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# EFFECTIVENESS OF TWO APPROACHES OF ORAL HEALTHCARE INTERVENTIONS TO MINIMIZE VENTILATOR ASSOCIATED PNEUMONIA [VAP] STATUS AMONG MECHANICALLY VENTILATED PATIENTS IN SELECTED HOSPITALS, MANGALURU

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## ABSTRACT

The aim of the study is to evaluate the effectiveness of two approaches of oral healthcare interventions to minimize Ventilator Associated Pneumonia [VAP] status among mechanically ventilated patients in selected hospitals, Mangaluru. An experimental approach was adopted to determine the effectiveness of oral healthcare interventions among patients on mechanical ventilation admitted in Intensive Care Units of selected hospitals at Mangaluru. Purposive sampling technique was adopted to select the sample and first 25 sample were allocated to experimental group I, second 25 to experimental group II and the next 25 were allocated to control group. Group I received oral healthcare with sodium bicarbonate and tooth brush, group II received oral healthcare with chlorhexidine and tooth brush while control group received the routine oral healthcare. Data was collected by using demographic and clinical proforma, oral swab culture, Oral Mucositis Assessment Scale (OMAS) and Clinical Pulmonary Infection Score (CPIS) in the Intensive Care Units of two multi speciality private medical college hospitals- A.J. Hospital and Research Centre, Father Muller Medical College Hospital. There was a significant difference in the oral status in experimental group I (t=2.419, p<0.05) between day 1, day 2 and day 3 and there was a highly significant difference in the oral status in experimental group II (t=2.846, p<0.05) between day 1, day 2 and day 3. There was no significant difference in the oral status in control group (t=0.265, p=0.719) before, during and after interventions. There was a significant difference in the CPIS score (F = 4.023, p < 0.05) between group I, group II and control group. The findings suggest that oral healthcare programme significantlyreduces VAP infection rate. Oral healthcare with chlorhexidine and tooth brushing is more effective in minimizing the VAP incidence than sodium bicarbonate.

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13



#### **INTRODUCTION**

Pneumonia is one of the most common complication of mechanical ventilation that occurs in 25% of patients who receives mechanical ventilation and is responsible for 90% of nosocomial infections.<sup>1</sup> Ventilator-Associated Pneumonia (VAP) is one of the encountered hospital-acquired most commonly infections seen in the critical care setting and can be linked to several adverse clinical outcomes.<sup>2</sup> The most important mechanism involved in the development of VAP is aspiration of oropharyngeal organisms into the lower respiratory tract, followed by bacterial proliferation and parenchymal invasion. The oropharynx and upper gastrointestinal tract are the potential reservoirs for bacteria associated with VAP, so the reduction of oral bacteria might have a potential for prevention of VAP.3 Routine oral hygiene care is designed to remove plaque and debris as well as replacing some of the functions of saliva, moistening and rinsing the mouth. Oral care can remove microorganisms from oral cavities. Adequate oral care and decontamination help prevent respiratory infections such as VAP and can reduce the incidence of VAP by 46% to nearly 90%, decreasing the associated costs.4

### Need for the study

Ventilator associated pneumonia (VAP) is defined as nosocomial pneumonia in ventilated patients that develop more than 48 hours after initiation of mechanical ventilation (MV).<sup>1</sup> VAP is the most frequently occurring nosocomial infections. According to data from the National Nosocomial Infection Surveillance System, VAP is the second most common nosocomial infection, after UTI, affecting approximately 27% of all critically ill1. patients.<sup>5</sup> The aspiration of microorganisms present in the oropharynx constitutes the common means of acquiring the disease and the principal risk factors are those that favor the colonization of the2. oropharynx or the stomach, the aspiration of the secretions into the lower respiratory tract and factors inherent in the host.<sup>6</sup> Pathogenic bacteria in dental provide a nidus of infection plaque for microorganisms responsible for the development of VAP.<sup>7</sup> Patients on mechanical ventilation often have a very dry mouth due to prolonged mouth opening which may be exacerbated by the side effects of medications used in their treatment. In healthy individuals, saliva functions to maintain oral health through its lubricating, antibacterial and buffering properties but patients on ventilators lack sufficient saliva for this to occur, and the usual stimuli for saliva production are absent.<sup>8</sup> Routine oral hygiene care is designed to remove plaque and debris as well

as replacing some of the functions of saliva, moistening and rinsing the mouth. Oral care can remove microorganisms from oral cavities. Adequate oral care and decontamination help prevent respiratory infections such as VAP and can reduce the incidence of VAP by 46% to nearly 90%, decreasing the associated costs.<sup>4</sup>

Scannapieco and collegues compared the colonization of dental plaque by respiratory pathogens in patients receiving treatment in medical ICUs with that of matched, untreated control subjects. They examined the association between oral hygiene status together with other variables and the prevalence of oral colonization by potential respiratory pathogens. The results showed that patients treated in the ICU harbored greater levels of dental plaque than the control subjects. The authors found that bacterial pathogens known to cause pneumonia were prevalent only in the dental plaque of patients treated in the ICU.9 There are various methods of oral healthcare being followed in Intensive Care Unit such as chlorhexidine mouth wash, sodium bicarbonate, Listerine, hydrogen peroxide etc as experienced by the investigator. But oral care protocol is not being maintained or implemented as per guidelines in most of the clinical care set ups. Hence the researcher felt the need to investigate an effective strategy of oral healthcare that can promote good oral hygiene and thus reduce VAP in patients. Thus the investigator was motivated to undertake a study to compare two techniques of oral hygiene and its impact on VAP and to develop an oral care protocol in the ICU.

#### Objectives

To determine oral status in mechanically ventilated patients initially before starting oral healthcare interventions Group I and Group II and control group.

To compare the oral status initially before, during and after the oral healthcare interventions between Group I, Group II and control group.

3. To assess the degree of oral mucositis in Group I, Group II and control group.

4. To compare VAP status between Group I, Group II and control group after oral healthcare interventions.

5. To find out the association of VAP status of mechanically ventilated patients receiving sodium bicarbonate mouthwash and chlorhexidine oral rinse with the demographic and clinical variables.

#### Hypotheses

 $H_1$ : There will be a significant difference in the mean oral status score before and after oral



healthcare interventions Group I and Group II

 $H_2$ : There will be a significant difference in the mean OMAS score among ventilated patients on day 1, day 2 and day 3

 $H_3$ : There will be a significant difference in the VAP status among ventilated patients in Group I, Group II and control groups on day 3.

 $H_4$ : There will be a significant association between VAP status scores and selected demographic and clinical variables of mechanical ventilated patients.

### METHODOLOGY

**Research approach**: A quantitative experimental research approach was adopted to determine the effectiveness of two approaches of oral healthcare interventions to reduce Ventilator Associated Pneumonia [VAP] in mechanical ventilated patients in selected hospitals, Mangalore.

**Research design:** Two group pre-test post test control group experimental research design was adopted for the study.

**Setting:** The study was conducted in Intensive Care Units of two multi speciality private medical college hospitals namely A.J. Hospital and Research Centre, which is 160 bedded super speciality hospital, A. J. Institute of Medical Sciences, a 800 bedded and Father Muller Medical College Hospital, a 1250 bedded multi speciality hospital in Mangaluru.

**Population:** In this study, target population comprised of women aged between 40-60 years with moderate to severe level of knee pain.

**Sample:**The sample comprised of 75 mechanically ventilated patients.

**Sample Techniques:** Purposive sampling technique was used to select the subjects for the study.

**Sampling Criteria:** The target population in this study consist of patients on mechanical ventilator admitted in Intensive Care Units of selected hospitals as per the criteria.

## **Inclusion Criteria**

Mechanically ventilated patients:

- aged over 20 years.
- admitted to any ICU.
- with oral endotracheal intubation.

### **Exclusion criteria**

Mechanically ventilated patients:

- with nasal intubation.
- with tracheostomy.
- with bleeding tendency.
- who cannot be placed in semi-fowler's position.
- with history of known allergy to chlorhexidine or sodium bicarbonate mouth wash.
- who arereintubated.
- who are diagnosed with any auto immune disease.

### RESULTS

Table 1 and Table 2 describes the characteristics of the sample that include the background information and the clinical characteristics.

The oral health status of mechanically ventilated patients is measured by OMAS and oral swab culture. Oral swab is taken on the first day before intervention and is sent for culture. OMAS is assessed every morning and evening for three consecutive days. Table 5, Figure 3 and 4 describes the oral health status of the sample.

There was a significant difference in the oral status in Group I (t=2.419, p=0.016) between day 1, day 2 and day 3 and there was a highly significant difference in the oral status in Group II (t=2.846, p=0.004) between day 1, day 2 and day 3. There was no significant difference in the oral status in control group (t=0.265, p=0.791) before, during and after interventions [Table 6]. There was a highly significant difference among the Group I (t=2.727, p<0.05) and very highly significant difference among Group II (t=3.298, p<0.05) but no significant difference among control group (t=0.900, p>0.05) in terms of ulceration. There was a highly significant difference among Group II (t=2.571, p<0.05) and no significant difference among Group I (t=1.680, p<0.05) and control group (t=1.887, p>0.05) in terms of erythema. [Table 7]

There was a significant difference in the CPIS score (F = 4.023, p < 0.05) between Group I, Group II and control group. [Table 8]

 Table 1. Distribution of Sample According to Demographic Variables

 N=25+25+25=75

Sl.		Group I		Group II		Control Group	
No. Demographic variables	F	%	F	%	f	%	
1. Age (in years)							
a. 0-40	8	32	8	32	9	36	



Sl.	Group I		Group II		Control Group	
No. Demographic variables	F	%	F	%	f	%
b. 41-60	13	58	12	48	12	48
c. >60	4	16	5	20	4	16
2. Gender						
a. Male	20	80	21	84	22	88
b. Female	5	20	4	16	3	12
3. Smoking habit						
a. Current	9	36	10	40	10	40
b. Former	4	16	5	20	4	16
c. Never	12	48	10	40	11	44
4. Alcohol consumption						
a. Current	9	36	10	40	8	32
b. Former	4	16	5	20	4	16
c. Never	12	48	10	40	13	52
5. Duration of hospitalization						
a. <1 Week	19	76	21	84	22	88
b. 1-3Week	6	24	4	16	3	12
c. $> 3$ Week	-	-	-	-	-	-
6. Diagnosis of the patient						
a. Acute	4	16	2	8	3	12
b. Respiratory failure/ Cardiovascular disease	2	8	3	12	2	8
c. GI disease	1	4	3	12	2	8
d. Renal disease	3	12	2	8	2	8
e. Sepsis	1	4	1	4	1	4
f. Trauma	10	40	12	48	15	60
g. Neurological disease	4	16	1	4	-	-
h. Others	-	-	1	4	-	-

# Table 2. Distribution of Sample According to Clinical Characteristics $N{=}25{+}25{+}25{=}75$

SI.	Group I		Group II		Control Grou	
No. Demographic variables	F	%	F	%	f	%
1. APACHE score						
a. 0-10	10	40	12	48	13	52
b. 11-20	14	56	12	48	12	48
c. 21-30	1	4	1	4	-	-
2. ASA score						
a. ASA 1	-	-	-	-	-	-
b. ASA 2	6	24	10	40	9	36
c. ASA 3	13	52	9	36	8	32
d. ASA 4	6	24	6	24	8	32
e. ASA 5	-	-	-	-	-	-
f. ASA 6	-	-	-	-	-	-
3. Indications for mechan	ical venti	lation				
a. Upper airway obstruction	2	8	-	-	1	4
b. Oxygenation failure	7	28	10	40	9	36
c. Secretion obstruction	1	4	2	8	1	4
d. Airway protection	8	32	6	24	4	16
e. Ventilatory failure	7	28	7	28	10	40
4. Prescribed Medications						
a. Antibiotics						



SI.		ıp I	Group II		Control Group	
No. Demographic variables	F	%	F	%	f	%
b. Yes	25	100	25	100	25	100
c. No	-	-	-	-	-	-
Antihistamines						
a. Yes	4	16	4	16	5	20
b. No	21	8421	84	20	80	-
Corticosteroids						
a. Yes	10	40	10	40	6	24
b. No	15	60	15	60	19	76
5. Name of the antibioti	cs prescri	bed				
a. Pencillin	7	28	11	44	9	36
b. Cephalosporins	11	44	8	32	8	32
c. Macrolides	-	-	-	-	-	-
d. Quinolones	2	8	3	12	2	8
e. Tetracycline	-	-	-	-	1	4
f. Aminoglycoside	5	20	3	12	5	20

Table 3. Oral Swab Culture Result of subjects on Day 1, Day 2 and Day 3  $N{=}25{+}25{+}25$ 

SI.	Gro	up I	Group	Group II		Group	Moon+SD	
No. Oral swab	F	%	f	%	f	%	Mean±SD	
Day 1								
1. No/mild growth	14	56	14	56	12	48	$0.56 \pm 12.22$	
2. Moderate growth	8	32	7	28	8	32	$0.60{\pm}14.30$	
3. Heavy growth	3	12	4	16	5	20	$0.72 \pm 18.40$	
Day 2								
1. No/mild growth	17	68	18	72	13	52	$0.36 \pm 8.64$	
2. Moderate growth	7	28	6	24	9	36	$0.32 \pm 8.32$	
3. Heavy growth	1	4	1	4	3	12	$0.60{\pm}14.30$	
Day 3								
1. No/mild growth	21	84	22	88	12	48	$0.16 \pm 4.18$	
2. Moderate growth	4	16	3	12	10	40	0.12±3.80	
3. Heavy growth	-	-	-	-	3	12	$0.64 \pm 14.50$	

Table 4. Organisms Isolated on day 1, day 2 and day 3 in subjects N=25+25+25

SI.	Group I		Gro	up II	Control group		
No. Micro-organism	F	%	f	%	f	%	
1. Klebsiella	2	8	3	12	3	12	
2. Streptococci	1	4	-	-	1	4	
3. Staphylococcus aureus	2	8	1	4	2	8	
4. Acinobacter	3	12	1	4	-	-	
5. Candida	2	8	3	12	3	12	
6. Diphtheroids	-	-	1	4	2	8	
7. Pseudomonas	1	4	2	8	-	-	
8. Moraxella	-	-	-	-	2	8	



SI.	Gro	up I	Grou	up II	Control group		
No. Criteria	F	%	f	%	F	%	
1. Ulceration							
Day 1							
Grade 0	16	64	18	72	18	72	
Grade 1	9	36	7	28	7	28	
Day 2							
Grade 0	21	84	22	88	20	80	
Grade 1	4	16	3	12	5	20	
Day 3							
Grade 0	22	88	24	96	20	80	
Grade 1	3	12	1	4	5	20	
2. Erythema							
Day 1							
Grade 0	20	80	18	72	18	72	
Grade 1	5	20	7	28	7	28	
Day 2							
Grade 0	23	92	21	84	21	84	
Grade 1	2	8	4	16	4	16	
Day 3							
Grade 0	23	92	23	92	22	88	
Grade 1	2	8	2	8	3	12	

# Table 5. Distribution of Subjects According to Oral Mucositis Assessment ScoreN=25+25+25

Table 6. Difference in the Oral Status within Group I, Group II And Control Group on Day 1, Day 2 and Day 3 N=25+25+25

Groups	Minimum score	Maximum score	t value	p value
Group I	0	2	2.419	0.016*
Group II	0	2	2.846	0.004**
Control group	0	2	0.265	0.791
		• • • • • • • • • • • • • • • • • • •	1 101	

t<sub>74</sub>=2.78, p<0.05

\*=significant, \*\*= highly significant

# Table 7. Difference in the OMAS Score among Group I, Group II and Control group N=25+25+25

OMAS	Groups	t value	p value
Ulceration	Group I	2.727	0.006**
	Group II	3.298	0.001***
	Control group	0.900	3.368
Erythema	Group I	11.680	0.093
	Group II	2.571	0.010**
	Control group	1.887	0.590
		• • • • • • • • • • • • • • • • • • • •	

 $t_{(10)}$ = 2.22, p<0.05

\*\*=highly significant, \*\*\*= very highly significant

# Table 8. Difference in the CPIS Score between Group I, Group II and Control Group N=25+25+25

Groups	Mean±SD	Minimum	Maximum	F value	p value
Group I	1.8±1.60	1	8		
Group II	1.4±0.91	1	2	4.023	0.022*
Control Group	2.7±2.38	1	9		
F = 3.12  p < 0.05			*_aignifi	aant	

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### DISCUSSION

The findings show that most of the sample were in the age group of 41-60 years as well as were males. In the present study, most of the subjects had a shorter duration of hospitalization and they were admitted to the ICU with the diagnosis of trauma. The average APACHE score of the sample in the present study was in between 11-20 and most of them were categorized into ASA 3. These findings are supported by a prospective, multi-centre, placebo controlled trial to document the effect of gingival and plaque decontamination on the rate of nosocomial and respiratory infections acquired in the ICU which was conducted at University hospital, Pittsburgh, USA. The study showed that out of 228 patients majority of them in the experimental group (53%) and control group (52%) were in the age group of 41-60 years (with mean age 53 years) and most of them were also males, majority of the patients admitted on mechanical ventilator were diagnosed with trauma (52%), highest percentage of the subjects in the experimental group (48%) and control group (36%) had an APACHE score in the range of 11-20.10

The present study showed that there was a significant difference in the oral status in Group I

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(p<0.05) between day 1, day 2 and day 3 and there was a highly significant difference in the oral status in Group II (p<0.05) between day 1, day 2 and day 3. There was no significant difference in the oral status in control group before, during and after interventions. This suggests that oral care is effective in improving oral health status in mechanically ventilated patients. A supportive true experimental study was conducted at MMIMS, Ambala with the aim to compare the effectiveness of 0.2% chlorhexidine and oral routine care in terms of oral health status and showed that there is a significant difference in the oral health status scores before and after providing oral healthcare in the experimental group (p<0.05), that is there was a significant reduction in the oral health status scores after providing oral care and concluded that oral care with chlorhexidine is effective in improving oral health status.11

There was a highly significant difference among the Group I (t=2.72, p<0.05) and very highly significant difference among Group II (t=3.29, p<0.05) but no significant difference among control group (t=0.90, p>0.05) in terms of ulceration. There was a highly significant difference among Group II (t=2.57,





p<0.05) and no significant difference among Group I (t=1.68, p>0.05) and control group (t=1.88, p>0.05) in terms of erythema. The findings of the present study suggest that oral care is effective in reducing oral mucositis among mechanically ventilated patients. This finding is supported by a randomized study which was conducted to assess efficacy of octenidol and chlorhexidine in prevention of oral mucositis and it showed a significant difference in the OMAS score in group II between day 1, day 2, day 3 and day 4 (p=0.001), but no significant difference between the groups. These findings also suggest that oral care with chlorhexidine is effective in reducing oral mucositis.<sup>12</sup>

One way ANOVA showed that there was a significant difference in the CPIS score (F = 4.023, p =0.002) between Group I, Group II and control group. The study also showed that there is a significant difference in leukocyte, tracheal secretions and radiographic findings between the groups (p<0.05). The mean±SD of CPIS score was 1.4±0.91 in group 2, which is less compared to group I and control group. These findings suggest that oral care with chlorhexidine and tooth brushing is effective in reducing VAP in mechanically ventilated patients. A randomized clinical trial conducted on 547 patients to examine the effect of chlorhexidine and tooth brushing in preventing VAP also showed that chlorhexidine and tooth brushing significantly reduced the incidence of VAP on day 3 (p=0.06).<sup>1</sup> The result of the present study is also substantiated with a similar randomized study conducted to determine the effectiveness of oral care intervention to reduce incidence of VAP which showed a significant reduction in the VAP status in the experimental group and there was a significant difference in the VAP status between the groups (p=0.002) which suggest that oral care with chlorhexidine and tooth brushing was effective in reducing VAP.<sup>13</sup> The findings demonstrated that an oral healthcare programme significantly reduced VAP infection rate.

#### CONCLUSION

The study highlights the importance of oral hygiene interventions including tooth brushing and its impact on the incidence of VAP. This study showed that oral care with chlorhexidine and tooth brushing can minimize the incidence of VAP in mechanically ventilated patients. Oral and dental care have been identified as standard measures against the prevention of VAP. Nurses can implement this intervention in critical care units to improve the oral health status of mechanically ventilated patients. The implementation of a comprehensive oral care protocol including tooth brushing may contribute to decreasing the risk of VAP.

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