

## Recent Advances in the Prevention and Management of Pressure Ulcers in ICU Patients

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### Abstract

**Introduction:** Skin injury or ulceration as a result of pressure and shear forces is being increasingly viewed as an indicator of the quality of care given to patients. Therefore, the testing of strategies to prevent the development of hospital-acquired pressure ulcers (HAPUs) is of growing interest in all healthcare settings. Nevertheless, pressure ulcers (PUs) remain a common problem in health care settings, especially in intensive care units (ICUs). Interventions for prevention and treatment of PUs are addressed in sections covering nutrition, repositioning and early mobilization, repositioning to prevent heel PUs, support surfaces, medical device management, and recommendations for special populations such as bariatric, critically ill, older adult, with spinal cord injury, pediatric, and in the operating room.

**Aim of Work:** In this review, we will discuss the recent advances in the prevention and management of pressure ulcers in ICU patients.

**Methodology:** We did a systematic search for Recent advances in the prevention and management of pressure ulcers in ICU patients using PubMed search engine and Google Scholar search engine. All relevant studies were retrieved and discussed.

**Conclusions:** This study investigated different strategies used to assess and prevent against HAPUs in ICU patients. A meta-analysis of this review suggest the positive effect of silicon foam dressing. However, the study have many limitations such as the use of various staging systems, the small sample size, the lack of randomization, the use of many heterogeneous studies and the compliance to the intervention techniques. Thus, we cannot suggest a conclusion about the effectiveness of one prevention technique over another. Further studies with more standardized criteria are required, including a standard definition and staging system of PUs, measurement of the compliance to the technique of prevention and recruiting a sample of a proper size. This will lead to trails with more generalizable and reliable results which can be to different patients, populations and settings.

**Keywords:** Pressure Ulcer; Ulcers; ICU

## Introduction

Skin injury or ulceration as a result of pressure and shear forces is being increasingly viewed as an indicator of the quality of care given to patients. Therefore, the testing of strategies to prevent the development of hospital-acquired pressure ulcers (HAPUs) is of growing interest in all healthcare settings. Nevertheless, pressure ulcers (PUs) remain a common problem in health care settings [1], especially in intensive care units (ICUs), with approximately 22% - 49% of critically ill patients affected [1]. The development of PUs is a complex process, dependent on a wide variety of extrinsic and intrinsic risk factors [2].

Various strategies have been examined in the prevention of PUs with different methodological approaches and in different clinical settings [3]. These studies aimed to inform the clinical decision making of healthcare workers of the best predictors and prevention strategies for HAPUs. However, these studies have limitations such as lack of uniformity in defining and staging of HAPUs and study power. It is argued that providing concise summaries of the supporting evidence, in terms of a systematic review, increases healthcare practitioners' satisfaction with, acceptance of, and level of implementation of specific strategies [4]. The National Pressure Ulcer Advisory Panel (NPUAP), the European Pressure Ulcer Advisory Panel (EPUAP), and the Pan Pacific Pressure Injury Alliance (PPPIA) collaborated to produce a comprehensive guideline that provides brief summaries of evidence-based recommendations for the prevention and treatment of HAPUs. The NPUAP, EPUAP, and PPPIA guideline is framed in two sections: prevention of PUs and interventions for prevention and treatment. Prevention is summarized through the topics of risk factors and the use of a risk assessment scale (RAS), skin and tissue assessment and preventive skin care. Interventions for prevention and treatment of PUs are addressed in sections covering nutrition, repositioning and early mobilization, repositioning to prevent heel PUs, support surfaces, medical device management, and recommendations for special populations such as bariatric, critically ill, older adult, with spinal cord injury, pediatric, and in the operating room.

Although the intensive care critically ill patient population was acknowledged in this international guideline, this document failed to address PU prevention in ICU from a strong evidence-based perspective. This is significant as ICU patients present the highest risk of HAPU development. To date, most systematic reviews have investigated the effectiveness of prevention strategies in general ward or healthcare settings. Because there are significant differences in patient acuity and diagnoses, care provided and environmental factors between ICU and general wards or units, it is inappropriate to extrapolate general care-related results to the intensive care setting. Further, no review of PU prevention strategies in ICU has been conducted since 2000 [5]. There is evidence that PU prevention is more effective with multiple prevention strategies. However, many studies employ a single intervention measured against standard care. Therefore, this systematic review examined the effectiveness of single prevention strategies on HAPUs in ICU patients with the goal of gathering scientific evidence to support or refute the benefit of using such strategies for critically ill patients. In this review, we will discuss the recent advances in the prevention and management of pressure ulcers in ICU patients.

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## Methodology

We did a systematic search for Recent advances in the prevention and management of pressure ulcers in ICU patients using PubMed search engine (<http://www.ncbi.nlm.nih.gov/>) and Google Scholar search engine (<https://scholar.google.com>). All relevant studies were retrieved and discussed. We only included full articles.

The terms used in the search were: pressure ulcer, ulcers, ICU.

## Prevention and management of pressure ulcers in ICU patients

The findings of this study were divided into two main sections: the ways to prevent pressure ulcers, and methods of treatment. We used the NPUAP, EPUAP, and PPPIA guideline to report the results (2014). When searching the recent literature, no studies assessed the

role of RASs in lowering the incidence of HAPUs in ICU patients. In 2012 [6] studied the efficacy the techniques used in the management of fecal incontinence in lowering the incidence of PU. Three strategies were compared with no significant effect on the incidence of HAPUs between the three groups [7] studied the effect of polarized light in preventing HAPUs in the sacral area and heels, he reported no effect on the development of PUs in all stages, after excluding stage I PUs, the incidence of HAPUs was reported to be significant lower. The effect of using silicone foam dressings on the incidence of HAPUs in the sacral area was investigated in three studies [8], with 0.12 overall decrease in size (95% CI: 0.05 - 0.29;  $p < .001$ ). Theilla., et al. [9] studied the effect of special nutritional strategies on the incidence of HAPUs in critical acute lung injuries patients, reporting reduction in the incidence of HAPU. However, the result were a little biased as the control group had more patient with Pus, so they were more liable to develop subsequent PUs.

Regarding the effect of 2-hour repositioning intervals on the incidence of HAPUs, Behrendt., et al. [3] investigated the effect of continuous bed pressure mapping (CBPM) with a 2-hour repositioning system, reporting significant difference in the incidence of second stage or greater HAPUs. The CBPM contains a special unit that sense and control the pressure in the mate and allow to monitor it using digitally generated images. This mat monitors and measures the levels of pressure on the whole body reminding the caregivers to reposition the patient every two hours. Still., et al. [10] investigated the strategy of switching teams composed of two trained caregivers reporting significant improvement in HAPUs incidence. However, the compliance of the team to the strategy, the preexisting prevention methods, and the duration of time to reach peak interface pressure were not reported. Manzano., et al. [11] conducted a cluster RCT study studying the effectiveness repositioning the patient (every two vs. four hours) in patients on mechanical ventilator managed with alternating pressure mattresses and with no effect on the incidence of HAPUs.

Multiple studies investigated the effect of patient positioning techniques. Van Nieuwenhoven., et al. [12] compared the effect of 28° backrest elevation versus 10° elevation in patients with semi-recumbent position and reported no differences in HAPUs incidence between each position groups (28% vs. 30% respectively). Schallom., et al. [13] compared the difference of 45°backrest elevation versus 30° elevation reporting no HAPUs developed for both groups. Girard., et al. [14] compared the prone and supine position regarding HAPUs incidence suggesting significantly higher HAPU incidence with prone position compared to a supine position in the first 7 days of patient admission. However, the frequency of patient repositioning, and the angle of lower part of the body, and the use of additional PU prevention strategies was not mentioned in the last 3 studies..

Upon searching the literature, no studies regarding repositioning the patient out of bed, what type of seats is better, the frequency and or duration of sitting out of bed and heel repositioning in ICU patients.

Two studies investigated the effect of using an active alternating pressure mattresses on the prevention of PU in ICU patients compared to mattress overlay. Malbrain., et al. [15] reported no difference between the two support surfaces regarding HAPUs incidence. In contrast, Manzano., et al. [11] reported that alternating pressure mattress was associated with lower incidence of stage II HAPUs or greater, compared to foam overlay mattress. Theaker., et al. [16] studied retrospectively the effect of alternating pressure mattresses compared to a low air loss mattress in ICU and reported no significant difference. The low air loss with microclimate management bed (LAL-MCM) was associated with significantly decreased of HAPUs compared to IP-AR [17]..

Jackson., et al. [18] reported that using a bed with the air fluidized mattress decreased HAPUs incidence in cardiothoracic ICU patients (40% pre- vs. 15% post-implementation). Recently, Ozyurek and Yavuz [19] investigated the effect of two viscoelastic mattresses; composed of two layers versus three layers, with no significant differences in HAPUS incidence..

A study in 2013 investigated the effectiveness urinary meatus HAPUs prevention strategies in the critical male patients [20] evaluating various techniques of intervention compared to washing the area around the catheter entry point once daily. The standard once a day washing method was associated with no difference in the incidence catheter-related PUs. While it was significantly decreased using the three times daily washing method.

Gregoretti, *et al.* [21] investigated the effect of using a prototype face masks (PMs) compared to conventional face masks (CMs) in reducing device-related PUs and reported significant improvement in device-related PUs. Weng, *et al.* [22] studied the effect of various protective dressings (hydrocolloid, and transparent film) with CM to prevent device-related PU, he reported a significant difference in the incidence of device-related Pus, but no difference in occurrence time was reported. Alali, *et al.* [23] examined with a retrospective study the effect of the timing of performing tracheostomy in patients with traumatic brain injury on HAPUs incidence in ICU, reporting that early tracheostomy (8 days of the patient's admission) was associated with lower incidence of HAPUs.

Uzun, *et al.* [24] found that increasing the awareness and understanding of PU prevention strategies for ICU nurses through two 2-hour seminars, was significant associated with reduction HAPUs incidence.

Due to small underpowered sample sizes with wide CIs some degree of uncertainty in interpretation of results of the found studies exists [7,13,15,16,18,21]. No evidence was found that the use of an RAS, was associated with reduction in PUs incidence in ICU. Tayyib, *et al.* [2] recommended developing a special RAS for ICU units, as the common RASs usually fails in recognizing higher risk patients in ICU. No study have ever assessed the association between risk and skin assessment and the development of PU, as risk and skin assessment cannot be considered a standalone event, nor an intervention. However, most guidelines recommend it to be involved in study protocols in order to identify high risk patients and implement the appropriate strategies..

In order to determine the right strategy to use with specific patient's condition (e.g. sepsis, hypotension, and multi-organ failure). The amount of evidence gathered was not enough to determine the best strategy to control fecal incontinence and keep the patients' skin clean and appropriately dry in order to decrease the development of HAPU, especially in the sacral area of ICU patients. In order to develop effective skin-care strategies, further studies are needed on how to manage the moisture, hygiene, hydration, and the pH of the skin.

When studying the effectiveness of positioning the patient and the angles of the backrest on preventing HAPUs. Supine position was found to be associated with the lowest interface pressure [25]. The standard method in preventing PU is repositioning the patient frequently every two hours [3], found it to be associated with lower incidence of HAPUs. According to [26] ICU patients are usually repositioned within an average period of 4.85 hours. However, the repositioning the patient every 4 hours using an alternating pressure air mattress was associated with similar effect on HAPUs, which suggest that the techniques of turning the patient, repositioning and using a support-surfaces may all interact with each other to give the best effect on HAPUs n.

In this review, after comparing various types of support surfaces, we were not able to determine the best support surfaces due to many reasons such as small sample sizes, variety of support surfaces, and ineffective use of PU staging strategies [11,15-19]. Further studies are required in order to detect the best surfaces in reducing the incidence of HAPU in ICU patients. Moreover, many techniques used to prevent PUs were studied and showed positive effect in preventing HAPUs; such as a diet with high protein and multivitamins intake, the use of polarized light over the susceptible areas, different timing to perform a tracheostomy, and training the caregivers and raise their awareness regarding the prevention techniques. However, further research is required to validate these finding.

Areas associated with the use of medical devices like the face, neck and thigh have a greater risk of developing pressure ulcers. The efficacy of using various devices and dressing materials, cleaning the device areas and changing the devices positioning in reducing PUs incidence was assessed by many trials, with no reliable results as the small sample size affected the reliability of the outcome.

When studying the effect of using silicon border foam dressings it was associated with less pressure ulcers in the heels and the sacral area. Same results were suggested by a meta-analysis, reporting lower incidence of sacral PUs. More studies are needed in order to find the best prevention strategy against heel PUs.

Most studies use various tools to assess the severity of PUs. Moreover, they do not assess the compliance of the caregivers to the studied technique itself or to any different prevention technique. This could affect the reliability of the results. Therefore, it is important to standardize the tools used in the assessment of severity, and monitoring the compliance of the caregivers, in order to develop better, more effective guidelines.

### Conclusion

This study investigated different strategies used to assess and prevent against HAPUs in ICU patients. A meta-analysis of this review suggest the positive effect of silicon foam dressing. However, the study have many limitations such as the use of various staging systems, the small sample size, the lack of randomization, the use of many heterogeneous studies and the compliance to the intervention techniques. Thus, we cannot suggest a conclusion about the effectiveness of one prevention technique over another. Further studies with more standardized criteria are required, including a standard definition and staging system of PUs, measurement of the compliance to the technique of prevention and recruiting a sample of a proper size. This will lead to trails with more generalizable and reliable results which can be to different patients, populations and settings.

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