundle and VAP rate ( $r = -0.534$   $p$  value=0.037 for one tailed test). The main limitation of the study was a lack of control group for the purpose of comparison and for establishment of causality.

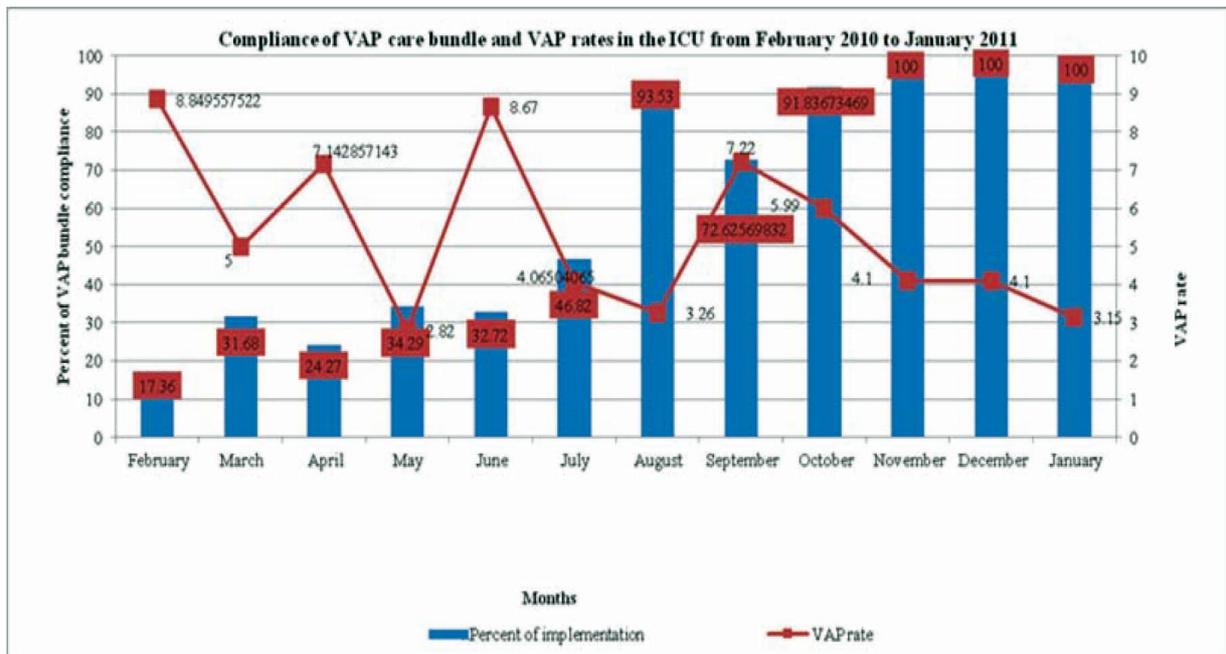
**CONCLUSION:**

The implementation of VAP care bundle has significant negative correlation with the VAP rate. Adopting VAP care bundle approach may help in reducing the morbidity and mortality in the ventilated patients. However a clinical trial with appropriate control should be conducted in order to establish causal relationship between the compliance rate of VAP care bundle and VAP rate.

Table 2  
VAP Care Bundle Implementation Report  
February 2010 - January 2011

Month	No. of observation	No. of implementation of VAP care bundle	Percent of implementation of VAP care bundle	VAP rate/1000 ventilator days
February	244	42	17.36	8.85
March	161	51	31.68	5.00
April	239	58	24.27	7.14
May	315	108	34.29	2.82
June	327	107	32.72	8.67
July	220	103	46.82	4.07
August	278	260	93.53	3.26
September	179	130	72.63	7.22
October	343	315	91.84	5.99
November	245	245	100.00	4.10
December	255	255	100.00	4.10
January	205	205	100.0	3.15

Fig 1:



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