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# Knowledge, Practice and Associated Factors of Adult Intensive Care Nurses' on Prevention of Ventilator Associated Pneumonia in Addis Ababa Public Hospitals, Addis Ababa, Ethiopia

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**Abstract:** Pneumonia is amongst the most leading cause of death in developing world where Ventilator Associated Pneumonia (VAP) is common among patients on mechanical ventilation/ intubation post hospitalization, and it is 6-20 times higher among patients in critical / intensive care units. Multiple factors were identified in different literatures for its occurrences. Poor nurses' knowledge and practices were repetitively reported from public hospitals in Ethiopia. The objective of this study is to assess knowledge, practice and associated factors of Adult Intensive Care nurses' on prevention of Ventilator Associated Pneumonia (VAP) in selected Hospitals in Addis Ababa, Ethiopia. A Facility based cross-sectional and observational study was conducted on 129 Adult Intensive Care nurses using self-administered questionnaire and observational checklist. The study shows that, Out of 129 respondents, 78 (60.5%) were females, 73 (56.6%) had diploma. There was a significant difference in knowledge between trained and non-trained adult intensive care nurses as found ($p_{value} = 0.04$) and as increased educational level ($p_{value} = 0.021$). Significant difference in practice was found between ICU nurses who had ICU training ($p_{value} = 0.038$) and between nurses with different years of working experiences ($p_{value} = 0.033$). Thus, the study reveals that majority of nurses working in the Adult Intensive Care Units had inadequate knowledge and practice.

**Keywords:** Knowledge, Practice, Nurse(s), Adult Intensive Care Unit, Ventilator Associated Pneumonia, Ethiopia

## 1. Introduction

### 1.1. Background

Ventilator Associated Pneumonia (VAP) is a prevalent nosocomial infections among patients on mechanical ventilation/intubation with rate ranging from 10%-70% in intensive care units that characterized by "a new or progressive pulmonary infiltrate, fever, leukocytosis and purulent trachea-bronchial secretions [1-3]. VAP was not present at the time of hospitalization, rather occurs 48 hours after the patient put on mechanical ventilation/intubation. The risks of VAP in critical/intensive care unit patient are 6-20 times higher since the intubation brings bacterial oro-pharyngeal colonization [4].

Aspiration is the primary routes of transmissions of pathogens from the upper respiratory systems to the lower respiratory tract; since the tube is located in the trachea [5-7]. Bacterial colonization of the lower respiratory tract is characterized by the absence/weak cough reflex and mucus secretions in patients on ventilation [8-9]. In addition to this, a cross contamination in the ICU is the major causes of ventilator associated pneumonia in critical/ intensive care patients [7, 10].

The Incidence of VAP depends on the duration of mechanical ventilation (IR of 3% in the first five days, then

2% in the next 6-10 days, and 1% after ten days) and it is a complication in 28% of patients on mechanical ventilation [10]. About 63% of patients admitted to ICU had oral colonization with pathogens [11]. Hospital stay dramatically increases mortality rates and risks [4, 12]. But, early detection (dx) and management may contribute to lower the incidence [4, 13].

VAP is a known serious health hazard among patients on mechanical ventilations with mortality rate ranges from 6-60% and as high as 74% [4, 10, 14].

In contrary to this, a systematic review and meta-analysis found no evidence of mortality related to VAP in patients with trauma (RR=1.09, 95%CI=0.87-1.37) and ARDS (RR=0.86, 95%CI=0.72-1.04)[10]. But, the study from Algeria [12, 15] and Senegal [16] shows 1.7% and 2.9% hospital wide mortality of VAP, respectively. In Senegalese ICU about half of those patients on mechanical ventilation acquired VAP [2, 16].

Lack of adequate nursing staffs (should ideally be 1:1) would greatly compromise the quality of care intended to be given to the patients which may be the reason for increased incidence in developing countries [7, 10]. Even though, VAP is also a problem in developed countries [3, 17-18], the incidences of the disease in developing countries were contributed a lot by inadequate knowledge and awareness of the disease and its courses [19-20].

### 1.2. Significance of the Study

The finding of this study is a grand input to be used by facilities that have been delineated with knowledge and practice of critical/intensive care nurses, and it helps other Governmental and NGO's as guidance/fertile land when working in improving and strengthening the knowledge and practice of adult intensive care nurses.

Overall, the findings have important implications for policy and decision making in health care planning, in allocating resources (human, financial and…etc) and also helps those program efforts working towards prevention of VAP and as well as in improving nurses' knowledge and practice (nursing care) with an entail to reduce or preventing VAP in the institution providing these services.

This study also enables academic and researchers to use the information for other related studies and also as a reference in their data banks.

### 1.3. The Research Gap (Questions)

1) What level of Knowledge do Adult intensive care nurses have in preventing VAP?
2) Are Adult intensive care nurses practicing preventive measures of VAP?
3) What are the other associated factors contributes for the development of VAP with regard to nurses and nursing care?
4) Is there any association between level(s) of Education, ICU training, year(s) of Experience, and Knowledge of Adult intensive care nurses on prevention of VAP?

*AIM OF THE STUDY/OBJECTIVES*
General objective:

To assess knowledge, practice and associated factors of Adult Intensive Care nurses' on prevention of Ventilator Associated Pneumonia (VAP) in selected Hospitals in Addis Ababa, Ethiopia.
*Specific Objectives:*
a. To assess the knowledge of Adult Intensive care nurses' on prevention of Ventilator Associated Pneumonia
b. To assess practices of Adult Intensive care nurses' on prevention of Ventilator Associated Pneumonia
c. To identify other factors associated with Adult Intensive Care Nurses' contributing to Ventilator Associated Pneumonia

## 2. Methods

### 2.1. Study Area

Addis Ababa, the capital city of Ethiopia; covering an area of 540 sq. km and she is the seat of the Economic Commission of Africa and Africa Union. The total population of the city is about 3.3 million with 5046 peoples per kilometer, more of slum and overcrowded.

### 2.2. Study Design

A facility based cross-sectional and observational study was conducted on 129 Adult intensive care nurses in purposively selected public hospitals in Addis Ababa, Ethiopia.

### 2.3. Study Population

Nurses working in the Adult intensive care units available at a time of data collection.

### 2.4. Sampling Technique

Purposive sampling method is employed (n=129, in purposive sampling, Sample size is determined not by statistical calculations but by data saturation).

### 2.5. Data Collection Tools and Methods

#### 2.5.1. Data Collection Tools

A questionnaire consists of part-I Questions used to assess socio-demographic information's, part-II Questions used to assess Adult Intensive Care Nurses Knowledge and part-III is an observational checklist used to assess the practice of intensive care nurses. Some of the questions were adopted from a reliable questionnaire used for the same research in Tanzania and South Africa. But, Questionnaire was modified according to Ethiopian context. Both adopted questions were again checked and assessed for their validity with the ICU experts and added to the questionnaire for the purpose of this study.

#### 2.5.2. Data Collection Methods
Using self-administered questionnaire and observational

checklist. Non-participant observational assessment method was used to gain insight into what was happening in to practice as it occur in the patients' natural environment in case where observer is not included in the observation. Information letters, consent forms and questionnaires were handed to nurses working in the Adult ICU; by data collectors.

### 2.6. Data Management and Quality Control

Data was coded and entered into EPI INFO 3.5.4 and Analyzed using SPSS version 20.0 for descriptive and inferential statistics. The data was double entered to check the consistency and was cleaned and edited before analysis. Frequency distributions, figures and tables were used to provide an overall and coherent presentation and description of data. Multivariate regression tests was used to express the magnitude and direction of the association between education levels, years of working in ICU, ICU training and intensive care nurses' knowledge and practice on prevention of VAP.

### 2.7. Ethical Considerations

1. An Ethical approval letter was given from Addis Ababa Research and Ethical review board after comprehensive review (AAU/ERC/No: 2006/11/11) and forgo letter to respective hospitals were given.

2. A brief Explanation of the purpose and importance of the study was given to participants (nurses) and assured that the obtained information will be confidential and used only for the purpose of study.

## 3. Results

### 3.1. Population Characteristics

Out 129 respondents, 78 (60.5%) were females, 73 (56.6%) had diploma, Majority of Adult Intensive Care nurses 79 (61.2%) had no ICU training, and 87 (67.5 %) had been working in the ICU for less than 6 years, 66 (51.2%) scored below mean score, had inadequate knowledge. There was a significant difference in knowledge between respondents with ICU training as found ($p_{value}$ = 0.04) and between participants with different educational level ($p_{value}$ = 0.021). Significant difference in practice was found between ICU nurses who had ICU training ($p_{value}$ = 0.038) and between nurses with different years of Experiences ($p_{value}$ = 0.041)

### 3.2. Level of Knowledge

Out of one hundred twenty nine Adult Intensive Care nurses, about 63 (48.8%) scores mean and above mean scores have adequate knowledge, whereas 66 (51.2%) were scores below mean scores have inadequate knowledge see table 1 (mean score=10.58 (52.9%))

*Table 1. Knowledge scores of Adult Intensive Care nurses' in preventing Ventilator Associated Pneumoniain selected public health facilities in Addis Ababa, Ethiopia, 2014.*

| S. no | Knowledge questions | Yes Freq (%) | No Freq (%) | Score(s) Out of 20 | Freq (%) |
|---|---|---|---|---|---|
| 1 | Oral is the best recommended route of intubation | 88(68.2) | 41(31.8) | 1 | 2(1.6) |
| 2 | Oral route is selected since it is not associated with sinusitis | 77(59.7) | 52(40.3) | 3 | 1(0.8) |
| 3 | A nurse is required to dispose a suction catheterimmediately after one single use | 64(49.6) | 65(50.4) | 6 | 1(0.8) |
| 4 | It is recommended to change humidifiers every day, whenever necessary. | 48(37.2) | 81(62.8) | 7 | 3(2.3) |
| 5 | Insertion of the suction catheter in to ETT is a sterile procedure | 93(72.1) | 36(27.9) | 8 | 18(14.0) |
| 6 | Dusting of Respiratory and bedside equipment should be done every shift, whenever soiled. | 32(24.8) | 92(75.2) | 9 | 24(18.6) |
| 7 | Head of the bed should be elevated from 30-45 degrees | 74(57.4) | 55(42.6) | 10 | 17(13.2) |
| 8 | A nurse caring a ventilated patient is require to wear clean gloves during oral suctioning | 77(59.7) | 52(40.3) | 11 | 21(16.3) |
| 9 | A nurse caring a ventilated patient is require to wash hands before and after oral/ ETT suctioning | 106(82.2) | 23(17.8) | 12 | 14(10.9) |
| 10 | It is recommended to perform oral care every 4-6 hrs, whenever necessary using swab moistened with mouth wash and water | 66(51.2) | 63(48.8) | 13 | 13(10.1) |
| 11 | Prolonged use of stress ulcer prophylaxis to a ventilated patient may increase the colonization density of the aero-digestive tract | 40(31.0) | 89(69.0) | 14 | 6(4.7) |
| 12 | Maintenance of adequate number of nurse to patient ratio in critical care setting is associated with decreased risk of VAP | 72(55.8) | 57(44.2) | 15 | 3(2.7) |
| 13 | Continuous education to ICU nurses on prevention of Nosocomial infection is associated with decreased rates of VAP | 91(70.5) | 38(29.5) | 16 | 1(0.8) |
| 14 | Chest physiotherapy is useful for decreasing risks for VAP | 31(24.0) | 98(76.0) | 17 | 2(1.6) |
| 15 | Adjustable beds is useful for reducing the risks for VAP | 102(79.1) | 27(20.9) | 18 | 1(0.8) |
| 16 | ETT suctioning should be done to patient as needed | 49(38) | 80(62) | 19 | 2(1.6) |
| 17 | Eating on high calorie diet for patient on mechanical ventilation will reduce the risk for VAP | 60(46.5) | 69(53.5) | | |
| 18 | Overfeeding of carbonated foods or fluids to a ventilated patient is associated with decreased risk of VAP | 42(32.6) | 87(67.4) | | |
| 19 | During the care to a ventilated patient maintaining adequate cuff pressure is important because it decrease the risk for VAP | 48(37.2) | 81(62.8) | | |
| 20 | Unplanned extubation is associated with increased risk of aspiration, therefore, increase the risk for VAP | 105(81.4) | 24(19.0) | | |
| | *Calculated mean score=10.58(52.9%)* | | | Total | 129(100% |

## 3.3. Practices
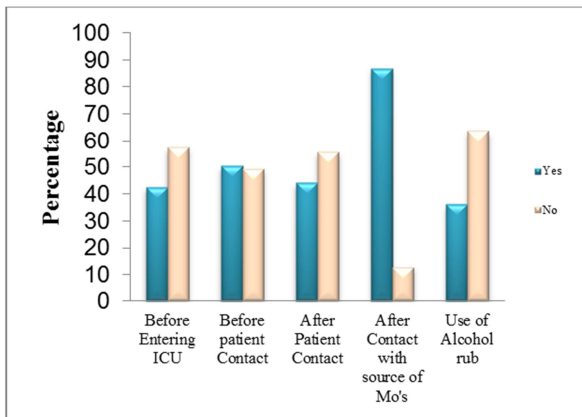
### 3.3.1. Hand Washing Practice



*Figure 1. Hand washing practices of Adult Intensive care nurses in selected public hospitals in Addis Ababa, Ethiopia, 2014.*

Large proportion of Adult Intensive Care nurses 55 (42.6%) observed are not wash their hands before entering ICU, 65 (50.4%) wash their hands before and 57 (44.2%) after patient contact. Large proportion of nurses 112 (86.8%) are observed to wash their hands after contact with a source of microorganism and also found that the use of alcohol rub is minimal 47(36.4%) as illustrated on figure 1.

*ETT suctioning*

Out of one hundred twenty nine Adult Intensive Care nurses, large proportion 117(90.7%) of nurses worn sterile gloves though small proportion 58 (45%) practice hand washing before see table 2 and 116 (89.9%) after suctioning, 45(34.9%) prepare sterile equipment and 78(60.5%) follow aseptic technique whereas 58(45%) were ensuring environmental cleanness, 78(60.5%) discard suction tube immediately after single use, 75(58.1%) cannot measure the amount and characteristics of secretions and majority of nurses 76 (58.9%) also cannot document the procedure.

*Table 2. Activities of Adult Intensive Care nurses during suctioning from ETT/ Tracheostomyin selected public hospitals in Addis Ababa, Ethiopia, 2014.*

| Activities | Resp. | Freq. | % |
|---|---|---|---|
| Hand washing Before suctioning | Yes | 58 | 45.0 |
| | No | 71 | 55.0 |
| Wear sterile gloves | Yes | 117 | 90.7 |
| | No | 12 | 9.30 |
| Prepare Sterile equipment | Yes | 45 | 34.9 |
| | No | 84 | 65.1 |
| Ensuring environmental cleanness | Yes | 58 | 45.0 |
| | No | 71 | 55.0 |
| Aseptic insertion of ETT | Yes | 50 | 38.8 |
| | No | 79 | 61.2 |
| Discard suction tube immediately after one single use | Yes | 78 | 60.5 |
| | No | 51 | 39.5 |
| Measure the amount and X-tics of secretion | Yes | 54 | 41.9 |
| | No | 75 | 58.1 |
| Hand washing after suctioning | Yes | 116 | 89.9 |
| | No | 13 | 10.1 |
| Documentation | Yes | 53 | 41.1 |
| | No | 76 | 58.9 |

*Correct practice (yes) only follows acceptable evidence based practice protocol/guidelines*

### 3.3.2. Oral Care Practice

Of all nurses 118 (91.5%) can suction the secretion as they accumulate whereas 49 (38%) wash their hands before oral care, and 127 (98.4%) wash their hands after oral care, 56 (43.4%) rinse mouth with clean swab and 24 (18.6) clean patients mouth using toothbrush or gauze moistened with mouth wash and 53 (41.1%) position the patient in the semi recumbent position while small proportion 6 (4.7%) of nurses clean and return equipment to its proper places see table 3.

*Table 3. Activities of Adult Intensive Care nurses during Oral care.*

| Activities | Resp. | Freq. | % |
|---|---|---|---|
| Hand washing Before Oral care | Yes | 49 | 38.0 |
| | No | 80 | 62.0 |
| Apply clean gloves | Yes | 11 | 8.50 |
| | No | 118 | 91.5 |
| Position the patient in a semi | Yes | 53 | 41.1 |
| recumbent | No | 76 | 58.9 |
| Clean mouth using toothbrush | Yes | 24 | 18.6 |
| | No | 105 | 81.4 |
| Rinse mouth with a clean swab | Yes | 56 | 43.4 |
| | No | 73 | 56.6 |
| Suction secretions as they accumulate, if necessary | Yes | 118 | 91.5 |
| | No | 11 | 8.50 |
| Apply water soluble jelly to patients lips | Yes | 61 | 47.3 |
| | No | 68 | 52.7 |
| Clean equipment and return to its proper place | Yes | 6 | 4.70 |
| | No | 123 | 95.3 |
| Hand washing after oral care | Yes | 127 | 98.4 |
| | No | 2 | 1.60 |
| Documentation | Yes | 58 | 45.0 |
| | No | 71 | 55.0 |

*Correct practice (yes) only follows acceptable evidence based practice protocol/guidelines*

### 3.4. Factors Associated with Knowledge

Adjusting for Education, Correlation between ICU training, years of ICU working experience and knowledge of ICU reveals that there is no significant difference in knowledge between participants with different years of experience as found (p $_{value}$ = 0.33). There is a significant difference in Knowledge between respondents with ICU training as found (OR= 1.61, p$_{value}$ = 0.038, 95%CI (1.02-2.56)) and between participants with different educational level (OR=1.87, p$_{value}$ = 0.04, 95%CI (1.18- 4.45)).

### 3.5. Factors Associated with Practice

Adjusting for level of Education, Correlation between ICU training, years of ICU working experience and knowledge of ICU reveals that there is Correlation between level of education, ICU training, years of working experience and practice of nurses working in the Adult Intensive care unit on prevention of VAP, there is no significant difference in practice between ICU nurses with different educational Level as found (p$_{value}$ = 0.55). Significant difference in practice was found between ICU nurses who had ICU training (OR= 1.39, p$_{value}$ = 0.041, 95%CI (1.03-2.85)) and between nurses with different years of Experiences (OR= 19.2, p$_{value}$ = 0.023, 95%CI (1.9-27.1)).

## 4. Discussion

### 4.1. Knowledge

In this study, one hundred and twenty nine (n=129) nurses working in the adult intensive care units were participated where majority were diploma nurses, less experienced (<10 years) and had no ICU training. Inadequate/lack of knowledge is said to be a barrier to practice, the knowledge scores and their level were, majority (51.2%) were scored below average had inadequate knowledge (mean value=10.58). Similar study from three hospital ICU's in South Africa [5] also revealed that about 23% reported having adequate knowledge on evidence based guidelines for prevention of ventilator associated pneumonia and a questionnaire distributed to 855 critical care nurses during annual congress of the Flemish society [21] of which 638 were completed, majority reported having inadequate knowledge. Most, 74% were females and majority had less than 10 years working experience in the ICU. The same study from Tanzania [19]also shows that majority of ICU nurses had no intensive care training and has less than 10 years of ICU experience. The knowledge assessing questions in the three setups were more or less likely asked the same knowledge aspiring questions.

### 4.2. Practice

In the current study, large proportion of Adult intensive care nurses (50.4%) observed were not wash (alcohol rub) their hands before entering the ICU/ before patient contact and surprisingly, majority were observed washing (alcohol rub) their hands after patient contact or possible sources of microorganisms. Similar study from Tanzania [19] support this finding that, of 30 ICU nurses observed, none washed their hands before entering to the ICU but a few were just before contacting the patient where majority (33.3%) washed their hands after contacting the patient. Hand washing is the cheapest and a primary steps in the health care infection prevention strategies/ protocols. But, as we understand from these studies large proportion were not wash their hands before entering ICU, even though the observer associate absence of tap and reagent for hand rub in the inlet door. In addition to this, dryness, fissures and irritations caused by soap or alcohol based hand rub were a major contributing factor for poor compliance in hand washing. It is also known that hand hygiene applications before patient contact is significantly worse than hand washing after all.

In this study, majority of Adult intensive care nurses undergoing Endo tracheal tube suctioning worn sterile glove but couldn't measure and document the amount and characteristics of the secretions. Similar study [1, 5, 10, 19, 22] also showed that; majority of ICU nurses maintain sterility of the suction catheter until it is inserted in to the air way and in contrast, a few maintain cleanness of ETT suctioning procedure and patient environment. Thus, ICU infections are prevalent in ICU patients due to poor adherence to aseptic procedures in those like that of ETT suctioning. That is why literatures were strongly emphasized on the application of aseptic technique in suctioning practices and hand washing before and after such procedures. Plus to this, the literature clearly suggests that gloves do not replace the need for hand washing. Besides, it resulted in high expenditure of gloves and internal stigma to patients where it couldn't be the case if hand washing practices secured in place [17, 21].

Though American dental association has no separate standards for orally intubated patients or for patients on mechanical ventilation, tooth brushing with tooth paste twice a day and swabbing the mouth every two to four hourly is recommended and was taken as oral care protocol in this setting. However, in this study observer found out that the use of tooth brush was inadequate/hardly in practice, a few were seen while applying a clean swab to clean the patient's mouth. The inadequate practices of tooth brushes were associated with fear of contamination and potential dislodgment of the tube by main. Besides it is time consuming and difficultness in manipulation of the tube (ETT) which limits accessibility to the oral cavity for brushing. But, a few were using a clean swab to rinse a patient's moth while the patient is positioned in semi recumbent position to prevent a back flow of oral secretions and aspirations. Therefore, oral care in this position is encourage-able unless contraindicated as in case of patients with head injury.

### 4.3. Associated Factors

The current study found out that knowledge of Adult intensive care nurses on prevention of ventilator associated pneumonia is statistically associated with ICU training, level of education and year of working experience in the ICU (Pvalue< 0.05), but this is not similar with the findings from

global European study [3], south Africa [5]and Tanzania [19]which indicate that there is no association between ICU nurses level of knowledge, and ICU training and year of working experience. These discrepancies may be related with small sample size they have been using unlike in case of this study. The other study from Cisanello hospital, Italy [17], indicated that nurses tend to apply measures/protocols and instructions given by physicians or colleagues without knowing why and for what they actually do. The same is true in this study and in addition, most nurses were practicing according to what they have learnt in school or gained by experience as evidenced by inadequate ICU trainee's and insufficient knowledge. From this we can simply understand that lack of ICU training contributes to inadequate knowledge and practices which in turn wash off their confidences to take actions and decisions. This contributes to delaines and multiple risks/complications to patients on mechanical ventilation/intubations, which can be preventable.

# 5. Conclusions

This study found out that:
i.   Majority of Adult intensive Care nurses have inadequate knowledge.
ii.  Nurses who trained and had high educational level had adequate knowledge than those nurses who had more years of experience.
iii. Experienced and trained nurses were practicing more adequately than novice nurses who had first and Second degree irrespective of their level of Education. i.e. Nurses who hold their first degree were observed that they practice less likely than those trained and experienced diploma nurses.
iv.  Hand washing, Environment and/ Equipment cleanness during ETT suctioning and oral care was observed to be inadequate, therefore, knowledge of Adult Intensive Care nurses on VAP preventive strategies does reflect in inadequate practical skills.

# 6. Recommendations

We would like to recommend those program efforts (including Government, privates, NGO's and Nursing Association) working towards prevention of VAP, and improving Knowledge and practices of Intensive care nurses.

# Abbreviations

ARDS- Acute Respiratory Distress Syndrome
ETT-Endotracheal tube
ICU-Intensive Care Unit
NGO- Non Government Organization
VAP- Ventilator Associated Pneumonia

# Competing Interest

The authors of this manuscript declare that they have no competing interest (financial or other) in this publication.

# Author's Contribution

GAW as a principal investigator was involved in all aspects of this study. DM and GGG provided the technical and intellectual inputs. All authors reviewed and approved various drafts and the final paper as well.

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