



# Good nursing practices towards patients on invasive mechanical ventilation in hospital emergency<sup>a</sup>

*Boas práticas de enfermagem a pacientes em ventilação mecânica invasiva na emergência hospitalar*

*Buenas prácticas de enfermería a pacientes en ventilación mecánica invasiva en emergencia hospitalaria*

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## ABSTRACT

**Objective:** To identify care conceived as good nursing practices for patients on invasive mechanical ventilation in the context of hospital emergency. **Method:** Descriptive, qualitative study, conducted from June to September 2017 with the participation of 16 nurses from general emergency room of a hospital in Brazil's southern region. Care, extracted from the literature and classified according to evidence level, were grouped into categories by similarity and selected in Discussion Groups. **Results:** The nurses considered a total of 13 care measures as good practices for the patients on mechanical ventilation. These care measures are related to endotracheal tube, ventilator and circuit, prevention of bronchoaspiration, infection control and sedation, analgesia/sleep, wakefulness/pain. Practices were extracted from studies with evidence levels IIb, IV and VI. **Conclusion and implications for practice:** Good nursing practices related to invasive mechanical ventilation, as conceived by nurses from the emergency room, scientifically supportive care towards patients on invasive ventilatory support and may be applied in similar contexts.

**Keywords:** Respiration, Artificial; Nursing Care; Emergency Nursing; Patient Safety.

## RESUMO

**Objetivo:** Identificar os cuidados concebidos como boas práticas de enfermagem a pacientes em ventilação mecânica invasiva no contexto de emergência hospitalar. **Método:** Estudo descritivo, qualitativo, realizado de junho a setembro de 2017. Participaram 16 enfermeiros da emergência geral de um hospital da região Sul do Brasil. Os cuidados, extraídos da literatura e classificados quanto ao nível de evidência, foram agrupados em categorias por similaridade e selecionados nos Grupos de Discussão. **Resultados:** Os enfermeiros consideraram como boas práticas aos pacientes em ventilação mecânica invasiva um total de 13 cuidados, os quais estão relacionados ao tubo endotraqueal, ao ventilador e circuito, à prevenção de broncoaspiração, ao controle de infecção e à sedação, analgesia/sono, vigília/dor. Os cuidados foram extraídos de estudos com níveis de evidência IIb, IV e VI. **Conclusão e implicações para a prática:** As boas práticas de enfermagem em ventilação mecânica invasiva, concebidas pelos enfermeiros da emergência, respaldam cientificamente a assistência ao paciente em suporte ventilatório invasivo, podendo ser aplicadas em contextos similares.

**Palavras-Chave:** Respiração Artificial; Cuidados de Enfermagem; Enfermagem em Emergência; Segurança do Paciente.

## RESUMEN

**Objetivo:** Identificar los cuidados concebidos como buenas prácticas de enfermería a pacientes en ventilación mecánica invasiva en el contexto de emergencia hospitalaria. **Método:** Estudio descriptivo, cualitativo, realizado entre junio y septiembre de 2017. Participaron 16 enfermeros de la emergencia general de un hospital de la región Sur de Brasil. Los cuidados, extraídos de la literatura y clasificados según el nivel de evidencia, se agruparon en categorías por similitud y seleccionados en los grupos de discusión. **Resultados:** Los enfermeros consideraron como buenas prácticas para pacientes con ventilación mecánica invasiva un total de 13 cuidados, relacionados con el tubo endotraqueal, el ventilador y circuito, la prevención de la broncoaspiración, el control de infección y la sedación, la analgesia/el sueño, la vigilia/dolor. Los cuidados fueron extraídos de estudios con niveles de evidencia IIb, IV y VI. **Conclusión e implicaciones para la práctica:** Las buenas prácticas de enfermería en ventilación mecánica invasiva, concebidas por enfermeros de emergencia, respaldan científicamente la atención al paciente con asistencia respiratoria invasiva y pueden aplicarse en contextos similares.

**Palabras clave:** Respiración Artificial; Atención de Enfermería; Enfermería de Urgencia; Seguridad del Paciente.

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## INTRODUCTION

Hospital Emergencies (HE) are complex units, organized in terms of physical and personnel structure with agility, skill, dexterity and ability to reason consciously and safely in the care for the population.<sup>1</sup> Critically ill patients are admitted to these units and often require tracheal intubation and invasive mechanical ventilation (IMV).<sup>2</sup> In the United States, annually hundreds of thousands of patients undergo mechanical ventilation in HE.<sup>3</sup> In Japan, 46.4% of patients under this type of ventilation were exclusively monitored outside the Intensive Care setting.<sup>4</sup>

However, pneumonia associated with mechanical ventilation (PAMV) has been attributed to intubation in HE and length of stay in this sector.<sup>5</sup> As late admission to the Intensive Care Unit (ICU) of mechanically ventilated patients in HE is also associated with higher mortality and additional resource utilization if the patient survives, a waiting time in HE not exceeding four hours is recommended.<sup>6</sup> Although these patients may benefit from immediate transfer to an ICU, this option is limited by overcrowding and scarce resources, which justifies the implementation of patient-directed care on mechanical ventilation in HE.<sup>7</sup>

Mechanical ventilation totally or partially replaces spontaneous ventilation and is indicated in acute respiratory failure (ARF) or acute-on-chronic. When used invasively, endotracheal tube or tracheostomy tube is used.<sup>8</sup> This kind of support requires specialized assistance from the multi-professional team,<sup>9</sup> being the nurse's responsibility to maintain the permeability of the intubated patient's airway areas, as well as the mastery over ventilator parameters, necessary to assess patient's adaptation to the parameters and to implement nursing care.<sup>10</sup>

Care considered as good care practices in the context of HE should be employed in order to promote patient safety and contribute to the service provided quality.<sup>11</sup> In nursing, good practices are understood as the interrelated and inseparable set of theories, techniques, processes and activities seen as the best available options for care in the area, keeping consistency with knowledge, values, contexts, environments, objectives and evidences in the interest of health.<sup>12</sup>

Considering the frequency of patients with respiratory instability using IMV in HE, the possibility of ventilator-patient mismatches, the risk of pneumonia associated with mechanical ventilation (PAMV) and the need for a trained professional to deal with all of these variations safely, this study was designed to identify care conceived as good nursing practice for patients on invasive mechanical ventilation in the context of hospital emergency.

## METHOD

Descriptive research of qualitative approach, developed in the emergency unit of a public general hospital in southern Brazil, reference in the care of patients with trauma. Study was approved by the Human Research Ethics Committee under

Opinion No. 1,807,924. Participants signed the Informed Consent Form.

Of the 20 nurses in the emergency unit, 16 participated in the study because they met the inclusion criteria: being a nurse and working in the sector for at least six months. Nurses working in an administrative position, on vacation or on leave during the period of data collection was excluded. Participants' choice is justified by the fact that the nurse is the nursing professional responsible for the patient under mechanical ventilation care.

Firstly, one of the researchers conducted a bibliographic survey from June to August 2017, in order to identify studies that addressed patient care on mechanical ventilation. To this end, the Latin American and Caribbean Health Sciences Literature (LILACS), Scientific Electronic Library Online (SciELO), Medical Literature Analysis and Retrieval System Online (MEDLINE/PubMed) and Nursing Database (BDENF) databases were consulted with the following descriptors/keywords: *Respiração Artificial; Respiração Mecânica; Ventilação Mecânica; Suporte Ventilatório; Respirador Mecânico; Ventilador Mecânico; Respiração por Aparelhos; Ventilação por Aparelhos; Cuidados de Enfermagem; Mechanical Ventilation; Artificial Respiration; Nursing Care; Respiración Artificial; Ventilación Mecánica; e Cuidados de Enfermería*. Nine studies were selected for full reading because they presented nursing care related to patients in IMV and level of evidence. These cares were grouped by similarity into six categories: endotracheal tube care; to ventilator and circuit; to bronchoaspiration prevention; to infection control; to sedation, analgesia/sleep and wakefulness/pain.

In order to select the care considered good practices for application to the emergency patient in IMV, Discussion Groups were held in September 2017, which took place in an emergency unit private room, immediately after the shift change and had an average duration of 90 minutes. Four groups were organized, on average with four day and night nurses, considering the participants' availability. One meeting was held with each group, conducted by one of the researchers. Initially, the group's objective was highlighted, and the nurses were advised that the selection of care should consider beside the level of evidence, the applicability in the context of the institution. Next, a multimedia chart with nursing care, level of evidence and response options was presented (Yes - possible to apply; No - impossible to apply). Participants discussed each care until agreement was reached on what was considered good practice.

For level of evidence classification, the type of study was considered, represented in seven levels: level Ia: Systematic review of Randomized Controlled Trials (RCTs); Ib level: Systematic review of nonrandomized trials; level IIa: Individual RCT; level IIb: Non-randomized trial; level III: Systematic review of correlation/observation studies; Level IV: Correlation study/observation; level V: Systematic review of descriptive, qualitative, physiological studies; level VI: Descriptive/qualitative/physiological/individual study; and level VII: Authorities' opinion, experts' committees.<sup>13</sup>

**Chart 1.** Nursing care by category and level of studies' evidence, SC, Brazil, 2017.

Care category	Nursing care	NE
Endotracheal tube care	Check <i>cuff</i> pressure and keep it between 20-30cmH <sub>2</sub> O <sup>14-19</sup>	IIb, IV, VI
	Proper endotracheal tube fixation and periodic replacement <sup>15,16</sup>	IV, VI
Ventilator and circuit related care	Replace ventilator circuit when visibly dirty <sup>15,18</sup>	IV, VI
	Beware of ventilator alarms <sup>16</sup>	VI
Related care to bronchial aspiration prevention	Keep the headboard elevated between 30 and 45° <sup>17-19</sup>	IIb, VI
Infection control related care	Perform ventilator assembly with aseptic technique and protect the Y-connection during system opening <sup>14,15</sup>	IIb, IV
	Make oral hygiene with chlorhexidine 0.12% <sup>14,18,19</sup>	IIb, VI
	Perform bronchial hygiene (aspiration) with aseptic technique after evaluations <sup>14,16-18</sup>	IIb, VI
	Wear personal protective equipment during bronchial hygiene <sup>14</sup>	IIb
	Avoid instilling physiological solution 0.9% or any other into the tube <sup>18</sup>	VI
	Wash the latex with distilled water or physiological solution and protect it in a clean, dry package after the procedure <sup>20</sup>	VI
	Hand hygiene before and after handling the ventilation system <sup>15,16,18,19</sup>	IV, VI
Care related to sedation, analgesia/sleep, wakefulness/pain	Evaluate sedated patients by sedation scale <sup>19</sup>	VI

\*Note: NE: Studies' level of evidence.

## RESULTS

Of the 16 participants, predominantly females, corresponded to fourteen nurses. All had more than six years of training and ten had specialization in the field of care for critically ill patients. Of the experts, two had a master's degree in health. Emergency time ranged from three to twenty-five years.

From the 18 listed care, 13 were conceived by nurses as good nursing practices for patients on invasive mechanical ventilation in the context of hospital emergency, extracted from studies with levels of evidence IIb, IV and VI (Chart 1). It was considered five precautions not applicable to the study context: discarding condensate from the ventilator circuit when present; wear personal protective equipment (PPE) to discard condensate; prefer closed to open system for the prevention of PAMV; use subglottic suction tube to prevent PAMV; and avoid unnecessary sedation.

## DISCUSSION

Good nursing practices for maintaining oxygenation in patients on emergency invasive mechanical ventilation were revealed in this study in order to promote greater safety and prevent adverse events.

Among related care to the endotracheal tube, nurses highlighted the verification and maintenance of *cuff* pressure

between 20 and 30 cmH<sub>2</sub>O, extremely important care in preventing complications<sup>21</sup> as lesions by direct compression of the tracheal mucosa, accidental displacement of the tube, and micro-bronchoaspiration.<sup>14</sup> In Brazil, the National Health Surveillance Agency (ANVISA) recommends the pressure between 25 to 30 cmH<sub>2</sub>O.<sup>22</sup>

There is no consensus in the literature about the level of pressure to be maintained in the *cuff*, but the mean pressure should be 25 cmH<sub>2</sub>O.<sup>14,17,23</sup> Endotracheal tubes have high pressure and low volume *cuff*, being the pressure of the *cuff* essential in tube handling.<sup>24</sup> As changing positions during nursing care can modify this pressure, it should be measured after changing patient's position and adjusted to the recommended limits.<sup>21</sup>

Respiratory equipments used for oxygen delivery and airway management are responsible for the highest pressure injury rates related to medical devices in critically ill patients. Endotracheal tube is indispensable to protect the airway in mechanically ventilated critically ill patients,<sup>24</sup> but tight lacing can cause labial and auricular damage.<sup>25</sup> A study on nursing care implemented for the prevention of cutaneous-mucosal lesions associated with invasive devices in the lower airways drew attention to the distancing of nurses from direct care through clinical evaluation and interventions aimed at this public.<sup>26</sup>

Regarding care directed to the mechanical ventilator and circuit, routine circuit replacement is not recommended, only when dirty

or damaged. To ensure safe use of this device, its packaging is fundamental.<sup>22</sup> Monitoring and verifying the triggering of ventilator alarms are the nurse's care in assisting critical patients. An alarm is triggered whenever threshold parameters are exceeded, which requires nurses to adhere to good monitoring practices as well as to solve common monitor problems,<sup>27</sup> in order to prevent prolonged periods of inadequate ventilation.

Research conducted with nursing professionals from three ICUs identified that the majority (82.8%) always observed ventilator alarms and in case of activation of the alarms, 70.7% of them used to investigate the cause and 20.7% sought another professional.<sup>16</sup> Inattention to alarms can have serious consequences on the patient's clinical conditions, so triggering them should not be overlooked. Although extracted from studies with evidence levels IV and VI, ventilator and circuit care was considered as good practice.

Care related to the prevention of bronchoaspiration conceived in the present investigation as good nursing practice was identified in research<sup>17</sup> with scientific evidence level IIb, indicating clinical relevance. Thus, the headboard angulation should be maintained between 30° and 45°,<sup>17</sup> except in the case of contraindication. This care, ideal for mechanically ventilated patients<sup>28</sup> because it prevents PAMV and other ventilator-associated events, it is classified as a basic practice given its simplicity, minimal risk, costlessness and potential patient benefit.<sup>29</sup> Despite its easy application, adherence rates to this care vary widely, signaling the need for strategies to raise awareness among professionals about the importance of this measure in the composition of good practice sets.<sup>30</sup>

Of the precautions related to infection prevention, four stand out due to the study's level of evidence (IIb), from which were extracted: ventilator assembly with aseptic technique and protection of the Y-connection during opening of the system for aspiration; oral hygiene with chlorhexidine 0.12%; bronchial hygiene (aspiration) with aseptic technique after evaluations; and use of personal protective equipment during bronchial hygiene.<sup>14</sup>

Ventilator preparation with aseptic technique<sup>14</sup> and protection of distal tracheal connection in open aspiration are justified by the potential risk of contamination during the procedure.<sup>15</sup> Therefore, it is recommended that the ventilator circuits and the tracheas final connection be packed in the plastic bag that packed the circuit. Such care measures are relevant in the PAMV prevention, whose rates are high.<sup>22</sup>

Oral hygiene, one of the gold standard interventions in controlling oral cavity colonization, inhibits biofilm formation and thereby invasion of the airways by infection-causing microorganisms.<sup>16,22</sup> A care *bundle* to prevent PAMV included, among the care that needs from daily checking of nurses to oral hygiene with chlorhexidine solution every 8 hours.<sup>31</sup> Research in ICUs revealed that 84.5% of nursing professionals performed oral hygiene on patients every 8, 12 or 24 hours and that the use of 0.12% chlorhexidine solution was the most effective and non-aggressive method for the oral mucosa in mechanically ventilated patients.<sup>16</sup> In the

Emergency service, the set of good practices for the prevention of PAMV was evaluated and oral hygiene showed compliance below 50%, reflecting the insufficiency of material and human resources, as well as the overcrowding of patients in Emergency intensive care.<sup>9</sup> These data indicate the need for improvement, considering the relevance of oral hygiene in preventing infection, its low cost and ease of implementation.

Tongue hygiene, often neglected by professionals, should also be performed. Pathogens present in tracheal aspirate from intubated patients were detected in the lingual biofilm, especially in those with PAMV or aspiration pneumonia, suggesting that improving oral hygiene in MV patients may reduce pneumonia rates.<sup>32</sup> For the removal of dental plaque and other debris from the teeth, tongue and oral mucosa a *swab* or toothbrush with minimal water to reduce the volume of any aspirated material can be used.<sup>33</sup>

Tracheal intubation and immobility imposed on the patient by sedation reduce mucociliary transport and promote retention of airway secretions.<sup>34</sup> Also, the endotracheal tube facilitates bacterial colonization of the tracheobronchial tree and predisposes to aspiration of secretion contaminated by decreased cough reflex, accumulation of secretion above the ballonet (subglottic space) and by the contamination of the tube itself.<sup>22</sup> Therefore, an important nursing care for mechanically ventilated patients is the aspiration of endotracheal secretion, necessary to maintain a permeable airway and facilitate ventilation and consequent gas exchange.<sup>35</sup>

About this nursing care, selected by nurses as good practice, the literature highlights the need for nurses to evaluate the patient before aspiration, but also during and after the technique, through physical examination and monitoring,<sup>36</sup> in order to ensure a safe procedure. During aspiration should be evaluated: respiratory sounds, oxygen saturation (SpO<sub>2</sub>), skin coloration, respiratory rate (RR), breathing pattern, ventilatory parameters and hemodynamic variables (if monitored).<sup>37</sup>

For bronchial hygiene the closed or open suction system can be used.<sup>37</sup> Aspiration is recommended when the patient presents clinical signs of tracheal secretion such as the presence of snoring or decreased respiratory sounds upon pulmonary auscultation, and its routine performance is not indicated to prevent airway obstruction.<sup>38</sup> As for the technique itself, it should not exceed 15 seconds by aspiration,<sup>37,38</sup> suction pressure should not exceed negative 150 mmHg (ideal from negative 80 to 120 mmHg), and hyperoxygenation with 100% inspired oxygen fraction should be used.<sup>37</sup> In choosing the probe it must be taken into account that its diameter should not exceed half of the inner diameter of the endotracheal tube.<sup>37,38</sup>

Regarding the use of personal protective equipment (PPE) during the aspiration technique, it is recommended to use gloves, goggles, mask and apron by the professional,<sup>37</sup> care that deserves attention for its relevance in the prevention of healthcare-related infections. A study revealed that 95% of professionals used PPE when aspirating secretions from patients under invasive mechanical

ventilation, which indicates sensitization for compliance with the technique. However, the use of gloves during the procedure had a professionals' lower adherence (88.2%).<sup>35</sup> Attention should be drawn to the proper use of PPE by nurses, as it has as its private activity the aspiration of the airways in critically ill patients undergoing orotracheal intubation or tracheostomy, in emergency units, intensive hospitalization, semi-intensive care, intermediate or other assistance units, according to Resolution no. 557 of the Federal Council of Nursing.<sup>39</sup>

As for the use of 0.9% physiological solution or any other solution inside the tube during aspiration should be routinely avoided,<sup>37,40</sup> as side effects such as decreased oxygen saturation, patient agitation and increased volume of secretions were observed after saline instillation with aspiration. Although this care is not routinely recommended for its potential harm to patients, it is still performed by nurses and physiotherapists, so these professionals' education should focus on best practices regarding endotracheal tube suction.<sup>40</sup>

Regarding endotracheal tube care, it is noteworthy that washing the latex with distilled water or physiological solution and protecting it at the end of aspiration with clean and dry packaging are measures to prevent and control infection of the patient on mechanical ventilation. About cleaning the latex aspiration and protection system in clean and dry packaging after the procedure, a study developed with nurses revealed the adoption of this practice by over 92% of nursing professionals.<sup>20</sup>

Hand hygiene before and after manipulating the ventilation system was also selected by the nurses in this study as good care practice. Recommended and proven to impact on the prevention of health care-related respiratory infections, including PAMV, hand hygiene was present in almost half (47.8%) of identified *bundles* in a review study, although their adherence among professionals remains below expectations, compromising patient safety.<sup>30</sup>

To evaluate the sedation level of those who are under MV in the Hospital Emergency, the proposal, extracted from a study with evidence level VI, is to use scales such as Richmond Agitation-Sedation Scale (RASS), which should be used to adjust drug infusion to meet patient's clinical need, avoiding excess sedation and minimizing the risk of treatment-induced adverse effects.<sup>41</sup>

Research limitation is considered as not including studies with higher level of evidence, since systematic reviews and randomized clinical trials are the gold-standard for the application of care in practice.

## CONCLUSION AND IMPLICATIONS FOR THE PRACTICE

Care measures designed as good nursing practice for patients on invasive mechanical ventilation are related to endotracheal tube, mechanical ventilator and breathing circuit, prevention of bronchoaspiration, infection control and sedation, analgesia/sleep, wakefulness/pain. Care measures were extracted from studies

with levels of evidence IIb, IV and VI and scientifically support patient care in invasive ventilatory support and can be applied in similar contexts.

## AUTHORS' CONTRIBUTIONS

Study conception and design. Data collection, analysis and interpretation. Results discussion. Content writing and/or critical review. Article final version approval. Responsibility for all aspects of the content and integrity of the published article: Cleveson dos Santos. Eliane Regina Pereira do Nascimento. Patrícia Madalena Vieira Hermida. Data analysis and interpretation. Results discussion. Content writing and/or critical review. Article final version approval. Responsibility for all aspects of the content and integrity of the published article: Tatiana Gaffuri da Silva. Results interpretation. Results discussion. Content writing and/or critical review. Article final version approval. Responsibility for all aspects of the content and integrity of the published article: Sabrina Guterres da Silva Galetto. Nelson Junior Cardoso da Silva. Data analysis. Content writing and/or critical review. Article final version approval. Responsibility for all aspects of content and integrity of published article: Nádia Chiodelli Salum.

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