

The Impact of Structured Teaching Program on ICU Nurses Regarding Prevention of Ventilator Associated Pneumonia

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Abstract: Ventilator Associated Pneumonia (VAP) is one of the most common device related infections in ICUs and although with advanced intervention strategies yet it is associated with high mortality rate. Prevention of VAP is vital while caring for mechanically ventilated patient. The nurse's role in prevention of VAP is extremely significant as they are the primary care givers and provide constant care to the critically ill patient. The research was conducted to evaluate the impact of structured teaching program on ICU nurses regarding prevention of ventilator associated pneumonia. The main objectives of the research study were to assess ICU nurses knowledge about prevention of VAP, to evaluate the effectiveness of structured teaching programme on prevention of VAP among ICU nurses and to determine the association among ICU nurses knowledge regarding prevention of VAP with their selected demographic variable. *Method:* An evaluative research model was used without any control group using pre- experimental design, with purposive sampling technique with one group pre-test and post-test. 60 Registered ICU Nurses were participated in study and evaluated using semi- structured knowledge questionnaire. STP was implemented, using same tool 7 days later post-test was conducted. *Results:* Overall, pretest knowledge scores on prevention of VAP was found to be 49.8% and the overall posttest knowledge scores were recorded as 74.4% thereby 24.6% of enhancement in the mean percentage knowledge score was found which is significant at with $P < 0.001$ level. Also significant association between knowledge scores & selected demographic variables were found with age (χ^2 28.01), marital status (χ^2 37.51), income (χ^2 36.11), professional educational qualification (χ^2 24.75), clinical experience (χ^2 37.98), knowledge about VAP (χ^2 38.5) and source of information on VAP (χ^2 16.93) and no association found with gender. *Conclusion:* The study concluded that knowledge deficiency persist among staff nurses regarding prevention of Ventilator Associated Pneumonia and STP shows efficiency in improving their knowledge.

Keywords: Ventilator Associated Pneumonia, Knowledge, ICU Staff Nurses, Structured Teaching Program

1. Introduction

Mechanical ventilation is a form of an artificial ventilation where mechanical device is used to assist or replace spontaneous breathing [1]. This may involve a machine called a ventilator and the breathing may be assisted by an Anesthesiologist, certified registered nurse anesthetist, physician, physician assistant, respiratory therapist, paramedic, or other suitable person compressing a bag or set of bellows. Mechanical ventilation is termed "invasive" if it involves any instrument penetrating through the mouth (such as an endotracheal tube) or the skin (such as a tracheostomy tube) [2].

Health care-associated infection (HCAI), also referred to nosocomial infection occurring in a patient during the process of care in a health-care facility at the time of admission, probably due to invasive lines used and not handling them appropriately. Such infections include urinary tract infection, ventilator associated pneumonia, surgical site infection and blood stream infection [3].

According to the Center for Disease Control and Prevention (CDC, 2012), Ventilator associated pneumonia (VAP) is that type of pneumonia developing 48 hours post intubation. It is diagnosed by the presence of a number of indicators including; manifestations of pulmonary infection as; presence of a disturbance in body temperature $> 38^\circ\text{C}$ or

< 36°C, leukocytosis and purulent tracheal secretions, new or persistent infiltrates detectable on chest radiographs, and positive deep tracheal aspiration culture [4].

NEED FOR THE STUDY:

Ventilator-associated pneumonia (VAP) incidence rate is still seen in the intubated patients which accounts of 8 to 28% as compared to other device related infections like urinary tract and skin where mortality is 1% to 4%. In India, Incidence of VAP was found to be 35.14%, out of which 44.23% had early-onset (<4 days MV) VAP and 55.77% had late-onset (>4 days MV) VAP. The overall mortality rate for VAP lies around 24% to 50% and increased with high risk pathogens to 76%. Despite the advancements in antimicrobial regimes, VAP continues to be an important cause of morbidity and mortality. VAP requires a rapid diagnosis and initiation of appropriate antibiotic treatment, as there is adverse effect of inadequate antibiotic treatment on patients' prognosis and the emergence of multidrug-resistant (MDR) pathogens [5].

Though there are so many measures done on prevention of VAP and researches ongoing still as VAP is still persist. Intensive care staff nurses knowledge and updates of the ventilator bundle and its applications for preventing VAP is still found lacking and limited. So researcher felt that need to conduct the study in intensive care staff nurses supported by current research and scientific evidence. Current practices on developing VAP among intubated patients can be assessed through appropriate literature reviews about the ventilator bundle and nursing practice, factors associated with VAP and by assessing evidence-based practices through education.

Education plays a vital role in the caring of patients with VAP and their prevention strategies. Through appropriate teaching programme risk and rate of VAP can be decreased significantly. Nurses are the primary care givers and are very resourceful in ICUs, who cares their patients all the time. So, if nurses improve their knowledge on prevention of VAP and implement appropriate evidence based practices, surely it will help in reduction of morbidity and mortality of critically ill patients due to VAP.

A cross-sectional study was conducted in Tanzania where structured questionnaire was administered among 116 ICU nurses. Data analysis using descriptive statistics and t-test. Results: The mean knowledge score was 3.86 (SD = 1.56), based on ten questions (equivalent to 38.6%). Nurses with a degree or higher level of nursing education performed significantly better than the nurses with lower level of nursing education ($p = 0.004$). The mean self-reported compliance score for EBPs for the prevention of VAP was 15.20 (SD = 0.93) which is equivalent to 60.8%. Conclusion: the higher the level of education the better prevention of VAP [6].

In India, tirupati, the study was conducted at Sri Venkateswara Institute of Medical Sciences, in ICU patients with clinically suspected VAP. The patients observed for the three years were 1159 in 2011, 903 in 2012 and 1022 in 2013, of whom 247, 297 and 303 had clinical and microbiological evidence of VAP, respectively, as per the

modified Clinical Pulmonary Infection Score (CPIS) 11 of more than six. During the study span significant growth of pathogens (mono or polybacterial) was found in 247 of 1159 (21.3%) patients in 2011, 297 of 903 (32.9%) in 2012 and 303 of 1022 (29.6%) in 2013. The VAP rates were 44.1, 43.8 and 26.3 per 1000 ventilator days in the three years, respectively [7].

1.1. Objectives

- 1) To assess the ICU nurses knowledge regarding prevention of ventilator associated pneumonia (VAP).
- 2) To find out the efficiency of structured teaching programme among ICUnurses on prevention of VAP.
- 3) To determine the association between the knowledge regarding prevention of VAP among ICU nurses with their selected demographic variable.

1.2. Hypothesis

H1: There will be a significant difference between ICU nurses knowledge level on pre and post administration of structured teaching programme.

H2: There will be a significant relationship between ICU nurses knowledge level on prevention of ventilator associated pneumonia and their socio demographic variables.

1.3. Research Variables

Independent variable - Structured Teaching Programme on prevention of VAP.

Dependent variable – Knowledge of ICU nurses regarding prevention of VAP.

Attribute variables - Age, Gender, Marital status, income, Professional qualification, Total clinical experience, Source of information on VAP.

1.4. Conceptual/Theoretical Frame Work

The conceptual frame work was developed by the investigator adopted from Health Promotion Model -Pender (1996). This is directed at increasing client's level of wellbeing.

- 1) It identifies the modifying factors like demographic variables that increase or decrease nurses contribution in promotion of health.
- 2) Indicate to nursing action (probably client participation in gaining knowledge regarding VAP prevention strategies.)
- 3) Nurses initiatives and involvement in health promotion behavior (acquiring information about VAP preventive strategies).

In this study, the Pender's health promotion model is adapted wherein the staff nurses act as an agent, and providing valuable clues regarding the clinical presentation of VAP and act as a strong member of health team in aiding physicians to diagnose and manage VAP in clinical set up. The goal is to explain the causes that interfere ICU nurses knowledge about VAP prevention.

Health promotion attitude of the ICU nurses regarding

prevention of VAP are depending on factors such as age, gender, income, marital status, professional educational qualification, total clinical experience and source of information regarding VAP.

If the ICU nurses have adequate knowledge about VAP prevention, they are mostly utilizing it in their practice which helps enhances health promotion behavior. If the knowledge is inadequate, vice versa.

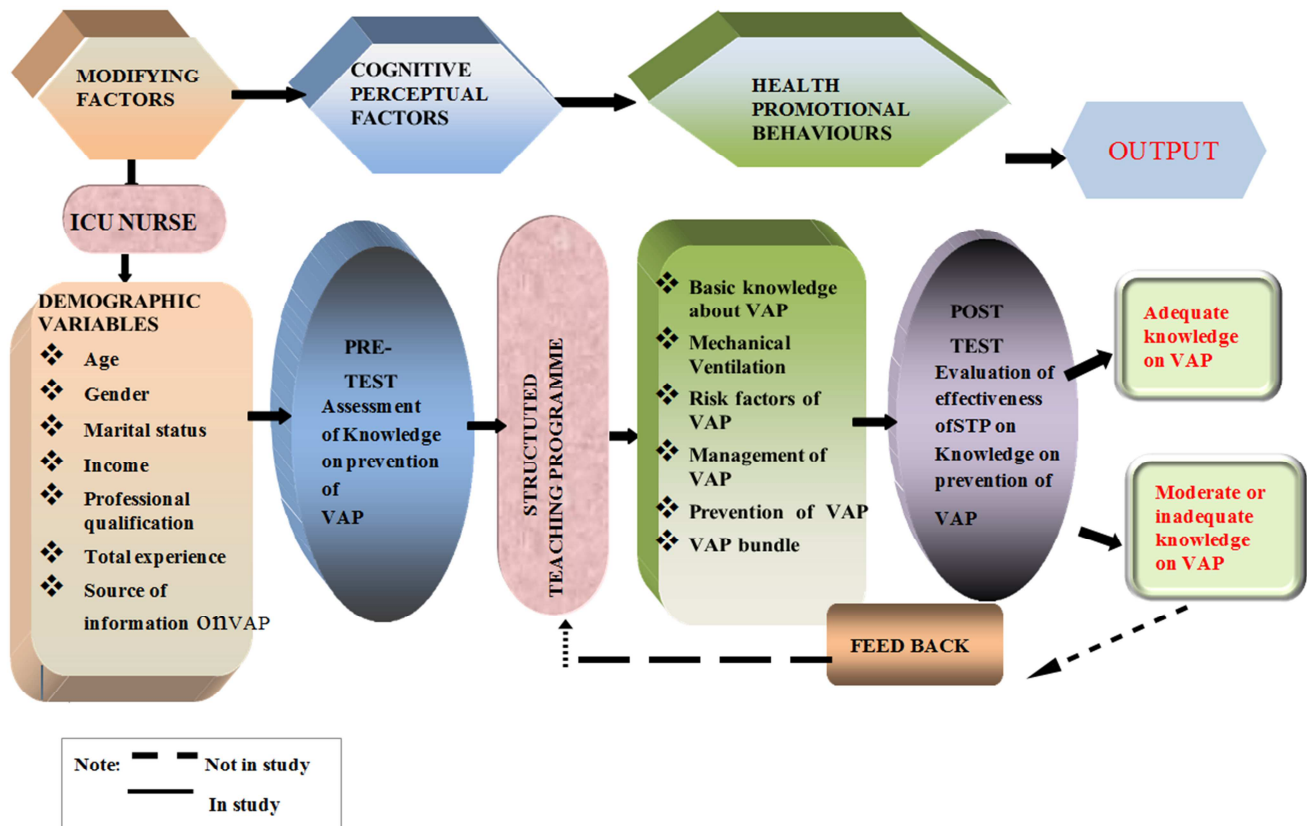


Figure 1. Theoretical framework on Health promotion model by Pender (1996).

2. Review of Literature

The review done based on the following indicators:

Incidence and prevalence of VAP

A study conducted in Bangkok, Thailand in the SICU of Siriraj Hospital, Mahidul University for 1 year period which aims to determine the incidence and risk factors of VAP, 228 patients were observed. 21 patients developed VAP (9.21%) or 8.21 per 1,000 ventilator-days with organism *A. baumannii* (66%), followed by *P. aeruginosa* (19%). Patients with VAP had higher APACHE II score (18 vs. 13, $P < 0.001$). Multiple logistic regression showed that numbers of CVC, intubation and surgery, the use of muscle relaxant and steroid were independent risk factors for developing VAP. Ventilator days and ICU length of stay were longer in the VAP group (25 vs. 6 and 25 vs. 7 days, respectively). Lastly, the hospital mortality rate was significantly higher in the VAP group (33% vs. 12%, $P = 0.008$). The incidence of VAP was 9.2% in the SICU of Siriraj Hospital, which was comparable with previous reports. Bundles of care to prevent VAP should include weaning from a ventilator [8].

Another study conducted in Karnataka, Kolar, India where 100 clinically suspected VAP patients were enrolled. Out of 100

patients VAP was diagnosed in 71% patients, where 66% were males and 34% were females with a mean age of 41.13 ± 15.38 (range 18 to 70 years). The incidence noted that 26.76% (19) were categorized as early onset VAP (within 96 hours) while 73.23% (52) were categorized as late onset VAP (after 96 hours) with a mean duration of ventilation of 5.32 ± 1.36 days. VAP rate ranging between 17 – 22/1000 patient ventilated days during the various months of the study period [9].

Risk factors and causes relating to ventilator associated pneumonia

A study was conducted in China to identify the potential risk factors of VAP and to present logistical regression prediction models of VAP occurrence in elderly Chinese patients receiving MV. Total 901 Patients (aged 80 years or above) receiving MV for ≥ 48 h were enrolled from the Chinese People's Liberation Army (PLA) General Hospital from January 2011 to December 2015. Univariate logistic regression models were performed to explore the relationship between risk factors and VAP. Out of 901 patients, 156 were diagnosed as VAP (17.3%). The incidence density of VAP was 4.25/1,000 ventilator days. Logistic regression analysis showed that the independent risk factors for elderly patients with VAP were COPD (OR = 1.526, $P < 0.05$), intensive care unit (ICU) admission (OR = 1.947, $P < 0.01$), the MV methods ($P < 0.023$),

the number of antibiotics administered ($OR=4.947$, $P < 0.01$), the number of central venous catheters ($OR=1.809$, $P < 0.05$), the duration of indwelling urinary catheter ($OR=1.805$, $P < 0.01$) and the use of corticosteroids prior to MV ($OR=1.618$, $P < 0.05$). Study concluded VAP occurrence is associated with a variety of controllable factors [10].

A prospective observational study was carried out in Madhya Pradesh, India to find out the incidence, risk factors and attributable mortality associated with VAP and various bacterial pathogens causing VAP in the ICU. Results showed the incidence of VAP was 57.14% and the incidence density of VAP was 31.7/1000 ventilator days. Trauma was the commonest underlying condition associated with VAP. The incidence of VAP increased as the duration of mechanical ventilation increased and there was a total agreement in bacteriology between semi-quantitative ETAs and BALs in the study. The overall mortality due to VAP was 48.33% [11].

Review related to prevention of VAP

A Pre and post intervention observational study done in Paris, France of 2 yrs multifaceted programme in 20-bed medical ICU. A total of 1649 ventilator-days were observed. Compliance assessment consisted of five 4-wk periods (before the intervention and 1 month, 6 months, 12 months, and 24 months thereafter). Results showed that Hand-hygiene and PPE use compliances were initially high (68% and 80%) and remained stable over time. Compliance with all other preventive measures was initially low and increased steadily over time (before 2-yr level, $p < .0001$). To assess overall performance of the 6 preventive measures, using ventilator-days as the unit of analysis, a composite score for preventive measures applied (range, 0–6) was developed. The median (interquartile range) composite scores for the five successive assessments were 2 (1–3), 4 (3–5), 4 (4–5), 5 (4–6), and 5 (4–6) points; they increased significantly over time ($p < .0001$). VAP prevalence rate decreased by 51% after intervention ($p < .0001$). The study concluded that the increased compliance with preventive measures directly dependent on healthcare workers' bedside performance [12].

A randomized study done over 1 year in tertiary level hospital at Rajasthan, India on ventilated patients aged from 24 to 80 yrs, where prevention of ventilator bundle checklist followed. According to the 2004 CDC (Center for Disease Control) guidelines, hands should be washed before and after patient contact and also in between patient contact. Chlorhexidine has been shown to be effective in the control of ventilator-circuit colonization and pneumonia caused by antibiotic-resistant bacteria. Oropharyngeal decontamination with Chlorhexidine solution has also been shown to reduce the occurrence of VAP in patients undergoing cardiac surgery. In order to further decrease the incidence of VAP, protocols and monitoring tools must be developed [13].

Knowledge of staff nurses regarding VAP prevention

A cross-sectional study done with 219 nurses working in 14 intensive care units at 11 Guilan hospitals. The self-administered questionnaire was used. Results: Of the 219 nurses, 171 (response rate 78.1%) participated in this study, and their mean knowledge score was 4.6. There was no significant relation

between nurses' knowledge score and their work experience ($P = 0.327$), education degree ($P = 0.189$), and their position ($P = 0.168$). Conclusion: The level of knowledge regarding VAP prevention seems inadequate in this study [14].

Effectiveness of structured teaching programme

A pre and post observational study was conducted in Jordan to identify the level of ICU nurses' knowledge of VAP and prevention measures. Data based on a self-reported questionnaire from 428 ICU nurses were analyzed. Paired t-tests were used. Results found more than three-quarters of nurses had a low knowledge level regarding pathophysiology, risk factors and VAP preventative measures. Nurses showed significant improvements in mean scores on the knowledge level of ventilator-associated pneumonia and prevention measures after an educational programme ($p < 0.05$) [15].

A Study pre and post-test design study was conducted in Guntur, Andhra Pradesh, India to assess the efficiency of structured teaching programme. Total 30 nurses were included and result showed majority of nurses 21 (96.6%) were having inadequate knowledge on prevention of VAP and about 9 (30%) were having average knowledge. The majority 29 (96.6%) of nurses were having above average knowledge on prevention of VAP and about 1 (3.33%) were having average knowledge on prevention of VAP. Conclusion: The study concluded that majority of the nurses were having insufficient knowledge which improved significantly post administration of structured teaching programme [16].

3. Methodology

3.1. Research Design

Pre-Experimental evaluative research design, One Group Pre-test and Post-Test adapted.

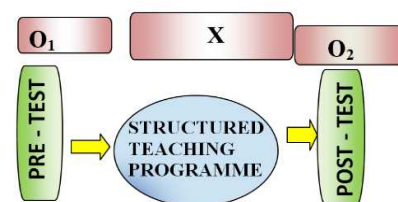


Figure 2. Schematic Representation of Research Design.

O1= Pre-test assessment of knowledge regarding prevention of VAP among ICU nurses

X = Administration of Structured teaching programme regarding prevention of VAP among ICU nurses

O2= Post-test assessment of knowledge regarding prevention of VAP among ICU nurses.

3.2. Variables of the Study

Independent variable: Structured teaching programme about VAP.

Dependent variable: Knowledge of ICU staff nurses about VAP.

Attribute variable/Demographic variable: This include age, gender, income, marital status, professional qualification,

Total clinical experience in years, Source of information regarding VAP.

3.3. Sample Size, Sampling Technique and Sample Selection Criteria

60 Registered Staff Nurses working in ICU. In the study, purposive sampling method through non-probability convenient sampling technique was used.

Sample Selection Criteria

Inclusion criteria: Nurses working in ICU at selected hospitals, present during data collection, interested to participate.

Exclusion criteria: Nurses working less than one year in ICU & have undergone special training.

3.4. Setting of the Study

The study was conducted in the Fortis Hospital which is 8.9Km, The Bangalore Hospital which is 8.5Km from Global College Of Nursing, Bengaluru. The settings selected due to geographical proximity, feasibility for conducting the study, availability of the required sample and familiarity of the investigator with these settings.

Population: Registered ICU Staff Nurses working at Fortis Hospital and The Bangalore Hospital, Bengaluru, Karnataka.

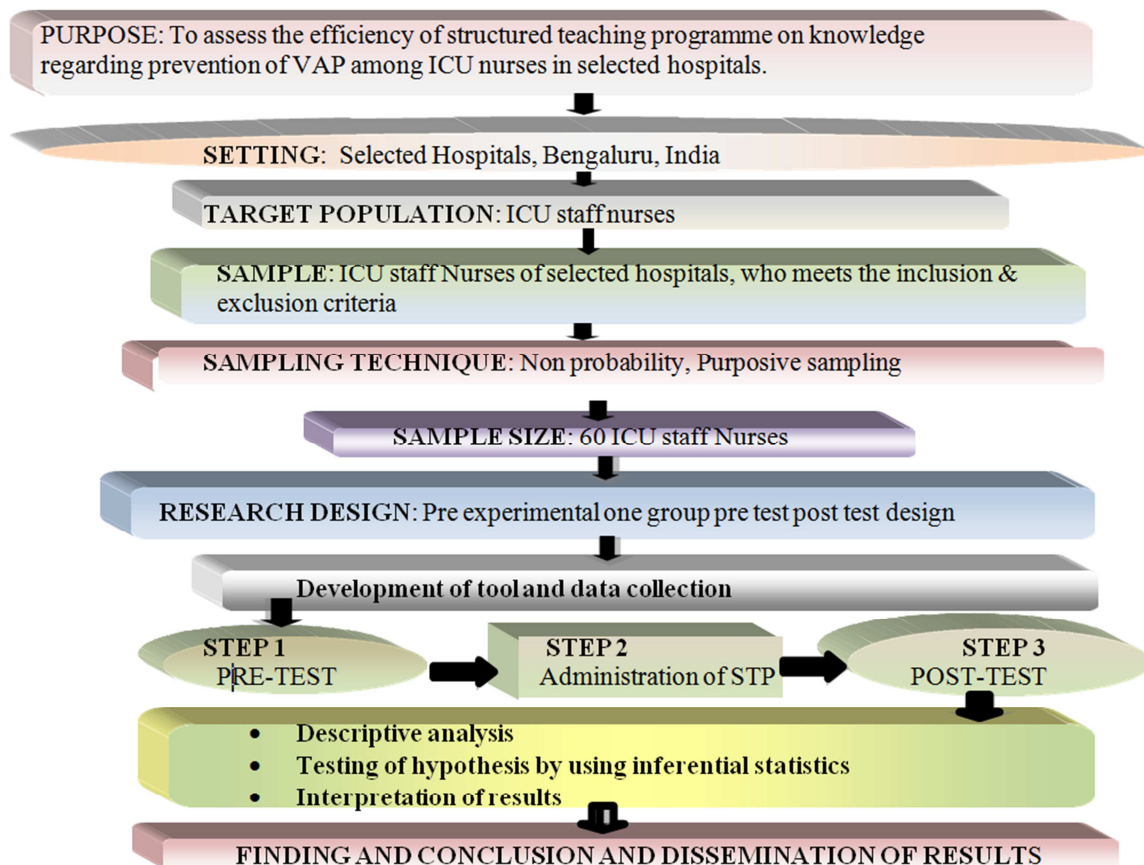


Figure 3. Research methodology flowchart.

3.5. Limitations of Study

The period of data collection was limited to 4 weeks, Only 60 Critical care nurses, ICU nurses of selected hospitals, only Nurses available at the time of data collection and evaluation of STP efficiency in terms of knowledge scores.

3.6. Selection and Development of Tool

A semi-structured knowledge questionnaire was utilized. The tool developed as followed:

3.6.1. Literature Review

The semi-structured Knowledge Questionnaire was developed after taking review of research and non-research

literature, as per CDC guidelines, Expert's opinions and suggestions and a blue print was prepared and knowledge items were developed.

3.6.2. Preparation of Semi-structured Knowledge Questionnaire: It Consisted of Two Parts

- 1) Section I: It included the personal and socio-demographic data which contains Age, gender, marital status, income, years of experience in ICU, education level and previous knowledge on VAP and source of information about prevention of VAP.
- 2) Section II: a semi-structured knowledge questionnaire was prepared which consists of 30 questions.

Blue print of tool (Questionnaire) was prepared and items were in 3 sections (A, B and C)

Part A consist of 08 items related to knowledge regarding definition (01), risk factors (04), causative organism (01), clinical manifestation (01), diagnosis (01). Part B with 10 validated questions which were adopted from a reliable questionnaire developed by Vandijck [17]. Part C with 12 questions which were adopted from a reliable sources by Tablan et al, recommended by CDC guidelines and corrected answer based on these too [18, 19]. The other added questions were prepared with guidance of literatures, CDC guidelines and ICU experts suggestions. Eight experts reviewed the tool. The knowledge scores ranged from 0 – 30.

SCORING: 'one' mark assigned for correct answer and 'zero' for wrong answer.

$$\text{Percentage} = \frac{\text{Gained marks}}{\text{Total marks}} \times 100$$

To rule out the association, the knowledge levels were divided into 3 categories.

Category	Marks	percentage
Inadequate knowledge	0-10	<=50%
Moderate knowledge	11-20	51% - 75%
Adequate knowledge	21-30	>75%

3.6.3. Structured Teaching Programme

Development of Content Blue Print: Objectives were formulated and systematically categorized as general

information, evidence based guidelines and general preventive strategies on VAP Prevention. The same blue print utilized in the preparation of STP.

Development of Structured Teaching Programme: Initial draft of STP was prepared considering corrections. The factors like professional qualification, teaching method and aids used and simple language were taken into account. Lecture cum discussion method was selected. The evaluation of structured teaching programme was planned through conducting post-test after 7 days of implementation the structured teaching programme. The STP was titled —Prevention of Ventilator Associated Pneumonia.

3.6.4. Content Validity

The semi-structured knowledge questionnaire and structured teaching programme were content validated by giving to 6 experts from nursing field, 1 ICU physician and 1 statistician. As per their suggestions the modifications were made and tool and STP were finalized.

3.7. Reliability

The semi-structured knowledge questionnaire was distributed to 6 subjects. The Test Retest method was implemented. The tool reliability was found to be 0.94. So the tool was considered reliable. Karl Pearson's formula was used.

Sno	Test	Retest	Reliability
1	15	14	$r = \frac{1/n \sum xy}{\sqrt{\frac{\sum x^2 - \bar{x}^2}{n}} \sqrt{\frac{\sum y^2 - \bar{y}^2}{n}}} = 0.935$ <p>The established reliability through Test Retest method for the tool was 0.94.</p>
2	12	13	
3	9	8	
4	11	10	
5	10	10	
6	14	13	

3.8. Pilot Study

To rule out feasibility and evaluative statistical analysis the study was commenced from 01-5-2019 to 07-05-2019 at Manipal Hospital, Bengaluru. Administrative and Medical ICU Consultant approval was obtained. After selecting six staff nurses by purposive sampling technique, pre-test was administered by using the semi-structured knowledge questionnaire and STP was administered for 45 min following pre test. After 7 days, the post-test was conducted by using the same semi- structured knowledge questionnaire to evaluate the effectiveness of STP. Result: The post-test mean percentage knowledge score (81%) was higher than the pre-test mean percentage knowledge score (40%). Enhancement score (41%) with Significant at 5% (P<0.05) level were found which makes the study feasible.

3.9. Data Collection Procedure for Main Study

Formal permission was obtained from administrative department and Medical superintendent of Fortis Hospital

and The Bangalore Hospital. From 15-5-2019 to 15-6-2019 in Fortis Hospital and from 25-5-2019 to 25-6-2019 The Bangalore Hospital data was collected respectively. The data collected was analyzed using both descriptive and inferential statistics.

Descriptive statistics: Frequencies and percentage distribution were used for analysis of socio demographic characteristics and the level of knowledge. Mean, Mean percentage and standard deviation were used for analyzing pre and post test scores.

Inferential statistics: paired t' test was applied to determine if there is any significant difference in the mean knowledge score of pre and post test findings. chi-square was applied to rule out the association between socio demographic variables with scores of nurses knowledge.

3.10. Ethical Consideration

The approval and ethical clearance were obtained from dissertation committee of the college. Permission was obtained from the administrative department and medical Superintendent of Fortis Hospital and The Bangalore Hospital. Participants were assured about confidentiality and

written consent was taken prior to data collection.

4. Results

The data collected was tabulated, analyzed and interpreted by using descriptive and inferential statistics. The level of significance was set at 0.05%.

Organization of the study findings:

The substantive summary of the analysis was under the following sections:

Section-1: Description of demographic variables of staff nurses in selected hospitals.

Table 1. Frequency and percentage distribution of demographic variables of staff nurses.

Section-2: Assessment of nurses knowledge pre and post test regarding VAP.

Table 2. Frequency and percentage distribution of staff nurses according to pre and post test level of knowledge regarding ventilator associated pneumonia.

Table 3. Mean and SD of pre and post test knowledge regarding ventilator associated pneumonia among staff nurses.

Section-3: STP efficiency on knowledge regarding ventilator associated pneumonia among staff nurses.

Table 4. Outcomes of paired t-test analysis of pre and post test knowledge regarding VAP.

Section-4: Association between the knowledge regarding ventilator associated pneumonia with selected demographic variables.

Table 5. Association between knowledge regarding ventilator associated pneumonia with selected demographic variables of staff nurses.

Section-1: Description of demographic variables of staff nurses in selected hospitals.

Table 1. Frequency and percentage distribution of demographic variables of staff nurses.

S.No	Demographic variables	Frequency	Percentage (%)
1.	Age in years		
	a. 21-30 years	30	50.0
	b. 31-40 years	21	35.0
2.	Marital status		
	a. Married	38	63.3
	b. Unmarried	22	36.7
3.	Sex		
	a. Male	10	16.7
	b. Female	50	83.3
4.	Income (Rs/months)		
	a. ≤15,000	16	26.7
	b. 15,001-20,000	18	30.0
	c. 20,001-25,000	15	25.0
	d. 25,001-30,000	7	11.7
5.	Educational status		
	a. Diploma	27	45.0
	b. BSc Nursing	22	36.7
	c. MSc Nursing	11	18.3
	d. PhD in nursing	0	0
6.	Work experience as a critical care nurse		
	a. 1-3 years	22	36.7
	b. 4-6 years	20	33.3
	c. 7-9 years	12	20.0
	d. 10 years and above	6	10.0
7.	Previous knowledge about ventilator associated pneumonia		
	a. Yes	42	70.0
	b. No	18	30.0
8.	If yes, Source		
	a. Mass media	11	26.2
	b. Health Personal	13	31.0
	c. Work shops and conferences	12	28.6
	d. Journals and book	6	14.3

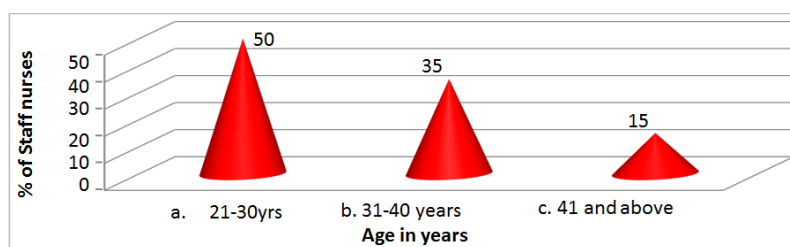


Figure 4. ICU nurses distribution according to age.

Figure 4 depicts the distribution of staff nurses by age. The above table shows that 50% of respondents were in the age group of 21-30 years followed by 35% in the age group of 31-40 years and 15% in the age group of 41 years and above.

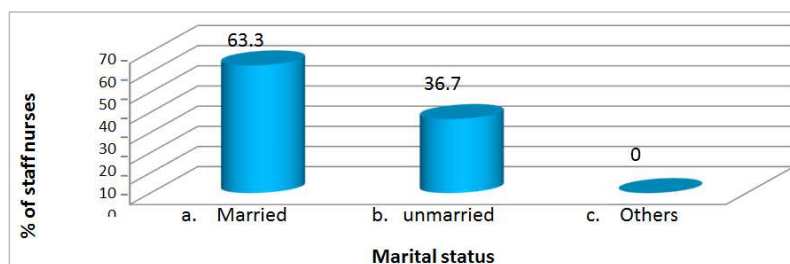


Figure 5. ICU nurses distribution according to marital status.

Figure 5 depicts the distribution of Staff Nurses by marital status. The above table indicates that 63.3% of nurses were married and 36.7% were unmarried.

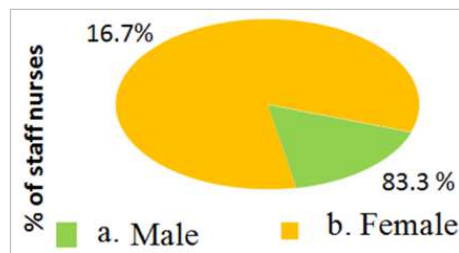


Figure 6. ICU nurses distribution according to gender.

Figure 6 depicts the distribution of staff nurses by gender. In relation to gender, majority 83.3% of nurses were females as compared to males 16.7%.

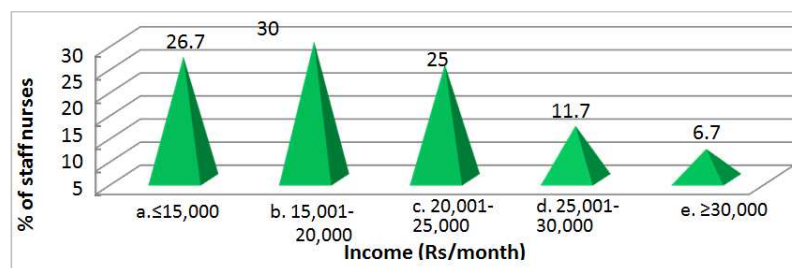


Figure 7. ICU nurses distribution according to income (Rs/month).

Figure 7 depicts the distribution of staff nurses by income. In relation to income, majority 30% of nurses were earning Rs.15,001-Rs.20,000, 26.7% were earning < Rs.15,000, 25% were earning Rs.20,000-Rs.25,000, 11.7% were earning Rs.25,000-Rs.30,000 and only 6.7% were earning equal to Rs.30,000 in this study group.

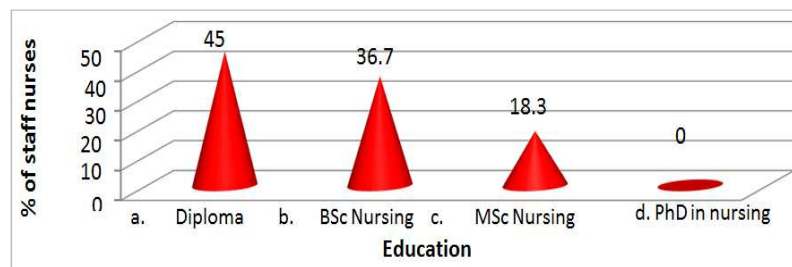


Figure 8. ICU nurses distribution according to level of education.

Figure 8 depicts the classification of Staff Nurses by professional educational qualification. It is found that 36.7% of the nurses were graduates in nursing and 45% were with Diploma in Nursing and only 18.3% were post graduate in Nursing, none has doctorate in Nursing in this study group.

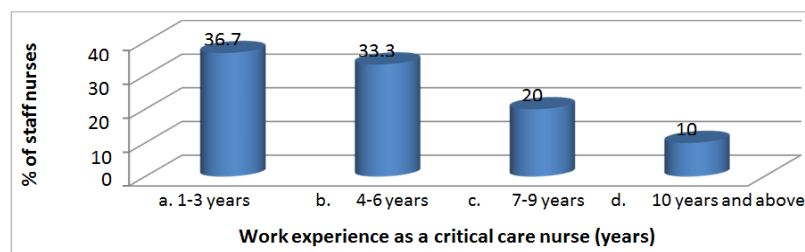


Figure 9. ICU nurses distribution according to work experience as a critical care nurse.

Figure 9 depicts the distribution of Staff Nurses by Total Clinical Experience in critical care. Majority 36.7% of the nurses had 1-3 years of clinical experience, 33.3% had 4-6 years of clinical experience, 20% had 7-9 years of clinical experience and 10% had above 10 years of clinical experience.

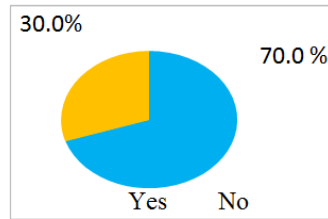


Figure 10. ICU nurses distribution according to pervious information regarding VAP.

Figure 10 depicts the distribution of staff nurses by previous information on VAP. Majority 70% of nurses were having information about VAP and 30% were not aware about VAP information in the study group.

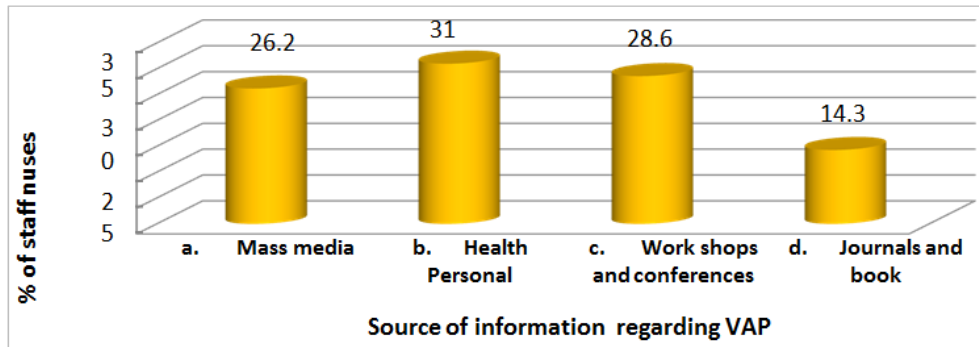


Figure 11. ICU nurses distribution according to source of information.

Figure 11 shows the classification of staff nurses based on the source of information on VAP. 31% of the nurses gained information about VAP through health personnel, 28.6% from workshops and conferences, 26.2% from mass media,

14.3% from journals and books.

Section 2: Assessment of nurses knowledge pre and post test regarding VAP

Table 2. Pre and Post test frequency and percentage distribution of staff nurses knowledge about VAP. N=60.

Sno	Level of knowledge	Pre test		Post test	
		Frequency	Percentage	Frequency	Percentage
1	Inadequate knowledge (<50%)	24	40.0	0	0
2	Moderately adequate (50-75%)	36	60.0	26	43.3
3	Adequate knowledge (>75%)	0	0	34	56.7
4	Over all	60	100	60	100

The above table 2. depicts the frequency and percentage of staff nurses according to level of knowledge regarding VAP. Of the sample, in pre test 24 (40.0%) ICU nurses showed inadequate knowledge, 36 (60.0%) showed moderately adequate knowledge and not found any staff with adequate knowledge. However, in post test 26 (43.3%) displayed moderately adequate knowledge, 34 (56.7%) adequate

knowledge and zero inadequate knowledge. It evidence the proportion of increase in level of knowledge.

Figure 12 represents 40% of ICU nurses knowledge during pre test was inadequate and remaining 60% was moderate. Changes noted after post test which shows test results that 56.7% of nurses had adequate knowledge and 43.3% shows moderate knowledge.

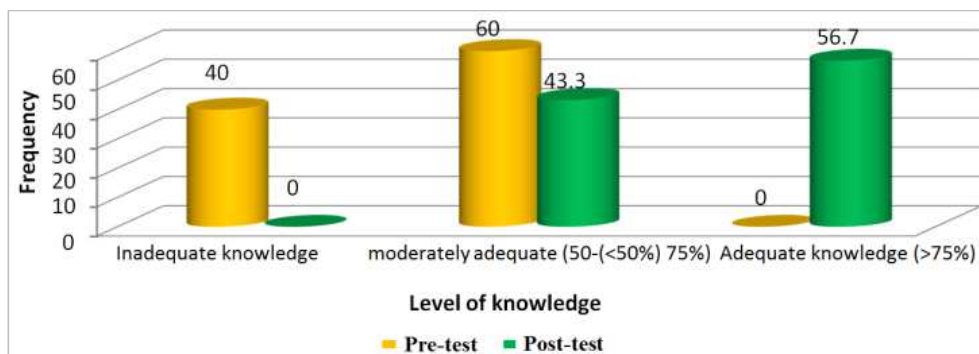


Figure 12. ICU nurses distribution according to level of knowledge regarding VAP.

Table 3. Pre and post test Mean and SD distribution of ICU nurses knowledge about VAP N=60.

S.no	Aspects of knowledge	Max score	Pre test			Post test				
			Range	Mean	SD	Mean %	Range	Mean	SD	Mean%
1.	General information	8	1-7	4.15	1.53	51.8	4-8	6.00	1.461	75.0
2	Evidence based guidelines of VAP	10	2-8	4.67	1.56	46.7	4-10	7.15	1.603	71.5
3	General prevention strategies on VAP	12	2-10	6.33	2.39	52.7	5-12	9-19	1.67	76.6
	over all	30	7-21	14.95	4.31	49.8	15-29	22.33	4.07	74.4

The above table 3 depicts the range, Mean, SD and Mean Score percent of pre and post test knowledge of ICU nurses regarding prevention of VAP. In pre test, the overall knowledge scores were ranging within 7-21 with mean and SD of 14.95 and 4.31 over the maximum score of 30. The pre test mean percentage was 49.8%. But after STP, the scores were ranging within 15-29 with mean and SD

of 22.33 and 4.07. The post test mean percentage was 74.4%. There was an increase of knowledge. Similarly, the mean score percent was computed over the different aspect of knowledge regarding prevention of VAP, found to be remain increased. It evidenced the increase in knowledge of ICU nurses regarding VAP after the administration of STP.

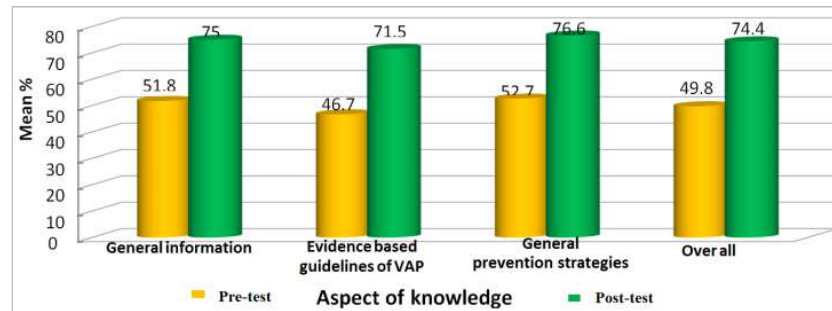
**Figure 13.** Pre and post test Mean percent of knowledge among ICU nurses.

Figure 13 depicts that overall pre test Mean knowledge score was 49.8% and post test it was 74.4% with enhancement of 24.6%. This enhancement clearly justify the statistical significance

of improved knowledge scores post teaching intervention.

Section -3: Effectiveness of STP among the ICU nurses on knowledge regarding prevention of VAP.

Table 4. Outcomes of paired t-test analysis of pre and post test on ICU nurses knowledge regarding prevention of VAP. N =60.

Sno	Variable	Max score	Paired t-difference (Enhancement)			t-test value	P-value
			Mean	SD	Mean%		
1.	General information	8	1.85	0.75	23.2	18.975*	p<0.001
2	Evidence based guidelines of VAP	10	2.48	0.65	24.8	29.560*	p<0.001
3	General prevention strategies on VAP	12	3.05	1.50	25.4	15.744*	p<0.001
	over all	30	7.38	2.02	24.6	28.345*	P<0.001

Note- * indicates significance.

The table 4 depicts the increase knowledge of ICU nurses about the overall aspect of knowledge regarding VAP. Of the maximum score of 30, pre-test shows 7.38 was the Mean difference of knowledge with mean gain of 24.6%. It was statistically significant (p<0.001). Similarly, the mean difference

between the pre and post test knowledge over the different aspects of knowledge also were noticed to stay significant (p<0.001). These statistical outcomes revealed that the intervention of STP is effective in improving the knowledge regarding prevention of ventilator associated pneumonia among staff nurses.

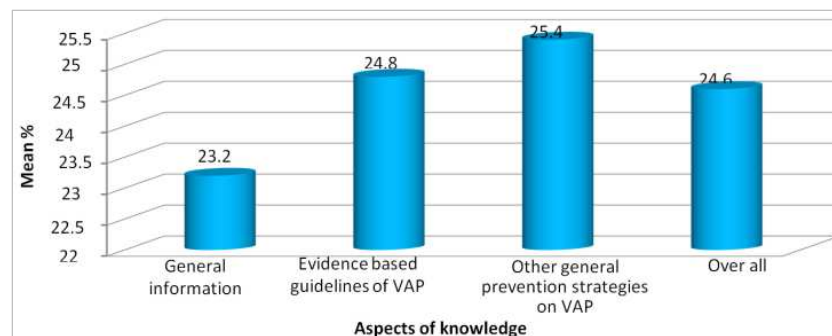
**Figure 14.** Enhancement percent of knowledge regarding VAP.

Figure 14 shows the mean pre-test, post-test and enhancement Knowledge scores on Prevention of VAP. The findings reveals that, in general information knowledge aspect pre-test mean percentage knowledge score was 51.8% which become 75% in post-test with an enhancement by 23.2%. Related to general preventive strategies the pre-test mean percentage knowledge score was 52.7% which become 76.6% in post-test with an enhancement by 25.4%. About evidence based guidelines the pre- test mean percentage knowledge score was 46.7% which become 71.5% in post-test with an enhancement by 24.8%.

Hypothesis testing-1

H₀: There is no significant difference between the knowledge of ICU nurses regarding ventilator associated pneumonia before and after the STP.

Vs

H₁: There is significant difference the knowledge of ICU nurses regarding ventilator associated pneumonia before and after the STP.

The Table 4 presents the mean difference between pre and post test of knowledge regarding ventilator associated pneumonia among staff nurses. On paired t-test it is found to remain significant at $p < 0.001$, Therefore, null hypothesis (H₀) was rejected and the research hypothesis (H₁) was accepted. With this evidence it was justified that there was significant efficiency of STP in improving ICU nurses knowledge regarding prevention of VAP.

Section-4: Association between the knowledge regarding ventilator associated pneumonia with selected demographic variables.

Table 5. Association between knowledge regarding VAP with ICU nurses selected demographic variables. N=60.

Sl. no	Demographic variables	Sample (N=60)		Level of knowledge				Chi- square value	p-value
				≤Median		>Median			
		F	%	F	%	F	%		
1.	Age in years							28.016, df=2, S	P<0.05
	a. 21-30 years	30	50.0	22	91.7	8	22.2		
	b. 31-40 years	21	35.0	2	8.3	19	52.8		
	c. 41 and above	9	15.0	0	0	9	25.0		
2	Marital status							37.512, df=1, NS	P<0.05
	a. Married	38	63.3	4	16.7	34	94.4		
	b. Unmarried	22	36.7	20	83.3	2	5.6		
	c. Others	0	0	0	0	0	0		
3	Sex							0, df=1, NS	p>0.05
	a. Male	10	16.7	4	16.7	6	16.7		
	b. Female	50	83.3	20	83.3	30	83.3		
4.	Income (Rs/months)							36.111, df=4, S	P<0.05
	a. ≤15,000	16	26.7	0	0	16	66.7		
	b. 15,001-20,000	18	30.0	12	33.3	6	25.0		
	c. 20,001-25,000	15	25.0	13	36.1	2	8.3		
	d. 25,001-30,000	7	11.7	7	19.4	0	0		
	e. ≥30,000	4	6.7	4	11.1	0	0		
5	Educational status							24.759, df=2, S	P<0.05
	a. Diploma	27	45.0	20	83.3	7	19.4		
	b. BSc Nursing	22	36.7	4	16.7	18	50.0		
	c. MSc Nursing	11	18.3	0	0	11	30.0		
	d. PhD in nursing	0	0	0	0	0	0		
6.	Work experience in ICU							37.980, df=3, S	P<0.05
	a. 1-3 years	22	36.7	20	83.3	2	5.6		
	b. 4-6 years	20	33.3	2	8.3	13	50.0		
	c. 7-9 years	12	20.0	2	8.3	10	27.8		
	d. 10 years and above	6	10.0	0	0	6	16.7		
7.	Previous knowledge about ventilator associated pneumonia							38.571, df=1, S	P<0.05
	a. Yes	42	70.0	36	100	6	25.0		
	b. No	18	30.0	0	0	18	75.0		
8.	If yes, Sources							16.937, df=3, S	P<0.05
	a. Mass media	11	26.2	11	30.0	0	0		
	b. Health Personal	13	31.0	12	33.3	1	16.7		
	c. Workshops and conferences	12	28.6	11	30.0	1	16.7		
	d. Journals and book	6	14.3	2	5.0	4	66.7		

Note: NS-Not significant ($p > 0.05$), S-significant ($p < 0.05$).

Hypothesis testing-2:

H₀: There is no significant association between ICU nurses knowledge regarding prevention of ventilator associated pneumonia with their selected demographic variables.

Vs

H₂: There is significant association between ICU nurses knowledge regarding prevention of ventilator associated pneumonia with their demographic variables.

The table 5 shows the outcomes of Chi-square test, which was carried out to determine the association between ICU nurses knowledge level regarding VAP with demographic variables. The study shows the level of knowledge was significantly associated with age, marital status, income, educational level, work experience in critical care nursing, previous knowledge regarding ventilator associated pneumonia and source of information at 0.05 level. But, the knowledge regarding ventilator associated pneumonia was not significantly associated with the other demographic variable of gender (ie, $p > 0.05$). Therefore, null hypothesis (H_0) was rejected and the research hypothesis (H_2) was accepted.

5. Discussion

The findings were discussed with following points:

a. Demographic Variable

The study revealed that

- 1) 50% of the staff nurses were 21-30 years, 35% were between 31-40 years and only 15% were above 41 years and above. 83.3% were females and 16.7% of them were males. 63.3% of staff nurses were Married and 36.7% of them were unmarried. 26.7% of staff nurses earns income of <Rs.15,000, 30% were earning Rs.15,001-Rs.20,000, 25% were earning Rs.20,001-Rs.25,000, 11.7% were earning Rs. 25,001- Rs.30,000 and 6.7% were earning > Rs.30,000. 45% of staff nurses were diploma holders in nursing and 36.7% of them were with BSc Nursing and 18.3% were with MSc. Nursing, none of them with PhD nursing. 36.7% of staff nurses were having 1-3 years of experience in ICU, 33.3% of them were having 4-6 years of experience as a critical care nurse, 20% of them were having 7-9 years of experience and 10% of them 10 years and above. 70% of staff nurses were having previous knowledge and 30% of staff nurses doesn't have knowledge about VAP.
- 2) With respect to source of information on Prevention of VAP, 26.2% were having knowledge source through mass media, 31% of them were through health personnel, 28.6% of them through workshops and 14.3% of them through journals

b. Assessment of ICU nurses knowledge regarding Prevention of VAP.

The study reveals that overall mean knowledge in pre-test is 49.8%, indicating ICU nurses has lacking knowledge regarding prevention of VAP, which brings importance of educational activities so that the knowledge level in future would be improved.

The above findings were supported by the below mentioned studies:

A survey was conducted at Ghent university, Netherland to assess ICU nurses knowledge of EBP for the prevention of VAP. Results revealed that only 20% of nurses were aware that ventilator circuits should be changed once in a week and

only 60% nurses knew that subglottic drainage of secretions would reduce VAP. This concluded that, nurses have lacking knowledge regarding recommendations for VAP prevention and continuing education would help to improve EBP [20].

c. Effectiveness of teaching strategies regarding Prevention of VAP

The study evidenced statistically as significant and that there was a markable improvement seen post STP among ICU nurses knowledge level. The overall Mean percentage knowledge score in the pre-test was 49.8% which raised to 74.4% during post-test with 24.6% of enhancement.

The above findings were supported by the below mentioned studies:

A study conducted at Krishna hospital Karad where 60 ICU nurse selected with simple random sampling and data was collected by semi-structured questionnaire. Descriptive and inferential statistics were used to analyze data. Results showed that the pre-test mean score was 10.516 with SD 2.658 and post-test mean score was 16.633 and SD 2.524 and the mean difference was 6.117 and calculated t value was 17.712 which is statistically significant at level of <0.001. The study concluded and revealed that the planned teaching programme is effective to improve the knowledge about ventilator associated pneumonia. [21]

d. Association between Nurses knowledge scores with demographic variables

The study reveal the level of knowledge was significantly associated with age, marital status, income, educational level, work experience in critical care nursing, previous knowledge regarding ventilator associated pneumonia and source of information at 0.05 level But, the knowledge regarding ventilator associated pneumonia was not significantly associated with the other demographic variable of gender (ie, $p > 0.05$).

The above findings were supported by the below mentioned studies:

A study conducted at Madrid, Spain to assess the knowledge and compliance with guidelines for prevention of VAP among physicians, nurses, and students in ICUs. 20-point questionnaire was used. The median scores for daily clinical practice for physicians and nurses were 5 (4-6) and 4 (3-5), respectively. HCWs with more than 1 year of ICU experience scored significantly better in personal knowledge than those with less experience. [22]

Testing of the hypothesis

H_1 - There will be a significant difference between ICU nurses knowledge scores pre and post test regarding prevention of Ventilator Associated Pneumonia.

The hypothesis H_1 is accepted due to significant change noticed between pre and post-test knowledge scores with paired t-test at $P < 0.001$ level. This results indicate that among ICU nurses the intervention of STP was significantly effective.

H_2 - There will be a significant association between ICU nurses knowledge scores pre and post test with selected demographic regarding prevention of Ventilator Associated Pneumonia.

The investigator accepts the hypotheses for significant association with age, marital status, income, educational level, work experience in critical care nursing, previous knowledge regarding VAP and source of information at 0.05 level. But, the knowledge regarding VAP was not significantly associated with the other demographic variable of gender (ie, $p > 0.05$). This result shows that there was significant association between knowledge regarding VAP with selected demographic variables of staff nurses.

6. Conclusion

The conclusion based on the findings presents:

- 1) The overall mean and mean percentage of pre-test knowledge scores on prevention of VAP was found to be 14.95 and 49.8% respectively which shows that the nurses were having lacking knowledge whereas post-test knowledge scores was found to be 22.33 and 74.4% respectively which shows that the nurses gained knowledge after teaching programme was implemented.
- 2) On aspect wise knowledge assessment during pre test, the highest knowledge was found on general preventive strategies on VAP 52.7% and lowest knowledge was found on evidence based guidelines on VAP 46.7%. In post test, the nurses gained a mean % knowledge of 76.6% on general prevention strategies and 71.5% on evidence based guidelines.
- 3) It was also noticed that, age, marital status, income, professional educational qualification, total clinical experience, previous knowledge on VAP were having high significant association with knowledge scores, whereas, gender has no association.
- 4) From this study it was concluded that work experience and previous knowledge about VAP was positively associated with nurses knowledge, emphasizing contuse knowledge upgrade. Additionally, ICU nurses who responded were having limited knowledge regarding VAP prevention on STP administration showed improvement. The nurses expressed that the teaching programme was informative and highly useful in their practical areas and it was found to be instructionally effective, appropriate and feasible.

Implications of the Study

The results of the study show that, the staff nurses had inadequate knowledge regarding prevention of VAP during pretest. In various nursing field study have its implication. For Instance,

Clinical Nursing: It support the nurses in reducing the mortality rate and length of hospital stay with VAP. Nursing professionals can provide a better management to VAP. Nurses as primary care givers can alert their co-workers about early diagnosis and treatment plans. Nurses can actively contribute to the prevention of VAP and its complications.

Nursing Education: Through nursing education students and novices can be trained which help in VAP prevention. The study emphasizes the need for periodical in-service

education for nurses regarding VAP, which helps to learn the preventive strategies of VAP. Nursing curriculum should emphasis on strengthening students clinical knowledge regarding various Hospital Acquired Infections (HAI) and disseminate the appropriate health information and technological advancements in medical profession related to management of VAP. Nursing students can be encouraged to take up projects and studies on VAP.

Nursing Administration: As an administrator nurses can develop new protocols and strategies regarding prevention of VAP and emphasize on implementing them which reduces this HAI. The nursing administrator can hire nurses who are trained or acquired certification on VAP prevention strategies. The nurse administrators develops innovative ideas and prepare appropriate teaching tool. As nurse administrators they can encourage clinical research in ICU on this topic and apply the findings in Prevention of VAP.

Nursing Research: Many new researchers can utilize the tool or research related to VAP and nurse attitude in it prevention. Through the research results new educational plans or courses can be developed which help in detail analysis on VAP prevention. Encourage to disseminate knowledge by publications and organizing journal clubs, workshops, seminars and conferences.

7. Recommendations

Multiple studies can be conducted with large sample to generalize the findings. A study on control group with experimental approach can be utilized for efficient results and additional demographic variables can be included in future. Nurses working in general and private hospital settings can be participated in further researches through comparative study. It can be conducted out to rule out the benefits of various teaching aids beneficial for VAP prevention.

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