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WHS Guidelines for the Treatment of Pressure Ulcers: 2023 Update

Lisa J. Gould
South Shore Hospital

Jenny Alderden
Boise State University

Rummana Aslam
Yale University

Adrian Barbul
Vanderbilt University

Kath M. Bogie
Louis Stokes Cleveland VA Medical Center

See next page for additional authors

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GUIDELINES

WHS guidelines for the treatment of pressure ulcers—2023 update

Lisa J. Gould MD, PhD, FACS[1,16] | Jenny Alderden PhD, APRN, CCRN, CCNS[2] | Rummana Aslam MD[3] | Adrian Barbul MD, FACS[4] | Kath M. Bogie DPhil, FAIMBE[5,6,17] | Mohamed El Masry MD, PhD[7,8] | Letitia Y. Graves PhD, RN[5,9] | E. Foy White-Chu MD, CWSP, AGSF[10,11] | Amany Ahmed MD[12] | KerriAnn Boanca MD[11] | Jessica Brash BSN, RN[9] | Katie R. Brooks DNP, AGPCNP[13] | Wendy Cockron MSN, APRN, AGACNP-BC, CNE[9] | Susan M. Kennerly PhD, RN, WCC, CNE, FAAN[14] | Aaron K. Livingston MD, PhD[11] | Jeni Page MSN, APRN, ACNP-BC[9] | Catherine Stephens MSN, RN[9] | Velena West MBA, RN[15] | Tracey L. Yap PhD, RN, WCC, CNE, FGSA, FAAN[13]

[1]South Shore Hospital, Weymouth, Massachusetts, USA

[2]School of Nursing, Boise State University, Boise, Idaho, USA

[3]School of Medicine, Yale University, New Haven, Connecticut, USA

[4]Vanderbilt University, Nashville, Tennessee, USA

[5]Louis Stokes Cleveland VA Medical Center, Cleveland, Ohio, USA

[6]Case Western Reserve University, Cleveland, Ohio, USA

[7]McGowan Institute for Regenerative Medicine, Department of Surgery, School of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

[8]Department of Plastic Surgery, Zagazig University, Zagazig, Egypt

[9]School of Nursing, The University of Texas Medical Branch, Galveston, Texas, USA

[10]VA Portland Health Care System, Portland, Oregon, USA

[11]Oregon Health and Science University, Portland, Oregon, USA

[12]School of Medicine, Zagazig University, Zagazig, Egypt

[13]Duke University School of Nursing, Durham, North Carolina, USA

[14]East Carolina University College of Nursing, Greenville, North Carolina, USA

[15]Michael E. DeBakey VA Medical Center, Houston, Texas, USA

[16]Chairperson WHS Pressure Ulcer Guideline Working Group

[17]Chairperson WHS Education Committee

Correspondence
Lisa J. Gould, South Shore Health Center for Wound Healing, 90 Libbey Parkway, Weymouth, MA 02189, USA.
Email: lgould44@hotmail.com

Abstract

The major populations at risk for developing pressure ulcers are older adults who have multiple risk factors that increase their vulnerability, people who are critically ill

Lisa J. Gould, Jenny Alderden, Rummana Aslam, Adrian Barbul, Kath M. Bogie, Mohamed El Masry, Letitia Y. Graves and E. Foy White-Chu were section leaders and contributed equally to the development of these guidelines.

and those with spinal cord injury/disease. The reported prevalence of pressure ulcers in the United States is 2.5 million. However, this estimate is derived from acute care facilities and does not include people who are living at home or in nursing facilities. Despite the implementation of hospital and facility-based preventive measures, the incidence of pressure ulcers has not decreased in decades. In addition to the burden of pain, infection and death, it is estimated that hospital-acquired pressure ulcers cost the health system $26.8 billion annually with over 50% of the cost attributed to treating Stage 3 and 4 pressure injuries. Thus, it is critical to examine the literature and develop guidelines that will improve the outcomes of this complex and costly condition. This guideline update is a compendium of the best available evidence for the treatment of Pressure Ulcers published since the last update in 2015 and includes a new section based on changing demographics entitled 'Palliative wound care for seriously ill patients with pressure ulcers'. The overall goal of the Wound Healing Society Guideline project is to present clear, concise and commercial free guidelines that clinicians can use to guide care, that researchers can use to develop studies that will improve treatment and that both clinicians and researchers can use to understand the gaps in our knowledge base.

KEYWORDS
guideline, palliative care, pressure ulcer, wound treatment

1 | INTRODUCTION

The major populations at risk for developing pressure ulcers are older adults who have multiple risk factors that increase their vulnerability, people who are critically ill and those with spinal cord injury/disease. The reported prevalence of pressure ulcers in the United States is 2.5 million.[1] However, this estimate is derived from acute care facilities and does not include people who are living at home or in nursing facilities. Despite implementation of hospital and facility-based preventive measures, the incidence of pressure ulcers has not decreased in decades. In addition to the burden of pain, infection and death, it is estimated that hospital-acquired pressure ulcers cost the health system $26.8 billion annually with over 50% of the cost attributed to treating Stage 3 and 4 pressure injuries.[2] Thus, it is critical to examine the literature and develop guidelines that will improve the outcomes of this complex and costly condition.

In 2016 the National Pressure Ulcer Advisory Panel (NPUAP), now National Pressure Injury Advisory Panel (NPIAP), met for a 'Staging Consensus Conference'. Based on the report of a task force and the consensus obtained at that conference, NPIAP recommended changing terminology from pressure ulcer to pressure injury, attempting to provide a better description of the stages that do not present with an open wound, that is, Stage I and Deep Tissue Injury.[3] Even years later, CMS, ICD-10, national and international organisations and the literature in general remain conflicted with some references to injury but most have retained the term 'ulcer'.[4] The terminology change is also confusing depending upon the duration of the wound, as clinicians are taught to change to 'ulcer' when a wound has been present for more than 30 days and some wounds are always referred to as ulcers, for example, diabetic foot, venous leg and arterial ulcers. This update to the Wound Healing Society guidelines will not, and is not intended to, solve the problems of terminology or staging. For consistency, the authors have agreed to use the '*pressure ulcer*' terminology in the preamble, stated guideline and principle, yet it will be clear that there is not a consensus in the cited literature.

2 | METHODS

There has been a proliferation of clinical guidelines since they were first recommended by the Institute of Medicine in 1990. Although the field has matured since the initial publication of the Wound Healing Society Guidelines in 2006, evidence for treatment of chronic wounds suffers from a lack of unbiased, randomised clinical trials. Thus, large-scale reviews, such as Cochrane, usually state that there is limited evidence to support the questions that are posed. This guideline update is a compendium of the best available evidence for the treatment of Pressure Ulcers published since the last update in 2015.[5] As such, the current work should be considered supplemental and complimentary to the original and 2015 update. The overall goal of the Wound Healing Society Guideline project is to present clear, concise and commercial free guidelines that clinicians can use to guide care, that researchers can use to develop studies that will improve treatment and that both clinicians and researchers can use to understand the gaps in our knowledge base.

The strength of evidence used in the previous guidelines has been retained:

Level I: Meta-analysis of multiple RCTs or at least two RCTs supporting the intervention of the guideline. Another route would be multiple laboratory or animal experiments with at least two clinical series supporting the laboratory results.

Level II: Less than Level I, but at least one RCT and at least two significant clinical series or expert opinion papers with literature reviews supporting the intervention. Experimental evidence that is quite convincing, but not yet supported by adequate human experience.

Level III: Suggestive data of proof of principle, but lacking sufficient data such as meta-analysis, RCT or multiple clinical series.

2.1 | Data sources and searches

The search strategy included Medline, PubMed, CINAHL, EBSCO, Embase and Cochrane databases using keywords specific to each subtopic from January 2015 to January 2023. Some older references are included if they were felt to be relevant but were omitted from previous editions of the guidelines and because the Palliative Care section is new many older references are included. Evidence was limited to that published in English language.

Topics and format are based on the previous publications although some new subtopics have been added and an entirely new section on pressure ulcer treatment for patients receiving palliative care has been added. Wording of some guidelines and principles have been revised to better reflect the supporting literature; these are noted as '*revised*'. To reduce bias, the pressure ulcer guideline development team is an interdisciplinary collaboration between wound care specialists including nurses, surgeons, primary care physicians, geriatricians, palliative medicine providers and researchers. The team was chosen based on expertise in the overall subject matter and then further divided based on specific clinical and research expertise for each sub-topic. Each subtopic was critically reviewed by the entire team. Citations are presented for each subtopic in reverse chronological order with a designation of the category of study design, which has also been modified since the last update based on trends in the current literature.

2.2 | Categories

RCT	Randomised controlled trial
STAT	Statistical analysis, meta-analysis, consensus
CER	Comparative Effectiveness Research: Comparing one or more treatments
PCOH	Prospective Cohort study
CASE S	Case series of 3–10 patients
RETROS	Retrospective study (>10 patients)
LIT REV	Literature Review
EXP	Experimental laboratory or animal study
TECH	Technique or methodology description
PATH S	Pathological series review

(Continues)

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4. Gould LJ, Bohn G, Bryant R, et al. Pressure ulcer summit 2018: An interdisciplinary approach to improve our understanding of the risk of pressure-induced tissue damage. *Wound Repair Regen*. 2019;27:497–508.
5. Gould L, Stuntz M, Giovannelli M, et al. Wound Healing Society 2015 update on guidelines for pressure ulcers. *Wound Repair Regen*. 2016;24(1):145–162.

3 | RESULTS

3.1 | Positioning and support surfaces

Guideline 1.1: Establish a repositioning schedule and avoid positioning patients on pressure ulcers and bony prominences (Level II).

Principle: Pressure injuries are thought to result from hypoperfusion to soft tissues. Compression of soft tissues against a bony prominence may contribute to hypoperfusion. It is reasonable to assume that pressure on a pre-existing injury may result in delayed healing. Patients should be repositioned to relieve pressure over bony prominences. The exact turning interval is not known and is derived empirically. Reductions in pressure injuries have been achieved, but positioning is not universally effective.

Evidence:

1. Yap TL, Horn SD, Sharkey PD, et al. Effect of varying repositioning frequency on pressure injury prevention in nursing home residents: TEAM-UP Trial Results. *Adv Skin Wound Care*. 2022;35(6):315–325. [RCT]
2. Alshahrani B, Sim J, Middleton R. Nursing interventions for pressure injury prevention among critically ill patients: a systematic review. *J Clin Nurs*. 2021;30(15-16):2151–2168. [LIT REV]

3. Choi JS, Hyun SY, Chang SJ. Comparing pressure injury incidence based on repositioning intervals and support surfaces in acute care settings: a quasi-experimental pragmatic study. *Adv Skin Wound Care*. 2021;34(8):1–6. [CLIN S]
4. Gillespie BM, Walker RM, Latimer SL, et al. Repositioning for pressure injury prevention in adults. *Cochrane Database Syst Rev*. 2020;6(6):CD009958. [STAT]
5. Avsar P, Moore Z, Patton D, O'Connor T, Budri AM, Nugent L. Repositioning for preventing pressure ulcers: a systematic review and meta-analysis. *J Wound Care*. 2020;29(9):496–508. [STAT]
6. Jiang Q, Liu Y, Yu H, et al. A multicenter, comparative study of two pressure-redistribution mattresses with repositioning intervals for critical care patients. *Adv Skin Wound Care*. 2020;33(3):1–9. [CLIN S]
7. Lovegrove J, Fulbrook P, Miles S. International consensus on pressure injury preventative interventions by risk level for critically ill patients: a modified Delphi study. *Int Wound J*. 2020;17(5):1112–1127. [STAT]
8. De Meyer D, Van Hecke A, Verhaeghe S, Beeckman D. PROTECT – Trial: a cluster RCT to study the effectiveness of a repositioning aid and tailored repositioning to increase repositioning compliance. *J Adv Nurs*. 2019;75(5):1085–1098. [RCT]
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10. Jocelyn Chew HS, Thiara E, Lopez V, Shorey S. Turning frequency in adult bedridden patients to prevent hospital-acquired pressure ulcer: A scoping review. *Int Wound J*. 2018;15(2):225–236. [LIT REV]
11. Darvall JN, Mesfin L, Gorelik A. Increasing frequency of critically ill patient turns is associated with a reduction in pressure injuries. *Crit Care Resusc*. 2018;20(3):217–222. [CLIN S]
12. 2016 WOCN Guidelines Wound Ostomy and Continence Nurses Society. Guideline for Prevention and Management of Pressure Ulcers (Injuries); 2016. Mt Laurel: Wound Ostomy and Continence Nurses Society. [STAT]

Guideline 1.2: Maintain the head of bed at the lowest degree of elevation consistent with medical conditions and other restrictions. When the head of bed is elevated, prevent downward migration. (Level II) (*revised*).

Principle: Elevation of the head of the bed produces higher interface pressures between the skin and the bed surface, which may predispose to the development of pressure ulcers. Migration in the bed results in friction and shearing forces. (*revised*).

Evidence:

1. Zhuo X, Pan L, Zeng X. The effects of the 45° semi-recumbent position on the clinical outcomes of mechanically ventilated patients: a systematic review and meta-analysis study. *Ann Palliat Med*. 2021;10(10):10643–10651.[STAT]
2. Lustig M, Wiggermann N, Gefen A. How patient migration in bed affects the sacral soft tissue loading and thereby the risk for a hospital-acquired pressure injury. *Int Wound J*. 2020;17(3):631–640. [EXP]
3. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance, Emily Haesler (Eds). Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline; 2019. www.internationalguideline.com [STAT]
4. Grap MJ, Munro CL, Schubert CM, et al. Lack of association of high backrest with sacral tissue changes in adults receiving mechanical ventilation. *Am J Crit Care*. 2018;27(2):104–113. [CLIN S]
5. Bridges E, Whitney JD, Burr R, Tolentino E. Reducing the risk for pressure injury during combat evacuation. *Crit Care Nurs*. 2018;38(2):38–45. [CLIN S]
6. Davis KG, Kotowski SE. Role of bed design and head-of-bed articulation on patient migration. *J Nurs Care Qual*. 2015;30(3). [EXP]

Guideline 1.3: Assess all patients for their risk of developing a pressure ulcer. Use a pressure-reducing surface in those patients at risk. Provide a support surface that is properly matched to the individual's need for pressure redistribution, shear reduction, and microclimate control. (Level I).

Principle: The goal of using a support surface is to reduce the forces of pressure and friction and shear against the patient's body. High-density foam support surfaces and reactive air surfaces were both found to reduce pressure injury incidence. Individual patient characteristics should influence the surface selection choice. If the patient 'bottoms out', that is, if there is <1 in. of material between the bed and the patient's body when feeling under the support surface with the palm of your hand, the device is considered ineffective. (*revised*).

Evidence:

1. Bambi AA, Yusuf S, Irwan AM. Reducing the incidence and prevalence of pressure injury in adult ICU patients with support surface use: a systematic review. *Adv Skin Wound Care. 2022*;35(5):263–270. [LIT REV]
2. Shi C, Dumville JC, Cullum N, Rhodes S, Leung V, McInnes E. Reactive air surfaces for preventing pressure ulcers. *The Cochrane Database Syst Rev*. 2021;5(5):CD013622. Published 2021 May 7. [STAT]
3. McNichol L, Mackey D, Watts C, Zuecca N. Choosing a support surface for pressure injury prevention and treatment. *Nursing*. 2020;50(2):41–44. [LIT REV]
4. Lovegrove J, Fulbrook P, Miles S. International consensus on pressure injury preventative interventions by risk level for critically ill patients: A modified Delphi study. *Int Wound J*. 2020;17(5):1112–1127. [STAT]
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6. Bueno de Camargo WH, Pereira RC, et al. The effect of support surfaces on the incidence of pressure injuries in critically ill patients: a randomized clinical trial. *Crit Care Res Pract*. 2018;37:12067. [RCT]
7. 2019 European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance, Emily Haesler (Eds). Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline; 2019. www.internationalguideline.com [STAT]
8. Shi C, Dumville JC, Cullum N. Support surfaces for pressure ulcer prevention: a network meta-analysis. *PLoS One*. 2018;13(2): e0192707. [STAT]
9. 2016 WOCN Guidelines Wound Ostomy and Continence Nurses Society. Guideline for Prevention and Management of Pressure Ulcers (Injuries). Mt Laurel: Wound Ostomy and Continence. [STAT]
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12. McNichol L, Watts C, Mackey D, Beitz JM, Gray M. Identifying the right surface for the right patient at the right time: generation and content validation of an algorithm for support surface selection. *J Wound Ostomy Continence Nurs*. 2015;42(1):19–37. [STAT]

Guideline 1.4: A reactive support surface may be appropriate for patients with a pressure ulcer who can assume a variety of positions without placing pressure on the site of injury or 'bottoming out'. (Level III).

Principle: A reactive support is defined as a powered or nonpowered support surface with the capability to change its load distribution properties only in response to applied loads. Reactive surfaces include foam, air, or gel-filled devices, as well as low air-loss mattresses or cushions. Rigorous review of clinical data regarding the use of support surfaces for the treatment of pressure ulcers (Guideline 1.3 addresses prevention) in the interval since the publication of the original guidelines have concluded that the quality of evidence is not sufficient to demonstrate a clear benefit for any specific type of support surface. However, there is low-certainty evidence that, compared with foam surfaces (reference treatment), people using reactive air surfaces may be more likely to experience pressure ulcer healing. Expert panel recommendations state that support surfaces should be considered an important component of a comprehensive pressure ulcer treatment program. (*revised*).

Evidence:

1. Shi C, Dumville JC, Cullum N, et al. Beds, overlays and mattresses for treating pressure ulcers. *Cochrane Database Syst Rev*. 2021;5 (5):CD013624. Published 2021 May 10. [STAT]
2. Shi C, Dumville JC, Cullum N, Rhodes S, Leung V, McInnes E. Reactive air surfaces for preventing pressure ulcers. *Cochrane Database Syst Rev*. 2021;5(5):CD013622. Published 2021 May 7. [STAT]
3. Nixon J, Brown S, Smith IL, et al. Comparing alternating pressure mattresses and high-specification foam mattresses to prevent pressure ulcers in high-risk patients: the PRESSURE 2 RCT. *Health Technol Assess*. 2019;23(52):1–176. [RCT]
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5. Rae KE, Isbel S, Upton D. Support surfaces for the treatment and prevention of pressure ulcers: a systematic literature review. *J Wound Care*. 2018;27(8):467–474. [LIT REV]
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Guideline 1.5: An active support surface may be appropriate for patients with multiple pressure ulcers, patients with a pressure ulcer who cannot assume a variety of positions in bed, patients who 'bottom out' on a reactive surface, or those whose ulcer is not progressing toward healing. (Level II).

Principle: An active support surface is a powered surface capable of changing its load distribution properties, with or without applied load. Currently, alternating-pressure mattresses are the only 'active' surface type available for clinical use. Evidence from one clinical trial (Nixon et al., 2016) affirms the appropriateness of active support surface use in patients with limited mobility. (*revised*).

Evidence:

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2. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance, Emily Haesler (Eds). Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline; 2019. www.internationalguideline.com [STAT]
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4. Shi C, Dumville JC, Cullum N. Support surfaces for pressure ulcer prevention: a network meta-analysis. *PLoS One*. 2018;13(2): e0192707. Published 2018 Feb 23. [STAT]
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6. McInnes E, Jammali-Blasi A, Bell-Syer SE, Leung V. Support surfaces for treating pressure ulcers. *Cochrane Database Syst Rev*. 2018;10(10):CD009490. Published 2018 Oct 11. [STAT]

Guideline 1.6: An air fluidized surface may be appropriate for individuals with Stage 3 or 4 pressure ulcers, or those recovering from surgical repair of a pressure ulcer. Patient comfort with mobility limitations imposed by air fluidized surfaces' immersive and enveloping qualities should also be considered. (Level III) (*revised*).

Principle: An air-fluidized bed support system reduces pressure through body 'flotation' on fine beads that are set in motion by warm, pressurised air to simulate fluid movement. Although recent evidence is lacking, results from a 2013 systematic review showed pressure ulcer healing improved with air-fluidized beds. Consideration of the individual's preferences is also important because air fluidized surfaces result in high levels of immersion (depth of penetration into the surface) and envelopment (surface moulding around the body), which may reduce the individual's ability to move independently in bed.

Evidence:

1. Arnold M, Yanez C, Yanez B. Wound healing in the long-term acute care setting using an air fluidized therapy/continuous low-pressure therapeutic bed: a multiple case series. *J Wound Ostomy Continence Nurs*. 2020;47(3):284–290. [CASE S]
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Guideline 1.7: Postural alignment, distribution of weight, balance, stability, and pressure redistribution should be considered in seated individuals. Patients who have a pressure ulcer should refrain from sitting on the affected area. (Level III) (*revised*).

Principle: Tissue compression between the sitting surface and bony prominence should be relieved in at-risk patients. In patients with a pressure ulcer, sitting on the pressure ulcer should be avoided.

Evidence:

1. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance, Emily Haesler (Eds). Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. www.internationalguideline.com 2019 [STAT]
2. Stephens M, Bartley CA. Understanding the association between pressure ulcers and sitting in adults what does it mean for me and my carers? Seating guidelines for people, carers and health & social care professionals. *J Tissue Viability*. 2018;27(1):59–73. [STAT]
3. Moore ZE, van Etten MT, Dumville JC. Bed rest for pressure ulcer healing in wheelchair users. *Cochrane Database Syst Rev*. 2016;10 (10):CD011999. [STAT]

Guideline 1.8: Use a seat cushion based on the needs of the individual who requires pressure redistribution in the sitting position with particular attention during patient toileting. Avoid using doughnut-type devices. (Level III) (*revised*).

Principle: A pressure ulcer prevention strategy for seated individuals should incorporate use of pressure redistributing seat cushions, inclusive of toileting. Examine seating cushions and devices for 'bottoming out'. Ring cushions (doughnut-type devices) that increase venous congestion and oedema should be avoided. (*revised*).

Evidence:

1. Damiao J, Gentry T. A systematic review of the effectiveness of pressure relieving cushions in reducing pressure injury. *Assist Technol*. 2022;1–5. [LIT REV]
2. Namba T, Furusawa K, Tanimoto Y, et al. Comparative analysis of effects of various toilet seat cushions on buttock pressure during toileting in persons with spinal cord injury. *The J Spinal Cord Med*. 2021;1–6. Advance online publication. [CLIN S]
3. García-Molina P, Casasus SR, Sanchis-Sánchez E, Balaguer-López E, Ruescas-López M, Blasco JM. Evaluation of interface pressure and temperature management in five wheelchair seat cushions and their effects on user satisfaction. *J Tissue Viability*. 2021;30(3):402–409. [CLIN S]
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6. 2016 WOCN Guidelines Wound Ostomy and Continence Nurses Society. Guideline for Prevention and Management of Pressure Ulcers (Injuries); 2016. Mt Laurel: Wound Ostomy and Continence Nurses Society. [CLIN S]

Guideline 1.9: Patients who use a wheelchair as their primary means of mobility should be provided with a wheeled mobility seating assessment and properly fitted wheelchair to ensure the entire system provides optimal postural support and maintains tissue integrity. The complete wheelchair mobility system includes postural supports, optimally fitted lower extremity footplates/protection, and an appropriate seat cushion. (Level III).

Principle: Postural alignment, distribution of weight, balance, stability, and pressure reduction must be considered for proper fitting of

wheelchairs and seat cushions. Distribution and immersive support of the patient's body weight is especially important for high-risk anatomic locations to reduce the forces of pressure and friction against the patient's body. The seating assessment should be repeated at least every 3 years and more frequently if the individual's condition changes (e.g., changes in weight or functional status). (*revised*).

Evidence:

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2. Whitford M, Mitchell SJ, Marzloff GE, et al. Wheelchair mobility-related injuries due to inadvertent lower extremity displacement on footplates: analysis of the FDA MAUDE database from 2014 to 2018. *J Patient Saf*. 2021;17(8):e1785–e1792. [CLIN S]
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4 | NUTRITION

Preamble: Successful healing depends on collagen synthesis/deposition and epithelial resurfacing, both processes being highly dependent on adequate nutrient stores and support. Protein, carbohydrates, vitamins, minerals, and trace elements play critical roles in these events. Nutritional status consistently stands out as a significant factor in the prevention and treatment of pressure ulcers. In spite of this very strong association, there are limited definitive studies documenting the efficacy of nutritional therapy for pressure ulcer healing.

Guideline 2.1: Nutritional assessment should be performed on entry to a new healthcare setting and whenever there is a change in an individual's health status that may increase the risk of malnutrition. (Level II – *no change*).

Principle: Nutritional intake must meet the patient's need for sufficient protein and energy to support the growth of granulation tissue. The patient's weight documented at health care visits or on admission to a clinical setting is a good starting point. Assess body weight regularly and when there is a change in an individual's condition that may increase the risk of undernutrition.

Pressure ulcer patients, even those who are overweight or obese, are often malnourished and protein deficient as evidenced by levels of low nutritional biomarkers and other performance status. Assessment of pre-albumin level (reflecting recent protein consumption) and serum albumin level (reflecting long-term protein consumption) is useful to identify outpatient ambulatory patients who are malnourished. These markers are not very effective in hospitalised or ill patients where levels of serum albumin and pre-albumin are influenced by hydration status, presence of infection, or acute stress and thus may not reflect actual nutritional deficit. No individual clinical parameter accurately and consistently identifies adult malnutrition. The Academy of Nutrition and Dietetics and the American Society for Parenteral and Enteral Nutrition suggest that presence of two or more of the following six parameters are strongly diagnostic of malnutrition: insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, localised or generalised fluid accumulation that may mask weight loss, and decreased functional status measured by hand grip. Other laboratory values associated with inflammation such as C-reactive protein, white blood cell count or blood glucose may be helpful in determining if malnutrition is related to starvation, chronic disease or acute disease/injury.

Resting energy expenditure is increased in patients with pressure ulcers while at the same time energy intake may be inadequate. Standard clinical approaches to determine energy requirements may underestimate actual need. Therefore, calculation of intake (kcal/kg/day) to meet true energy demand may require adjustment (increase) to account for this in patients with pressure ulcers. Encourage nutritional support if an individual is undernourished. Under-nutrition is associated with poor clinical outcomes, including increased risk of mortality, so early identification of actual or potential nutritional need allows for timely intervention to mitigate nutritional decline.

Updated Evidence:

1. Munoz N, Litchford M, Cox J, Nelson JL, Nie AM, Delmore B. Malnutrition and pressure injury risk in vulnerable populations: Application of the 2019 international clinical practice guideline. *Adv Skin Wound Care*. 2022;35:156–165. [LIT REV]
2. Munoz N, Posthauer ME, Cereda E, Schols J, Haesler E. The role of nutrition for pressure injury prevention and healing: the 2019 international clinical practice guideline recommendations. *Adv Skin Wound Care*. 2020;33:123–136. [LIT REV]
3. Cederholm T, Jensen GL, Correia MITD, et al. GLIM criteria for the diagnosis of malnutrition—a consensus report from the global clinical nutrition community. *Clin Nutr*. 2019;38(1):1–9. [LIT REV]
4. Citty SW, Cowan JL, Wingfield Z, Stechmiller J. Optimising nutrition care for pressure injuries in hospitalised patients. *Adv Wound Care*. 2019;2:309–322. [LIT REV]
5. Gould LJ, Bohn G, Bryant R, et al. Pressure ulcer summit 2018: an interdisciplinary approach to improve our understanding of the risk of pressure-induced tissue damage. *Wound Repair Regen*. 2019;27(5):497–508. [STAT]
6. Jaul E, Barron J, Rosenzweig JP, Menczel J. An overview of co-morbidities and the development of pressure ulcers among older adults. *BMC Geriatr*. 2018;18(305). [LIT REV]
7. Ness SJ, Hickling DF, Bell JJ, Collins PF. The pressures of obesity: the relationship between obesity, malnutrition and pressure

injuries in hospital inpatients. *Clin Nutr*. 2018;37(5):1569–74. [RETROS]
8. Mcclave SA, Taylor BE, Martindale RG, et al. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *J Parenteral Enteral Nutr*. 2016;40(2):159–211. [STAT]

Guideline 2.2: Promote nutritional supplementation if an undernourished individual is at risk of developing a pressure ulcer. (Level III – *no change*).

Principle: Nutrients are basic to cellular integrity and data suggest that a nutritional supplement may have a modest effect in preventing the development of pressure ulcers, largely in stage 1 ulcers. Dietary intake through meals and other supplementation should be monitored to assess intake adequacy.

Updated Evidence:

1. da Silveira JB, Teixeira GM, Baron MV, Caron-Lienert RS. Impact of nutrition on the prevention and treatment of pressure injuries in critically ill patients: an integrative review. *Adv Skin Wound Care*. 2022;35(10):566–572. [LIT REV].

Guideline 2.3: Ensure adequate dietary intake to prevent undernutrition to the extent that this is compatible with the individual's wishes. (Level I – *increased*).

Principle: Adequate nutrition is essential for life and undernutrition is associated with the development of pressure ulcers. Providing nutrition supports pressure ulcer healing or improvement in ulcer status and is associated with preventing pressure ulcers. Nonetheless, the nutritional plan needs to be consistent with the individual's personal goals and medical condition.

Updated Evidence:

1. Yap J, Holloway S. Evidence-based review of the effects of nutritional supplementation for pressure ulcer prevention. *Int Wound J*. 2021;18(6):805–821. [LIT REV]

Guideline 2.4: If dietary intake continues to be inadequate, impractical or impossible, nutritional support using other routes should be considered with the goal of achieving positive nitrogen balance (~30–35 calories/kg/day and 1.25–1.50 g of protein/kg/day) according to the goals of care. (Level II – *increased*).

Principle: Anabolism is facilitated with a positive nitrogen balance and when individuals are not able to meet nutritional needs through oral intake, alternative methods should be undertaken to optimise nutritional status.

Updated Evidence:

1. Woo HY, Oh SY, Lim L, Im H, Lee H, Ryu HG. Efficacy of nutritional support protocol for patients with pressure ulcer: comparison of before and after the protocol. *Nutrition*. 2022;99-100:111638. [PCOH].
2. Stracci G, Scarpellini E, Rinninella E, et al. Effects of enteral nutrition on patients with pressure lesions: a single center, pilot study. *Eur Rev Med Pharmacol Sci*. 2020;24(3):1563–1570. [CASE S].
3. Wong A, Goh G, Banks MD, Bauer JD. Economic evaluation of nutrition support in the prevention and treatment of pressure ulcers in acute and chronic care settings: a systematic review. *J Parenter Enteral Nutr*. 2019;43(3):376–400. [LIT REV].

Guideline 2.5: Give vitamin and mineral supplements if deficiencies are confirmed or suspected. (Level I – *increased*).

Principle: Supplements of vitamins and minerals that are needed for wound healing should be provided when intake is insufficient or when a deficit is identified. The unique contribution of specific vitamins, minerals or amino acids is uncertain. However, enhanced supplements consisting of various combinations of Vitamins A, C, E, zinc, fatty acids and arginine are associated with pressure ulcer healing and/or prevention of ulcer formation. Amino acid supplements have been effective in the healing some non-pressure related wounds. Emerging evidence suggests that arginine may increase the rate of healing in patients with pressure ulcers.

Updated Evidence:

1. Cheshmeh S, Hojati N, Mohammadi N, et al. The use of oral and enteral tube-fed arginine supplementation in pressure injury care: a systematic review and meta-analysis. *Nurs Open*. 2022;9:2552–2561. [STAT]
2. Daher GS, Choi KY, Wells JW, Goyal N. A systematic review of oral nutritional supplement and wound healing. *Ann Otol Rhinol*. 2022;131(12):1358–1368. [LIT REV]
3. Bafna K, Chen T, Simman R. Is treating patients with stage 4 pressure ulcers with vitamins A and C, zinc, and arginine justified? *Wounds*. 2021;33(3):77–80. [LIT REV]
4. Chu AS, Delmore B. Arginine: what you need to know for pressure injury healing. *Adv Skin Wound Care*. 2021;34(12):630–636. [LIT REV]
5. Mehl AA, Damião AO, Viana SD, Andretta CP. Hard-to-heal wounds: a randomised trial of an oral proline-containing supplement to aid repair. *J Wound Care*. 2021;30(1):26–31. [RCT]
6. Saeg F, Orazi, R Bowers GM, Janis JE. Evidence-based nutritional interventions in wound care. *Plast Reconstr Surg*. 2021;148(1):226–238. [LIT REV]
7. Cereda E, Klersy C, Andreola M, et al. Cost-effectiveness of a disease-specific oral nutritional support for pressure ulcer healing. *Clin Nutr*. 2017;3:246–252. [CASE S]

5 | INFECTION

Preamble: Infection results when the microbe: host defence equilibrium is upset in favour of the microbes. Infection plays various roles in aetiology, healing, operative repair, and complications of pressure ulcers. Therefore, guidelines are necessary to address the treatment of infection in each of these circumstances.

Guideline 3.1: Treat distant infections (e.g., urinary tract, cardiac valves, cranial sinuses) with appropriate antibiotics in pressure ulcer-

prone patients or patients with established ulcers. (Level II – *no change*).

Principle: Bacteria entering the bloodstream or lymphatics can lodge in compressed tissue, denervated tissue, oedematous tissue, or established wounds by the compromised tissue acting as a *locus minoris resistentiae*.

No updated evidence.

Guideline 3.2 (*Revised*): Remove all necrotic or devitalized tissue by sharp, enzymatic, biological, mechanical, ultrasonic or autolytic debridement. Larval therapy provides both debridement and antibacterial activity. Although there are no recent randomised controlled trials of larval therapy for pressure ulcers, this biologic therapy has been shown to reduce the time to debridement but does not significantly increase the rate of healing in leg ulcers. (Level I – *no change*).

Principle: Necrotic tissue is laden with bacteria while devitalized tissue impairs the body's ability to fight infection and serves as pabulum for bacterial growth.

Updated Evidence:

1. McLaughlin CJ, Fornadley JM, Fields K, Armen S, Laufenberg L. Biodebridement in the surgical intensive care unit: unique therapy for unique patients. *Am Surg*. 2022;88(6):1330–1333. [LIT REV]
2. Swanson T, Ousey K, Haesler E, et al. IWII Wound Infection in Clinical Practice consensus document: 2022 update. *J Wound Care*. 2022;31(Suppl 12):S10–S21. [STAT]
3. Alam W, Hasson J, Reed M. Clinical approach to chronic wound management in older adults. *J Am Geriatr Soc*. 2021;69(8):2327–2334. [LIT REV]
4. Al-Jalodi O, Serena LM, Breisinger K, Patel K, Harrell K, Serena TE. A novel debridement device for the treatment of hard-to-heal wounds: a prospective trial. *J Wound Care*. 2021;30(Suppl 5):S32–S36. [PCOH]
5. Kataoka Y, Kunimitsu M, Nakagami G, Koudounas S, Weller CD, Sanada H. Effectiveness of ultrasonic debridement on reduction of bacteria and biofilm in patients with chronic wounds: a scoping review. *Int Wound J*. 2021;18(2):176–186. [STAT]
6. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed). EPUAP/NPIAP/PPPIA; 2019. [STAT]
7. Podd D. Beyond skin deep: managing pressure injuries. *JAAPA*. 2018;31(4):10–17. [LIT REV]
8. Patry J, Blanchette V. Enzymatic debridement with collagenase in wounds and ulcers: a systematic review and meta-analysis. *Int Wound J*. 2017;14(6):1055–1065. [STAT]
9. Schultz G, Bjarnsholt T, James GA, et al. Consensus guidelines for the identification and treatment of biofilms in chronic nonhealing wounds. *Wound Repair Regen*. 2017;25(5):744–757. [STAT]

Guideline 3.3 (*revised*): If there is suspected infection in a debrided ulcer, or if contraction and epithelialization from the margin are not progressing within 2 weeks of debridement and relief of pressure, determine the type and level of infection in the debrided ulcer by tissue biopsy or by a validated quantitative swab technique. Punch biopsies are a safe procedure for obtaining tissue for histologic or microbiologic analysis. (Level I – *no change*).

Principle: The reference standard for the diagnosis of infection of chronic wounds is a tissue biopsy for culture obtained after debridement to remove bacteria that are present as surface colonisation. If quantitative cultures are obtained, microbial loads of $>10^5$ of any organism per gram of wound tissue or the presence of any level of beta-haemolytic streptococcus is typically considered an indicator of infection of chronic wounds.

Updated Evidence:

1. Swanson T, Ousey K, Haesler E, et al. IWII wound infection in clinical practice consensus document: 2022 update. *J Wound Care*. 2022;31(Suppl 12):S10–S21. [STAT]
2. Bowers S, Franco E. Chronic wounds: evaluation and management. *Am Fam Physician*. 2020;101(3):159–166. [LIT REV]
3. Serena TE, Cole W, Coe S, et al. The safety of punch biopsies on hard-to-heal wounds: a large multicentre clinical trial. *J Wound Care*. 2020;29:Sup2c, S4–S7. [RCT]
4. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed.). EPUAP/NPIAP/PPPIA; 2019. [STAT]
5. Ricci JA, Bayer LR, Orgill DP. Evidence-based medicine: the evaluation and treatment of pressure injuries. *Plast Reconstr Surg*. 2017;139(1):275e–286e. [LIT REV]
6. Bosanquet DC, Wright AM, White RD, Williams IM. A review of the surgical management of heel pressure ulcers in the 21st century. *Int Wound J*. 2016;13(1):9–16. [LIT REV]
7. Ramsay S, Cowan L, Davidson JM, Nanney L, Schultz G. Wound samples: moving toward a standardised method of collection and analysis. *Int Wound J*. 2016;13(5):880–891. [LIT REV]
8. Zhao R, Liang H, Clarke E, Jackson C, Xue M. Inflammation in chronic wounds. *Int J Mol Sci*. 2016;17(12):2085. [LIT REV]
9. Dana AN, Bauman WA. Bacteriology of pressure ulcers in individuals with spinal cord injury: What we know and what we should know. *J Spinal Cord Med*. 2015;38(2):147–160. [LIT REV]

Guideline 3.4: Classic signs of infection, that is, purulent exudate, heat, oedema and erythema, may or may not be present. Signs and symptoms of chronic wound infection include:

1. Delayed healing defined as a lack of progress toward the closure of the wound and no decrease in wound size. If a standard of care is provided and there is no evidence of improvement within 2 weeks, an infection should be suspected.
2. Discoloration of granulation tissue (edematous granulation tissue or pale, dusky in colour), as opposed to red beefy colour of healthy granulation tissue.
3. Friable granulation tissue that bleeds spontaneously or bleeds with little provocation.

4. Pocketing at the base of the wound or recessed areas with an absence of granulation tissue.
5. Foul odour, typically caused by Gram-negative organisms and usually associated with anaerobic organisms.
6. Wound breakdown, characterised by increased size, loss of epithelium, bony exposure and nonadherent granulation tissue, results from abnormal collagen formation caused by high bioburden.
7. An increased level of pain, even in the absence of any discernible signs of inflammation, may signal that the wound is infected. Limited information is available regarding the relationship between pain and special groups (e.g., children, end-of-life patients, bariatric patients, spinal cord injury patients, etc.). Clinicians need to be aware of nonverbal pain indicators and maintain a high index of suspicion that the wound is infected if nonverbal patients manifest these behaviours.

(Level I – *no change*)

Principle: Classic signs of inflammation (purulent exudate, erythema, heat) may be absent in the presence of a wound infection. These signs are often used to diagnose infection; however, their presence/absence is not specific for infection, particularly in chronic wounds. The term 'local wound infection' more accurately describes the stage of infection in which covert (subtle) local clinical signs and symptoms of infection (e.g., pocketing, epithelial bridging and hypergranulation) can be identified by clinicians before the wound exhibits overt (classic) signs and symptoms of infection.

Updated Evidence:

1. Swanson T, Ousey K, Haesler E, et al. IWII wound infection in clinical practice consensus document: 2022 update. *J Wound Care*. 2022;31(Suppl 12):S10–S21. [STAT]
2. Bowers S, Franco E. Chronic wounds: evaluation and management. *Am Fam Physician*. 2020;101(3):159–166. [LIT REV]
3. Le L, Baer M, Briggs P, et al. Diagnostic accuracy of point-of-care fluorescence imaging for the detection of bacterial burden in wounds: results from the 350-patient fluorescence imaging assessment and guidance trial. *Adv Wound Care*. 2021;10(3):123–136. [RCT]
4. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed.). EPUAP/NPIAP/PPPIA; 2019. [STAT]
5. Blanco-Blanco J, Gea-Sánchez M, Valenzuela-Pascual F, Barallat-Gimeno E, Espart A, Escobar-Bravo MÁ. Are the classic signs of infection in concordance with results from percutaneous aspiration to diagnose infection in pressure injuries? *J Adv Nurs*. 2017;73(6):1433–1442. [RETROS]

Guideline 3.5: Little evidence exists supporting the use of one type of wound cleansing solution or technique for pressure ulcers. Systemic antibiotics have not been shown to lower bacterial bioburden in wounds. Topical antimicrobials (silver-containing cream, antimicrobial containing foam dressing, cadexomer iodine) have been shown to decrease the bacterial load in an ulcer. Avoid wound cleansing with antiseptic agents as granulation tissue will be destroyed. Furthermore, tap water is also appropriate to use to cleanse wounds. (Level I – *no change*).

Principle: Pressure ulcers contain an endogenous bacterial load, which should be managed to prevent the progression from colonisation to infection.

Updated Evidence:

1. Cwajda-Białasik J, Mościcka P, Szewczyk MT. Antiseptics and antimicrobials for the treatment and management of chronic wounds: a systematic review of clinical trials. *Postepy Dermatol Alergol*. 2022;39(1):141–151. [STAT]
2. Swanson T, Ousey K, Haesler E, et al. IWII wound infection in clinical practice consensus document: 2022 update. *J Wound Care*. 2022;31(Suppl 12):S10–S21. [STAT]
3. Alam W, Hasson J, Reed M. Clinical approach to chronic wound management in older adults. *J Am Geriatr Soc*. 2021;69(8):2327–2334. [LIT REV]
4. Koyanagi H, Kitamura A, Nakagami G, Kashiwabara K, Sanada H, Sugama J. Local wound management factors related to biofilm reduction in the pressure ulcer: a prospective observational study. *Jpn J Nurs Sci*. 2021;18(2):e12394. [PCOH]
5. Woo K, Dowsett C, Costa B, Ebohon S, Woodmansey EJ, Malone M. Efficacy of topical cadexomer iodine treatment in chronic wounds: systematic review and meta-analysis of comparative clinical trials. *Int Wound J*. 2021;18(5):586–597. [STAT]
6. Dinh A, Bouchand F, Davido B, et al. Management of established pressure ulcer infections in spinal cord injury patients. *Med Mal Infect*. 2019;49(1):9–16. [LIT REV]
7. Dissemond J, Böttrich JG, Braunwarth H, Hilt J, Wilken P, Münter KC. Evidence for silver in wound care – meta-analysis of clinical studies from 2000 to 2015. *J Dtsch Dermatol Ges*. 2017;15(5):524–535. [STAT]
8. Schultz G, Bjarnsholt T, James GA, et al. Consensus guidelines for the identification and treatment of biofilms in chronic nonhealing wounds. *Wound Repair Regen*. 2017;25(5):744–757. [STAT]
9. Bellingeri A, Falciani F, Traspedini P, et al. Effect of a wound cleansing solution on wound bed preparation and inflammation in chronic wounds: a single-blind RCT. *J Wound Care*. 2016;25(3):160, 162–166, 168. [RCT]
10. Norman G, Dumville JC, Moore ZE, Tanner J, Christie J, Goto S. Antibiotics and antiseptics for pressure ulcers. *Cochrane Database Syst Rev*. 2016;4(4):CD011586. [STAT]

Guideline 3.6: Obtain bacterial balance ($<10^5$ cfu/g of tissue and no beta-haemolytic streptococci) in the pressure ulcer before attempting surgical closure by skin graft, direct wound approximation, pedicled or free flap. (Level I – *no change*).

Principle: A wound containing contaminated foci with $>10^5$cfu/g of tissue cannot be readily closed, as the incidence of wound site complications including dehiscence and persistent infection is 50%–100%.

Updated Evidence:

1. Serena TE, Cole W, Coe S, et al. The safety of punch biopsies on hard-to-heal wounds: a large multicentre clinical trial. *J Wound Care*. 2020; 29:Sup2c, S4–S7. [RCT]
2. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed). EPUAP/NPIAP/PPPIA; 2019. [STAT]

Guideline 3.7: Obtain bone biopsy for culture and histology in cases of suspected osteomyelitis associated with a pressure ulcer. (Level I – *increased*).

Principle: The sensitivity and specificity of noninvasive tests for diagnosing osteomyelitis are not as high as direct bone biopsy and are not as useful in determining treatment.

Updated Evidence:

1. Chicco M, Singh P, Beitverda Y, Williams G, Hirji H, Rao GG. Diagnosing pelvic osteomyelitis in patients with pressure ulcers: a systematic review comparing bone histology with alternative diagnostic modalities. *J Bone Jt Infect*. 2020;6(1):21–32. [STAT]
2. Darren Wong, Paul Holtom, Brad Spellberg, Osteomyelitis complicating sacral pressure ulcers: whether or not to treat with antibiotic therapy. *Clin Infect Dis*. 2019;68(2):338–342. [STAT]
3. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed). EPUAP/NPIAP/PPPIA; 2019. [STAT]
4. Wong D, Holtom P, Spellberg B. Osteomyelitis complicating sacral pressure ulcers: whether or not to treat with antibiotic therapy. *Clin Infect Dis*. 2019;68(2):338–342. [STAT]
5. Nicksic PJ, Sasor SE, Tholpady SS, Wooden WA, Gutwein LG. Management of the pressure injury patient with osteomyelitis: an algorithm. *J Am Coll Surg*. 2017;225(6):817–822. Erratum in: *J Am Coll Surg*. 2018;227(2):302. [LIT REV]
6. Ricci JA, Bayer LR, Orgill DP. Evidence-based medicine: the evaluation and treatment of pressure injuries. *Plast Reconstr Surg*. 2017;139(1):275e–286e. [LIT REV]

Guideline 3.8: Once confirmed, osteomyelitis underlying a pressure ulcer should be adequately debrided and treated with culture-guided antibiotics. Flap reconstruction with well-vascularized tissue may facilitate healing of osteomyelitis in appropriately selected patients. (Level I – *no change*).

Principle: Muscle, myocutaneous, and fasciocutaneous flaps effectively control bacterial levels under acute experimental conditions. However, acute osteomyelitis in pressure ulcers is associated with a high rate of recurrence unless eradicated by a combination of debridement of devitalized bone and antibiotic therapy. Not all patients are appropriate candidates for flap reconstruction. Culture-guided antibiotic therapy for osteomyelitis is recommended for 6 weeks. Eight weeks of antibiotic therapy is recommended for MRSA osteomyelitis.

Updated Evidence:

1. Fähndrich C, Gemperli A, Baumberger M, et al. Treatment approaches of stage III and IV pressure injury in people with spinal cord injury: a scoping review. *J Spinal Cord Med*. 2022:1–11. [STAT]
2. Spellberg B, Aggrey G, Brennan MB, et al. Use of novel strategies to develop guidelines for management of pyogenic osteomyelitis in adults: a WikiGuidelines Group Consensus Statement. *JAMA Netw Open*. 2022;5(5):e2211321. [STAT]
3. Wong D, Holtom P, Spellberg B. Osteomyelitis complicating sacral pressure ulcers: whether or not to treat with antibiotic therapy. *Clin Infect Dis*. 2019;68(2):338–342. [STAT]
4. Kreutzträger M, Voss H, Scheel-Sailer A, Liebscher T. Outcome analyses of a multimodal treatment approach for deep pressure ulcers in spinal cord injuries: a retrospective cohort study. *Spinal Cord*. 2018;56(6):582–590. [RETROS]
5. Nicksic PJ, Sasor SE, Tholpady SS, Wooden WA, Gutwein LG. Management of the pressure injury patient with osteomyelitis: an algorithm. *J Am Coll Surg*. 2017;225(6):817–822. Epub 2017 Sep 5. Erratum in: *J Am Coll Surg*. 2018;227(2):302. [LIT REV]
6. Ricci JA, Bayer LR, Orgill DP. Evidence-based medicine: the evaluation and treatment of pressure injuries. *Plast Reconstr Surg*. 2017;139(1):275e–286e. [LIT REV]

Guideline 3.9: Heel ulcers do not need debridement if they lack signs of inflammation/infection (oedema, erythema, drainage) and are stable with intact dry eschar. (Level I – *increased*).

Principle: The determination of whether to debride heel ulcers depends upon the clinical goals. In those patients with dry heel eschar who cannot be revascularized, have multiple comorbidities, and are immobile with no functional goals the heel eschar may be left intact. Heel ulcers with dry eschar should be monitored closely and debrided if they develop signs of infection.

Updated Evidence:

1. Delmore B, Ayello EA. Heel pressure injuries in the adult critical care population. *Crit Care Nurs Clin North Am*. 2020;32(4):589–599. [LIT REV]
2. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed). EPUAP/NPIAP/PPPIA; 2019. [STAT]
3. Rivolo M, Dionisi S, Olivari D, et al. Heel pressure injuries: consensus-based recommendations for assessment and management. *Adv Wound Care*. 2020;9(6):332–347. [STAT]
4. Bosanquet DC, Wright AM, White RD, Williams IM. A review of the surgical management of heel pressure ulcers in the 21st century. *Int Wound J*. 2016;13(1):9–16. [LIT REV]

Guideline 3.10: The establishment of bacterial biofilm contributes to the development of chronic non-healing wounds. A biofilm should be suspected with poorly healing chronic wounds, as well as wounds

with a high multispecies bacterial burden and can be identified using molecular microbial identification. Sharp debridement significantly reduces the number of microorganisms in a wound bed and is vital in biofilm control. Multiple other approaches and methods, such as laser light therapy, photodynamic therapy, low-frequency ultrasound, larval therapy, and wireless bio-electric dressings, have shown potential in combating biofilm infection. However, further research with randomised controlled trials is warranted to confirm clinical effectiveness of these alternative approaches. (Level I – *increased*)

Principle: Bacterial biofilm is a significant barrier to wound healing. Biofilms are communities of microorganisms organised into microcolonies that grow within a matrix of secreted extracellular polymeric substance. As a result, they are typically multispecies and metabolically inert. These characteristics make them resistant to most currently used antimicrobial techniques. In animal models, biofilm formation in the wound is associated with continuous inflammation and delayed wound healing.

Updated Evidence:

1. Gomes F, Furtado GE, Henriques M, et al. The skin microbiome of infected pressure ulcers: A review and implications for health professionals. *Eur J Clin Invest*. 2022;52(1):e13688. [LIT REV]
2. Swanson T, Ousey K, Haesler E, et al. IWII Wound Infection in Clinical Practice consensus document: 2022 update. *J Wound Care*. 2022;31(Suppl 12):S10–S21. [STAT]
3. Akhtar F, Khan AU, Misba L, Akhtar K, Ali A. Antimicrobial and antibiofilm photodynamic therapy against vancomycin resistant Staphylococcus aureus (VRSA) induced infection in vitro and in vivo. *Eur J Pharm Biopharm*. 2021;160:65–76. [EXP]
4. Kataoka Y, Kunimitsu M, Nakagami G, Koudounas S, Weller CD, Sanada H. Effectiveness of ultrasonic debridement on reduction of bacteria and biofilm in patients with chronic wounds: a scoping review. *Int Wound J*. 2021;18(2):176–186. [LIT REV]
5. Sen CK, Roy S, Mathew-Steiner SS, Gordillo GM. Biofilm management in wound care. *Plast Reconstr Surg*. 2021;148(2):275e–288e. [LIT REV]
6. Shibata K, Ogai K, Ogura K, et al. Skin physiology and its microbiome as factors associated with the recurrence of pressure injuries. *Biol Res Nurs*. 2021;23(1):75–81. [PCOH]
7. Barki KG, Das A, Dixith S, et al. Electric field based dressing disrupts mixed-species bacterial biofilm infection and restores functional wound healing. *Ann Surg*. 2019;269(4):756–766. [EXP]
8. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed). EPUAP/NPIAP/PPPIA; 2019. [STAT]
9. Rupel K, Zupin L, Ottaviani G, et al. Blue laser light inhibits biofilm formation in vitro and in vivo by inducing oxidative stress. *npj Biofilms Microbiomes*. 2019;5(1):29. [EXP]
10. Chang YR, Perry J, Cross K. Low-frequency ultrasound debridement in chronic wound healing: a systematic review of current evidence. *Plast Surg (Oakv)*. 2017;25(1):21–26. [LIT REV]
11. Nakagami G, Schultz G, Gibson DJ, et al. Biofilm detection by wound blotting can predict slough development in pressure ulcers: a prospective observational study. *Wound Repair Regen*. 2017;25(1):131–138. [PCOH]
12. Rahim K, Saleha S, Zhu X, Huo L, Basit A, Franco OL. Bacterial contribution in chronicity of wounds. *Microb Ecol*. 2017;73(3):710–721. [LIT REV]
13. Schultz G, Bjarnsholt T, James GA, et al. Consensus guidelines for the identification and treatment of biofilms in chronic nonhealing wounds. *Wound Repair Regen*. 2017;25(5):744–757. [STAT]
14. Snyder RJ, Bohn G, Hanft J, et al. Wound biofilm: current perspectives and strategies on biofilm disruption and treatments. *Wounds*. 2017;29(6):S1–S17. [LIT REV]
15. Zhao R, Liang H, Clarke E, Jackson C, Xue M. Inflammation in chronic wounds. *Int J Mol Sci*. 2016;17(12):2085. [LIT REV]
16. Scalise A, Bianchi A, Tartaglione C, et al. Microenvironment and microbiology of skin wounds: the role of bacterial biofilms and related factors. *Semin Vasc Surg*. 2015;28(3-4):151–159. [LIT REV]
17. Suleman L, Percival SL. Biofilm-infected pressure ulcers: current knowledge and emerging treatment strategies. *Adv Exp Med Biol*. 2015;831:29–43. [LIT REV]

Guideline 3.11: Minimally invasive methods to monitor the wound bed in real time may provide objective means to evaluate healing and guide therapy. Further research with randomised controlled trials is warranted for standardisation. One example is testing wound fluid for proteolytic activity. High levels of proteases may be indicative of wound infection or may be due to host factors. Concurrent treatment of wound infection with a targeted protease modulator may facilitate wound closure. Wound fluid can be retested as needed until the levels of proteases are normal. Vacuum drainage, extraction from absorbent material or collection beneath occlusive dressings can serve as methods for gathering samples of chronic wound fluid. The choice of collection technique hinges on factors such as the specific wound type and the volume of fluid involved. (Level I – *increased*).

Principle: The remodelling and deposition of extracellular matrix in the wound bed is affected by proteolytic activity. The total protease activity is a combination of host and bacterial proteases which act synergistically to promote tissue breakdown in infected wounds. Bacterial proteases may upregulate host production of matrix metalloproteinases. The combination of bacterial and host proteases can lead to an imbalance resulting in tissue destruction, cytokine degradation and loss of cellular function. Modulation of protease levels may facilitate healing.

Updated Evidence:

1. Harvey J, Mellody KT, Cullum N, Watson REB, Dumville J. Wound fluid sampling methods for proteomic studies: a scoping review. *Wound Repair Regen*. 2022;30(3):317–333. [STAT]
2. Serena TE, Bayliff SW, Brosnan PJ. Bacterial protease activity: a prognostic biomarker of early wound infection. *J Wound Care*. 2022 31(4):352–355. [RCT]

3. Brown MS, Ashley B, Koh A. Wearable technology for chronic wound monitoring: current dressings, advancements, and future prospects. *Front Bioeng Biotechnol*. 2018;6:47. [LIT REV]
4. Patry J, Blanchette V. Enzymatic debridement with collagenase in wounds and ulcers: a systematic review and meta-analysis. *Int Wound J*. 2017;14(6):1055–1065. [STAT]
5. Ramsay S, Cowan L, Davidson JM, Nanney L, Schultz G. Wound samples: moving toward a standardised method of collection and analysis. *Int Wound J*. 2016;13(5):880–891. [LIT REV]
6. Kitamura A, Yoshida M, Minematsu T, et al. Prediction of healing progress of pressure ulcers by distribution analysis of protein markers on necrotic tissue: a retrospective cohort study. *Wound Repair Regen*. 2015;23(5):772–777. [RETROS]
7. McCallon SK, Frilot C. A retrospective study of the effects of clostridial collagenase ointment and negative pressure wound therapy for the treatment of chronic pressure ulcers. *Wounds*. 2015;27 (3):44–53. [RETROS]

6 | WOUND BED PREPARATION

Preamble: Wound bed preparation is defined as the management of the wound to accelerate endogenous healing or to facilitate the effectiveness of other therapeutic measures. The aim of wound bed preparation is to convert the molecular and cellular environment of a chronic wound to that of an acute healing wound.

Guideline 4.1: Examination of the patient as a whole is important to evaluate and correct causes of tissue damage. It is important to examine the patient's systemic diseases and medications. (Level I – *no change*).

Principle: When integrating the necessary steps of the wound bed preparation process, it is paramount to first consider other contributing aetiologies that might interfere with wound closure and to evaluate the individuals' other indirect comorbidities. General medical history, including a medication record, will help in identifying and correcting systemic causes of impaired healing. Any major illness, systemic disease or drug therapies that cause alterations in immune functioning, metabolism, nutrition, and tissue perfusion will interfere with wound healing. Systemic disease, such as systemic sepsis, organ failure, (hepatic, renal, respiratory, gut), major trauma/burns, diabetes, autoimmune diseases will delay wound healing.

Updated Evidence:

1. Alam W, Hasson J, Reed M. Clinical approach to chronic wound management in older adults. *J Am Geriatr Soc*. 2021;69(8):2327–2334. [LIT REV]
2. Eriksson E, Liu PY, Schultz GS, et al. Chronic wounds: treatment consensus. *Wound Repair Regen*. 2022;30(2):156–171. [STAT]

Guideline 4.2: Examination of the patient as a whole is important to evaluate and correct causes of tissue damage. It is important to examine the patient's nutritional status. (Level II – *no change*).

Principle: Nutrition must be adequate to provide sufficient protein to support the growth of granulation tissue. Patients' barriers to achieving dietary sustenance should be kept in mind when prescribing supplementation. (See also the nutritional sections of this guideline).

No updated evidence.

Guideline 4.3: Examination of the patient as a whole is important to evaluate and correct causes of tissue damage. It is important to examine the patient's tissue perfusion and oxygenation. (Level I – *no change*).

Principle: Wounds will heal in an environment that is adequately oxygenated. Oxygen delivery to the wound will be impaired if tissue perfusion is inadequate. Dehydration and factors that increase sympathetic tone such as cold, stress, or pain will all decrease tissue perfusion. Cigarette smoking decreases tissue oxygen by peripheral vasoconstriction. Patients whose wounds are ischemic should be referred to a vascular surgeon before aggressively engaging in moist wound healing and wound debridement.

No updated evidence.

Guideline 4.4: Initial debridement is required to remove the obvious necrotic tissue, excessive bacterial burden, and cellular burden of dead and senescent cells. Please refer to Guideline 3.2 for additional methods of debridement that have been shown to reduce bacterial burden. Maintenance debridement is needed to maintain the appearance and readiness of the wound bed for healing.

The healthcare provider can choose from a number of debridement methods including sharp, mechanical, enzymatic and autolytic. More than one debridement method may be appropriate. (Level I – *no change*).

Principle: Once tissue perfusion is checked (see Guideline #4.3) and ischemia has been ruled out, initial and maintenance debridement of devitalized tissue in the wound bed should become routine with regards to wound care. Debridement will remove necrotic tissue, senescent cells, decrease bacterial bioburden and disrupt biofilms. The health care provider can choose from a number of debridement methods including sharp, mechanical, enzymatic and autolytic. More than one debridement method may be appropriate. Goals in selecting a debridement method include considerations of pain, acceptability to the patient and caregivers and availability (as not all methods are readily available). Wounds covered with dry eschar that are not infected, but ischemic should not be debrided until patient's arterial flow is re-established and/or unless symptoms of acute infection or wet gangrene ensue.

A. Surgical or sharp debridement: involves use of instruments (scissors, scalpels, forceps) or laser to remove necrotic tissue from the wound. Debridement of large amounts of necrotic tissue should be done in the operating room. Surgical debridement is indicated when the goal is to achieve fast and effective removal of large amounts of necrotic tissue. Surgical debridement is contraindicated if there is lack of expertise in this method, inadequate vascular supply to the wound and absence of systemic antibacterial coverage in systemic sepsis. Relative contraindication is bleeding disorders or anticoagulation therapy.

Updated Evidence:

1. Anvar B, Okonkwo H. Serial surgical debridement of common pressure injuries in the nursing home setting: Outcomes and findings. *Wounds*. 2017; 29(7):215–221. [RETROS]
2. Bosanquet DC, Wright AM, White RD, Williams IM. A review of the surgical management of heel pressure ulcers in the 21st century. *Int Wound J*. 2016;13(1):9–16. [LIT REV]
3. Eriksson E, Liu PY, Schultz GS, et al. Chronic wounds: treatment consensus. *Wound Repair Regen*. 2022;30(2):156–171. [STAT]

B. Mechanical debridement: physically removes necrotic tissue with wet-to-dry dressings, wound irrigation, and whirlpool techniques. Wet to dry dressing may induce mechanical separation of eschar but can be painful and if dry, may damage viable newly formed tissue. High or low pressure streams or pulsed lavage may be quite effective in removing loose necrotic tissue, provided the pressure does not cause trauma to the wound bed. Effective ulcer irrigation pressures range from 4 to 15 psi of pressure. A 30 mL syringe filled with saline can be used to flush a wound through an 18 gauge catheter. Irrigation pressures below 4 psi may not be effective to cleanse the wound and pressures greater than 15 psi may cause trauma and drive the bacteria into the tissue. Whirlpool therapy is no longer recommended due to increased risk for bacterial contamination, circulatory compromise and tissue maceration. There are other materials such as monofilament fibre technology that have demonstrated to be effective in removal of slough and biofilms and are atraumatic to wound bed.

Updated Evidence:

1. Roes C, Calladine L, Morris C. Biofilm management using monofilament fibre debridement technology: outcomes and clinician and patient satisfaction. *J Wound Care*. 2019;28(9):608–622. [CASE S]
2. Schultz GS, Woo K, Weir D, Yang Q. Effectiveness of a monofilament wound debridement pad at removing biofilm and slough: ex vivo and clinical performance. *J Wound Care*. 2018;27(2):80–90. [EXP] [CASE S]

C. Enzymatic debridement: is achieved by topical application of exogenous enzymes to the wound surface to remove necrotic tissue.

No updated evidence.

D. Autolytic debridement: is achieved when a moist wound environment is created over time by the use of an occlusive dressing. These dressings allow the natural wound fluid and its endogenous enzymes to soften and liquefy slough and promote granulation. During each dressing change the wound needs to be cleansed to remove devitalized tissue created in the autolytic process. If tissue autolysis is not apparent in 1–2 weeks, another debridement method should be used. Autolytic debridement is not recommended for infected wounds or very deep wounds that require packing.

No updated evidence.

E. Biological debridement: is the application of irradiated maggots delivered from the *Lucilia sericata* fly to a necrotic wound that both eat and chemically degrade necrotic tissue.

No updated evidence.

Guideline 4.5: Wounds should be cleansed initially and at each dressing change using a pH-balanced, nonirritating, nontoxic solution. Routine wound cleansing should be accomplished with a minimum of chemical and/or mechanical trauma. (Level III – *no change*).

Principle: Cleansing the wound removes loose impediments that can deter wound healing. Clinical experience has shown that mild soap (nonperfumed, without added anti-bacterial agents and at skin pH: 4.5–5.7) and water for cleansing, used regularly, is effective, safe and cheap. Using tap water from a reliable source does not increase the rate of infection (see Guideline #3.5). A 2008 Cochrane review on wound cleansers specifically for pressure ulcers supports the use of solutions that are least cytotoxic to the wound bed including saline, water, and acetic acid (0.5%–1.0%). However, there is currently no evidence to support the use of any particular wound cleanser over another. Wound antiseptic agents, for example, hydrogen peroxide, hypochlorite solution, acetic acid, chlorhexidine, povidone/iodine, cetrimide, and others have antibacterial properties, but are all toxic to healthy granulation tissue. Solutions with dilute stabilised hypochlorous acid as the active agent have shown efficacy against biofilms. Further studies are necessary to investigate and compare the in vivo efficacy of these products in clinical care.

Updated Evidence:

1. Masunaga A, Kawahara T, Morita H, Nakazawa K, Tokunaga Y, Akita S. Fatty acid potassium improves human dermal fibroblast viability and cytotoxicity, accelerating human epidermal keratinocyte wound healing in vitro and in human chronic wounds. *Int Wound J*. 2021;18(4):467–77. [EXP]
2. Harriott MM, Bhindi N, Kassis S, et al. Comparative antimicrobial activity of commercial wound-care solutions on bacterial and fungal biofilms. *Ann Plast Surg*. 2019;83(4):404–410. [EXP]
3. Moore Z, Cowman S. A systematic review of wound cleansing for pressure ulcers. *J Clin Nurs*. 2008;17(15):1963–1972. [STAT]

Guideline 4.6: Infection control should be achieved by reducing wound bacterial burden and achieving wound bacterial balance. (For detailed information on this please refer to Guideline #3 on Infection) (Level I – *no change*).

Principle: Infection will cause wound healing failure often with progressive deterioration of the wound. Systemically administered antibiotics do not effectively decrease bacterial levels in granulating wounds. Other methods that may be suitable include enhancing host defence mechanisms, debridement, wound cleaning, and topical antimicrobials. For ulcers with 1×10^6 or higher cfu/gram of tissue or any tissue level of beta haemolytic streptococci following adequate debridement, decrease the bacterial level by a topical antimicrobial. Once in bacterial balance, that is, 10^5 cfu or less/gram of tissue and no beta haemolytic streptococci in the ulcer, discontinue the use of topical antimicrobial to minimise possibility of emergence of resistance. In chronic wounds, the pathogen species maybe more important than number of bacteria. Obtain bone biopsy for culture and histology (gold standard) in case of suspected osteomyelitis. Treat

confirmed debrided osteomyelitis with flap containing muscle or fascia and culture-determined antibiotics.

No updated evidence.

Guideline 4.7: For nonischemic wounds, achieve local moisture balance by management of exudate. (Level I – *no change*).

Principle: Local moisture balance is necessary to facilitate granulation and reepithelization of the ulcer. A moist wound environment accelerates wound healing with more rapid epithelization. Many dressings now combine wound bed preparation, that is, debridement and/or antimicrobial activity, with moisture control. Moist wound dressings should keep the ulcer bed continuously moist and at the same time control the exudate to prevent desiccation of the ulcer bed and maceration of the peri-ulcer skin. The use of haemostatic dressings may be required immediately after sharp debridement, especially in patients taking anticoagulants. Moist dressings should be re-instituted as soon as haemostasis is achieved. Moist dressings may also be used in conjunction with mechanical or enzymatic debridement techniques. (For more details see Guideline #5: Dressings).

Updated Evidence:

1. Develle R, Schaerf R, Najibi S, Conrad J, Abate G. Efficacy and safety of regenerated cellulose topical gauze haemostats in managing secondary haemostasis: a randomised control trial. *J Wound Care*. 2020;11:670–677 [CER]
2. Keast DH, Janmohammad A. The hemostatic and wound healing effect of chitosan following debridement of chronic ulcers. *Wounds*. 2021;33(10):263–270. [PCOH]
3. Thibodeaux KT, Speyrer MS, Thibodeaux RP, Rogers AA, Rippon MG. Management of postoperative bleeding in surgically debrided wounds: topical haemostat versus electrocautery. *J Wound Care*. 2020;29(8):444–451. [CER]

Guideline 4.8: Biofilm (*new*): Early intervention with multiple therapies and effective antibiofilm antiseptics is key to reduce biofilm and inflammation. (Level II).

Principle: Biofilm is prevalent in chronic wounds and a major barrier to wound healing. The immunological response to biofilms causes tissue damage and impairs healing. Wound biofilm makes the chronic wound resistant to topical and systemic antimicrobials unless the biofilm matrix is interrupted by debridement. Biofilms form not only on the surface of the wound but also exist below the surface. Debridement is one of the most important treatment strategies against biofilms, but does not remove all biofilm, and therefore cannot be used alone—this is one of the critical principles of wound bed preparation. Biofilms can reform rapidly; repeated debridement alone is unlikely to prevent biofilm regrowth; however, effective topical antiseptic application within this time-dependent window can suppress biofilm reformation.

Updated Evidence:

1. Ghoreishi FS, Roghanian R, Emtiazi G. Novel chronic wound healing by anti-biofilm peptides and protease. *Adv Pharm Bull*. 2022;12(3):424–436. [LIT REV]
2. Malone M, Schultz G. Challenges in the diagnosis and management of wound infection. *Br J Dermatol*. 2022;187(2):159–166. [LIT REV]
3. Brown HL, Clayton A, Stephens P. The role of bacterial extracellular vesicles in chronic wound infections: current knowledge and future challenges. *Wound Repair Regen*. 2021;29(6):864–880. [LIT REV]
4. Koyanagi H, Kitamura A, Nakagami G, Kashiwabara K, Sanada H, Sugama J. Local wound management factors related to biofilm reduction in the pressure ulcer: a prospective observational study. *Jpn J Nurs Sci*. 2021;18(2):e12394. [CASE S]
5. Raziyeva K, Kim Y, Zharkinbekov Z, Kassymbek K, Jimi S, Saparov A. Immunology of acute and chronic wound healing. *Biomolecules*. 2021;11(5):700. [LIT REV]
6. Azevedo MM, Lisboa C, Cobrado L, Pina-Vaz C, Rodrigues A. Hard-to-heal wounds, biofilm and wound healing: an intricate interrelationship. *Br J Nurs*. 2020;29(5):S6–S13. [LIT REV]
7. Nakagami G, Schultz G, Kitamura A, et al. Rapid detection of biofilm by wound blotting following sharp debridement of chronic pressure ulcers predicts wound healing: a preliminary study. *Int Wound J*. 2020;17(1):191–196.[EXP]
8. Schwarzer S, James GA, Goeres D, et al. The efficacy of topical agents used in wounds for managing chronic biofilm infections: a systematic review. *J Infect*. 2020;80(3):261–270. [LIT REV]
9. Schultz G, Bjarnsholt T, James GA, et al. Consensus guidelines for the identification and treatment of biofilms in chronic nonhealing wounds. *Wound Repair Regen*. 2017;25(5):744–757. [STAT]

Guideline 4.9: There should be an ongoing and consistent documentation of wound history, recurrence and characteristics (location, staging, size, base, exudates, infection condition of surrounding skin and pain). The rate of wound healing should be evaluated to determine if treatment is optimal. (Level III – *no change*).

Principle: Ongoing evaluations of wound bed preparation are necessary because if the ulcer is not healing at the expected rate, interventions for wound bed preparation need to be reassessed. The longer the duration of the ulcer, the more difficult it is to heal. If an ulcer is recurrent, patient education or issues of prevention and long-term maintenance need to be reassessed.

No updated evidence.

7 | DRESSINGS

Preamble: There is a multitude of choices for topical treatment of pressure ulcers. Many dressings combine wound bed preparation, that is, debridement and/or antimicrobial activity, with moisture control and most strive for reducing the frequency of dressing changes to reduce overall treatment cost. These guidelines are intended to assist the clinician in making decisions regarding the value and best use of these advanced wound care products.

Guideline 5.1: Treat all nonischemic wounds using a dressing that will maintain a moist wound environment. (Level I – *no change*).

Principle: A moist wound environment physiologically favours cell migration and matrix formation while accelerating healing of wounds by promoting autolytic debridement. Moist wound healing also reduces wound pain.

Updated Evidence:

1. Vaziri M, Hasanpour Dehkordi A, Salehi Tali S, Ebrahimi N. The effects of Boswellia (Frankincense) gel and hydrocolloid dressing on healing of second- and third-degree pressure ulcers among hospitalised patients. *J Herbal Med*. 2021;29:100461. [RCT]
2. Smaropoulos E, Cremers NAJ. Treating severe wounds in paediatrics with medical grade honey: a case series. *Clin Case Rep*. 2020;8(3):469–476. [CASE S]
3. Hampton S. Turning black or yellow wounds red using a hydroresponsive dressing. *Br J Community Nurs*. 2019;24(Suppl 3):S20–S24. [CASE S]
4. Nazarko L. Choosing the correct wound care dressing: an overview. *J Commun Nurs*. 2018;32(5):42+. https://link.gale.com/apps/doc/A584852868/AONE?u=txshracd2618&sid=googleScholar&xid=994c1a0b [TECH]
5. Westby MJ, Dumville JC, Soares MO, Stubbs N, Norman G. Dressings and topical agents for treating pressure ulcers. *Cochrane Database Syst Rev*. 2017;6(6):CD011947. [STAT]
6. Dumville JC, Keogh SJ, Liu Z, Stubbs N, Walker RM, Fortnam M. Alginate dressings for treating pressure ulcers. *Cochrane Database Syst Rev* 2015;5:CD011277. [STAT]

Guideline 5.2 (*revised*): Use clinical judgement to select a moist wound dressing. (Level I – *no change*).

Principle: Results from existing studies have not demonstrated any specific moisture retentive topical therapy to be superior in terms of healing rate. Wet-to-dry dressings are not continuously moist and are an inappropriate wound dressing selection. Some dressings can provide both a moist wound environment and decrease bacterial bioburden in the wound (see References #9–17 (below) and also Guideline #4.6).

Updated Evidence:

1. Asgari P, Zolfaghari M, Bit-Lian Y, Abdi AH, Mohammadi Y, Bahramnezhad F. Comparison of hydrocolloid dressings and silver nanoparticles in treatment of pressure ulcers in patients with spinal cord injuries: a randomised clinical trial. *J Caring Sci*. 2022;11(1):1–6. [RCT]
2. Aswathanarayan JB, Rao P, Siddaiahswamy HM, Sowmya GS, Rai RV. Biofilm-associated infections in chronic wounds and their management. In: Advances in Experimental Medicine and Biology. Cham: Springer. [LIT REV]
3. Menack MJ, Thibodeaux KT, Trabanco C, Sabolinski ML. Effectiveness of type I collagen matrix plus polyhexamethylene biguanide antimicrobial for the treatment of pressure injuries. *Wounds*. 2022;34(6):159–164. [RETROS]
4. Menegasso JF, Moraes NAC, Vásquez TP, Felipetti FA, Antonio RV, Dutra RC. Modified montmorillonite-bacterial cellulose composites as a novel dressing system for pressure injury. *Int J Biol Macromol*. 2022;194:402–411. [EXP]
5. Monteiro Vasconcelos F, Cabral Pereira da Costa C, et al. Microbiological identification and resistance profile of microorganisms in pressure injuries after the use of polyhexamethylene biguanide: a series of fourteen cases. *Wounds*. 2022;33(2):51–56. [CASE S]
6. He W, Wu J, Xu J, Mosselhy DA, Zheng Y, Yang S. Bacterial cellulose: functional modification and wound healing applications. *Adv Wound Care*. 2021;10(11):623–640. [LIT REV]
7. Pereira GF, Balmith M, Nell M. The efficacy of honey as an alternative to standard antiseptic care in the treatment of chronic pressure ulcers and diabetic foot ulcers in adults. *Asian J Pharm Clin Res*. 2021;14(11):30–40. [LIT REV]
8. Rippon MG, Rogers AA, Ousey K. Antimicrobial stewardship strategies in wound care: evidence to support the use of dialkylcarbamoyl chloride (DACC)-coated wound dressings. *J Wound Care*. 2021;30(4):284–296. [LIT REV]
9. Sankar J, Lalitha V, Rameshkumar R, Mahadevan S, Kabra SK, Lodha R. Use of honey versus standard care for hospital-acquired pressure injury in critically ill children: a multicenter randomised controlled trial. *Pediatr Crit Care Med*. 2021;22(6):e349–e362. [RCT]
10. Senejko M, Pasek J, Szajkowski S, Cieślar G, Sieroń A. Evaluation of the therapeutic efficacy of active specialistic medical dressings in the treatment of decubitus. *Postepy Dermatol Alergol*. 2021;38(2):75–79. [RCT]
11. Zhang L, Wang S, Tan M, Zhou H, Tang Y, Zou Y. Efficacy of oxidised regenerated cellulose/collagen dressing for management of skin wounds: a systematic review and meta-analysis. *J Evid Based Complementary Altern Med*. 2021;1058671. [STAT]
12. Chin IBI, Yenn TW, Ring LC, et al. Phomopsidione-loaded chitosan polyethylene glycol (peg) nanocomposite dressing for pressure ulcers. *J Pharm Sci*. 2020;109(9):2884–2890. [EXP]
13. Wei M, Jiagn Q, Niu N, et al. Reduction of biofilm in chronic wound by antibacterial protease combined with silver dressing. *Int J Clin Exp Med*. 2019;12(10):12293–12302. [RCT]
14. Nogueira F, Gouveia IC. Amino acid-based material for the complementary therapy of decubitus ulcers. *J Microbiol Biotechnol*. 2017;27(4):747–758. [EXP]
15. Gong F, Niu J, Pei X. Clinical effects of *Angelica dahurica* dressing on patients with I-II phase pressure sores. *Die Pharmazie*. 2016;71(11):665–669. [RCT]
16. Jull AB, Cullum N, Dumville JC, Westby MJ, Deshpande S, Walker N. Honey as a topical treatment for wounds. *Cochrane Database Syst Rev*. 2015;3:CD005083. [STAT]
17. Yunoki S, Kohta M, Ohyabu Y, Iwasaki T. In vitro parallel evaluation of antibacterial activity and cytotoxicity of commercially available silver-containing wound dressings. *Plast Surg Nurs*. 2015;35(4):203–211. [EXP]

Guideline 5.3: Select a dressing that will manage the wound exudate and protect the peri-ulcer skin. (Level I – *no change*).

Principle: Periwound maceration and continuous contact with wound exudate can enlarge the wound and impede healing.

Updated Evidence:

1. Chotchoungchatchai S, Krairit O, Tragulpiankit P, Prathanturarug S. The efficacy of honey and a Thai Herbal Oil preparation in the treatment of pressure ulcers based on Thai traditional medicine wound diagnosis versus standard practice: An open-label randomised controlled trial. *Contemp Clin Trials Commun*. 2020;17:100538. [RCT]
2. Hasegawa M, Inoue Y, Kaneko S, et al. Wound, pressure ulcer and burn guidelines – 1: guidelines for wounds in general, second edition. *J Derm*. 2020;47(8):807–833. [LIT REV]
3. Chamorro AM, Vidal Thomas MC, Mieras AS, et al. Multicenter randomised controlled trial comparing the effectiveness and safety of hydrocellular and hydrocolloid dressings for treatment of category II pressure ulcers in patients at primary and long-term care institutions. *Int J Nurs Stud*. 2019;94:79–185. [RCT]
4. Rosa CA, Paggiaro AO, Carvalho VF. Effect of hydrogel enriched with alginate, fatty acids, and vitamins a and e on pressure injuries: a case series. *Plast Surg Nurs*. 2019;39(3):87–94. [CASE S]
5. Welch D, Hepworth L, Barrett S, Overfield J, Forder R. Clinical evaluation of the effect of ActivHeal Aquafiber Ag dressing. *Wounds UK*. 2017;13(4):118–126. [CASE S]
6. Bullough L, Fumerola S, Forster E, Ivins N, Timmons J. A small multicentre evaluation of a new gelling fibrous silver dressing. *J Community Nurs*. 2015;29(2):34–40. [CASE S]
7. Hao DF, Feng G, Chu WL, Chen ZQ, Li SY. Evaluation of effectiveness of hydrocolloid dressing vs ceramide containing dressing against pressure ulcers. *Eur Rev Med Pharm Sci*. 2015;19(6):936–941. [CASE S]
8. Qaseem A, Humphrey LL, Forciea MA, Starkey M, Denberg TD, Clinical Guidelines Committee of the American College of Physicians. Treatment of pressure ulcers: a clinical practice guideline from the American College of Physicians. *Ann Intern Med*. 2015;162(5):370–379. [LIT REV]

Guideline 5.4: Select a dressing that minimises issues with friction, shearing, skin irritation and additional pressure (Level II – *no change*).

Principle: Wound location, peri-wound skin quality, incontinence of urine or stool and patient activity can all affect the choice of dressing. Some dressings have been designed to be self-adherent; some are designed to fill a cavity. Additional tissue damage may result if the dressing causes increased pressure on the wound or damages adjacent tissue.

Updated Evidence:

1. Bai Y, Li X, Zhang M. Study on the effect of combined application of foam dressing, hydrocolloid dressing and wound treatment on nursing prognosis and pressure score improvement of patients with stage I-II pressure ulcer. *Int J Clin Exp Med*. 2020;13(9):6379–6386. [RCT]
2. Henson A, Kennedy-Malone L. A quality improvement project comparing two treatments for deep-tissue pressure injuries to feet and lower legs of long-term care residents. *Adv Skin Wound Care*. 2020;33(11):594–598. [RETROS]
3. Kamińska MS, Cybulska AM, Skonieczna-Żydecka K, Augustyniuk K, Grochans E, Karakiewicz B. Effectiveness of hydrocolloid dressings for treating pressure ulcers in adult patients: a systematic review and meta-analysis. *Int J Environ Res Public Health*. 2020;17(21):7881. [STAT]
4. Takahashi J, Nakae K, Miyagawa M, et al. Plastic wrap as a dressing material to treat stage II pressure ulcers: a randomized controlled trial to evaluate plastic wrap dressing treatment versus standard treatment. *Int J Clin Exp Med*. 2020;13(9):7154–7161. [RCT]
5. Walker RM, Gillespie BM, Thalib L, Higgins NS, Whitty JA. Foam dressings for treating pressure ulcers. *Cochrane Database Syst Rev*. 2017;10(10):CD011332. [STAT]

Guideline 5.5: Select a dressing that is cost effective. (Level I – *no change*).

Principle: Because the initial cost of moist gauze is lower than advanced wound care products, there is a perception that moist gauze is more cost effective. When determining cost efficacy, it is important to take into consideration health care provider time, patient care goals and resources, frequency of dressing changes, ease of use and healing rate, as well as the unit cost of the dressing.

Updated Evidence:

1. Dreyfus J, Delhougne G, James R, Gayle J, Waycaster C. Clostridial collagenase ointment and medicinal honey utilisation for pressure ulcers in US hospitals. *J Med Econ*. 2018;21(4):390–397. [RETROS]
2. Swan J. Use of dermal gel pads in preventing and managing pressure ulcers in ICU: an audit. *Br J Nurs*. 2018;27(20):S42–S47. [RETROS]
3. Inoue KC, Matsuda LM. Cost-effectiveness of two types of dressing for prevention of pressure ulcer. *Acta Paul Enferm*. 2015;28(5):415–419. [RCT]

8 | SURGICAL TREATMENT

Preamble: Surgical treatment of pressure injury/ulcers is often considered to be a final invasive choice for wounds refractory to less aggressive care or for use when rapid closure is indicated, however, recent literature suggests that surgery can and should be performed safely in properly selected patients. Peri-operative morbidity and greater risk of complications are inherent to surgical options, including anaesthetic risk. Surgical procedures can be divided into those which prepare the patient for successful healing, such as debridement, and those which provide definitive closure. Reports of randomised clinical trials for operative treatment of pressure ulcers are almost non-existent in the literature. A Cochrane review from 2016 found no published or unpublished RCTs addressing surgical treatment of pressure ulcers, nor any registered studies investigating the role of reconstructive

surgery in the management of pressure ulcers.[1] A more recent Cochrane review identified a single small RCT but report that the study did not answer the questions posed in terms of the difference in the two techniques on wound healing, reopening or recurrence.[2]

This does not imply that there are no data, but that studies comparing similar groups of patients undergoing reconstructive surgery to those who did not have surgery have not been done. These revised guidelines contain new recommendations related to surgical decision making and peri-operative management of pressure ulcer patients. Case reports and technique-specific articles were excluded in this review.

1. Wong JKF, Amin K, Dumville JC. Reconstructive surgery for treating pressure ulcers. *Cochrane Database Syst Rev*. 2016;1.
2. Norman G, Wong JKF, Amin K, Dumville JC, Pramod S. Reconstructive surgery for treating pressure ulcers. *Cochrane Database Syst Rev*. 2022;10:CD012032.

Guideline 6.1: Irregular wound extensions, forming sinuses or cavities, must be explored and unroofed and treated. (Level III – *no change*).

Principle: Tissue not exposed to treatment agents or devices cannot be expected to respond to the regimen and proceed to healing. Negative pressure wound therapy with irrigation may facilitate mechanical debridement and cleansing of complex deep wounds.

Updated Evidence:

1. Wei Z, Zhu J, Lin T, et al. Application of damage control surgery in patients with sacrococcygeal deep decubitus ulcers complicated by sepsis. *J Int Med Res*. 2021;49(10):3000605211049876. [RETROS]
2. Matiasek J, Djedovic G, Kiehlmann M, Verstappen R, Rieger UM. Negative pressure wound therapy with instillation: effects on healing of category 4 pressure ulcers. *Plast Aesthet Res*. 2018;5:36. [CASE S]
3. Davis KE, Moquin KJ, Lavery LA. The fluid dynamics of simultaneous irrigation with negative pressure wound therapy. *Int Wound J*. 2016;13:469–474. [EXP]
4. Tian G, Guo Y, Zhang Li. Non-invasive treatment for severe complex pressure ulcers complicated by necrotizing fasciitis: a case report. *J Med Case Rep*. 2015;9:220. [CASE S]

Guideline 6.2: Necrotic tissue must be debrided. See Guideline #4.4 in Wound Bed Preparation. (Level I – *no change*).

Principle: Nonviable tissue is detrimental to wound healing. Therefore, it should be debrided to allow the wound to proceed to closure. Debridement should be performed on a regular basis with a systematic approach, as visual inspection is unreliable. Debridement is effective and safe in older adults.

Updated Evidence:

1. Anvar B, Okonkwo H. Serial surgical debridement of common pressure injuries in the nursing home setting: outcomes and findings. *Wounds*. 2017;29(7):215–221. [RETROS]

Guideline 6.3: Infected tissue must be treated by topical antimicrobials, systemic antibiotics, or surgical debridement. See Infection Guidelines. (Level I – *no change*).

Principle (*revised*): Systemic antibiotics are recommended only when there is clinical evidence of systemic sepsis, spreading cellulitis or underlying osteomyelitis. The NICE guidelines (2014), EPUAP, NPIAP and PPPIA Guidelines for Prevention and Treatment of Pressure Ulcers/Injuries (2019) and the International Wound Infection Institute (IWII, 2022) all recommend using multiple signs and symptoms, observing for indirect indicators of systemic infection (e.g., anorexia, delirium and/or confusion) and only doing a wound culture when infection is suspected. The majority of pressure ulcers will improve with debridement. When possible antibiotic therapy should be held until operative wound and/or bone cultures can be obtained. Infected soft tissue or bone will prevent wound healing, whether it is spontaneous or with the aid of surgical intervention. Only tissue with a low bacterial count (10^5/g tissue) and with no beta-haemolytic streptococcus will proceed to closure. Bone biopsy remains the gold standard for diagnosing pelvic osteomyelitis associated with pressure ulcers.

Updated Evidence:

1. Swanson T, Ousey K, Haesler E, et al. IWII wound infection in clinical practice consensus document: 2022 update. *J Wound Care*. 2022;31(Suppl 12):S10–S21. [STAT]
2. Chicco M, Singh P, Beitverda Y, Williams G, Hirji H, Rao GG. Diagnosing pelvic osteomyelitis in patients with pressure ulcers: a systematic review comparing bone histology with alternative diagnostic modalities. *J Bone Jt Infect*. 2020;6(1):21–32. [STAT]
3. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance, Emily Haesler (Ed). Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline; 2019. www.internationalguideline.com [STAT]
4. Andrianasolo J, Ferry T, Boucher F, et al. Pressure ulcer-related pelvic osteomyelitis: evaluation of a two-stage surgical strategy (debridement, negative pressure therapy and flap coverage) with prolonged antimicrobial therapy. *BMC Infect Dis*. 2018;18(1):166. [RETROS]
5. Khansa I, Barker JC, Ghatak PD, Sen CK, Gordillo GM. Use of antibiotic impregnated resorbable beads reduces pressure ulcer recurrence: a retrospective analysis. *Wound Rep Regen*. 2018;26:221–227. [RETROS]
6. Ohlmeier M, Bode A, Suero EM, et al. Outcome of subtrochanteric femur resection in patients with spinal cord injuries. *J Wound Care*. 2018;27(11):774–778. [RETROS]
7. Dudareva M, Ferguson J, Riley N, Stubbs D, Atkins B, McNally M. osteomyelitis of the pelvic bones: a multidisciplinary approach to treatment. *J Bone Jt Infect*. 2017;2(4):184–193. [CASE S]
8. Kamradt T, Klein S, Zimmermann S, et al. Bacterial load of conditioned pressure ulcers is not a predictor for early flap failure in spinal cord injury. *Spinal Cord*. 2017;55(6):535–539. [CASE S]

9. Tedeschi S, Negosanti L, Sgarzani R, et al. Superficial swab versus deep-tissue biopsy for the microbiological diagnosis of local infection in advanced-stage pressure ulcers of spinal-cord-injured patients: a prospective study. *Clin Microbiol Infect*. 2017;23 (12):943–947. [CASE S]
10. Le Fort M, Rome-Saulnier J, Lejeune F, et al. Sepsis of the hip due to pressure sore in spinal cord injured patients: advocacy for a one-stage surgical procedure. *Spinal Cord*. 2015;53(3):226–231. [RETROS]

Guideline 6.4 (*revised*): Underlying bony prominences and fibrotic bursa cavities should be removed. (Level II – *no change*).

Principle: Soft tissue compression between the skeleton and support surfaces leads to pressure necrosis. When performing pressure ulcer surgery, removal of prominences, without excessive excision, alleviates pressure points. Heterotopic ossification associated with pressure ulcers should be removed. Neurogenic heterotopic ossification may require removal to restore joint mobility and remove potential pressure points, however, the rate of recurrence is unpredictable and complications are frequent.

Updated Evidence:

1. Yang K, Graf A, Sanger J. Pressure ulcer reconstruction in patients with heterotopic ossification after spinal cord injury: a case series and review of literature. *J Plast Reconstr Aesthet Surg*. 2017;70 (4):518–528. [CASE S]
2. Rubayi S, Gabbay J, Kruger E, Ruhge K. The modified girdlestone procedure with muscle flap for management of pressure ulcers and heterotopic ossification of the hip region in spinal injury patients: a 15-year review with long-term follow-up. *Ann Plast Surg*. 2016;77 (6):645–652. [RETROS]
3. Genet F, Ruet A, Almangour W, Gati L, Denormandie P, Schnitzler A. Beliefs relating to recurrence of heterotopic ossification following excision in patients with spinal cord injury: a review. *Spinal Cord*. 2015;53(5):340–344. [LIT REV]

Guideline 6.5: Bone excision must not be excessive. (Level III – *no change*).

Principle: Extensive bone excision, especially at the ischial location, can expose deeper structures such as the urethra, or cause a shift of weight bearing, resulting in excessive pressure elsewhere.

No updated evidence.

Guideline 6.6 (*revised*): Patients with sacral and ischial pressure ulcers may benefit from faecal and urinary diversion. However, surgical diversion is not always required to obtain a healed wound and may carry substantial risk. (Level II – *no change*).

Principle: Unless a fistulous track has developed, surgical diversion of the urinary or faecal stream may not be required to heal perianal and perineal pressure ulcers and may carry substantial morbidity and mortality. The risks, benefits and alternative modalities should be evaluated and discussed with the patient and caregivers. Use of a bowel program or catheterization can divert urine and faecal material without the need for additional surgery.

Updated Evidence:

1. Rubio GA, Shogan BD, Umanskiy K, Hurst RD, Hyman N, Olortegui KS. Simple diverting colostomy for sacral pressure ulcers: not so simple after all. *J Gastrointest Surg*. 2022;27(2):382–389. [STAT]
2. Pontell ME, Kucejko R, Scantling D, Weingarten M, Stein DE. Morbidity and mortality in patients undergoing faecal diversion as an adjunct to wound healing: a NSQIP comparison study. *Eur J Plast Surg*. 2019;42:283–290. [STAT]
3. Ratnasekera A, Derr L, Finnegan MJ, Berg DA. Predictors of morbidity in patients undergoing diverting colostomy for non-healing sacral, perineal or ischial wounds. *Wound Med*. 2016;14:12–15. [RETROS]
4. Raup VT, Eswara JR, Weese JR, Potretzke AM, Brandes SB. Urinary-cutaneous fistulae in patients with neurogenic bladder. *Urology*. 2015;86(6):1222–1227. [RETROS]

Guideline 6.7: Consider radical procedures such as amputation or hemicorporectomy only in the rare and extreme cases. (Level II – *no change*).

Principle: Amputation, hemipelvectomy or hemicorporectomy have significant morbidity and mortality, shift pressure points, and rarely address the underlying problem leading to extensive, recurrent pressure ulcers.

Updated Evidence:

1. Georgiou I, Kruppa P, Ghods M. Use of a total leg fillet flap to cover multiple pelvic pressure ulcers. *Plast Reconstr Surg Glob Open*. 2019;7(1):e2084. [TECH]
2. Bosanquet DC, Wright AM, White RD, Williams IM. A review of the surgical management of heel pressure ulcers in the 21st century. *Int Wound J*. 2016;13:9–16. [LIT REV]

Guideline 6.8: A pressure ulcer should be closed surgically if it does not respond to wound care and there is no other contraindication to the surgical procedures. Exceptions may include the elderly or patients with a fatal illness, for whom palliative, local wound care is more appropriate. (Level I – *increased*).

Principle: Wound closure decreases protein loss, fluid loss, the possibility of wound infection, and the later development of malignancy in the wound. Early complication rates are acceptably low.

Updated Evidence:

1. Chiang IH, Wang CH, Tzeng YS. Surgical treatment and strategy in patients with multiple pressure sores. *Int Wound J*. 2018;15:900.
2. Huang CY, Chang CW, Lee SL, et al. The change of clinical features and surgical outcomes in patients with pressure injury during the COVID-19 pandemic. *Int Wound J*. 2022;29. doi: 10.1111/iwj.13944. [RETROS]
3. Pignatti M, D'Arpa S, Roche N, et al. Surgical treatment of pressure injuries in children: A multicentre experience. *Wound Repair Regen*. 2021;29(6):961–972. [RETROS]

4. Lauer H, Goertz O, Kolbenschlag J, Hernekamp JF. Gluteal propeller flaps – a reliable reconstructive alternative for elderly patients with pressure ulcers of the sacrum. *J Tissue Viability*. 2019;28(4):227–230. [CASE S]
5. Firriolo JM, Ganske IM, Pike CM, et al. Long-term outcomes after flap reconstruction in pediatric pressure ulcers. *Ann Plast Surg*. 2018;80(2):159–163. [RETROS]
6. Tran BNN, Chen AD, Kamali P, Singhal D, Lee BT, Fukudome EY. National perioperative outcomes of flap coverage for pressure ulcers from 2005 to 2015 using American College of Surgeons National Surgical Quality Improvement Program. *Arch Plast Surg*. 2018;45(5):418–424. [STAT]
7. Zhao JC, Zhang BR, Shi K, et al. Couple-kissing flaps for successful repair of severe sacral pressure ulcers in frail elderly patients. *BMC Geriatr*. 2017;17:285. [CASE S]
8. Diamond S, Moghaddas HS, Kaminski SS, Grotts J, Ferrigno L, Schooler W. National outcomes after pressure ulcer closure: inspiring surgery. *Am Surg*. 2016;82(10):903–906. [STAT]
9. Tashiro J, Gerth DJ, Thaller SR. Pedicled flap reconstruction for patients with pressure ulcers: complications and resource utilization by ulcer site. *JAMA Surg*. 2016;151(1):93–94. [STAT]
10. Kenneweg KA, Welch MC, Welch PJ. A 9-year retrospective evaluation of 102 pressure ulcer reconstructions. *J Wound Care*. 2015;24 Suppl 4a:S12–S21. [RETROS]
11. Lim S, Kim BD, Kim JY, Ver Halen JP. Preoperative albumin alone is not a predictor of 30-day outcomes in pressure ulcer patients: a matched propensity-score analysis of the 2006–2011 NSQIP datasets. *Ann Plast Surg*. 2015;75(4):439–447. [STAT]

Guideline 6.9: Composite tissue closure leads to the best chance of sustained wound closure, although recurrence and recidivism are continuing problems. (Level II – *no change*).

Principle: The most durable wound closure fills the ulcer with bulk and provides padding over the underlying structures with a tension-free closure. Flap selection for pressure ulcer coverage need not include muscle tissue. It has been demonstrated that there is no statistically significant difference between musculocutaneous, fasciocutaneous, and perforator-based flaps for post-operative complications or recurrence. Therefore, selection of flap material for pressure ulcer coverage can be based on the characteristics of the wound, limitations of the donor and recipient sites and goals of the procedure.

Updated Evidence:

1. Vathulya M, Praveen AJ, Barik S, Jagtap MP, Kandwal P. A systematic review comparing outcomes of local flap options for reconstruction of pressure sores. *Ann Plast Surg*. 2022;88(1):105–113. [STAT]
2. Şibar S, Findikcioglu K, Guney K, Tuncer S, Ayhan S. Effect of flap selection on the postoperative success of sacral pressure injuries: a retrospective analysis. *Wounds*. 2021;33(10):271–276. [RETROS]
3. Montag E, Ueda T, Okada A, Onishi B, Gemperli R. Reconstruction of acquired ischiatic and perineal defects: an anatomical and clinical comparison between gluteal thigh and inferior gluteal perforator flaps. *Eur J Plast Surg*. 2018;41:41–48. [RETROS, Path S]
4. Oksman D, de Almeida OM, de Arruda RG, de Almeida MLM, do Carmo FS. Comparative study between fasciocutaneous and myocutaneous flaps in the surgical treatment of pressure ulcers of the sacral region. *JPRAS Open*. 2018;16:50–60. ISSN 2352-5878. [CASE S]
5. Liu X, Lu, W, Zhang Y, et al. Application of gluteus maximus fasciocutaneous V-Y advancement flap combined with resection in sacrococcygeal pressure ulcers: a CONSORT-compliant article. *Medicine*. 2017;96(47):1–5. [CASE S]
6. Thirumalasisamy T, Sethuraja K. Formulation of reconstruction protocol for sacral pressure sore defects. *J Dent Med Sci*. 2017;16 (12):17–26. [CASE S]
7. Mahmoud, WH. Pelvic pressure sores reconstruction by the v–y advancement flaps: a 2-year experience. *Egypt J Surg*. 2016;35 (3):189–195. [CASE S]
8. Marchi M, Battaglia S, Marchese S, Intagliata E, Spataro C, Vecchio R. Surgical reconstructive procedures for treatment of ischial, sacral and trochanteric pressure ulcers. *G Chir*. 2015;36(3):112–116. [CASE S]

Guideline 6.10: Management to address muscle spasms and fixed contractures must occur preoperatively and continue at least until the wound is completely healed. (Level III – *no change*).

Principle: Spasm may put traction on a wound to cause dehiscence of the suture line. Spasms and fixed contractures may limit postoperative positioning and leave the patient at risk for new pressure ulcer formation.

Updated Evidence:

1. Billington ZJ, Henke AM, Gater DR. Spasticity management after spinal cord injury: the here and now. *J Pers Med*. 2022;12:808. [LIT REV]
2. Negosanti L, Sanguinetti G, Gaiani L, et al. Spinal cord injury patients with spasticity and pressure sores: preliminary report on reconstruction with botulinum toxin treated muscle flaps. *Integr Mol Med*. 2019;6:1–3. [CASE S]
3. Palazón-García R, Alcobendas-Maestro M, Esclarin-de Ruz A, Benavente-Valdepeñas AM. Treatment of spasticity in spinal cord injury with botulinum toxin. *J Spinal Cord Med*. 2019;42(3):281–287. [RETROS]

Guideline 6.11 (*revised*): Anchoring the flap with deepithelialized tissue eliminates dead space and may decrease the rate of postoperative dehiscence. (Level III – *no change*).

Principle: Anchoring the flap to the bone is often difficult. Small case series suggest that inserting a deepithelialized portion of a flap will effectively obliterate undermined areas and reduce shearing forces.

Updated Evidence:

1. Gargano F, Edstrom L, Szymanski K, et al. Improving pressure ulcer reconstruction: our protocol and the COP (cone of pressure) flap. *Plast Reconstr Surg Glob Open*. 2017;5(3):e1234. [CASE S]

2. Moon SH, Choi JY, Lee JH, Oh DY, Rhie JW, Ahn ST. Feasibility of a deepithelialized superior gluteal artery perforator propeller flap for various lumbosacral defects. *Ann Plast Surg*. 2015;74(5):589–593. [CASE S]

Guideline 6.12 (*revised*): Address modifiable risk factors prior to proceeding with flap reconstruction in patients with pressure ulcers including optimising glucose control in the peri-operative period. (Level I – *no change*).

Principle: Numerous factors are associated with flap complications and pressure ulcer recurrence and must be considered when offering flap reconstruction with the goal of optimising the patient's modifiable risk factors prior to surgery. Poorly controlled diabetes leads to significantly greater rates of both dehiscence and pressure ulcer recurrence. Diabetic patients are also more than twice as likely to develop pressure ulcers peri-operatively as nondiabetics and have an increased rate of post-operative infection after flap reconstruction.

Updated Evidence:

1. Lee D, Kim MJ, Hahn HM. Analysis of factors affecting the outcome of flap reconstruction for pressure ulcers. *J Wound Manag Res*. 2021;17(1):30–38. [RETROS]
2. Luo J, Carter GC, Agarwal JP, Kwok AC. The 5-factor modified frailty index as a predictor of 30-day complications in pressure ulcer repair. *J Surg Res*. 2021;265:21–26. [STAT]
3. Lindqvist EK, Sommar P, Stenius M, Lagergren JF. Complications after pressure ulcer surgery – a study of 118 operations in spinal cord injured patients. *J Plast Surg Hand Surg*. 2020;54:3, 145–150. [RETROS]
4. Alfonso AR, Kantar RS, Ramly EP, et al. Diabetes is associated with an increased risk of wound complications and readmission in patients with surgically managed pressure ulcers. *Wound Repair Regen*. 2019;27:249–256. [STAT]
5. Morel J, Herlin C, Amara B, et al. Risk factors of pelvic pressure ulcer recurrence after primary skin flap surgery in people with spinal cord injury. *Ann Phys Rehabil Med*. 2019;62(2):77–83. [RETROS]
6. Kwok AC, Simpson AM, Willcockson J, Donato DP, Goodwin IA, Agarwal JP. Complications and their associations following the surgical repair of pressure ulcers. *Am J Surg*. 2018;216(6):1177–1181. [STAT]
7. Sirimaharaj W, Charoenvicha C. Pressure ulcers: risk stratification and prognostic factors that promote recurrence after reconstructive surgery. *Int J Low Extrem Wounds*. 2018;17(2):94–101. [RETROS]
8. Wurzer P, Winter R, Stemmer SO, et al. Risk factors for recurrence of pressure ulcers after defect reconstruction. *Wound Repair Regen*. 2018;26:64–68. [RETROS]
9. Bamba R, Madden JJ, Hoffman AN, et al. Flap reconstruction for pressure ulcers: an outcomes analysis. *Plast Reconstr Surg Glob Open*. 2017;5(1):e1187. [RETROS]
10. Chiu YJ, Liao WC, Wang TH, et al. A retrospective study: multivariate logistic regression analysis of the outcomes after pressure sores reconstruction with fasciocutaneous, myocutaneous, and perforator flaps. *J Plast Reconstr Aesthet Surg*. 2017;70(8):1038–1043. [RETROS]
11. Han HH, Ko JG, Rhie JW. Factors for postoperative complications following pressure ulcer operation: stepwise multiple logistic regression analysis. *Int Wound J*. 2017;14(6):1036–1040. [CASE S]
12. Lim S, Kim BD, Kim, JYS, Ver Halen JP. Preoperative albumin alone is not a predictor of 30-day outcomes in pressure ulcer patients: a matched propensity-score analysis of the 2006–2011 NSQIP datasets. *Ann Plast Surg*. 2015;75(4):439–447. [STAT]

Guideline 6.13 (*new*): Incisional negative pressure wound therapy (iNPWT) may reduce post-operative complications after flap reconstruction for pressure ulcers. (Level III).

Principle: There is a growing body of evidence supporting the use of iNPWT in patients at high risk for surgical complications, specifically surgical site infection and wound dehiscence. Wound dehiscence is the most common complication after flap reconstruction for pressure ulcers. The majority of patients with pressure ulcers fit criteria to be considered at high risk for both wound dehiscence and surgical site infection after flap reconstruction.

Evidence:

1. Hsu KF, Kao T, Chu PY, et al. Simple and efficient pressure ulcer reconstruction via primary closure combined with closed-incision negative pressure wound therapy (CiNPWT)—experience of a single surgeon. *J Pers Med*. 2022;12:182. [RETROS]
2. Papp AA. Incisional negative pressure therapy reduces complications and costs in pressure ulcer reconstruction. *Int Wound J*. 2019;16:394–400. [PCOH]
3. Willy C, Agarwal A, Andersen CA, et al. Closed incision negative pressure therapy: international multidisciplinary consensus recommendations. *Int Wound J*. 2017;14(2):385–398. [STAT]

Guideline 6.14 (*new*): A standardised protocol for peri-operative and post-operative management of patients undergoing pressure ulcer reconstruction will lead to reduced complications and reduced recurrence. (Level II).

Principle: Standardised protocols that include wound bed preparation, inclusion of a multi-disciplinary team, flap choice and appropriate off-loading for healing and prevention of recurrence. This is especially important for spinal cord-injured patients who continue to have the greatest risk for recurrence after surgical reconstruction.

Evidence:

1. Brown AL, Hassanein AH, Gabriel K, Mailey BA. SPINE: an initiative to reduce pressure sore recurrence. *Plast Reconstr Surg Glob Open*. 2022;10(11):e4625. [RETROS]
2. Fagotti de Almeida CE, Cirino Dos Santos APB, Biaziolo CFB, et al. The role of the perioperative prone position in the low recurrence of pressure injuries in the pelvic region. *J Wound Care*. 2022;31(1):92–98. [CASE S]

3. Joshi CJ, Carabano M, Perez LC, et al. Effectiveness of a fluid immersion simulation system in the acute post-operative management of pressure ulcers: a prospective, randomised controlled trial. *Wound Repair Regen*. 2022;30(4):526–535. [RCT]
4. Asanza JL, Matsuwaka ST, Keys K, Arrowood C, Doan MM, Burns SP. Comparing 4- and 6-week post-flap protocols in patients with spinal cord injury. *J Spinal Cord Med*. 2021;44(3):392–398. [RETROS]
5. Braafhart M, de Laat HEW, Wagner T, van de Burgt EWT, Hummelink S, Ulrich JO. Surgical reconstruction of pressure ulcers in spinal cord injury individuals: A single- or two-stage approach? *J Tissue Viability*. 2020;29(4):319–323. [RETROS]
6. Chen CY, Chiang IH, Ou KL, et al. Surgical treatment and strategy in patients with pressure sores: a single-surgeon experience. *Medicine (Baltimore)*. 2020;99(44):e23022. [CASE S]
7. Yanagi H, Terashi H, Takahashi Y, et al. The Japanese registry for surgery of ischial pressure ulcers: STANDARDS-I. *J Wound Care*. 2020;29(Suppl 9a):S39–S47. [PCOH]
8. Chiang I-H, Wang C-H, Tzeng Y-S. Surgical treatment and strategy in patients with multiple pressure sores. *Int Wound J*. 2018;15(6):900–908. [CASE S]
9. Kreutzträger M, Voss H, Scheel-Sailer A, Liebscher T. Outcome analyses of a multimodal treatment approach for deep pressure ulcers in spinal cord injuries: a retrospective cohort study. *Spinal Cord*. 2018;56(6):582–590. [RETROS]
10. Lefèvre C, Bellier-Waast F, Lejeune F, et al. Ten years of myocutaneous flaps for pressure ulcers in patients with spinal lesions: analysis of complications in the framework of a specialised medical-surgical pathway. *J Plast Reconstr Aesthet Surg*. 2018;71(11):1652–1663. [RETROS]
11. Paker N, Buğdaycı D, Gökşenoğlu G, Akbaş D, Korkut T. Recurrence rate after pressure ulcer reconstruction in patients with spinal cord injury in patients under control by a plastic surgery and physical medicine and rehabilitation team. *Turk J Phys Med Rehabil*. 2018;64(4):322–327. [RETROS]
12. Jordan SW, De la Garza M, Lewis VL. Two-stage treatment of ischial pressure ulcers in spinal cord injury patients: technique and outcomes over 8 years. *J Plast Reconstr Aesthet Surg*. 2017;70(7):959–966. [CASE S]
13. Ljung AC, Stenius MC, Bjelak S, Lagergren JF. Surgery for pressure ulcers in spinal cord-injured patients following a structured treatment programme: a 10-year follow-up. *Int Wound J*. 2017;14(2):355–359. [RETROS]
14. Milcheski DA, Mendes RR da S, Feitas FR de, Zaninetti G, Moniero AA, Germerli R. Brief hospitalization protocol for pressure ulcer surgical treatment: outpatient care and one-stage reconstruction. *Rev Col Bras Cir*. 2017;44(6):574–581. [CASE S]
15. Thomson CH, Choudry M, White C, Mecci M, Siddiqui H. Multidisciplinary management of complex pressure sore reconstruction: 5-year review of experience in a spinal injuries centre. *Ann R Coll Surg Engl*. 2017;99(2):169–174. [CLIN S]
16. Jósvay J, Klauber A, Both B, Kelemen PB, Varga ZZ, Pesthy PC. The operative treatment of pressure sores in the pelvic region: A 10-year period overview. *J Spinal Cord Med*. 2015;38(4):432–438. [RETROS]

9 | ADJUVANT THERAPIES

Preamble: Emerging evidence on adjuvant therapies suggests potential benefit for pressure ulcer healing. To date, there are insufficient studies demonstrating superiority over other more traditional wound treatments. Until further evidence of efficacy is established, consider the use of adjuvant therapy after evaluating individual patient and ulcer characteristics and when (1) healing fails to progress using conventional therapy and (2) under circumstances where the economic or physical burden of adjuvant therapy is consistent with patient goals and circumstances.

9.1 | Topical Agents

Guideline 7a.1 (*revised*): Consider the use of growth factor therapy for pressure ulcers that are not responsive to initial comprehensive therapy and/or before surgical repair. (Level II – *no change*).

Principle: Growth factors are required for normal healing, and chronic wounds have shown growth factor deficiencies and imbalances. Platelet rich plasma (PRP) gel consists of cytokines, growth factors, chemokines and a fibrin scaffold derived from a patient's blood. The mechanism of action of PRP gel is thought to be inducing and stimulating cellular and molecular processes enhancing wound healing. Use of an activated donor macrophage suspension has some promising preliminary results, but completion of definitive clinical trials and FDA approval have not yet been granted.

Achievement of some degree of ulcer closure, even if not complete, increases the ease of surgical closure. PRP may improve the healing of some chronic wounds, it is unclear whether pressure ulcer treatment benefits from this intervention.

To date, no growth factor or platelet rich plasma product has received approval for pressure ulcer treatment and evidence regarding the efficacy of PRP is conflicting.

Updated Evidence:

1. Scevola S, Nicoletti G, Brenta F, Isernia P, Maestri M, Faga A. Allogenic platelet gel in the treatment of pressure sores: a pilot study. *Int Wound J*. 2010;7:184–190. [RCT]
2. Hesseler MJ, Shyam N. Platelet-rich plasma and its utility in medical dermatology: a systematic review. *J Am Acad Dermatol*. 2019;81(3):834–846. [LIT REV]
3. Martinez-Zapata MJ, Martı-Carvajal AJ, Sola I, et al. Autologous platelet-rich plasma for treating chronic wounds. *Cochrane Database Syst Rev*. 2012;10:CD006899. [STAT]
4. Zuloff-Shani A, Adunsky A, Even-Zhav A, et al. Hard to heal pressure ulcers (stage III-IV): efficacy of infected activated macrophage suspension (aMS) as compared with standard of care (SOC) treatment controlled trial. *Arch Gerontol Geriatr*. 2010;51:268–272. [RCT]

9.2 | Devices

Guideline 7b.1: Negative pressure wound therapy (NPWT) is a safe and effective treatment for chronic stage III or IV pressure ulcers. (Level I – *no change*).

Principle: NPWT uses negative pressure applied to the wound to remove exudate and debris. Current literature has demonstrated NPWT promotes granulation tissue formation and removal of necrotic tissue, which may lead to the reduction of the size of the wound and shorter the healing times.

Updated Evidence:

1. Şahin E, Rizalar S, Özker E. Effectiveness of negative-pressure wound therapy compared to wet-dry dressing in pressure injuries. *J Tissue Viability*. 2022;31(1):164–172. [RCT]
2. Song YP, Wang L, Yuan BF, et al. Negative-pressure wound therapy for III/IV pressure injuries: A meta-analysis. *Wound Repair Regen*. 2021;29(1):20–33. [STAT]

Guideline 7b.2 (*new*): Use of conventional therapy and negative pressure wound therapy with instillation and dwell (NPWTi-d) may be more beneficial than conventional therapy and negative pressure wound therapy (NPWT) alone in the management of chronic Stage III–Stage IV pressure ulcers. (Level III).

Principle: The literature supports that NPWTi-d, when compared to conventional NPWT alone, may aid in the removal of fibrinous debris and promotion of granulation tissue formation through irrigation of the wound in a negative pressure environment. The most effective type of instillation has not been determined and further research is warranted to examine the benefit of NPWTi-d with regards to wound location, depth, and underlying comorbidities.

Updated Evidence:

1. Pan S, Xiong L, Wang Z, et al. Therapeutic effect and mechanism of negative pressure wound therapy with Huoxue Shengji decoction instillation for chronic skin ulcers. *Evid Based Complement Alternat Med*. 2022;2022:5183809. [RCT]
2. Arowojolu OA, Wirth GA. Sacral and ischial pressure ulcer management with negative-pressure wound therapy with instillation and dwell. *Plast Reconstr Surg*. 2021;147(1S-1):61S–67S. [LIT REV]
3. Isaac DL. Complex wound management using negative pressure wound therapy with instillation and dwell time in a cancer care setting. *Wounds*. 2020;32(5):118–122. [EXP]
4. Latouche V, Devillers H. Benefits of negative pressure wound therapy with instillation in the treatment of hard-to-heal wounds: a case series. *J Wound Care*. 2020;29(4):248–253. [CLIN S]

Guideline 7b.3 (*revised*): Electrical stimulation used in conjunction with conventional therapy may be useful in the treatment of chronic Stage II–Stage IV pressure ulcers. (Level I – *no change*).

Principle: Current evidence indicates high voltage monophasic pulsed current (HVMPC) is effective in the treatment of chronic pressure ulcers by reducing the wound area, enhancing the likelihood of achieving complete wound healing and decreasing the probability of worsening healing.

Updated Evidence:

1. Chen L, Ruan Y, Ma Y, Ge L, Han L. Effectiveness and safety of electrical stimulation for treating pressure ulcers: a systematic review and meta-analysis. *Int J Nurs Pract*. 2023;29(2):e13041. [STAT]
2. Girgis B, Duarte JA. High voltage monophasic pulsed current (HVMPC) for stage II-IV pressure ulcer healing. A systematic review and meta-analysis. *J Tissue Viability*. 2018;27(4):274–284. [STAT]
3. Polak A, Kucio C, Kloth LC, et al. A randomised, controlled clinical study to assess the effect of anodal and cathodal electrical stimulation on periwound skin blood flow and pressure ulcer size reduction in persons with neurological injuries. *Ostomy Wound Manage*. 2018;64(2):10–29. [RCT]
4. Khouri C, Kotzki S, Roustit M, Blaise S, Gueyffier F, Cracowski JL. Hierarchical evaluation of electrical stimulation protocols for chronic wound healing: an effect size meta-analysis. *Wound Repair Regen*. 2017;25(5):883–891. [STAT]

Guideline 7b.4 (*new*): Use of ultrasound may be useful as an adjunct therapy for pressure ulcers unresponsive to standard therapy. Both non-thermal low frequency and high frequency pulsed current ultrasound have been used. (Level III).

Principle: Ultrasound has been reported to increase blood flow and oxygenation to the wound area and may stimulate cellular activity that promotes tissue regeneration. Further research is necessary to confirm the efficacy of low and/or high frequency ultrasound as a tool for the management of pressure ulcers.

Updated Evidence:

1. Marzloff G, Ryder S, Hutton J, Ott K, Becker M, Schubert S. Emerging technologies in the wound management field. *Phys Med Rehabil Clin N Am*. 2022;33(4):901–914. [LIT REV]
2. Wagner-Cox P, Duhame HM, Jamison CR, Jackson RR, Fehr ST. Use of noncontact low-frequency ultrasound in deep tissue pressure injury: a retrospective analysis. *J Wound Ostomy Continence Nurs*. 2017;44(4):336–342. [RETRO S]
3. Honaker JS, Forston MR, Davis EA, Weisner MM, Morgan JA, Sacca E. The effect of adjunctive noncontact low frequency ultrasound on deep tissue pressure injury. *Wound Repair Regen*. 2016;24(6):1081–1088. [EXP]
4. Polak A, Taradaj J, Nawrat-Szoltysik A, et al. Reduction of pressure ulcer size with high-voltage pulsed current and high-frequency ultrasound: a randomised trial. *J Wound Care*. 2016;25(12):742–754. [RCT]

Guideline 7b.5 (*new*): Laser therapy may result in improvement in pressure ulcer healing when used in conjunction with traditional therapy. (Level III).

Principle: Laser therapy may aid in the health of pressure ulcers through the inhibition of inflammatory processes and stimulation of tissue regeneration. However, further research with randomised controlled trials is warranted to confirm clinical effectiveness, including the most effective wavelengths, duration of therapy, depth of wound and underlying comorbidities.

Updated Evidence:

1. Taradaj J, Shay B, Dymarek R, et al. Effect of laser therapy on expression of angio- and fibrogenic factors, and cytokine concentrations during the healing process of human pressure ulcers. *Int J Med Sci*. 2018;15(11):1105–1112. [EXP]
2. Ruh AC, Frigo L, Cavalcanti MFXB, et al. Laser photobiomodulation in pressure ulcer healing of human diabetic patients: gene expression analysis of inflammatory biochemical markers. *Lasers Med Sci*. 2018;33(1):165–171. [EXP]
3. Kuffler DP. Improving the ability to eliminate wounds and pressure ulcers. *Wound Repair Regen*. 2015;23(3):312–317. [LIT REV]

10 | PALLIATIVE WOUND CARE FOR SERIOUSLY ILL PATIENTS WITH PRESSURE ULCERS

Preamble: Palliative wound care refers to the relief of wound symptoms and suffering in the context of a serious illness. In this emerging area of pressure ulcer care for patients with a serious illness, there are varying definitions and inclusion criteria. There are also ethical limitations for clinical trials to include patients who are receiving comfort-focused care in the last few weeks of their life. However, more people are living longer with serious illness, and these patients should be enrolled in studies that will determine how best to optimise their care. The immobility and frailty that accompanies people during a serious illness puts them at high risk of pressure ulcer development. These guidelines refer to patients living with serious illness and reflect the best evidence and current opinion. This is regardless of whether they are in the last few weeks of their life or not. These recommendations should be considered in conjunction with the guidelines for general treatment of pressure ulcers, if appropriate for the patient and their caregivers.

10.1 | Risk Assessment in Serious Illness

Guideline 8.1: For critically ill patients in the intensive care unit, use Jackson-Cubbin Scale to identify patients at high risk for developing pressure ulcers. (Level II).

Principal: Braden Scale and Jackson–Cubbin Scale have the strongest validation for determining risk of pressure ulcer formation in ICU patients. Jackson–Cubbin should be used over Braden as it has a higher predictive value in the ICU patient population. Analytic studies suggest that some sub scores (body mass index, nutrition, respiration, age, and transportation) may not be significant contributors to pressure ulcer risk. Further research is needed to help refine and simplify the Jackson–Cubbin assessment.

Evidence:

1. Zhang Y, Zhuang Y, Shen J, et al. Value of pressure injury assessment scales for patients in the intensive care unit: systematic review and diagnostic test accuracy meta-analysis. *Intensive Crit Care Nurs*. 2021;64:103009. [STAT]
2. Higgins J, Casey S, Taylor E, Wilson, R, Halcomb P. Comparing the Braden and Jackson/Cubbin pressure injury risk scales in trauma-surgery ICU patients. *Crit Care Nurse*. 2020:40(6):52–61. [STAT]
3. Ahtiala MH, Soppi E, Kivimäki R. Critical evaluation of the Jackson/Cubbin pressure ulcer risk scale – a secondary analysis of a retrospective cohort study population of intensive care patients. *Ostomy Wound Manage*. 2016;62(2):24–33. [STAT]
4. García-Fernández FP, Pancorbo-Hidalgo PL, Agreda JJ. Predictive capacity of risk assessment scales and clinical judgment for pressure ulcers: a meta-analysis. *J Wound Ostomy Cont Nurs*. 2014;41(1):24–31. [STAT]

Guideline 8.2: For patients on home palliative care, Hospice or who are at end-of-life use of the Palliative Performance Scale (PPS) with 40% cut off will identify patients at high risk for pressure ulcers. (Level III).

Principal: For patients on home palliative care, Hospice or who are at end of life, the Palliative Performance Scale (PPS) has high predictive value for development of pressure ulcers. The PPS is a rapid assessment that can be completed without a physical evaluation. This scale can be used via telehealth, phone, or when the patient is too painful to move.

Evidence:

1. Artico M, Dante A, D'Angelo D, et al. Prevalence, incidence and associated factors of pressure ulcers in home palliative care patients: a retrospective chart review. *Palliat Med*. 2018;32(1):299–307. [RETROS]
2. Maida V, Lau F, Downing M, Yang J. Correlation between braden scale and palliative performance scale in advanced illness. *Int Wound J*. 2008;5(4):585–90. [STAT]

10.2 | Positioning and Support Surfaces

Guideline 8.3: Repositioning and turning frequency for patients receiving palliative care ought to be in accordance with the individual's goals, comfort and tolerance. Turning should occur with a flexible, individualised schedule. Many patients will prefer a single position for comfort, especially when actively dying. (Level III).

Principle: When possible, standard recommendations for pressure ulcer prevention or treatment with turning to offload pressure at regular intervals should be employed. However, for patients with a serious illness, the goals of comfort and minimal disruption take priority. There are conditions that may impede standard pressure ulcer

prevention including autonomic instability, incident pain, bone metastases, pathological fractures or dyspnoea with movement. It is important for patients and their families to be educated about the rationale for frequent repositioning or turning. Clinicians must recognise that patients and family may choose to prioritise comfort and accept the potential risk for pressure damage or poor healing. These wishes should be documented accordingly. When pressure-reducing support surfaces are used, turning frequency can be reduced (i.e., from every 2 h to every 4 h), thereby increasing patient comfort. Exact turning intervals for optimal pressure ulcer prevention in patients with serious illness are not well defined.

Evidence:

1. Yap TL, Horn SD, Sharkey PD, et al. Effect of varying repositioning frequency on pressure injury prevention in nursing home residents: TEAM-UP trial results. *Adv Skin Wound Care*. 2022;35(6):315–325. [RCT]
2. Gillespie BM, Walker RM, Latimer SL, et al. Repositioning for pressure injury prevention in adults. *Cochrane Database Syst Rev*. 2020;6(6):CD009958. Published 2020 Jun 2. [STAT]
3. Vickery J, Compton L, Allard J, Beeson T, Howard J, Pittman J. Pressure injury prevention and wound management for the patient who is actively dying: evidence-based recommendations to guide care. *J Wound Ostomy Continence Nurs*. 2020;47(6):569–575. [LIT REV]
4. Jocelyn Chew HS, Thiara E, Lopez V, Shorey S. Turning frequency in adult bedridden patients to prevent hospital-acquired pressure ulcer: a scoping review. *Int Wound J*. 2018;15(2):225–236. [LIT REV]
5. Langemo D, Haesler E, Naylor W, Tippett A, Young T. Evidence-based guidelines for pressure ulcer management at the end of life. *Int J Palliat Nurs*. 2015;21(5):225–232. [STAT]
6. Chrisman CA. Care of chronic wounds in palliative care and end-of-life patients. *Int Wound J*. 2010;7(4):214–235. [LIT REV]
7. Navaid M, Melvin T, Berube J, Dotson S. Principles of wound care in hospice and palliative medicine [published correction appears in *Am J Hosp Palliat Care*. 2011 Jun;28(4):292]. *Am J Hosp Palliat Care*. 2010;27(5):337–341. [LIT REV]
8. Eisenberger A, Zeleznik J. Pressure ulcer prevention and treatment in hospices: a qualitative analysis. *J Palliat Care*. 2003;19(1):9–14. [RETROS]

Guideline 8.4: Pre-medication with analgesic or sedative medication may allow for more frequent turning and skin care for those who have significant pain with position changes. This must be balanced with the potential for sedation to impede spontaneous movements, as well as an individual's goals of care for interaction with others. (Level III).

Principle: For some individuals with serious illness, movement can cause significant pain. Pressure ulcer prevention or management may still warrant frequent repositioning to offload pressure. In such cases, it is recommended that individuals receive pre-medication with an analgesic or sedating medication 20–30 min prior to planned position changes. The sedating side effects may reduce their spontaneous movements in bed; these spontaneous movements actually allow for minor shifts in pressure. The patient's goals and wishes in regard to alertness and pain control must be taken into consideration. As noted in the prior guideline, an individual's goals for comfort and a single position may supersede adherence to strict turning schedules.

Evidence:

1. Cornish L. Preventing and managing pressure ulcers in patients receiving palliative care. *Nurs Older People*. 2021;33(4):34–41. [LIT REV]
2. Magnani C, Giannarelli D, Casale G. Procedural pain in palliative care: is it breakthrough pain? a multicenter national prospective study to assess prevalence, intensity, and treatment of procedure-related pain in patients with advanced disease. *Clin J Pain*. 2017;33(8):707–714. [STAT]
3. Langemo D, Haesler E, Naylor W, Tippett A, Young T. Evidence-based guidelines for pressure ulcer management at the end of life. *Int J Palliat Nurs*. 2015;21(5):225–232. [STAT]

Guideline 8.5: Patients living with a serious illness who are at high risk for pressure ulcers should be placed on a reactive support surface to reduce pressure. A standard hospital or home mattress is not sufficient for pressure ulcer prevention. Those patients receiving palliative wound care for a pressure ulcer may be considered for an active pressure reducing support mattress. This can allow for less frequent turning and promote comfort. (Level I).

Principle: Patients with serious illnesses have many risk factors for the development of pressure ulcers. The management and prevention of pressure ulcers should include use of a pressure-relieving support surface, with careful attention to patient comfort in patients with a serious illness. Selection of a support surface is based on a comprehensive assessment to determine an individual's need for pressure redistribution, shear reduction, and microclimate control. For those living with serious illness, patient comfort may be prioritised over the type of recommended surface. While some studies indicate differences in comfort scores between varying surfaces, in patients living with serious illness selection should be individualised and based on availability, cost and prognosis. Use of a pressure-relieving support surface may allow for less frequent turning, thereby promoting patient comfort in cases of incident pain.

Evidence:

1. Shi C, Dumville JC, Cullum N, et al. Beds, overlays and mattresses for preventing and treating pressure ulcers: an overview of Cochrane Reviews and network meta-analysis. *Cochrane Database Syst Rev*. 2021;8(8):CD013761. Published 2021 Aug 16. [STAT]
2. McNichol L, Mackey D, Watts C, Zuecca N. Choosing a support surface for pressure injury prevention and treatment. *Nursing*. 2020;50(2):41–44. [STAT]
3. Marutani A, Okuwa M, Sugama J. Use of 2 types of air-cell mattresses for pressure ulcer prevention and comfort among patients

with advanced-stage cancer receiving palliative care: an interventional study. *Wound Manag Prev*. 2019;65(5):24–32. [RCT]
4. Serraes B, van Leen M, Schols J, Van Hecke A, Verhaeghe S, Beeckman D. Prevention of pressure ulcers with a static air support surface: a systematic review. *Int Wound J*. 2018;15(3):333–343. [STAT]
5. Langemo D, Haesler E, Naylor W, Tippett A, Young T. Evidence-based guidelines for pressure ulcer management at the end of life. *Int J Palliat Nurs*. 2015;21(5):225–232. [STAT]
6. Meaume S, Marty M. Pressure ulcer prevention and healing using alternating pressure mattress at home: the PARESTRY project. *J Wound Care*. 2015;24(8):359–365. [STAT]
7. Navaid M, Melvin T, Berube J, Dotson S. Principles of wound care in hospice and palliative medicine. *Am J Hosp Palliat Care*. 2011;28 (4):292. [LIT REV]
8. Thompson, P, Anderson, J, Langemo, D, Hanson, D, Hunter, S. Support surfaces: definitions and utilisation for patient care. *Adv Skin Wound Care*. 2008;21(6):264–266. [LIT REV]

10.3 | Nutrition

Guideline 8.6: For pressure ulcer prevention and treatment in patients with a serious illness and in the intensive care unit, they should have daily nutritional assessments due to high risk for undernutrition and pressure ulcer formation. (Level III).

Principle: Adequate nutrition is a protective factor in pressure ulcer formation for patients with serious illness who are in the intensive care unit (ICU). Only half of ICU patients achieve calorie and protein nutrition goals. Under-nutrition is often due to frequent interruptions of nutrition due to procedures, diagnostic testing, and sedation. Limited evidence suggests that reaching nutrition goals within the first 72 hours of admission to the ICU may mitigate pressure ulcer formation, but more research is needed to determine appropriate calorie and protein targets and appropriate nutritional routes.

Evidence:

1. Yap J, Holloway S. Evidence-based review of the effects of nutritional supplementation for pressure ulcer prevention. *Int Wound J*. 2021;18(6):805–821. [LIT REV]
2. Kim H, Stotts NA, Froelicher ES, Engler MM, Porter C. Why patients in critical care do not receive adequate enteral nutrition? A review of the literature. *J Crit Care*. 2012;27(6):702–713. [LIT REV]
3. Langemo DK, Black J. Pressure ulcers in individuals receiving palliative care: a national pressure ulcer advisory panel white paper. *Adv Skin Wound Care*. 2010;23(2):59–72. [STAT]

Guideline 8.7: Alternative routes of nutrition, other than dietary intake, should not be considered in patients with advanced dementia and/or 1 month or less prognosis. (Level I).

Principle: Patients with severe dementia should not be provided with artificial nutrition, as artificial nutrition does not reduce aspiration risk, improve quality of life, reduce mortality or decrease pain. Artificial nutrition can increase the risk of pressure ulcers by worsening delirium and need for restraints to keep the feeding tube in place. Patients with a prognosis of <1 month should not be given artificial nutrition due to limited benefit and increased risk of harm including: oedema, diarrhoea, and increased discomfort.

Evidence:

1. Davies N, Barrado-Martín Y, Rait G, et al. Enteral tube feeding for people with severe dementia. *Cochrane Database Syst Rev*. 2021;8 (8):CD013503. [LIT REV]
2. Munoz N, Posthauer ME, Cereda E, Schols JMGA, Haesler E. The role of nutrition for pressure injury prevention and healing: the 2019 International Clinical Practice Guideline Recommendations. *Adv Skin Wound Care*. 2020;33(3):123–136. [STAT]
3. Hui D, Dev R, Bruera E. The last days of life: symptom burden and impact on nutrition and hydration in cancer patients. *Curr Opin Support Palliat Care*. 2015;9(4):346–354. [LIT REV]

10.4 | Wound Bed Preparation

Guideline 8.8: Assess pressure ulcer-related pain at every visit; this includes pain associated with dressing removal/application, cleansing, debridement, and pain between dressing changes. (Level III).

Principle: Patient reported pain is the best indicator of pain. Pressure ulcers are often painful. Nursing home residents may experience increasing bodily pain intensity with advanced stage injury. Pain is often associated with dressing changes. Those living with serious illness may suffer from pain for other reasons, such as metastatic disease, dyspnoea or anxiety, and it is important to delineate whether the pressure ulcer is contributing to the suffering. For those patients with cognitive or verbal impairments, consider using the Visual Analog Scale (VAS) or Wong-Baker FACES Pain Rating Scale (FRS) in the assessment.

Evidence:

1. Ahn H, Stechmiller J, Fillingim R, Lyon D, Garvan C. Bodily pain intensity in nursing home residents with pressure ulcers: analysis of national minimum data set 3.0. *Res Nurs Health* 2015;38 (3):207–212. [STAT]
2. McGinnis E, Briggs M, Colllinson M, et al. Pressure ulcer related pain in community populations: a prevalence study. *BMC Nurs*. 2014;13:16 [STAT]
3. Price PE, Fagervik-Morton H, Mudge EJ, et al. Dressing-related pain in patients with chronic wounds: an international patient perspective. *Int Wound J*. 2008;5(2):159–171. [STAT]
4. Freeman K, Smyth C, Dallam L, Jackson B. Pain measurement scales: a comparison of the visual analogue and faces rating scales in measuring pressure ulcer pain. *J Wound Ostomy Continence Nurs*. 2001:28(6):290–296. [STAT]

Guideline 8.9: Use non-pharmacologic and topical pharmacologic means to address procedural-related pressure ulcer pain. (Level II).

Principle: This guideline uses wound procedural-related pain literature to address pressure ulcer procedural-related pain. Wound quality of life studies suggest that desiccant dressings, especially gauze, increase pain. When doing dressing changes consider non-pharmacologic interventions. These include providing education to the patient and empowering their ability to ask for 'time-outs', using non-adherent dressings, soaking dressings with lukewarm water before removal, cleansing wounds gently with lukewarm water, managing oedema in extremity wounds and avoiding unnecessary exposure to the air. Prior to sharp debridement or for highly painful dressing changes, consider topical pharmacologic options such as lidocaine. The duration of application depends on the formulation; liquid is faster acting than creams or gels. If within their scope of practice and if deemed necessary based on the pain assessment, clinicians can infiltrate the wounds with lidocaine prior to procedures.

Evidence:

1. Admassue BM, Ferede YA, Tegegne BA, Lema GF, Admass BA. Wound-related procedural pain management in a resource limited setting: systematic review. *Int J Surg Open*. 2022;47(5):100549. [STAT]
2. Gallagher R. The management of wound-related procedural pain (volitional incident pain) in advanced illness. *Curr Opin Support Palliat Care*. 2013;7(1):80–85. [LIT REV]
3. Woo KY, Abbott LK, Librach L. Evidence-based approach to manage persistent wound-related pain. *Curr Opin Support Palliat Care*. 20;137:86–94. [LIT REV]

Guideline 8.10: Consider topical metronidazole and/or antiseptics or charcoal/activated charcoal for odour management (Level III).

Principle: Pressure ulcers are sometimes malodorous, and the odour is largely attributed to anaerobes. Patients suffer from isolation if they or their visitors perceive odour. Topical metronidazole is an off-label treatment with proven efficacy against odour in all wound types, including pressure ulcers. The efficacy does not vary by modality. Metronidazole comes in gel, cream or tablets which can be crushed. Cleansing the wound with antiseptics, such as sodium hypochlorite, hypochlorous acid or iodine, all demonstrate positive odour neutralising effects but may increase pain. Since these antiseptics may be cytotoxic, consider patient-centred goals (odour control vs. healing) when selecting these agents. Charcoal/activated charcoal, applied over the dressing, can also absorb odours. However, charcoal dressings can be cost-prohibitive.

Evidence:

1. Akhmetova A, Saliev T, Allan IU, Illsley MJ, Nurgozhin T, Mikhalovsky S. A comprehensive review of topical odour-controlling treatment options for chronic wounds. *J Wound Ostomy Continence Nurs*. 2016;43(6):598–609. [LIT REV]
2. Lyvers E. Topical metronidazole for odour control in pressure ulcers. *Consult Pharm*. 2015;30(9):523–526. [LIT REV]
3. Beer EH. Palliative wound care. *Surg Clin North Am*. 2010;99(5):899–919. [LIT REV]

10.5 | Dressings

Guideline 8.11: Use prophylactic dressings over bony prominences for pressure ulcer prevention in patients in the intensive care unit. (Level I).

Principle: Patients with a serious illness, especially those in the intensive care unit, are at very high risk of pressure ulcers. Prophylactic dressings, in particular silicone adhesive dressings with multi-layer foam, have proven to reduce pressure ulcer incidence in the intensive care setting. These dressings have proven to be cost-effective. Further research is needed to determine whether it is efficacious to use prophylactic dressings outside of the intensive care setting for those with serious illness and/or at end of life.

Evidence:

1. Davies P. Role of multi-layer foam dressings with Safetac in the prevention of pressure ulcers: a review of the clinical and scientific data. *J Wound Care*. 2016;(1 Suppl):S1, S4–S23. [LIT REV]
2. Santamaria N, Liu W, Gerdtz M, et al. The cost–benefit of using soft silicone multilayered foam dressings to prevent sacral and heel pressure ulcers in trauma and critically ill patients: a within-trial analysis of the Border Trial. *Int Wound J*. 2015;12(3):344–350. [STAT]

10.6 | Systemic

10.6.1 | Skin failure and pressure ulcers at end-of-life

Guideline 8.12: Distinguish pressure ulcers from unavoidable skin failure when patient is at end-of-life (Level III).

Principle: Individuals who are critically ill and at the end of life are prone to increased skin breakdown. The phenomena of increased skin breakdown have been classified with multiple terms designating skin failure, the most commonly used being Kennedy terminal ulcers (KTU), Skin Changes at Life's End (SCALE), and Trombley–Brennan terminal tissue injuries (TB-TTI). Generally, these changes are not considered to be pressure ulcers but hypothesized to be due to hypoperfusion, malnutrition and toxin buildup associated with end of life and critical illness. A recent survey of wound healing clinicians reached 85% consensus that KTU, SCALE and TB-TTI, and skin failure at end of life are unavoidable and not attributable to substandard care. The same survey found a lack of consensus as to whether pressure ulcers are part of skin failure. There is no validated risk stratification scoring for skin failure. Currently it is unclear whether SCALE, KTU, TB-TTI and skin failure are unique diagnoses or a continuum of the same process. More research is required to determine whether skin failure can be prevented and to optimise risk assessment, treatment options and classifications.

Evidence:

1. Sibbald RG, Ayello EA. Results of the 2022 wound survey on skin failure/end-of-life terminology and pressure injuries. *Adv Skin Wound Care*. 2023;36:151–157. [STAT]

2. Dalgleish L, Campbell J, Finlayson K, et al. Understanding skin failure: a scoping review. *Adv Skin Wound Care*. 2021;34(10):542–550. [LIT REV]
3. Roca-Biosca A, Rubio-Rico L, De Molina-Fernández MI, Martinez-Castillo JF, Pancorbo-Hidalgo PL, García-Fernández FP. Kennedy terminal ulcer and other skin wounds at the end of life: an integrative review. *J Tissue Viability*. 2021;30(2):178–182. [LIT REV]
4. Ayello EA, Levine JM, Langemo D, Kennedy-Evans KL, Brennan MR, Sibbald RG. Reexamining the literature on terminal ulcers, SCALE, skin failure, and unavoidable pressure injuries. *Adv Skin Wound Care*. 2019;32(3):109–121. [LIT REV]
5. Latimer S, Shaw J, Hunt T, Mackrell K, Gillespie BM. Kennedy terminal ulcers: a scoping review. *J Hosp Palliat Nurs*. 2019;21(4):257–263. [LIT REV]

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None of the authors have reported a conflict of interest relevant to the reported work.

ORCID

Lisa J. Gould https://orcid.org/0000-0001-5167-4679
Kath M. Bogie https://orcid.org/0000-0003-1020-9695
Mohamed El Masry https://orcid.org/0000-0002-2686-1509
Letitia Y. Graves https://orcid.org/0000-0002-6443-0566

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