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Research Article

**RELATIONSHIP BETWEEN ORAL HEALTH CARE STATUS
& INCIDENCE OF VENTILATOR ASSOCIATED
PNEUMONIA IN ICU PATIENTS**

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Abstract:**Background**

Ventilator-associated pneumonia (VAP) is pneumonia that develops two days (48 hours) after ventilator placement (Center for Disease Control and Prevention, 2016). VAP is the most common type of nosocomial pneumonia and a leading cause of morbidity and mortality particularly among intensive care unit (ICU) patients.

Objective: To study the association between oral health and ventilator-associated pneumonia (VAP) among critically ill patients.

Methods: A prospective cohort study was conducted among 162 critically ill patients, chosen via non-probability – consecutive sampling, of both genders, aged 18 and above and newly intubated and treated with mechanical ventilator at a tertiary hospital. After taking written informed consent from the study subjects, data was collected using a structured, interview based questionnaire containing inquiries about basic biodata, sociodemographic details and disease particulars. Oral health status was assessed using Oral Health Assessment Tool (OHAT) and Plaque Index (PI). Clinical Pulmonary Infection Score >6, was assessed on Day 4 after intubation. The data obtained was analyzed using MS. Excel 360 and SPSS v. 21.0.

Result: Among the 162 patients, 38.9% were females, while the remaining 61.1% were males. The mean age of sample stood at 47 years ($SD \pm 11.3$) and most (50.62%) of the subjects were aged 52 and above. The oral health status of patients deteriorated after intubation. Early-onset VAP developed in 69 patients (42.6%). Moderately unhealthy and unhealthy oral conditions based on OHAT scores were associated with a three-fold or higher increased risk of VAP. Patients with moderate-to-very poor oral hygiene assessed by PI had increased VAP risk of nearly two-folds.

Conclusion: After careful consideration, it can be concluded that there is a strong association between poor oral health and increased risk for early-onset VAP. Routine oral care possibly prevents VAP development among critically ill patients treated with mechanical ventilator.

Keywords: Ventilator Associated Pneumonia, Intensive Care Unit, Oral Health Status, Plaque Index & Intubation.

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INTRODUCTION:

Ventilator-associated pneumonia (VAP) is pneumonia that develops two days (48 hours) after ventilator placement. VAP is the most common type of nosocomial pneumonia and a leading cause of morbidity and mortality particularly among intensive care unit (ICU) patients. In developing countries, VAP rates vary from 10 to 41.7 per 1000 ventilator-days and are associated with mortality rates ranging from 24% to 76%. [1, 2]

Recent evidence has demonstrated that poor oral hygiene and oropharyngeal bacterial colonization are significant risk factors for VAP. The oral cavity of intubated patients contains high amounts of respiratory pathogens such as Methicillin-resistant *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and many Gram-negative bacilli. The same oral respiratory pathogens were also identified in specimen collected from lungs of intubated patients who subsequently developed VAP. [3, 4]

Oropharyngeal colonization was associated with infections of the lower respiratory tract in ICU patients, and many respiratory infections are caused by pathogens which initially colonize in the oral cavity. Therefore, the oropharynx appears to serve as a reservoir for VAP causing bacteria in intubated ICU patients. In addition, higher amount of dental plaque and lower salivary volume are correlated with pneumonia and poor oral health significantly increases pneumonia risk up to 9.6-folds, depending on oral health indicators. [5, 6]

Although oral health status in critically ill patients is an important factor in VAP development, it is omitted in most VAP-related studies. Further, while a few studies have shown that effective oral care for intubated patients prevents VAP, most of these studies were carried out in critical care settings where treatment plans, staff-to-patient ratio and necessary care equipment are generally adequate. However, in most developing countries, such resources are limited and many critically ill patients may need to be cared for outside of the critical care settings. [7, 8]

VAP risk associated with oral health among this population is unknown and proper oral care intervention for these intubated patients has not been established. Therefore, this study was conducted to evaluate the association between oral health and early-

onset VAP among critically ill patients receiving care in critical and non-critical care settings.

METHODOLOGY:

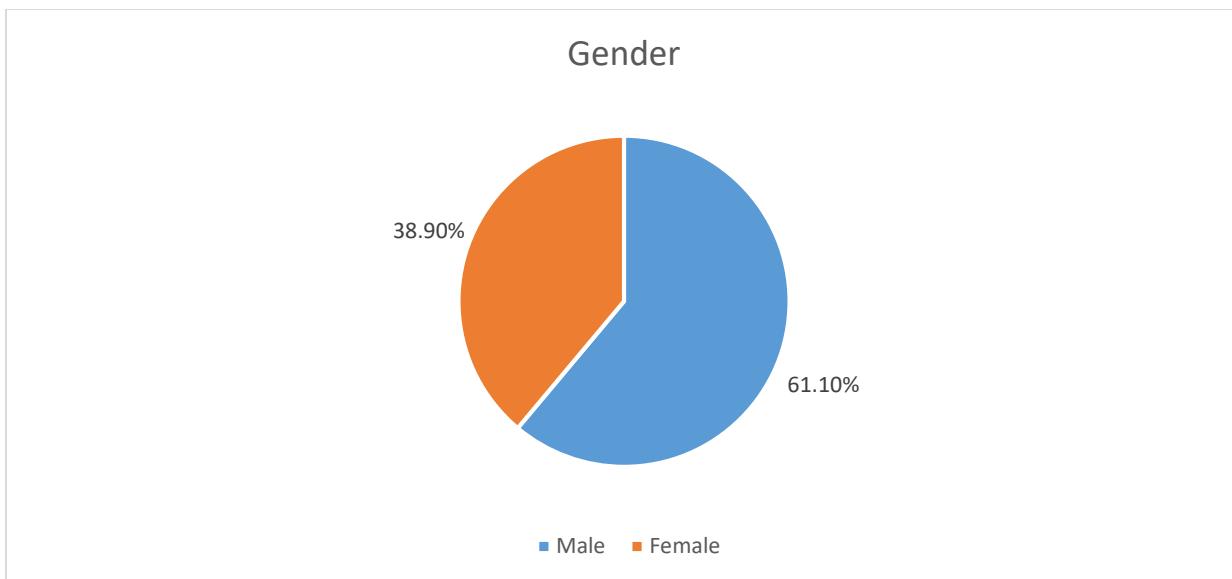
A prospective cohort study was conducted among 162 critically ill patients, chosen via non-probability – consecutive sampling, of both genders, aged 18 and above and newly intubated and treated with mechanical ventilator at Liaquat University Hospital. After taking written informed consent from the study subjects, data was collected using a structured, interview based questionnaire containing inquiries about basic biodata, sociodemographic details and disease particulars. Oral health status was assessed using Oral Health Assessment Tool (OHAT) and Plaque Index (PI). Clinical Pulmonary Infection Score >6, was assessed on Day 4 after intubation. The data obtained was analyzed using MS. Excel 360 and SPSS v. 21.0.

The study outcome was incidence of early-onset VAP, which developed 48–96 h after intubation. Measurements of VAP occurrence were done twice, during 48–72 h (Day 2) after endotracheal intubation to exclude those already had pneumonia and again at 96 h (Day 4) after intubation to determine VAP development. The modified Clinical Pulmonary Infection Score (CPIS) was used for VAP diagnosis. Points were assigned to patients based on 6 variables, each worth 0–2 points, including (i) body temperature, (ii) white blood cell count, (iii) tracheal secretions, (iv) oxygenation, (v) chest radiograph findings, and (vi) cultures of tracheal aspirates.

A trained oral healthcare professional performed oral examinations at Day 2 after intubation and before VAP developed. The examinations included Oral Health Assessment Tool (OHAT), and Plaque Index (PI). OHAT assesses eight indicators including lips, tongue, gingiva and tissues, saliva, natural teeth, dentures, oral cleanliness, and dental pain. The scoring for each category is on a 3-point scale with 0 = healthy, 1 = changes, and 2 = unhealthy. The total score is a summation of eight categories with the maximum score of 16.

RESULTS:

Among the 162 patients, 38.9% were females, while the remaining 61.1% were males. The mean age of sample stood at 47 years ($SD \pm 11.3$) and most (50.62%) of the subjects were aged 52 and above.



The study sample consisted of 183 critically ill patients. However, 13 patients (7.1%) died and eight patients (4.4%) were discharged from the hospital before reaching Day 4 after intubation. As a result, 162 patients (88.5%) were left to provide VAP information at Day 4.

Most patients were admitted after having accidents or traumatic injuries and had more than one diagnosis. The leading diagnosis was various degrees of head injury (56.3%). Many of these patients had skull fracture (13.7%), some forms of brain or meningeal hemorrhages (41%), or brain swelling (9.3%). Other less common diagnoses included pneumothorax (7.7%) and blunt chest or blunt abdominal injuries (3.3%).

The oral health status of patients deteriorated after intubation. Early-onset VAP developed in 69 patients

(42.6%). Two days after intubation, changes were most prominent in lips and oral cleanliness components of the OHAT score in this sample. Almost all patients had swelling and dry lips with either red or ulcerated corners. At Day 2 after intubation, all oral indicators in the OHAT changed toward unhealthy condition and almost all patients had poor oral cleanliness. Over a half (62.3%) of the patients had halitosis (bad breath) and plaque or food particles in most areas of the mouth.

OHAT SCORE		
Healthy (0 - 6.3)	7 (10.1%)	45 (48.4%)
Moderate (6.4 – 9)	41 (59.4%)	32 (34.4%)
Un-Healthy (9.1 – 14)	21 (30.5%)	16 (17.2%)
PLAQUE INDEX (P.I)		
Good to Very Good (0 – 0.99)	25 (36.2%)	57 (61.3%)
Moderate to Very Poor (1 – 3.00)	44 (63.8%)	36 (38.7%)

DISCUSSION:

The majority of the patients in this study ($n = 137$, 84.6%) received treatment with MV outside a critical care setting. Critically ill patients in this study who were treated with MV had poor oral health status two days after intubation as reflected by both overall high OHAT and PI scores. Poor oral health was associated with higher incidence of early VAP (within 48–96 h after endotracheal intubation). [9, 10]

Poor oral health status is linked to VAP development through several biological mechanisms. Endotracheal intubation leaves the patients' mouth open, which may lead to changes in the oral environment and flora that support VAP development. The oral tissues swiftly dry out, and become inflamed and injured, creating a favorable environment for the growth of respiratory pathogen. Dental plaque and oral organisms rapidly increase over time and salivary production slows down. This leads to lower oral pH and creates an oral environment that is also favorable for microbial growth and proliferation. [11, 12]

Hospitals around the world have an oral care protocol for all patients, very few have oral care guidelines for patients at risk for VAP as recommended for critical care context. Oral care is done by registered nurses every 2–4 h. Cotton swabs soaked with chloro-xylenol mixture are used to brush the patients' oral cavity (mostly buccal surface of the teeth). Once all swabs are used, remaining chloro-xylenol is injected into the patients' oral cavity using a small syringe and removed by suctioning catheter. [13, 14]

In addition, endotracheal intubation also prevents normal swallowing and coughing and stops epiglottis closure. As respiratory pathogens continue to multiply within the plaque, bacteria move into the subglottic secretion pool, collecting around the endotracheal cuff. Once the bacteria laden secretions are dropped or aspirated around the cuff or through cuff folds, they enter the lungs and initiate infection. Oral bacteria of patients treated with MV are positively correlated with bacteria that cause VAP. [15, 16]

The positive association between poor oral health status and VAP development in the present study is consistent with previous research and confirms that poorer oral health status leads to increased risk of VAP among critically ill patients who were treated with MV. This study contributes several important findings. It is the first study to identify the association between oral health status and VAP development among critically ill patients in Pakistan.

Nevertheless, this study has some limitations. Results are generalizable to only earlyonset VAP among critically ill patients treated with MV in tertiary care-level hospitals. In addition, oral health was assessed only once in this study. We therefore could not evaluate whether oral health worsened each additional day of MV use nor whether VAP risk increases as the oral health status deteriorates.

CONCLUSION:

After careful consideration, it can be concluded that the association between oral health and heightened risk for VAP is worryingly established. Thus it is recommended that a good oral health status be maintained among ventilator patients so that morbidity pertaining to VAP may be minimized.

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