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Research Article
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Artículo de Investigación

Contribution of convergent care research to preventing pneumonia associated with mechanical ventilation

Contribuição da pesquisa convergente assistencial para prevenção de pneumonia associada à ventilação mecânica

Contribución de la investigación convergente-asistencial para prevenir la neumonía asociada con la ventilación mecánica

Bruna Karla Dutra[I], *Laura Menezes Silveira*[I], *Fabiana Bolela*[I], *Mariele Lenhari*[I], *Angelita Maria Stabile*[I]

[I]*Universidade de São Paulo. Ribeirão Preto, São Paulo, Brazil*

ABSTRACT

Objective: to develop a protocol for the prevention of pneumonia associated with mechanical ventilation, with the participation of the health personnel who will use it and applying the framework of convergent care research. **Method**: data were collected by individual interview and three group meetings with the health personnel, and analyzed using the Morse and Field framework. The study was approved by a research ethics committee. **Results**: the care cited in the individual interviews was organized by level of evidence, as suggested in the Guidelines of the American Thoracic Society. In the group meetings, care was discussed according to its relevance in preventing pneumonia. The care mentioned as relevant made up the final version of the protocol. **Conclusion**: convergent care research framework made it possible to develop a protocol for the prevention of pneumonia associated with mechanical ventilation, with the involvement of health personnel working in the Intensive Care Unit.
Descriptors: Intensive Care Units; Respiration, Artificial; Cross Infection; Pneumonia, Ventilator Associated; Protocols.

RESUMO

Objetivo: elaborar um protocolo para prevenção de pneumonia associada à ventilação mecânica com a participação dos profissionais que o utilizarão, por meio do referencial da pesquisa convergente assistencial. **Método:** foi realizada uma entrevista individual e três encontros grupais com os profissionais. Para a análise dos dados foi utilizado o referencial de Morse e Field. O estudo foi aprovado por um Comitê de Ética em Pesquisa. **Resultados:** os cuidados citados nas entrevistas individuais foram organizados de acordo com o nível de evidência sugerido no *Guideline da American Thoracic Society*. Nos encontros grupais os cuidados foram discutidos de acordo com a relevância na prevenção da pneumonia. Os cuidados elencados como relevantes compuseram a versão final do protocolo. **Conclusão:** o referencial da pesquisa convergente assistencial possibilitou a elaboração de um protocolo para prevenção de pneumonia associada à ventilação mecânica, com o envolvimento dos profissionais atuantes na Unidade de Terapia Intensiva.
Descritores: Unidades de Terapia Intensiva; Respiração Artificial; Infecção Hospitalar; Pneumonia Associada à Ventilação Mecânica; Protocolos.

RESUMEN

Objetivo: elaborar un protocolo para la prevención de la neumonía asociada a la ventilación mecánica con la participación de los profesionales que lo utilizarán, a través del marco de la investigación convergente-asistencial. **Método:** se realizó une entrevista individual y tres encuentros en grupo con los profesionales. Para el análisis de los datos, se utilizó el marco Morse y Field. El estudio fue aprobado por un Comité de Ética en Investigación. **Resultados:** la atención mencionada en las entrevistas individuales se organizó de acuerdo con el nivel de evidencia sugerido en la Guía de la *American Thoracic Society*. En las reuniones de grupo, se discutió la atención según su relevancia en la prevención de la neumonía. Los cuidados enumerados como relevantes constituyeron la versión final del protocolo. **Conclusión**: el marco de la investigación convergente-asistencial permitió desarrollar un protocolo para la prevención de neumonías asociadas a la ventilación mecánica, con la participación de los profesionales que trabajan en la Unidad de Cuidados intensivos.
Descriptores: Unidad de Cuidados Intensivos; Respiración Artificial; Infección Hospitalaria; Neumonía Asociada al Ventilador; Protocolos.

INTRODUCTION

Invasive mechanical ventilation is a widely used therapy, mainly in Intensive Care Units, being essential to save lives of critically-ill patients[1], as this technology is able to totally or partially replace the patient's spontaneous breathing[2].

Among the most common complications in the Intensive Care Unit is ventilator-associated pneumonia, an infection associated with increased permanence on invasive mechanical ventilation, length of stay in the Intensive Care

Corresponding author: Angelita Maria Stabile. E-mail: angelita@eerp.usp.br
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Unit, and increased consumption of antibiotics and hospitalization costs[3]. Ventilator-associated pneumonia corresponds to 15% of all the health care-related infections and approximately 25% of all the infections acquired in Intensive Care Units. In addition, global mortality can vary from 20% to 60%[4].

Ventilator-associated pneumonia is defined as an infection of the lung parenchyma that develops 48-72 hours after initiation of invasive mechanical ventilation and up to 48 hours after extubation[5]. The clinical criteria are characterized by the presence of new or progressive persistent infiltrate or consolidation or cavitation, fever, leukopenia, emergence of purulent secretion or changes in the appearance and amount of the secretion[4].

Due to the high mortality and treatment costs, health care institutions have been seeking ways to prevent the occurrence of ventilator-associated pneumonia in their Intensive Care Units[6,7], as onset of this condition is related to the care provided to the patient and to the activities of the professionals working in these units[8].

Using protocols can be a simple and low-cost measure to prevent ventilator-associated pneumonia. On the other hand, adherence to the protocols is the key for prevention because they usually improve care, favor the use of scientifically supported practices, minimize variability of the information and courses of action among the members of the health team, and establish action and cooperation limits across the many professionals.

The protocols must be elaborated in a collective manner by the professionals involved, towards a common objective. Thus, when well-grounded, care begins to be observed and conducted by everyone. However, when a protocol is elaborated without the participation of the professionals who will actually put it into practice, there cannot be adherence, which impairs its implementation[9].

Thus, the objective of this study was to develop a protocol for the prevention of ventilator-associated pneumonia with the participation of the professionals who will use it, by means of the Convergent Care Research framework.

METHOD

This is a qualitative study that used the Convergent Care Research framework, which is based on the understanding that research problems arise from the professional practice and aims at identifying vulnerable points or at noticing potentialities that contribute to the proposal of adequate solutions directed to a specific context. For this reason, that research modality always requires the researcher's involvement in the problem-questions resulting from the practice.

The commitment of Convergent Care Research is to indicate innovations for nursing and health care, articulating those involved in the context to be researched in a relationship of mutual cooperation, in order to promote integration between theory and practice, thinking and doing, in order to renew this same practice[10]. This study was elaborated according to the Consolidated Criteria for Reporting Qualitative Research (COREQ).

It was developed in a private hospital form southern Minas Gerais that has 50 beds, six of them in the ICU. There is a mean of 20 monthly ICU admissions, with a mean hospitalization time of nine days, and clinical conditions account for 70% of the hospitalizations.

All nurses, nursing technicians, physical therapists and physicians who were working in the Intensive Care Unit of the institution for at least six months from January to June 2017 were invited to participate. The invitation to participate was made in person by the researcher herself, who is also inserted in the assistance context of this setting.

Elaboration of the protocol included four stages. In the first stage, an individual interview was carried out with each professional and they were asked to list which care measures were important for the prevention of ventilator-associated pneumonia.

In the second stage, the professionals were allocated in two groups according to time availability, taking due to care to combine the different professional categories. In these groups, the care measures for the prevention of ventilator-associated pneumonia, which were listed in the individual interviews, were discussed, without identifying the professional who suggested them.

In the third stage, a meeting was proposed with all the professionals participating in the research, to present the ideas that emerged in both groups, so that everyone could make a decision regarding the best courses of action to be included in the protocol.

In the fourth stage, a meeting was held with all the participants to present the care measures that would comprise the protocol. Both the individual interviews and the groups were audio-recorded. The interviews and the group meetings took place in the service's premises, always seeking to safeguard the participants' privacy. Each interview lasted approximately 20 minutes and the group meetings, nearly one hour and a half.

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For analysis and interpretation of the data obtained in the aforementioned stages, a theoretical framework by Morse and Field was used, recommended for the Convergent Care Research methodology[11], which consists of four phases: apprehension, synthesis, theorization, and recontextualization. The apprehension phase consisted in data collection, organization and synthesis of the diverse information from the careful reading of the interviews obtained, seeking to apprehend what was presented by the participants and resulting in a list of behaviors grouped into categories according to the level of evidence, which should comprise the prevention protocol for ventilator-associated pneumonia. The synthesis consisted in the analysis of the diverse information obtained, taking into account the data associations and variations[11,12].

It was in this phase that the care measures for the prevention of ventilator-associated pneumonia emerged, which were grouped into categories. These categories were analyzed based on the level of evidence. For this, the classification described in the American Thoracic Society guideline was adopted, which organizes care measures into levels of evidence: level I (high): well-conducted evidence, randomized clinical trials; level II (moderate): well-designed evidence, non-randomized controlled trials (including cohort, series of patients, and case-control studies). It also includes any large casuistic in which systematic analysis, as well as reports of new therapies that were not collected in a randomized way; and level III (low): evidence from case studies and experts' opinion[12].

After the levels of evidence of the care measures were categorized, they were taken to group discussions in order to share the results obtained in the interviews and collectively select the care measures that would comprise the prevention protocol for ventilator-associated pneumonia, considering the professionals' opinions, the evidence of the care measures, and the feasibility of performing these practices in the institution's assistance context. Theorization was achieved through intellectual work, which consisted in interpreting the data presented by the participants, with the measures selected by the professionals, during the three group meetings, about the measures for the prevention of ventilator-associated pneumonia, thus resulting in the elaboration of the institutional protocol. Recontextualization took place in the fourth meeting, during which the results obtained were presented and shared, in order to respond to the research objective.

This study respected the ethical characteristics and requirements of Resolution No. 466, dated December 12th, 2012, of the National Health Council, and was approved by the institution's Research Ethics Committee. All the professionals accepted to participate by signing the Free and Informed Consent Form.

RESULTS

The study participants were 17 professionals: five physicians, two physiotherapists, three nurses and seven nursing technicians. The working time of these professionals in the unit varied from one year and six months to nine years. Two professionals who were part of the Intensive Care Unit team were not included in the study: a nursing technician for working at the institution for less than six months, and a nurse who refused to participate in the study.

The actions mentioned by the professionals and the frequency with which each of them was cited can be seen in Figure 1.

In the second stage, the participants were divided into two groups consisting of different professional categories; not all the professionals who participated in the individual interview were able to participate in the groups; therefore, group 1 had the participation of six professionals and seven professionals participated in group 2. Each care measure listed by the team was discussed, considering their level of evidence. The groups raised various points regarding the use of an open or closed suction system:

> *There is the cost...the cost is very high, I think that there's no need, if we emphasize suction, not leaving it only to the physical therapist, if the technician, the nurse, passes by and sees that he needs it, and the physical therapist is in another bed, he can aspirate, because everyone here has training (group 1).*

Points about oral hygiene and the actions that were already being adopted divergently in different shifts were also raised:

> *It's because here we use gauze with a spatula, I think that a brush would help a lot, it would be even more efficient than gauze...a soft little brush for children (group 1).*
>
> *In the other hospital, the hygiene kit is a vat, with a kelly and a normal forceps, then we take it, make a small pack, fasten it and take it to the patient, without fear... now with the gauze we're even afraid of the gauze getting inside the patient's mouth... you could think about assembling 5 of these kits (group 2).*
>
> *When it comes to the diet, to be able to give a bath, here there's no fixed time to give a bath, then, now we're dividing night baths and day baths, but the diet has to be stopped when it's time for the bath, because if the patient's stomach is still full, it can lead to microsuction (group 1).*

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Level of evidence	Action	Number of times mentioned
Level of Evidence I (High)	Hand hygiene	3
	Maintain headboard elevated (from 30º to 45º)	7
	Disinfection of circuits	2
	Use of gloves	1
	Filter exchange	6
	Assessment of the need for intubation	1
	Reassessment of extubation with the intention of avoiding reintubation	1
	Perform endotracheal suction with aseptic technique	14
Level of Evidence II (Moderate)	Maintain cuff pressure (20 cm H_2O)	1
	Maintain the circuit in an elevated position, avoiding return of condensates	3
	Oral hygiene with chlorhexidine 0.12%	10
	Rational use of antibiotics	3
	Reduce intubation time	2
	Use subglottic tube	1
Measures for which there is no level of evidence	Care with fixation and handling	2
	Perform motor physiotherapy	1
	Perform tracheostomy	1
	Decubitus change for pulmonary decompression	8
	Nutritional support	2
	Verification of nasoenteric tube position	2
	Suspension of diet prior to bed bath, avoiding gastroesophageal reflux	4
	Aseptic orotracheal intubation	2
	Suction has to be performed by means of a closed system	1

FIGURE 1: Care measures mentioned by the professionals and included in the ventilator-associated pneumonia prevention protocol according to the level of evidence, Passos, MG, Brazil, 2017.

It was also suggested that the actions were duly executed by everyone, so that all shared responsibility for them:

> *What happens is that if the professional has time to do it, he goes there, but if he sees that the procedure is not necessary, he doesn't do it, but sees it anyway...otherwise, if he doesn't have time, he doesn't go (group 1).*
>
> *It has to be done, and one is done in the day and one at night, then it has to be checked, it must have a checklist (group 2).*

In the third stage, there was a meeting in which 15 professionals participated to discuss the results presented and to align courses of action, such as defining the frequency of oral hygiene every 12 hours, using the kit containing forceps, gauze, topical chlorhexidine 1% and spatula; in relation to the use of a closed or open system for suction, it was established that with any restriction to disconnect the mechanical ventilator, such as in cases of Acute Respiratory Distress Syndrome, the closed system must be used. Additionally, to formalize these and other care measures, it was suggested that a specific form should be prepared for the record, which should include the time of suction, verification of cuff pressure, whose frequency was established to be every 12 hours, performance of oral hygiene, and filter verification.

Thus, in the fourth stage, after the meetings, the protocol was prepared, describing all the peculiarities of the unit where the study was conducted, the activities to be performed, and which professional was responsible for each activity.

When performing orotracheal intubation, the medical team must perform hand hygiene before the procedure, use personal protective equipment (goggles, mask, isolation gowns), wear sterile gloves, and use a subglottic tube. The physiotherapy team must inflate the cuff with a pressure between 20 and 25 mmHg and fix it properly.

While the patient is on mechanical ventilation, the nursing team is responsible for hand hygiene, following the recommendation of the institutional standard operating procedure; wearing sterile gloves when performing invasive procedures on the patient; keeping the headboard elevated between 30º to 45º, ensuring that the bottom of the bed is suitable for the patient, keeping it straight; performing oral hygiene at least twice a day, using aqueous chlorhexidine (0.12%); suspending diet infusion at least 1 hour before performing any procedure that requires keeping the headboard at 0º, such as baths; decubitus change, according to the pressure ulcer prevention protocol, maintaining

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caution during the procedure; and performing endotracheal suction, whenever necessary, using the conventional system and with aseptic technique.

The physiotherapy team must perform hand hygiene, following the recommendation of the institutional standard operating procedure; use sterile gloves when performing invasive procedures on the patient; carefully change the locking strap of the orotracheal cannula, thus avoiding the risk of accidental extubation; perform endotracheal suction, whenever necessary, using the conventional system and with aseptic technique; verify the respiratory filter daily and change it, if it presents excessive humidity; verify the ventilator circuit daily, observing its aspect and, when it presents dirt, change it, keeping the circuit always elevated; maintain cuff pressure between 20 and 25 mmHg, measuring it twice a day; and perform motor physiotherapy in all patients under mechanical ventilation.

The medical team is responsible for evaluating the possibility of reducing sedation on a daily basis; if the period of orotracheal intubation exceeds 15 days, evaluate the indication for tracheostomy; and use antimicrobials only when necessary for treatment and not prophylaxis purposes.

To conclude, some important observations were attached for the best follow-up of the protocol prepared by the team, such as: for patients with significant pulmonary involvement, for example, Acute Respiratory Distress Syndrome, the closed suction system must be used; to perform the patient's oral hygiene, the kit for this procedure must be taken from the Sterilized Materials Center, and these procedures must be performed daily and/or during each shift.

All 17 professionals attended the last meeting. The protocol was read and all the professionals approved and signed it, attesting to its collective elaboration. Those who were present reinforced the importance of the protocol for the institution and reported their impressions about the experience of having participated in its joint elaboration.

DISCUSSION

After the interviews, it could be noticed that all the care measures for the prevention of ventilator-associated pneumonia were mentioned, and that each professional could contribute so that these measures are included in the protocol. The Convergent Care Research framework enabled involvement of the team that assists the critically-ill patient, propitiating the mutual production, development, diffusion and application of knowledge in the assistance practice scenario allied to the scientific evidence.

The action most frequently cited by the professionals was endotracheal suction with aseptic technique. As this is a necessary and widely used invasive procedure for patients in the Intensive Care Unit, it is essential to monitor asepsis precision, especially hand hygiene, in order to avoid contamination and minimize the risk of iatrogenic complications for the patients[8].

Also regarding endotracheal suction, some participants mentioned the frequency with which suction should be performed. In relation to this aspect, the need is highlighted for caution at the time of suction to avoid complications such as trauma, bronchospasm, pain, discomfort, alteration of parameters like respiratory rate and increased intracranial pressure, in addition to the entry of bacteria into the respiratory tract, thus contributing to the occurrence of respiratory infections[13].

In relation to the type of system used, if open or closed, for both systems the impact for the prevention of ventilator-associated pneumonia is similar. A study that compared both types did not find differences in the occurrence of ventilator-associated pneumonia[14].

Another care measure mentioned was the patient's position on the bed, which directly interferes in the respiratory mechanics. The recommendation is to maintain the headboard at an angle from 30º to 45º to reduce the risk of pneumonia, in addition to allowing more homogeneous alveolar ventilation[4]. A study showed that positioning at 0º increases resistive pressure and that, at 60º, it increases elastic pressure; however, positioning at 30º determines the system's dynamic compliance[15].

An elevated headboard also prevents the occurrence of diet bronchoaspirations, another topic addressed by the participants. Diet infusion through a tube can be considered as a predisposing factor for ventilator-associated pneumonia, due to the risk of suction of gastric content. Thus, care measures such as watching the presence of gastric distension and verifying the tube's position must be adopted to avoid bronchoaspiration[8].

In relation to the ventilator's circuit, the participants indicated that it should be maintained high. Maintaining the respirator's tracheae elevated leaves them free of water or condensation, replacement being indicated only in cases of

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failure, dirt or discharge from the Intensive Care Unit[8]. There are no specific recommendations in relation to the time that the circuit can remain assembled awaiting hospitalization of the patient[4].

Most of the patients on invasive mechanical ventilation are bedridden, and decubitus changes are necessary, not only to prevent pressure ulcers, but also to avoid complications such as lung secretion stasis, contributing to the prevention of pneumonia[16].

When performing decubitus change, it is important to pay attention to the cuff pressure, which must be maintained between 20 and 25 cmH_2O. Lower pressure values increase the risk for suction of gastroesophageal and oropharyngeal secretions. Cuff pressure reduction when the patient is positioned laterally and facing the ventilator was identified in one study[17]. Thus, to avoid significant loss of cuff pressure, the team must regularly check and record the pressure of this device, mainly when there is a decubitus change in order to prevent the occurrence of ventilator-associated pneumonia.

The possibility of early extubation must be evaluated daily, with the purpose of reducing the time of invasive mechanical ventilation and, consequently, reducing the risk of ventilator-associated pneumonia. Gradual reduction of the sedation levels and daily interruption are safe strategies that reduce the time of mechanical ventilation and, consequently, reduce the rate of pneumonia[4,8].

The time to perform the tracheostomy is still controversial; however, it offers more comfort, facilitates the patient's movement, allows for the introduction of food or medication via the oral route, reduces the risk of self extubation, facilitates oral hygiene, allows for spontaneous bronchial hygiene and suctioning of tracheal secretions, and also avoids bronchoaspirations[8].

The oral cavity is a gateway for microorganisms. In the Intensive Care Unit routine, verification of mucosal integrity and oral hygiene are relevant actions in the prevention of ventilator-associated pneumonia; however, these measures are often performed incorrectly and inefficiently, or simply not performed[4].

Deficient or nonexistent oral hygiene leads to the formation of bacterial plaques[8]. A study evidenced that when oral hygiene was conducted with chlorhexidine 0.12%, there was a reduction in the incidence of ventilator-associated pneumonia[8]. Considering that ventilator-associated pneumonia leads to increased hospitalization costs and that oral antisepsis with chlorhexidine is a low-cost measure, oral hygiene becomes a highly recommended measure in Intensive Care Units[18].

Another care measure that exerts a direct influence on the prevention of infections such as ventilator-associated pneumonia is hand hygiene, which is the main route of microorganism transmission. Due to its high efficacy in preventing and controlling the assistance-related infections and to its low cost, hand hygiene is frequently addressed in educational campaigns[19].

In this context, it is emphasized that the main problem of hand hygiene failure is negligence in performing the procedure, as it is not sufficient to merely adhere to the practice, but to perform it completely; otherwise, there will be no effective reduction of the hands' microbiota. Though economical and fast, hand hygiene is a measure that contributed with crucial improvement for the control of infections in the professional practice. In health institutions that implement Bundles, an increase in hand hygiene compliance is observed, which has repercussions on the incidence of ventilator-associated pneumonia[20].

Thus, all the care measures mentioned in the prevention of ventilator-associated pneumonia and the reflections made in the meetings with the participants of this study allow, with the aid of Convergent Care Research, for the exploration, reflection and deepening of different actions and measures. The Convergent Care Research framework allows for dialog between research and assistance, providing the application of both activities in the same physical space, in order to check the production of new knowledge and change in the assistance practice.

On the other hand, this method requires a continuous review of the professionals' stance and attitude towards the obstacles and needs for transformation thereby emerging. One of the limitations of this study lies in the non-participation of all the professionals in all the stages for the elaboration of the protocol to prevent ventilator-associated pneumonia.

CONCLUSION

The Convergent Care Research framework enabled the elaboration of a protocol for the prevention of ventilator-associated pneumonia, with the involvement of the professionals working in the Intensive Care Unit, showing the motivation of each individual to add knowledge from their specialty to the protocol.

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In addition to that, there was interaction among all members of the professional categories working in the sector, discussion of knowledge and care practices, and proposal and alignment of care measures for the critically-ill patient in order to prevent ventilator-associated pneumonia.

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