

LASTING LEGACY IN INTENSIVE CARE MEDICINE



Preventing pressure injuries among patients in the intensive care unit: insights gained

Fiona Coyer^{1,2*} , Sonia Labeau^{3,4} and Stijn Blot^{5,6}

© 2022 The Author(s)

Why, in the first quarter of the twenty-first century, do pressure injuries (PIs) remain a perennial problem for patients admitted in the intensive care unit (ICU)? PIs are associated with substantial morbidity, thereby burdening the patient and the healthcare system through pain, emotional distress, recovery, and prolonged hospitalization [1]. ICU patients have one of the highest incidence and prevalence rates of PI as they often combine a high index of acute illness with underlying conditions (e.g., chronic obstructive pulmonary disease) facilitating skin breakdown [2, 3]. ICU patients have a nearly fourfold higher risk for hospital-acquired PI compared to non-ICU patients [4]. International data from 1117 ICUs in 90 countries highlighted an ICU-acquired PI prevalence of 16.2% (95% confidence interval [CI], 15.6–16.8) [5]. Compared with countries with a high-income economy, the prevalence of ICU-acquired PIs appears higher in low- and lower-middle-income economies (odds ratio 1.8, 95% CI 1–3.3) [5]. Nearly one-third of all PI occur on the sacrum and heels [2, 5]. Device-related PIs accounts for up to 74% of all reported ICU-acquired PIs [6]. Albeit that generic PI risk scores have demonstrated their value in non-ICU populations, prediction of ICU-acquired PIs remains challenging because of variations in heterogeneity, and the determinative importance of local case-mix, and organizational factors [7, 8]. Anyhow, ICU-specific risk factors often include aspects of organ support such as vasopressor use, mechanical ventilation, and renal

replacement therapy [5]. Therefore, ICU patients represent a unique population where the risk for PIs is arguably different in many ways from other patient groups.

Knowledge gains and prevention improvements

PI preventative strategies have a solid base and, with knowledge gained, the arsenal of preventative measures is growing. However, most of these insights are derived from studies outside the ICU [1]. Therefore, their value in high-risk ICU patients remain often uncertain. Nevertheless, there are two areas where advances in ICU-acquired PI prevention have been made: continuous bedside pressure mapping (CBPM) [9, 10] and prophylactic dressing use [11, 12].

Reducing the pressure at the interface between the body and the support surface (mattress) is a cogent clinical intervention to reduce PI development [1]. CBPM uses a pressure sensing mat integrated into the support surface and connected to a visual three-dimensional computer display at the patient's bedside of a full-body graphic pressure image using colors and analysis of peak pressures. Clinicians can use the image as a guide to adjust the patient's position to reduce pressure. Data from CBPM can guide individualized timing of repositioning, adherence to a repositioning schedule, and the effectiveness of off-loading measures. Repositioning should aim for maximal off-loading of all bony prominences and redistribution of pressure [1]. However, as patients may be hemodynamically unstable and potentially unable to be repositioned, CBPM may assist clinicians in making incremental position changes or micro-shifts to decrease areas of high pressure.

CBPM has been shown to assist in PI prevention. Reports from a randomized trial showed a reduced ICU-acquired PI rate with use of CBPM [9]. Similarly, following the introduction of CBPM, another study showed a reduction in not only the number of ICU-acquired PIs

*Correspondence: f.coyer@qut.edu.au

¹ School of Nursing, Queensland University of Technology and Intensive Care Services, Royal Brisbane and Women's Hospital, Butterfield St, Herston, QLD 4021, Australia

Full author information is available at the end of the article

but also the severity of PIs resulting in significant cost savings [10].

Pressure mapping does have some shortcomings, including variations in the reporting and display of pressures, and differences in measurable peak pressures among manufacturers. Still, the CBPM visual display provides data that can augment the assessment of the anatomical areas of potential tissue damage. Pressure alone is not a reliable indicator of risk for skin breakdown as pressure is not the only risk factor. Interface peak pressures of comparable values will result in different tissue loads in different individuals depending on individual body morphology. However, the cost of CBPM can be difficult to justify in resource-limited countries, thus contributing to a lack of uptake. In these circumstances, regular repositioning and use of alternating pressure air mattresses are recommended [1].

A second area where progress have been achieved is the application of prophylactic dressings. This strategy, a supplement standard PI prevention approach, has gained considerable momentum as acknowledged in the current guidelines [1]. Dressings, such as foams, films and hydrocolloids, when applied to skin surfaces provide a cushioning layer between the support surface and the skin. This is postulated to redistribute pressure and shear, and potentially reduce excessive skin moisture thereby lowering PI risk [1, 11]. Multilayer dressings may reduce sheer and compression forces by horizontal transposition of

the dressing layers relative to each other and a sufficiently large dressing allows the transmission of shear forces to a wider area away from the anatomical area of interest.

A systematic review of the effectiveness of prophylactic sacral dressings to prevent PIs, included six studies that all compared the intervention to standard care [10]. However, four of the six studies were conducted on one dressing type. Moderate effectiveness of prophylactic dressings was reported with an overall relative risk indicating that prophylactic dressings reduced sacral PI risk by 83% in the subgroup of patients in the ICU [12]. Prophylactic dressings may also be potentially cost-effective where 22 patients reportedly need to be treated to prevent one PI [12]. Importantly, the superiority of one dressing over another remains unproven [1, 12].

This intervention was widely accepted during the coronavirus disease 2019 (COVID-19) pandemic where patients were prone for prolonged periods [13, 14]. One quality improvement report described the effectiveness of prophylactic dressings in preventing facial PI among prone patients where 17 of 25 patients in the no dressing group developed a PI compared to 6 of 24 patients in the dressing group ($p=0.003$) [15]. Prophylactic dressings remain an adjunct to PI prevention strategies. The application of an adhesive dressing to an at-risk part of the anatomy does not mean that visual skin inspections should occur less frequently. Regular visual skin inspection is a key component of PI prevention [1].




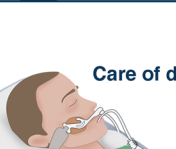


Practical suggestion	Rationale
 <p>Avoiding pressure is the foundation</p>	<p>PI cannot develop in the absence of pressure. Routine monitoring by either clinical observation or continuous pressure monitoring device is the key</p>
 <p>Regular skin assessment</p>	<p>Physical examination of the patient's skin is essential to PI prevention, diagnosis and treatment. Skin assessment should be performed regularly, at least once per shift, and more often as required</p>
 <p>Skin hygiene</p>	<p>Use a cleansing agent that is pH neutral. Do not vigorously rub or massage the patient's skin. Keep the skin clean and dry. Apply a fragrance-free moisturiser as required</p>
 <p>Care of devices</p>	<p>Devices, such as endotracheal tubes, nasogastric tubes and indwelling urinary catheters, should be sized appropriately. The skin and tissue under and around the device should be assessed regularly, at least every 4h. Reposition the device regularly. Consider applying a prophylactic dressing to the skin under the device to redistribute pressure and a barrier cream to the skin under the device to create a protective physical barrier from moisture. Regularly re-evaluate the need for the device</p>
 <p>Repositioning</p>	<p>Consider the most appropriate support surface for the patient. Current evidence is conflicted regarding different repositioning frequencies. Positions and repositioning frequencies will vary dependent on the type of matters (dynamic versus static), the patient's medical condition and hemodynamic stability. Always check the positioning of the bony prominences. Heels should be suspended off the bed</p>
 <p>Apply dressing to skin areas at risk</p>	<p>Consider the use of a dressing applied to skin areas at risk of increased bodyweight forces such as the sacrum and heels, or pressure from medical devices</p>

Fig. 1 Practical suggestions for pressure injury prevention

Practical suggestions for clinicians

There are valuable lessons to be learned from understanding knowledge gains in PI prevention. All ICU patients are at high risk for PI development with some being at very high risk. Figure 1 presents six practical approaches to alleviate PI development. However, we posit that using these strategies as a bundle may evidence greater effect.

Take-home message

PIs remain a constant problem for ICU patients due to their multiple risk factors and the nature of their critical illness. Although knowledge has been gained in the use of prophylactic skin dressings and CBPM, further work is needed to address different dressings, dressings in head-to-head trials, and interventions to improve repositioning.

Author details

¹ School of Nursing, Queensland University of Technology and Intensive Care Services, Royal Brisbane and Women's Hospital, Butterfield St, Herston, QLD 4021, Australia. ² Institute for Skin Integrity and Infection Prevention, University of Huddersfield, Huddersfield, UK. ³ School of Healthcare, Nurse Education Programme, HOGENT University of Applied Sciences and Arts, Ghent, Belgium. ⁴ Education Office, HOGENT University of Applied Sciences and Arts, Ghent, Belgium. ⁵ Department of Internal Medicine and Pediatrics, Ghent University, Ghent, Belgium. ⁶ UQ Centre for Clinical Research (UQCCR), Faculty of Medicine, The University of Queensland, Brisbane, Australia.

Funding

Open Access funding enabled and organized by CAUL and its Member Institutions.

Declarations

Conflicts of interest

FC holds a consultancy for Molnlycke Pty LTD. Molnlycke had no input into the inception, development or writing of this manuscript. SL, SB: no conflict of interest.

Open Access

This article is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, which permits any non-commercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc/4.0/>.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Received: 20 June 2022 Accepted: 20 July 2022

Published online: 22 August 2022

References

1. European Pressure Ulcer Advisory Panel (EPUAP), National Pressure Injury Advisory Panel (NPIAP) and Pan Pacific Pressure Injury Alliance (PPPIA) (2019) Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline. EPUAP
2. Chaboyer WP, Thalib L, Harbeck EL, Coyer FM, Blot S, Bull CF et al (2018) Incidence and prevalence of pressure injuries in adult intensive care patients: a systematic review and meta-analysis. *Crit Care Med* 46:e1074–e1081
3. Martin-Loeches I, Rose L, Afonso E, Benbenishty J, Blackwood B, Boulanger C et al (2022) Epidemiology and outcome of pressure injuries in critically ill patients with chronic obstructive pulmonary disease: a propensity score adjusted analysis. *Int J Nurs Stud* 129:104222. <https://doi.org/10.1016/j.ijnurstu.2022.104222>
4. Coyer F, Miles S, Gosley S, Fulbrook P, Sketcher-Baker K, Cook JL et al (2017) Pressure injury prevalence in intensive care versus non-intensive care patients: a state-wide comparison. *Aust Crit Care* 30:244–250
5. Labeau SO, Afonso E, Benbenishty J, Blackwood B, Boulanger C, Brett SJ et al (2021) Prevalence, associated factors and outcomes of pressure injuries in adult intensive care unit patients: the DecubICUs study. *Intensive Care Med* 47:160–169
6. Fulbrook P, Lovegrove J, Miles S, Isaqi B (2022) Systematic review: incidence and prevalence of mucous membrane pressure injury in adults admitted to acute hospital settings. *Int Wound J* 19:278–293
7. Deschepper M, Labeau SO, Waegeman W, Blot SI (2021) Pressure injury prediction models for critically-ill patients should consider both the case-mix and local factors. *Intensive Crit Care Nurs* 65:103033. <https://doi.org/10.1016/j.iccn.2021.103033>
8. Deschepper M, Labeau SO, Waegeman W, Blot SI (2022) Heterogeneity hampers the identification of general pressure injury risk factors in intensive care populations: a predictive modelling analysis. *Intensive Crit Care Nurs* 68:103117. <https://doi.org/10.1016/j.iccn.2021.103117>
9. Behrendt R, Ghaznavi AM, Mahan M, Craft S, Siddiqui A (2014) Continuous bedside pressure mapping and rates of hospital-acquired pressure ulcers in a medical intensive care unit. *Am J Crit Care* 23:127–133
10. Yesantharao PS, El Eter L, Javia V, Werthman E, Cox C, Keenan J, Moseley R, Orosco R, Cooney C, Caffrey J (2021) Using pressure mapping to optimize hospital-acquired pressure injury prevention strategies in the burn intensive care unit. *J Burn Care Res*. <https://doi.org/10.1093/jbcr/irab061>
11. World Union of Wound Healing Societies (WUWHS) Consensus Document (2016) Role of Dressings in pressure ulcer prevention. *Wounds International*. Available at www.woundsinternational.com. Accessed May 25 2022
12. Fulbrook P, Mbuvi V, Miles S (2019) Effectiveness of sacral prophylactic protective dressings to prevent pressure injury: a systematic review and meta-analysis. *Int J Nurs Stud*. <https://doi.org/10.1016/j.ijnurstu.2019.103400>
13. Team V, Jones A, Weller CD (2022) Prevention of hospital-acquired pressure injury in COVID-19 patients in the prone position. *Intensive Crit Care Nurs* 68:103142. <https://doi.org/10.1016/j.iccn.2021.103142>
14. Barakat-Johnson M, Carey R, Coleman K, Counter K, Hocking K, Leong T, Levido A, Coyer F (2020) Pressure injury prevention for COVID-19 patients in a prone position. *Wound Pract Res* 28:50–57
15. Otto P, Großkreutz T, Koberich S (2022) Silicone adhesive multilayer foam dressings for preventing facial pressure injuries in COVID-19 patients in prone position. *J Intensive Care Soc*. <https://doi.org/10.1177/2F17511437221079122>