ARTIGO 15

THE IMPACT OF THE INTERPROFESSIONAL LEARNING IN VENTILATOR-ASSOCIATED PNEUMONIA: BUNDLES IMPLEMENTATION IN AN INTENSIVE CARE UNIT

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Objective: to verify the impact of the bundles and the interprofessional learning for the prevention of mechanical ventilation-associated pneumonia of an intensive care unit (ICU). Methodology: This was a quasi-experimental study performed in an ICU of a public hospital in Diamantina, Minas Gerais. Were included in this study 56 professionals who provided direct assistance to patients in mechanical ventilation. The data collection took place in three phases: pre-intervention, which consisted of direct observation and interview; intervention, in which training was performed through clinical simulations; and post-intervention, in which the impact of the strategies implemented through direct observation, was evaluated. Differences between pre and post groups were assessed using McNemar's test. An alpha level of 0.05 set a priori was used, and a Bonferroni correction determined statistical significance for the case of multiple comparisons. Results: After the intervention, there was increased adherence to endotracheal cuff pressure (8.10%), daily interruption of sedation (16.67%) and subglottic aspiration (18.75%). It was significant ($p < 0{,}0083$) in the associations between the professional category versus non-aspiration, bed head positioning, oral hygiene frequency and the type of hand hygiene after intervention. Conclusions: There is still a gap to be detected in the bundle implementation and the positive impact generated by the inter-professional knowledge, mainly because it is not immediate but in the long term to obtain the desired feedback.

Descriptors: Pneumonia, Ventilator-Associated; Patient Care Bundles; Infection Control; Quality Improvement; Public Health Surveillance; Intensive Care Units.

O IMPACTO DA APRENDIZAGEM INTERPROFISSIONAL NA PNEUMONIA ASSOCIADA A VENTILADORES: IMPLEMENTAÇÃO DE BUNDLES EM UMA UNIDADE DE CUIDADOS INTENSIVOS

Objetivo: verificar o impacto dos bundles e o aprendizado interprofissional para a prevenção da pneumonia associada à ventilação mecânica de uma Unidade de Terapia Intensiva (UTI). Método: estudo quase-experimental realizado em uma UTI de um hospital público de Diamantina, Minas Gerais. Foram incluídos neste estudo 56 profissionais que prestaram assistência direta aos pacientes em ventilação mecânica. A coleta de dados ocorreu em três fases: pré-intervenção, que consistiu em observação direta e entrevista; intervenção, na qual foi realizado treinamento por meio de simulações clínicas; e pós-intervenção, em que foi avaliado o impacto das estratégias de observação direta. As diferenças entre os grupos pré e pós foram avaliadas pelo teste de McNemar. Um nível alfa de 0,05 a priori foi usado, e a correção de Bonferroni determinou significância estatística para o caso de comparações múltiplas. Resultados: Após a intervenção, houve aumento da adesão ao monitoramento da pressão do cuff endotraqueal (8,10%), interrupção diária da sedação (16,67%) e aspiração subglótica (18,75%). Foi significante ($p < 0{,}0083$) as associações entre a categoria profissional versus a não aspiração, posicionamento da cabeceira da cama, frequência de higiene bucal e o tipo de higienização das mãos após a intervenção. Conclusões: Ainda existe uma lacuna a ser detectada na implantação do bundle e o impacto positivo gerado pelo conhecimento interprofissional, principalmente por não ser imediato, mas a longo prazo, para obtenção do feedback desejado.

EL IMPACTO DEL APRENDIZAJE INTERPROFESIONAL EN LA NEUMONÍA ASOCIADA A VENTILADORES: APLICACIÓN DE PAQUETES EN UNA UNIDAD DE ATENCIÓN INTENSIVA

Objetivo: verificar el impacto de los bundles y el aprendizaje interprofesional para la prevención de la neumonía asociada a la ventilación mecánica de una unidad de cuidados intensivos (UCI). Método: Este fue un estudio cuasi experimental realizado en una UCI de un hospital público en Diamantina, Minas Gerais. Se incluyeron en este estudio 56 profesionales que prestaron asistencia directa a los pacientes en ventilación mecánica. La recolección de datos se realizó en tres fases: pre-intervención, que consistió en observación directa y entrevista; intervención, en la cual se realizó entrenamiento por medio de simulaciones clínicas; y post-intervención, en que se evaluó el impacto de las estrategias de observación directa. Las diferencias entre los grupos pre y post se evaluaron mediante la prueba de McNemar. Se usó un nivel alfa de 0,05 a priori, y se usó una corrección de Bonferroni para determinar la significación estadística en el caso de comparaciones múltiples. Resultados: Después de la intervención, hubo aumento de la adhesión al monitoreo de la presión del cuff endotraqueal (8,10%), interrupción diaria de la sedación (16,67%) y aspiración subglótica (18,75%). Fue significativa ($p < 0{,}0083$) las asociaciones entre la categoría profesional frente a la no aspiración, la posición de la cabecera de la cama, la frecuencia de higiene oral y el tipo de higiene de las manos después de la intervención. Conclusiones: Aún existe una laguna a ser detectada en la implantación del bundle y el impacto positivo generado por el conocimiento interprofesional, principalmente por no ser inmediato, pero a largo plazo, para obtener el feedback deseado.

Descriptores: Neumonía Asociada al Ventilador; Paquetes de Atención al Paciente; Control de Infecciones; Mejoramiento de la Calidad; Vigilancia en Salud Pública; Unidades de Cuidados Intensivos

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INTRODUCTION

Prolonged use of mechanical ventilation (MV) predisposes patients to develop adverse events such as sepsis, Acute Respiratory Distress Syndrome (ARDS), pulmonary embolism, barotrauma, pulmonary edema and mechanical ventilation-associated pneumonia (VAP)[(1)].

The VAP may occur in patients submitted to MV for more than 48 hours[(2-3)]. The presence of the endotracheal tube all interferes in the protective physiological reflexes of the upper airways, resulting in less clearance of microorganisms, such as Gram-negative bacteria, that accumulate above the cuff in the oropharyngeal secretions3. Such a complication in the respiratory tract may lead to prolonged ventilation, long stay in the Intensive Care Unit (ICU) and increased health costs1. It is estimated that the mortality after occurrence of VAP is 20.2% in 14 days and 25.1% in 28 days[4].

The Institute for Healthcare Improvement (IHI) introduced in 2004 the notion of bundle for the prevention of VAP. The bundle consists of a set of interventions based on scientific evidence that, when implemented, may improve health outcomes and patient care[5]. Since its implementation, there has been a decline in VAP rates in the United States, with 3.6 cases per 1000 days in the ventilator[6].

In Brazil, reporting VAP data did not used to be mandatory until 2016, according to the National Program for Prevention and Control of Health Care-Related Infections its incidence showed a reduction of 4.9% in relation to 20157-8.

International and Brazilian guidelines establish recommendations for detection and prevention of VAP, but difficult institutional control1-2,8. These recommendations include hand hygiene (HH), bedhead elevation at 30-45°, daily interruptions of sedation, daily spontaneous breathing trials, thromboembolism prophylaxis, oral hygiene care with chlorhexidine gluconate, subglottic secretion drainage, constant monitoring of cuff pressure and team training1-2,8.

Compliance with such recommendations includes, above all, daily surveillance and educational training measures, since limited surveillance may prevent assessment of the positive impact a bundle can have on ICUs8. Although successful reduction of VAP rates with bundles has been demonstrated in recent years, there is still no sustained effect of preventive measures in clinical practice[9-10]. Such facts have been confirmed by the absence of substantial improvement in VAP rates in the last decade[(11)].

In this context, monitoring the feedback from the multidisciplinary team regarding the measures to prevent VAP can be a strategy that points out gaps and health indicators that subsidize investments in improving care practices based on training and continuing education. Based on the above, the aim of the present study was to verify the impact of the bundles and the interprofessional learning for the prevention of mechanical ventilation-associated pneumonia of an Intensive Care Unit.

METHODOLOGY

Type of study

This was a quasi-experimental study.

Local of study

This study was performed in a 20-bed ICU of a public hospital in Diamantina, Minas Gerais, conducted between August 2017 and May 2018.

Research participants

Were included in this study all 62 professionals from ICU (8 physioterapists,9 nurses and 45 nursing technicians) who provided direct assistance to patients in MV. Professionals who were on medical leave, maternity leave or vacations were excluded, as well as those who were not found after the third attempt to approach them.

Data collect

The data collections were divided into three phases:

Phase 1 - Pre-intervention period: consisted of the direct observation of the teams during the maintenance and manipulation of the patient under MV. A total of 9 nurses, 6 physiotherapists and 41 nursing technicians participated in this phase. The following variables were observed: high decubitus from 30° to 45° (The angle of the head of bed was measured with an electronic device present on the bed), cuff pressure verification, oral hygiene with chlorhexidine gluconate 0.12%, sedation minimized, subglottic aspiration (Indicated whether the subglottic drainage lumen was connected to the wall suctional the appropriate intermittent negative pressure), and HH before and after aspiration.

The observation was made by three researchers, duly calibrated, that already working in the UTI, seeking to soften the Hawthorne effect, that is, so that care professionals did not associate the reason for the presence of the observer with this study. Furthermore, electronic systems applied in the UTI measured the compliance rates of PAV, eliminating many of Hawthorne effect inherent to direct observation.

The Hawthorne effect is defined as changes of the research participants behaviour when involved in a trial because of increased knowledge or interest or else due to feeling observed in the trial. According to the definition mentioned above, the Hawthorne effect refers to the awareness of being studied and the subsequent change in behaviour to produce outcomes consistent with the expectations of the researchers. The Hawthorne effect is likely to be the greatest for short-term trials and practically non-existent during long observation periods of several years.

The observation sessions were distributed by the day and night work shifts, every Monday and Tuesday, with an average duration of three hours per shift.

In this same phase, interviews were conducted about measures to prevent VAP based on the Guidelines: Centers for Disease Control and Prevention (CDC) (2018)1, Society for Healthcare Epidemiology of America and Cambridge University (SHEA) (2014)2, National Institute for Health and Care Excellence (NICE) (2016)10 and Brazilian Health Surveillance Agency (ANVISA) (2017)7. Interventions occurred individually, maintaining the confidentiality and non-embarrassment of the participant, and 4 nurses, 5 physiotherapists and 30 nursing technicians accepted to participate in this stage.

Phase 2 - Intervention period: it was carried out by three researchers of the present study in a pre-scheduled place through "scenic clinical simulations" with skill training on prevention measures for VAP11. Such training allowed the healthcare workers to relate theory and practice, and the researchers themselves acted as patients and professionals, as indicated in a scenic simulation11. The training was carried out with all 56 professionals from ICU during fifteen days and lasted 1 hour/each shift. So that all healthcare workers could participate in all the different scenarios assembled.

During the training, different scenarios were constructed with the following themes: HH, oral hygiene, tracheal and subglottic aspiration, the importance of early sedation withdrawal, cuff check and bedhead elevation from 30° to 45°. In order to set up the scenario, physical and material resources of the ICU were used, such as: sterile and procedural gloves, surgical mask, goggles, liquid soap, 70% alcohol, endotracheal tube together with cuff, cuffometer, aspiration probe, aspirator, gauze, wooden spatula, tooth brush and 0.12%chlorhexidine gluconate.

Phase 3 - Post-intervention period: aimed to evaluate the impact of the strategies implemented in phase 2 of the study on the adherence to measures for preventing VAP. It was performed 30 days after the intervention, also conducted through direct observation of the professionals, using the same observation method and instrument of phase 1.

Data analysis

The analyzes were performed with the aid of the statistical software Statistical Package for the Social Sciences (SPSS) version 20. For the data comparison was performed a Pearson chi-square test when the expected value was > 5 and Fisher's exact test when the expected value was <5. The significance was level 5% (p = 0.05) and the confidence interval was 95%. Differences between pre and post groups were assessed using McNemar's test. An alpha level of 0.05 set a priori was used, and a Bonferroni correction was used to determine statistical significance in the case of multiple comparisons. Considering the Bonferroni correction, significant differences were only with p < 0,0083.

Ethical procedures

The present study was approved by the Research Ethics Committee/UFVJM under the opinion number 2,417,012 and conducted according to the Declaration of Helsinki of 1975, revised in 2013. The professionals who agreed to participate of this study signed the Informed Consent Term (ICT).

RESULTS

In the present study, 56 professionals participated in the direct observation phase, with 9 (16.0%) nurses, 6 (11.0%) physiotherapists and 41 (73.0%) nursing technicians. Table 1 shows the distribution of VAP prevention measures after direct observation in the pre- and post-intervention periods.

Table 1: Distribution of measures to prevent mechanical ventilation-associated pneumonia in the pre and post-intervention period. Diamantina, MG, Brazil, 2018.

High decubitus (30º-45º)			0.218
Yes	47 (90.4)	49 (90.4)	
No	5 (9.6)	3 (5.8)	
Cuff pressure verification			0.335
Yes	34(66.7)	37(72.5)	
No	17 (33.3)	14 (27.5)	
Oral hygiene			0.598
Yes	30 (57.7)	41 (78.8)	
No	11 (21.2)	22 (42.3)	
Daily interruption of sedation			0.439
Yes	35 (67.3)	42 (80.8)	
No	17 (32.7)	10 (19.2)	
Subglottic aspiration			0.170
Yes	13 (28.9)	16 (35.6)	
No	32 (71.1)	29 (64.5)	
HH‡ before aspiration			0.040§
Yes	1 (2.3)	8 (18.2)	
No	43 (97.7)	36 (81.9)	
HH‡ after aspiration			0.037§
Yes	19 (38.8)	37 (94.9)	
No	30 (61.2)	2 (5.1)	

*Ventilation-Associated Pneumonia; †Significance test from Mc Nemar calculation; ‡HH-Hand Hygiene; §(p<0.05) statistically significant.

Table 2 shows the measures for VAP presented in the pre-intervention period during the interview by professional category. In this stage, only 4 (44.0%) nurses, 5 (83.0%) physiotherapists and 30 (73.0%) nursing technicians accepted to answer the interview script

Table 2: Distribution of care measures for ventilation-associated pneumonia prevention as presented by professional category. Diamantina, MG, Brazil, 2018.

Care measures for VAP* prevention	Category			
	Nurse N (%)	Physiotherapist N (%)	NursingTechnician N (%)	P-value†
HH‡				
No	2 (50.0)	4 (80.0)	29 (97.0)	0.002§
Yes	2 (50.0)	1(20.0)	1 (33.0)	
Elevated bed head				
No	1 (25.0)	0 (0.0)	3 (10.0)	0.644
Yes	3 (75.0)	5 (100.0)	27 (90.0)	
Decrease sedation				
No	4 (100.0)	2 (40.0)	28 (93.0)	0.008§
Yes	0 (0.0)	3 (60.0)	2 (7.0)	
Aspiration of the airways				
No	1 (25.0)	1(20.0)	7 (23.0)	0.953
Yes	3 (75.0)	4 (80.0)	23 (77.0)	
Oral hygiene				
No	2 (50.0)	2 (40.0)	9 (30.0)	0.740
Yes	2 (50.0)	3 (60.0)	21 (70.0)	
Monitoring cuff				
No	4 (100.0)	2 (40.0)	20 (67.0)	0.247
Yes	0 (0.0)	3 (60.0)	10 (33.0)	

*Ventilation-Associated Pneumonia; †Significance test from Fisher's exact calculation; ‡HH-Hand Hygiene; §(p < 0,0083) statistically significant with Bonferroni correction.

Table 3 presents the risk factors for VAP presented by each professional category during the interview associated with working and training time of the multidisciplinary team.

Table 3: Distribution of the level of significance of prevention measures associated with the professional category, working time and professional training in the Intensive Care Unit. Diamantina, MG, Brazil, 2018.

		Professional category				Intensive care unit working time (years)				Professional training time (years)			
Risk factors associated with VAP*		Nurse N(%)	Physiotherpist N (%)	Nursing Technician N (%)	P-value†	Up to 5 N (%)	5 to 10 N(%)	> 10 N(%)	P-value†	Up to 5 N (%)	5 to 10 N (%)	>10 N (%)	P-value†
Not keeping bed head elevated between 30 and 45°	Yes	3 (75)	4 (80)	19 (63)	0.758	8(57)	9 (69)	9 (90)	0.203	7 (50)	15 (75)	5 (100)	0.003‡
	No	1 (25)	1 (20)	11(3)		6 (43)	4 (31)	1(10)		7 (50)	5 (25)	0 (0)	
Not performing oral hygiene	Yes	2 (50)	0 (0)	10 (33)	0.322	4 (26)	5 (38)	3 (30)	0.628	5 (36)	5 (25)	2 (40)	0.772
	No	2 (50)	5 (100)	20 (67)		10 (74)	8 (62)	7 (70)		9 (64)	15(75)	3 (60)	
Not performing aspiration with aseptic technique	Yes	1 (20)	4 (80)	7 (23)	0.002‡	4 (29)	5 (38)	3 (30)	0.628	3 (21)	7 (35)	1 (20)	0.348
	No	3 (80)	1 (20)	23 (77)		10 (71)	8 (62)	7 (70)		11 (79)	13 (65)	4 (80)	
Ideal positioning (30° to 45°)	Yes	2 (50)	5 (100)	2 (7)	0.006‡	4 (29)	0 (0)	0 (0)	0.009‡	10 (71)	19 (95)	3 (60)	0.245
	No	2 (50)	0 (0)	28 (93)		10(71)	13(100)	10(100)		4 (29)	1(5)	2 (40)	

*Ventilation-Associated Pneumonia; †Significance test from Fisher's exact test; ‡(p < 0,0083) statistically significant with

Bonferroni correction.

Table 4 presents distribution of ventilation-associated pneumonia prevention measures associated to the professional category in the Intensive Care Unit.

Table 4: Distribution of ventilation-associated pneumonia prevention measures associated to the professional category in the Intensive Care Unit. Diamantina, MG, Brazil, 2018.

Variables	Prevention measures	Professional category			
		Nurse N (%)	Physiotherapist N (%)	Nursing Technician N (%)	P-value*
Function of cuff	Prevent aspiration	3 (75)	5(100)	7(23)	0.043†
	Fix the tube	0 (0)	0(0)	7(23)	
Frequency of oral hygiene	12/12h	4(100)	2(40)	25(83)	0.037†
	8/8h	0(0)	3(60)	2(7)	
HH‡ before Intervention	70% Alcohol	0(0)	1(20)	2(7)	0.928
	Simple Hygiene	1(25)	1(20)	3(1)	
	Simple Hygiene + 70% alcohol	3(75)	3(60)	25(83)	
HH ‡after Intervention	70% Alcohol	0(0)	1(20)	1(3)	0.015†
	Simple Hygiene	0(0)	1(20)	2(7)	
	Simple Hygiene + 70% alcohol	4 (100)	3(60)	27(90)	

*Significance test from Fisher's exact calculation Bonferroni correction; † (p < 0,0083) statistically significant; ‡HH-Hand Hygiene.

Table 5: Distribution of ventilation-associated pneumonia prevention measures associated to the professional category in the Intensive Care Unit. Diamantina, MG, Brazil, 2018.

Variables	Prevention measures	Intensive care unit working time (years)				Professional training time (years)			
		Up to 5 N(%)	5 to 10 N(%)	>10 N(%)	P-value*	Up to 5 N(%)	5 to 10 N(%)	> 10 N(%)	P-value*
Function of cuff	Prevent aspiration	5(36)	4 (31)	6(60)	0.347	3(21)	9 (45)	2(40)	0.599
	Fix the tube	1(7)	4(31)	1(10)		2(14)	4 (20)	1(20)	
Frequency of oral hygiene	12/12h	13(93)	9 (69)	7(70)	0.620	12(86)	16 (80)	3(60)	0.337
	8/8h	1(7)	2 (15)	2(20)		0(0)	4 (20)	1(20)	
HH‡ before Intervention	70%Alcohol	0(0)	1 (8)	2(20)	0.004†	0(0)	3 (15)	0(0)	0.214
	Simple Hygiene	2(14)	0 (0)	3(30)		1(7)	4 (20)	0(0)	
	Simple Hygiene + 70%alcohol	12(86)	12 (92)	5(50)		13(93)	13(65)	5(100)	
HH ‡after Intervention	70%Alcohol	0(0)	1(8)	1(10)	0.05†	0 (0)	1(5)	1(20)	0.048†
	Simple Hygiene	1(7)	0(0)	1(10)		1(7)	2(10)	0 (0)	
	Simple Hygiene + 70% alcohol	13(93)	12(92)	8(80)		13(93)	17(85)	4(80)	

DISCUSSION

Considering the pre and post-intervention periods, we found that adherence to cuff pressure check increased by 8.10% (Table 1), being cited by 60% of physiotherapists and 33% of nursing technicians (Table 2). The cuff pressure measurement verifies the pressure value that should be high enough to avoid leakage that would make mechanical MV ineffective, thus preventing the progression of secretions from the oropharynx to the lower airways[4-12].

A prospective observational study demonstrated that such a criterion significantly reduced the incidence of VAP (p <0.05)12. On the other hand, a meta-analysis showed that continuous control of cuff pressure had no significant impact on secondary outcomes, such as duration and days free of MV, antimicrobial treatment, permanence or mortality in the ICU (p> 0.05)[13].

MV patients receive continuous infusion of sedation so that their discomfort and pain are relieved. Thus, they are at risk of prolonged sedation and, consequently, become susceptible to VAP due to the high risk of aspiration and reduction of the cough reflex14. In the present study there was an increase of 16.67% in relation to adherence to daily interruption of sedation (Table 1), and it is known that this measure reduces the number of days spent in the ventilator and the number of infections associated with prolonged use of MV(14-15). Further the decrease sedation versus category was significant (p=0.008) even after bonferroni correction. Reduced duration of patients to daily sedation interruptions until awake, resulting in shorter duration of mechanical ventilation (4.9 versus 7.3 days, P = 0.004) and shorter stays in the ICU16. Further analgesia alone without accompanying sedation may provide benefit of shorter durations of mechanical ventilation and has become part of the Society for Healthcare Epidemiology of America (SHEA) guidelines for VAP prevention[(2)].

Another recommended measure is the aspiration of subglottic secretion, which in this study increased adherence in 18.75% after the intervention. A prospective study of patients undergoing cardiac surgery demonstrated that aspiration of subglottic secretion reduced the incidence of VAP, days in MV and antimicrobial costs[(17)].

Another important strategy for reducing and preventing VAP is the HH. HH is recognized as the most effective in the prevention of Health Care-Related Infections (HCRI), but still presents with low adherence in the health services, with worldwide rates of 38.7% and national rated of approximately 43.7%18-19.

HH before and after aspiration of subglottic secretion presented a significant value (p <0.05). There was a rate of 88.81% in the post-intervention period for HH before the procedure and 94.88% after. These rates are similar to those reported by Lake Of The Woods District Hospital in Canada with 87.7% of adherence to HH before the intervention and 93.2% after the educational intervention[(20)].

In the present study, HH presented a low percentage in the interview, being mentioned by 50% of the nurses, 33% of the nursing technicians and 20% of the physiotherapists. A cross-sectional study of direct observation in an Intensive Care Unit showed greater adherence by physical therapists (53.5%), followed by nurses (47.5%) and nursing technicians (29.8%)[(19)].

Regarding the measure of bedhead elevation between 30 and 45°, the adherence rate remained at 90.38% in the pre- and post-intervention period (Table 1) and it was cited by most professionals during the interview period. The purpose of this intervention is to avoid the patient's positioning in the supine position, a risk factor for the development of VAP, in order to prevent gastroesophageal reflux and aspiration to the lower airways21. A meta-analysis of 10 randomized clinical trials with 878 participants compared the semi-sloping position and the supine position. The former has significantly reduced (p <0.05) the risk of clinical suspicion of VAP compared with the supine position (14.3 versus 40.2%)[22].

Regarding oral hygiene with the use of 0.12% chlorhexidinegluconate, there was an increase of 26.89% in the post-intervention period. Review with randomized clinical trials found that mouthwash or gel reduced the risk of VAP compared with placebo from 25% to about 19% (p <0.05)22. Furthermore, there was no significant (p <0.05) evidence between the use of chlorhexidine gluconate in oral hygiene versus duration of mechanical MV and ICU stay 22. Several factors may contribute to variations in oral care, including education, nursing practice and availability of resources23-24.

However, the correct use of chlorhexidinegluconate, used daily from 12 to 12 hours after oral and mechanical hygiene, prevents the formation of biofilm and reduce the colonization of gram-negative bacteria and, consequently the risk of VAP[(24).]

Regarding the answers obtained during the interview (Table 2), the level of knowledge among the professional categories varied over the VAP prevention measures. This result may indicate poor knowledge and fragmented work of each health professional, and the need for staff training25-26.

A cross-sectional study presented significance (p <0.05) between professional experience and adherence to VAP prevention measures[(25)]. In this study, there was a significant value (p <0.05) between professional training time versus absence of bedhead elevation as a risk factor associated with VAP (Table 3) and type of MH after intervention (Table 4 and 5).

The professional category presented significance (p <0.0083) when associated with aseptic aspiration and the position of the patient in MV (Table 3). There was also significance (p <0.0083) when the professional category was associated with cuff function, oral hygiene frequency and type of HH after intervention (Table 4).

Such results may indicate different knowledge between professional categories, which raises the need to implement educational measures and effective surveillance of the VAP rates in the ICU. A case-control study demonstrated that through training with team feedback nurses increased their knowledge and adherence to VAP prevention measures26. The increase in adherence to bedhead elevation increased from 79.2% to 100% after the educational intervention, interruption of sedation increased from 62.5% to 70.85%, and the use of chlorhexidine gluconate for oral care increased significantly (p <0.05), from 50% to 100%26.

In the present study, the working time was significant (p <0.05) when associated with the bedhead positioning (30-45°). To date, the authors think that head of bed elevation to 300 to 450 provides the safest positioning for the prevention of VAP in hemodynamically stable patients[24-27].

We found that 100% of the professionals who had been working more than five years answered it correctly. The type of HH performed before and after intervention also had a significant value (p <0.05) when associated to ICU work time. According to a review study a work overload, lack of healthcare workers and frequency of hospitalizations are issues that influence how and when professionals will perform HH[27].

The bundle implementation provides safe multi-professional evidence-based assistance that involves a multidisciplinary approach28. One of the obstacles to adherence to evidence-based guidelines is the lack of information. Although it is not the only solution, theoretical information is inevitably required to develop prevention approaches[28].

Studies have demonstrated the efficiency of the measures recommended in bundles for VAP prevention10, 29-30. In this present work the incidence of VAP decreased from 12.4 to 9.11 per 1000 days of ventilation in the period of study. Another quasi-experimental study that also used bundle of VAP found that the infection rate decreased from 15.9/1000 days of ventilation before the intervention to 8.5/1000 days of ventilation after the intervention30. Implementation of bundle can significantly shorten the duration of mechanical ventilation and reduce the incidence of VAP. However, all the measures associated with this decrease need to be long-term to be effective and generate positive impacts generally dependent on the cultural and institutional reality. The bundle is a prerequisite for VAP prevention, but it is not an enough condition since it must be carried out collectively, with systematic and constant training associated with the prospective surveillance of VAP rates.

Study limitation

An important limitation can be considered: relatively small chance of a Hawthorne effect was possible, as the study was unblinded. However, the staff was informed of the study during the observation period as well as during the intervention period, thus minimiz¬ing the probability of a Hawthorne effect.

Another Limitation of our study include the when interpreting the rate of VAP, the probability of aspiration with intubation or community-acquired pneumonia was not considered.

Study contributions to practice

The bundle for VAP contributed to improv the staff's understanding of the mechanical ventilation weaning protocol; increased adherence; and started a trend in reducing the rate of VAP, reducing the duration of mechanical ventilation, and constructing a culture of patient safety.

CONCLUSION

The results of the present study pointed out that the adequate performance of the team to comply with the bundle measures for VAP prevention depends on the training, work time and professional category.

The direct observation of the professionals pointed out that there was a significant increase (p <0.05) of HH from 88.81% to 94.88% after aspiration. Subglottic aspiration, although not significant (p = 0.170) also increased by 18.75%, comparing the pre- and post-intervention periods. Such a rate may indicate the team's fragmented knowledge about HH measures and subglottic aspiration. Intuitively, all measures that shorten the duration of intubation and decrease the transmission of resistant microbes should positively impact rates of VAP.

However, there is a gap to be detected in the bundle's implementation and in the positive impact generated by inter-professional knowledge, mainly because it is not immediate but in the long term to obtain the desired feedback. Finally, even in the knowledge of the entire multi-professional team, continuous monitoring is required to support the improvement of infection rates associated with VAP from the bundle implementation.

Contributors

All authors contributed to design, acquisition and statistical analysis of data. Further, all authors critically revised the manuscript and approved the final version. Furthermore, this study contributed to the implementation of an educational program as the instrument for disseminating patient safety concepts and providing detailed information about the implementation of well-known VAP prevention measures.

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