Nursing Interventions in the Prevention of Pressure Ulcers Associated with Medical Devices in Intensive Care: A Scoping Review

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Abstract. Pressure ulcers are a recurring problem in the hospital environment, directly related to the health status of individuals. In critically ill patients, admitted to intensive care units, these lesions often appear associated to the medical devices to which they are connected. The literature review concludes that, sometimes, nursing interventions to prevent these injuries are undervalued hence, associated with the risk factors of critically ill patients, it leads to an increase in the incidence of injuries. The present Scoping Review aimed to answer the research question, formulated according to the PCC acronym: "What are the nursing interventions for the prevention of pressure ulcers associated to medical devices in intensive care units?". The data search made in the MEDLINE and CINAHL databases, with inclusions criteria, allowed the identification of primary and secondary articles published between 2017 and 2022. The results of this secondary study show the medical devices that are most associated with pressure injuries in intensive care units are the nasogastric tube, the non-invasive ventilation face mask, the urinary catheter, the pulse oximeter, the electrocardiogram monitoring electrodes and venous catheters. Preventive measures include: nursing care in the fixation of medical devices; frequent repositioning of medical devices; protection and padding of body areas in contact with medical devices; replacement of rigid devices with flexible devices, when available; professional attention so that medical devices are not under patients; early assessment and removal of medical devices when clinically possible. It is concluded that as the incidence of this problem is an indicator of the quality and safety of health care, health institutions should implement policies to assess, prevent and treat it. There is a need to think of technological solutions that can reduce the risk and/or achieve the determination of skin changes suggestive of risk of injury.

Keywords: Nursing care · Prevention · Pressure ulcer · Intensive Care Unit

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1 Introduction

Pressure Ulcers (PU) are prevalent in healthcare, in part, due to the various factors that can lead to their origin, such as immobility, incontinence, skin characteristics, sensory perception and the client's state of consciousness [1]. People hospitalized in Intensive Care Units (ICU) are more susceptible to the appearance of this type of injury, because in addition to being connected to a wide variety of medical devices, they present risk factors related to the disease and state of health, which give them greater vulnerability [2, 3].

Studies indicate that pathophysiological events such as hypoxia, changes in hemodynamic stability and tissue perfusion, need to use vasopressor and inotropic drugs, associated with greater fragility and vulnerability, as well as possible tissue failure are the main cause of PU prevalence [1–4]. They also refer that all these criteria, in association with greater immobility of clients, administration of sedatives and intravenous analgesics, mechanical ventilation and the critical condition of the client, promote the risk factors for the development of PU [2–4].

Hospitalization of more than 10 days, greater number of medical devices used in the client, history of diabetes mellitus and kidney injury, hypercapnia, hypoxemia, hypotension, gastrointestinal hemorrhage, edema, parenteral nutrition, use of vasopressors and sedatives and low score on the Braden scale, due to sensory limitations, mobility and poor nutrition are identified as major causes of risk for people in ICU [5, 6].

Some of the PUs are associated with medical devices and a study observes a prevalence of 0% and 33% in the 30 hospitals where the investigation took place [5]. Contrary to what one might think, medical devices do not only cause category I or II injuries, they are also associated with deep tissue injuries (III and IV) and those of an indeterminable degree [1, 5]. The most affected areas of the body are the fingers, nose, mouth and lips, cheeks and legs [5].

Regarding medical devices, oximeters, endotracheal tubes, nasogastric tubes, CPAP and BiPAP masks, high-flow nasal cannulas, bone traction devices, chest tubes, thromboprophylactic stockings and urinary catheters are those that are mostly responsible for these lesions [5–8]. The odds of developing PU associated with medical devices increase by 5% per day of ICU stay and 23% for each device present in that person [7].

The the European Pressure Ulcer Advisory Panel, National Pressure Ulcer Advisory Panel and the Pan Pacific Pressure Injury guidelines recognize the risk of injury to people with medical devices and recommend that nursing care integrate interventions to mitigate or eliminate the risk and increase the safety of patients. Most vulnerable people [9].

In view of the above, the objective of this study is to identify nursing interventions for the prevention of pressure ulcers associated to medical devices in intensive care units.

2 Method

In view of the objective of the study and after a first review of the literature to identify literature on the topic, a scoping review was chosen to determine the existing evidence on a given topic, regardless of the type of evidence and its quality [10–13]. This type of systematic review is useful because of its broad nature, as it aims to provide a map of the evidence that has been produced on a topic [10, 13].

The research question, formulated according to the PCC acronym is: "What are the nursing interventions for the prevention of pressure ulcers associated to medical devices in intensive care units?". Being "P" the Population, "C" the Concept and "C" the Context [10, 13]. For the present scoping review, the following eligibility criteria were defined for the studies of the bibliographic sample: Population: adults and elderly people hospitalized in ICU, connected to medical devices; Concept: nursing interventions to prevent PU associated with the same devices and Context: ICU. The following were defined as exclusion criteria: studies addressing a pediatric population (under 18 years of age); adult and elderly population who are hospitalized in ICU, but who do not have medical devices; nursing interventions other than prevention of PU associated with medical devices; opinion articles and addressing contexts such as: inpatient services, emergency services, community services and residential structures for the elderly.

In order to carry out the literature search, terms in natural and indexed language were used (MeSH (Medical Subject Headings) terms for the Medline search and the Subject Headings for CINAHAL).

The research was carried out in June 2022 with the help of the Boolean operators "OR" and "AND". The query built for use in the aforementioned databases was [(elder* OR age* OR old* OR older person OR older adult OR frail older adult OR frail older adults OR adult OR young adult NOT adolescent NOT children NOT neonatal) AND (nursing prevention intervention OR nursing preventive care OR nurs*) AND (pressure ulcer OR pressure ulcers OR pressure ulcer* OR pressure injury OR pressure sore* OR pressure damage OR decubits ulcer OR MDRPU OR medical device-related pressure ulcers) AND (technology OR devices OR equipment OR material OR tools OR medical devices OR medical equipment OR medical tools OR medical technology OR medical device related OR device-related OR medical device OR equipment and supplies) AND (intensive care unit OR intensive care OR intensive medicine unit OR critical care OR critical patient OR ICU NOT neonatal intensive care NOT pediatric intensive care)].

Articles that have full text available were also defined as inclusion criteria; primary and secondary articles; dated between 2017 and 2022, written in Portuguese, Spanish or English.

After identifying the articles that answered the research question and met the inclusion criteria, a search was carried out on Google Scholar and repositories of reference in the area for the identification of guidelines and gray literature on the subject.

The screening process of the articles was carried out by 2 researchers, independently, and the non-conformities were evaluated by a third reviewer [10]. To extract the content of the articles, a table was created in which the following was recorded: identification of the article; authorship, year and type of publication; method and main results/conclusions. The results of the articles that allowed answering the research question were extracted and submitted to narrative synthesis.

3 Results

The first search carried out resulted in 533 articles. After applying the inclusion criteria, 130 articles were obtained. Subsequently, the titles of the articles obtained were read, and 114 articles were excluded. 16 articles were read in full and 4 were included that answered the research question.

The articles included by abstract and full reading were essentially incidence and prevalence studies, etiology studies and economic studies.

The search in the gray literature allowed the identification of 37 articles, but only 2 answered the research question.

To facilitate the understanding of the research carried out and the results obtained after the inclusion and exclusion criteria, a Prisma Flow Diagram was prepared (Fig. 1), presented below.

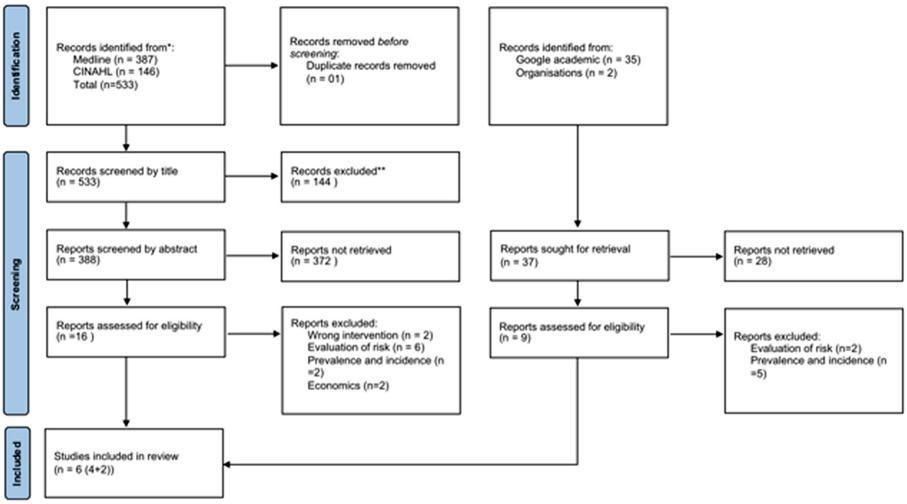

Fig. 1. PRISMA ScR. Lisbon, 2022.

The 6 studies comprising the bibliographic sample were published between 2019 [14–16] and 2022 [19], 4 were carried out in Brazil [14, 16–18], one in the USA [15] and another in the United Kingdom [19]. The study designs are heterogeneous (Table 1) but allow to answer the study question.

Table 1. Studies constituting the bibliographic sample. Lisbon, 2022.

Article/year/country	Type of Study	Objectives	Results
[14] 2019 Brazil	Integrative literature review	To identify and analyze the scientific evidence regarding the occurrence of Medical Device-Related Pressure Injuries, considering the development sites; and to describe the devices of risk and the measures of prevention and treatment	Overall measures to prevent and treat MDRIs included periodic skin assessment, repositioning of devices and use of dressings to reduce shear force. Consider the application of dressings that promote pressure redistribution and absorb body moisture in areas in contact with medical devices and fixers; apply dressings below medical devices, lift and/or move the device often to examine the skin below it and reposition for pressure relief. When repositioning does not relieve pressure, it is important not to create more pressure by placing tight bandages under and over the devices
[15] 2019 USA	Organization's process improvement model	To decrease the incidence of nasogastric tube-related hospital-acquired pressure injury	The team implemented guidelines using the simple mnemonic "CLEAN": correct tube position, stabilize tube, evaluate area under/near tube, alleviate pressure, note date and time The incidence rate of nasogastric tube-related hospital-acquired pressure injury (0.13 per 1000 patient days in 2015) decreased 100% (0.0 per 1000 patient days in 2016) after the guidelines were implemented in the organization

(*continued*)

Table 1. (*continued*)

Article/year/country	Type of Study	Objectives	Results
[16] 2021 Brazil	Descriptive and qualitative study	Understand the care implemented by the nursing team for the prevention of PU associated with medical devices in critically ill patients	Nursing care in the fixation of devices; frequent repositioning of the clients; protection and padding of body areas in contact with the devices; substitution of rigid materials for flexible materials, when possible; professionals' attention so that the devices are not under the clients; assessment and early removal of devices when clinically possible
[17] 2021 Brazil	observational, prospective, quantitative field study	To assess the occurrence of Medical Device-Related Pressure Injury (MDRPI) in an adult ICU	Among the main preventive measures, it was observed the application of gauzes on pressure points caused by respiratory devices and treatment measures such as decompression, repositioning of the device above the lesion and application of dressings for wound evolution
[18] 2021 Brazil	Delphi	Develop and validate a bundle for the prevention of pressure injuries related to medical devices in critically ill adult patients	21 priority care listed by the experts for the prevention of MDPRI are presented. This care involves handling the device, mucosal skin integrity, nutrition and mobilization of the person
[19] 2022 UK	Observational	To explore medical-device related pressure ulcers (MDRPU) in an intensive care unit (ICU) at the Royal United Hospitals Bath NHS Foundation Trust (RUH)	Measures focused on skin checking, offloading and rotation of devices, including endotracheal tubes, non-invasive ventilation, nasogastric (NG) and nasojejunal (NJ) tubes and catheters. A specific comfort and pressure care record was developed for ICU to record the assessments of these at-risk areas

The content analysis of the articles in this ScR allows us to observe that preventive measures for PU associated with medical devices include nursing care in fixing medical devices [14–19]. There is a need for planning by the interprofessional team to carefully choose the appropriate material for fixing the device [18]; if possible, replacing rigid devices with flexible devices, when available [16]; maintenance and fixation of the devices on the skin with suitable material, if necessary use devices and materials that prevent friction [14, 16, 18] or the protection and padding of body areas in contact with medical devices [16], consider the application of dressings that promote pressure redistribution and absorb body moisture in areas in contact with medical devices and fixers [14]. The positioning of the devices must be done anatomically [18], ensuring that they are not under the patients [16].

The authors recommend systematic skin assessment [14, 16, 18, 19]; with the removal of the fixation to assess the skin and early identification of possible pressure zones [16, 19]. The repositioning and/or alternation of the device insertion and fixation site [14, 16–19] are important to avoid pressure. When repositioning does not relieve pressure, it is important not to create more pressure by placing tight bandages under and over the devices [14]. In the event of erythema, reposition the device elsewhere [17].

Hygiene care and maintenance of skin hydration under and around the devices [14, 18] should be guaranteed, as well as monitoring hydration and nutrition [18].

The team should evaluate and consider early removal of devices, when clinically possible [16, 18]; draw up accurate records [18] that may include an instrument for assessing the risk of pressure associated with the presence of the devices [19].

To control this problem it is necessary to train the team [15, 16], and involve everyone. One of the studies presents a mnemonic to aid the intervention - "CLEAN": correct tube position, stabilize tube, evaluate area under/near tube, alleviate pressure, note date and time [15] which in a creative and easy form demonstrated the promotion of team adherence to the introduction of preventive measures.

4 Discussion

In the ICU, patients have one or more medical support or intervention devices (for monitoring, respiratory support or feeding) [1–4, 16] which in themselves increase the risk of PU. For example, inadequate fixation of the nasogastric tube around the nostril quickly leads to tissue ischemia, leading to lesion formation [16].

The preventive measures identified in this ScR are in line with the recommendations of the European Pressure Ulcer Advisory Panel, National Pressure Ulcer Advisory Panel and the Pan Pacific Pressure Injury [9] namely the evaluation and selection of the device according to its ability to reduce damage, shape and size suitable for the individual and correct use and fixation of the devices; regular monitoring of the device clamping tension and the comfort of the person; frequent assessment of the skin under and around the device (looking for signs of PU); regular repositioning of the medical device avoiding pressure and twisting of the same; removal of devices as early as possible; placement of prophylactic dressings under medical devices [9].

It should be noted that despite being a common problem, with high economic translations [20, 21], organizations are not fully aware of its resolution. This statement is

supported by the fact that in many hospitals the devices and materials available are more rigid, which provides less comfort to the client and increases the probability of PU [16]. One of the sample studies presents as an example of this, the NIV face masks, which, if they were more malleable and, therefore, slightly more comfortable, would not cause so much pressure on the skin [16].

Some materials such as electrode cables, probes, tubes and caps are inadvertently left under the clients, by health professionals [16], either because of the workload, or because of the devaluation of the risk they pose to skin integrity. In preventive terms, this issue is an alert to the need to form multidisciplinary teams and develop strategies to increase the adherence of professionals to preventive measures [22, 23]. Different studies that aimed to assess pressure ulcer prevention practice among nurses revealed that PU prevention practice was not adequate [24, 25], which justifies the investment in training in the work context and in the training of nurses for the systematic introduction of preventive measures in the clinical practice [22].

A recent study conducted in China aimed to describe the level of Chinese ICU nurses' knowledge, attitudes, and self-reported practices of PI prevention concluded that mean scores of participants' knowledge, attitude, and their self-report practice were 65.82 ± 9.29, 76.65 ± 8.62, and 83.35 ± 13.55, respectively [26], which leads the authors to recommend that nursing administrators explore strategies to guarantee nurses' participation and to improve training quality in order to increase training effectiveness in the future [26].

In addition to training professionals, the development of acronyms [15] or algorithms [27] can enhance the intervention of the team to solve this problem. A study aimed at developing and testing the effectiveness of an algorithm to prevent medical device–related pressure injuries in intensive care unit patients concluded that it was an effective and safe intervention that can contribute to providing a higher quality of nursing care [27].

It is recommended that future studies combine training interventions and cognitive-behavioral strategies to increase professionals' adherence to PU prevention.This ScR has limitations associated with access restrictions to the full text, in open access and in Portuguese, English and Spanish, which may have conditioned the non-inclusion of studies that answered the question. Furthermore, the assessment of the quality of the evidence was not carried out. Despite these limitations, we consider that the results are valid to be implemented in the clinical practice of nurses in intensive care, contributing to the mitigation of the incidence and prevalence of PU associated to medical devices.

5 Conclusions

Interventions for the prevention of PU associated with medical devices are clearly autonomous interventions by nurses and are based on simple, cost-effective and safe care for patients, such as: correct fixation of medical devices, frequent repositioning, protection of body areas in contact with devices, the substitution of rigid materials for flexible ones, avoidance of excessive pressure that the devices can cause and the evaluation and removal of the same as early as possible.

The curricula of nursing courses must include content related to this type of PU and organizations must invest in continuing education. As it is an indicator of the quality of nursing care and an important factor in the quality of life of clients, this need is even greater.

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