A case study to assess the effect of bundle care on respiratory hygiene among the children on mechanical ventilator in the Pediatric Intensive Care Unit.

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ABSTRACT

Introduction:

Every year million of patients received mechanical ventilator treatment and most of sample develop the ventilator associated infections. The ventilator bundle is an effective method to reduce VAP rates in PICU. To prevent from the ventilator associated infections we can implement bundle care which included hand washing, adherence of personal protective equipment, suctioning, elevate the head if the beds, regular monitor of vital signs, change of position, oral care, and change of humidified water. A systematic introduction of bundle care can decrease both infection and antibiotic use, especially for those children who require longer duration of ventilation.Institute for Health Care Improvement (IHI), USA has developed the concept of 'Bundle' to help clinician deliver bedside care more reliably and effectively. Each bundle consists of three to five elements, all of which are well established practices and evidence based but are not usually, uniformly practised at the bedside. This concept has been initiated as a quality improvement process as it was realized that clinician's practice pattern vary and bedside application of standard guidelines are not uniform reflecting in inappropriate care. This is mostly applicable to Critical Care Practice as the patient group are heterogeneous, have a high mortality, many care givers involved in patient care resulting in heterogeneous care delivery with resultant increase in mortality. Each element of this bundle may be practiced separately but application of the entire bundle gives the most consistent result in achieving best patient outcome.**The present study title:** A case study to assess the effect of bundle care on respiratory hygiene among the children on mechanical ventilator in the Paediatric Intensive CareUnit. The objectives are to identify the respiratory hygiene of the children on mechanical ventilator. To find out the effect of bundle care on respiratory hygiene.**Material and Methods**: In present study, researcher adopted case study research design.The study carried out 10 samples. Ethical clearance was taken. A Non-probability Purposive Sampling Technique was used. The significance was calculated by using mean, standard deviation, and calculated 't' value, and association was done by Fisher's exact test with demographic variable. **Result**: Before bundle care 60% of the children on mechanical ventilator had severe respiratory hygiene (score 7-10) and 40% of sample had moderate respiratory hygiene (score 4-6).After bundle care, 80% of the children on mechanical ventilator had mild respiratory hygiene (score 1-3) and 20% of sample had moderate respiratory hygiene (score 4-6).This indicates that the respiratory hygiene of the children on mechanical ventilator improved remarkably after bundle care.. **Conclusion**: It has been observed that average respiratory hygiene score before bundle care was 7.2 which reduced to 2.8 after bundle care. T-vale for this test was 7.8 with 9 degrees of freedom. At baseline, all the children on mechanical ventilators had positive microbiological test. In posttest, all the children on mechanical ventilators had negative microbiological test.

Keywords: (Effect, Deep Breathing Exercise, Pop up toys, Incentive spirometry, Respiratory status, Children, Lower respiratory tract infection)

INTRODUCTION

Every year million of patients received mechanical ventilator treatment and most of sample develop the ventilator associated infections. The ventilator bundle is an effective method to reduce VAP rates in PICU. To prevent from the ventilator associated infections we can implement bundle care which included hand washing, adherence of personal protective equipment, suctioning, elevate the head if the beds, regular monitor of vital signs, change of position, oral care, and change of humidified water. A systematic introduction of bundle care can decrease both infection and antibiotic use, especially for those children who require longer duration of ventilation.Ventilator-associated pneumonia (VAP) is a serious health care-associated infection, resulting in high morbidity and mortality. It also prolongs hospital stay and drives up hospital costs. Measures employed in preventing ventilator-associated pneumonia in developing countries

are rarely reported. In this study we tried to assess the efficacy of our designed "VAP prevention bundle" in reducing VAP rate in our neonatal intensive care unit.Ventilator-associated pneumonia (VAP) is pneumonia that develops 48 hours or longer after mechanical ventilation is given by means of an endotracheal tube or tracheostomy. Ventilator-associated pneumonia (VAP) results from the invasion of the lower respiratory tract and lung parenchyma by microorganisms. Intubation compromises the integrity of the oropharynx and trachea and allows oral and gastric secretions to enter the lower airways.Ventilator-associated pneumonia (VAP) is relatively common in mechanically-ventilated children, but there is a wide variation in reported VAP rates, depending on settings and geographical regions. Surveillance definitions in children are challenging.

NEED FOR THE STUDY

In India, every year 300000 patients receive a treatment on mechanical ventilator. The incident density rate of ventilator associated pneumonia 21.87 per 1000 ventilated cases.6

The incidence of VAP was 57.14%. The incidence of VAP is directly proportional to the duration of mechanical ventilation. The most common pathogens causing VAP were Acinetobacter spp. and Pseudomonas aeruginosa and were associated with a high fatality rate.7

Intensive care units have come to represent the most frequently identifiable source of nosocomial infections within the hospital, with the infection rates and rate of antimicrobial resistance several fold greater than the general hospital settings. Ventilator-associated pneumonia (VAP) is defined as nosocomial pneumonia in mechanically ventilated patients that develops more than 48 hours after initiation of mechanical ventilation (MV).VAP is the second most common nosocomial infection after urinary tract infection in paediatric intensive care unit, patients accounting for 20% of nosocomial infection in this population.8

Ventilator-associated pneumonia, the second most common hospital-acquired infection in paediatric intensive care units, is linked to increased morbidity, mortality, and lengths of stay in the hospital and intensive care unit, adding tremendously to health care costs. Prevention is the most appropriate intervention.9

Ventilator associated pneumonia (VAP) is the second most common nosocomial infection diagnosed in mechanically ventilated patients with incidence of 20-36%, mainly caused by Gram-negative organisms in our country. Decrease in PaO2/FIO2 (arterial oxygen tension/fractional inspired oxygen) is an early marker of VAP. Impaired consciousness, re-intubation and continuous sedation are the most important risk factors of VAP

OBJECTIVES OF THIS STUDY

1. To identify the respiratory hygiene of the children on mechanical ventilator.
2. To find out the effect of bundle care on respiratory hygiene.

REVIEW OF LITERATURE

A. Review of literature related bundle care

LodhaR. (2012) conducted a study in New Delhi, India to study the efficacy of oral mucosal decontamination with chlorhexidine gel for the prevention of ventilator-associated pneumonia in children between 3 months and 15 yrs. Samples were selected through double blind randomized placebo controlled trial in paediatric intensive care unit of a tertiary care hospital in north India who required orotracheal or nasotracheal intubation and mechanical ventilation. Out of two hundred eighty-three children only eighty-six patients fulfilled the study requirements. Among sample forty-one children received 1% chlorhexidine, whereas 45 received placebo application. Patients of both groups were comparable with respect to baseline characteristics. Incidence of ventilator-associated pneumonia was 39.6/1,000 ventilator days with 1% chlorhexidine and 38.1/1,000 ventilator days with placebo (relative risk 1.03, confidence interval 0.44-2.42, p = .46). The mortality rates were similar in the two groups (p = .81). Causes of ventilator-associated pneumonia were gram-negative, with acinetobacter species being the most common (14 of 26). No side effects of the applied gel were seen in either group.

Sharma H.(2009) conducted a study in Punjab, India to determine incidence, related factors, outcome, bacterial organisms and their sensitivity patterns with regard to ventilator-associated pneumonia (VAP) in children. A Prospective cohort study conducted in Level III PICU of Dayan and Medical College and Hospital among the Children in the age group of 1 month to 15 years, admitted to the paediatric intensive care unit requiring ventilator support for at least 48 hours. Total Forty patients met the inclusion criteria and 8 (20%) had VAP. The risk factor significantly related with development of VAP was the use of H(2) blockers (Ranitidine) for >2 days. All other related factors were not significantly related to occurrence of VAP. the study findings showed that Use of H(2) blockers (Ranitidine) is associated with higher incidence of VAP in children.

Saleh SH.(2015) conducted a study in Egypt to assess the efficacy of designed "VAP prevention bundle" in reducing VAP rate in intensive care unit. This prospective before-and-after study was conducted at Zagazig University hospital among 143 mechanically ventilated patients, all who had mechanical ventilation for ≥ 48 h were eligible. VAP rates were evaluated before and after full implementation of comprehensive preventive measures specifically designed by infection control team. Among 143 mechanically ventilated neonates, 73 patients developed VAP (51%) throughout the study period. The rate of VAP was significantly reduced from 67.8% (42/62) corresponding to 36.4 VAP episodes/1000 mechanical ventilation days (MV days) in phase-I to 38.2% (31/81) corresponding to 23 VAP/1000 MV days (RR 0.565, 95% confidence interval 0.408-0.782, p = 0.0006) after VAP prevention bundle implementation . The commonest micro-organisms isolated throughout the study were gram-negative bacteria (63/66, 95.5%) particularly Klebsilla pneumonia (55/66, 83.4%). The study finding showed that Implementation of multifaceted infection control bundle resulted in reduction of VAP rate, length of stay in NICU

B. Review of literature related to mechanical ventilator.

Zhao (2017) conducted A prospective study to observe the impact of improving the compliance of ventilator bundle on morbidity of ventilator-associated pneumonia (VAP) in pediatric intensive care unit (PICU) patients undergoing mechanical ventilation (MV) guided by context of Joint Commission International (JCI) settings, and to study the oral care efficacy of suction tube sponge brush. During the study period, a total of 2 733 patients admitted to the ICU, including 1 403 patients undergoing MV. Ninety-four of the 1 403 patients with community-acquired pneumonia (CAP), aspiration pneumonia, back elevation ban, incomplete information, and withdrew from the study were excluded. 1 399 patients undergoing MV were enrolled in the final analysis, with total MV days of 11 012 days, and 94 patients occurred VAP. The annual incidence of VAP was progressively declined from 2013 to 2016, and the VAP cases per 1 000 MV days were 17.0, 10.0, 5.9, 3.5 cases, respectively. Based on the VAP incidence rate in 2013, the IRR of VAP from 2014 to 2016 was also progressively declined, which was 0.59 [95% confidence interval (95%CI) = 0.35-0.98], 0.35 (95%CI = 0.18-0.64), and 0.21 (95%CI = 0.09-0.41), with statistical significance (all P < 0.05). Ventilator bundle can effectively reduce the morbidity of VAP in the context of JCI settings, and the oral care by using suction tube sponge brush and chlorhexidine can effectively improve oral hygiene.

SrinivasaR. (2015) conducted a study in Pondicherry, Indian open-label randomized controlled trial. The study was conducted in Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry, India among 150 children less than 12 years admitted in PICU were recruited from November 2011 to July 2013. Patients were randomized into two groups after stratification based on age groups. Children in the intervention group received probiotic preparation twice a day beginning from the day of ICU admission till 7 days or discharge from ICU, whichever was earlier. Children who received prophylactic probiotics had a lower incidence of VAP compared to the control group (17.1 % in the probiotics group vs 48.6 % in the control group, p < 0.001; 22 per 1,000 ventilated days vs 39 per 1,000 ventilated days, p = 0.02). On multiple logistic regression analysis, use of prophylactic probiotics decreased the incidence of VAP by 77 % and reduced the duration of ICU and hospital stays by an average of 2.1 and 3.3 days, respectively, after adjusting for the other confounders. Prophylactic probiotics administration resulted in reduction of the incidence of VAP in critically ill children in a setting where baseline VAP rates are high. The intervention was found to be safe.

Radhakrishnan (2012) conducted a study. This was a before-after study to determine rates of VAP during a period of active surveillance without the implementation of the multidimensional infection control program (phase 1) to be compared with rates of VAP after implementing such a program, which included the following: bundle of infection control interventions, education, outcome surveillance, process surveillance, feedback on VAP rates, and performance feedback on infection control practices (phase 2). This study was conducted by infection control professionals applying the National Health Safety Network's definitions of health care-associated infections and the International Nosocomial Infection Control Consortium's surveillance methodology. During the baseline period, we recorded a total of 5,212 mechanical ventilator (MV)-days, and during implementation of the intervention bundle, we recorded 9,894 MV-days. The VAP rate was 11.7 per 1,000 MV-days during the baseline period and 8.1 per 1,000 MV-days during the intervention period (relative risk, 0.69; 95% confidence interval, 0.5-0.96; P = .02), demonstrating a 31% reduction in VAP rate. Our results show that implementation of the International Nosocomial Infection Control Consortium's multidimensional program was associated with a significant reduction in VAP rate in PICUs of developing countries.

EXPERIMENTAL SECTION

Material and method:

In present study, researcher adopted case study research design. The study carried out 10 samples. Ethical clearance was taken. A Non-probability Purposive Sampling Technique was used. The significance was calculated by using mean, standard deviation, and calculated 't' value, and association was done by Fisher's exact test with demographic variable.

Description of Tool: The tool includes two sections:

1. Section A: Clinical profile of the children
2. Section B: Observational Checklist to assess the bundle care

Scoring was grade as

normal (score 0)
mild (score 1-3)
moderate (score 4-6)
severe (score 7-10)

Plan for Data Analysis:

The analysis was done by using the data of section-I and section-II and presents them in tables, graphs and figures.

For the analysis of demographic data frequencies and percentage was calculated. The significance was calculated by using mean, standard deviation, and calculated 't' value, and association was done by Fisher's exact test with demographic variable.

RESULT AND DISCUSSION

Section I

Description of samples (children on mechanical ventilators) based on their personal characteristics

n=10

Demographic variable	Frequency	Percentage
Age		
2 months to 1 year	1	10%
1 to 3 years	4	40%
3 to 6 years	2	20%
6 to 13 years	3	30%
Gender		
Male	5	50%
Female	5	50%
Days on ventilation		
1-2 days	1	10%
3-5 days	6	60%
5-7 days	2	20%
More than 7 days	1	10%
Ventilation		
Continuous Positive Airway Pressure	10	100%

Type of ventilation		
Invasive ventilators	10	100%
Antibiotics		
Yes	9	90%
No	1	10%
Type of suction		
Intermittent suction	10	100%
Type of primary diagnosis		
Respiratory	9	90%
Septicaemia	1	10%

10% of the children were 2 months-1 years of age, 40% of sample had age 1 to 3 years, 20% of sample had age 3 to 6 years and 30% of sample had age 6 to 13 years. 50% of samples were males and 50% of samples were females.10% of samples were on ventilation for 1-2 days, 60% of samples were on ventilation for 3-5 days, 20% of samples were on ventilation for 5-7 days and 10% of samples were on ventilation for more than 7 days.

Section II

n=10

Respiratory hygiene	**Before**	
	Freq	**Percentage**
Normal (Score 0)	0	0%
Mild (Score 1-3)	0	0%
Moderate (Score 4 -6)	4	40%
Severe (Score 7-10)	6	60%

60% of the children on mechanical ventilator had severe respiratory hygiene (score 7-10) and 40% of sample had moderate respiratory hygiene (score 4-6).

Section III

Table 3: Effect of bundle care on respiratory hygiene

n=10

Respiratory hygiene	**Before**		**After**	
	Freq	**%**	**Freq**	**%**
Normal (Score 0)	0	0%	0	0%
Mild (Score 1-3)	0	0%	8	80%
Moderate (Score 4 -6)	4	40%	2	20%
Severe (Score 7-10)	6	60%	0	0%

Before bundle care, 60% of the children on mechanical ventilator had severe respiratory hygiene (score 7-10) and 40% of sample had moderate respiratory hygiene. After bundle care**,** 80% of the children on mechanical ventilator had mild respiratory hygiene (score 1-3) and 20% of sample had moderate respiratory hygiene (score 4-6).This indicates that the respiratory hygiene of the children on mechanical ventilator improved remarkably after bundle care.

Table 3: Effect of bundle care on respiratory hygiene

n=10

Microbiological test Result	Baseline		Posttest	
	Freq	%	Freq	%
Positive	10	100%	0	0%
Negative	0	0%	10	100%

At baseline, all the children on mechanical ventilators had positive microbiological test. In posttest, all the children on mechanical ventilators had negative microbiological test. This indicates that the bundle care improved the respiratory hygiene of the children on mechanical ventilator.

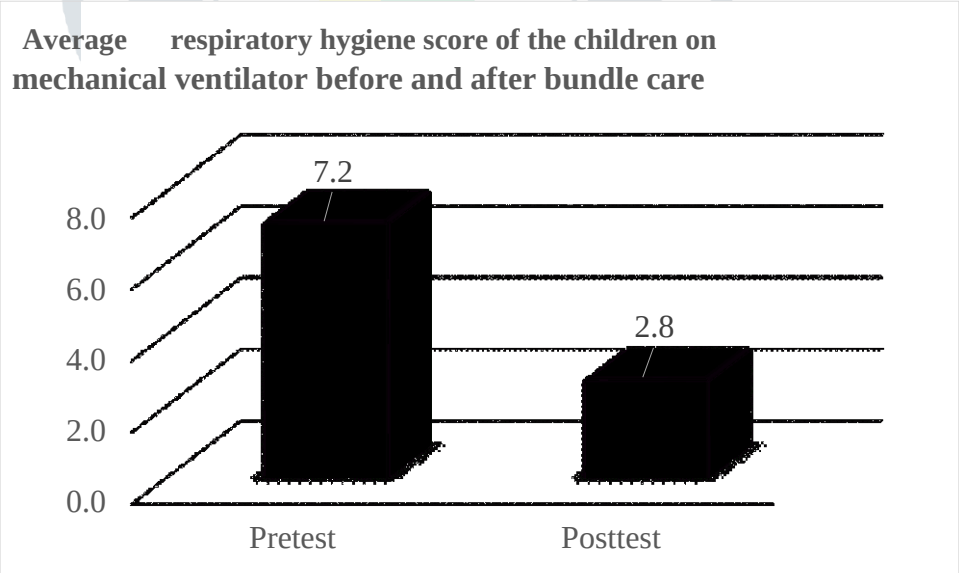
Table 5:Paired t-test for the effect of bundle care on respiratory hygiene

n=10

	Mean	SD	T	Df	p-value
Pretest	7.2	2.0	7.8	9	0.000
Posttest	2.8	0.8			

Average respiratory hygiene before bundle care was 7.2 which reduced to 2.8 after bundle care. T-vale for this test was 7.8 with 9 degrees of freedom. Corresponding p-value was of the order of 0.000, which is small (less than 0.05), the null hypothesis is rejected.

n = 10



bar graph showing analysis of data related to average respiratory hygiene score of the children before and after bundle care

Discussion

The present study was designed study to assess the effect of bundle care on respiratory hygiene among the children on mechanical ventilator in the Paediatric Intensive Care Unit. , researcher adopted case study research design. The study carried out 10 samples. Ethical clearance was taken. A Non-probability Purposive Sampling Technique was used.

A similar study conducted by Richard B. Et.al (2016) To characterize ventilator-associated pneumonia (VAP) in paediatric intensive care unit (PICU), implement an evidence-based paediatric VAP prevention bundle, and reduce VAP rates. The setting is a 25-bed PICU in a 475-bed free-standing paediatric academic medical centre. VAP was diagnosed according to Centres for Disease Control and National Nosocomial Infections Surveillance System definitions. A paediatric VAP prevention bundle was established and implemented. Baseline VAP rates were compared with implementation and post-bundle-implementation periods. VAP is significantly associated with increased PICU length of stay, mechanical ventilator days, and mortality rates (length of stay VAP 19.5+/-15.0 vs non-VAP 7.5+/-9.2, P< .001; ventilator days VAP 16.3+/-14.7 vs non-VAP 5.3+/-8.4, P< .001; mortality VAP 19.1% vs non-VAP 7.2%, P= .01). The VAP rate was reduced from 5.6 (baseline) to 0.3 infections per 1000 ventilator days after bundle implementation; P< .0001. Subglottic/tracheal stenosis, trauma, and tracheostomy are significantly associated with VAP. PICU VAP is associated with increased morbidity and mortality rates. A multidisciplinary improvement team can implement a sustainable paediatric-specific VAP prevention bundle, resulting in VAP rate reduction**.**

Conclusion

It has been observed that average respiratory hygiene score before bundle care was 7.2 which reduced to 2.8 after bundle care. T-vale for this test was 7.8 with 9 degrees of freedom. At baseline, all the children on mechanical ventilators had positive microbiological test. In posttest, all the children on mechanical ventilators had negative microbiological test. This is evident that the respiratory hygiene of the children on mechanical ventilator improved significantly after bundle care. The result of the present study shows that there will be significant difference in bundle care on respiratory hygiene among the children on mechanical ventilator; hence the null hypothesis is rejected.

IMPLICATIONS

The finding of this study is implicated in following headings-

Nursing Education

Nursing education is rapidly developing in India and nurses from our country can be found all over the world providing care and assistance. The education curriculum in nursing must include imparting knowledge about the issue and use of various teaching strategies for health education. In India importance has been given to awareness and promotion of health rather than curative aspect, nursing education must emphasize on preventive aspect of health. The Researcher can use the result of the study as an informative illustration for the nursing staff of PICU.

Nursing Practice

Nurses should always take part in different educational programs to improve and update their knowledge. Nurses should always do evidence based practice and this will lead to patient satisfaction. Nursing is a process of action, reaction, interaction and transaction whereby nurses assist individual of any age group to meet their basic needs in coping with their health problems at some particular point in their life cycle. The nurse should have knowledge about bundle care and should know about how to implement bundle care to maintain the respiratory hygiene among the children on mechanical ventilator.

Nursing Administration

Nursing administration as a profession is unique because it addresses the response of individual and families to actual or potential problems in humanistic manner. Nurses have many roles, such as care giver, decision maker, advocate and teacher. Nursing administration department can conduct continuing nursing education program on respiratory hygiene and how to implement bundle care on mechanical ventilator.

Nursing Research

The nurse researcher should be able to conduct the research on various aspects of awareness about management of respiratory hygiene and implementation strategy of bundle care on patients who are on mechanical ventilator.

LIMITATIONS

This study is limited to PICU of Dr.D.Y.Patil Hospital, Pimpri, Pune.
The study is limited for a period of only for one and half month
This study is limited only to those children who are on Mechanical ventilator.
The study is limited to those Children between the age group of 2 months to 13 years.

RECOMMENDATIONS

The study can be done on various setting.
The study can be done for a longer period.
A comparative study can be done.
A Survey among PICU nurses to identify the prevalence of respiratory diseases among children on Mechanical Ventilator.

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