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Prevention of pressure-induced skin and soft tissue injury

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INTRODUCTION

Pressure-induced skin and soft tissue injuries are among the most common conditions encountered in hospitalized patients or those requiring long-term institutional care [1]. Prevention is a cost-effective approach that positively impacts health status [2-5]; targeting high-risk hospital patients will both save money and increase quality-adjusted life-years [6]. As of October 2008, guidelines from the Center for Medicare and Medicaid Services (CMS) in the United States state that hospitals will no longer receive additional payments when patients develop stage 3 or 4 pressure-induced injuries, and hospital reimbursements are being adjusted by their pressure-induced skin and soft tissue injury rate (table 1) [7,8]. Failure to provide appropriate prevention and care may also expose providers to liability [9].

The prevention of pressure-induced skin and soft tissue injuries will be reviewed here. The treatment, epidemiology, pathogenesis, clinical manifestations, and staging are discussed separately. (See "Epidemiology, pathogenesis, and risk assessment of pressure-induced skin and soft tissue injury" and "Clinical staging and general management of pressure-induced skin and soft tissue injury".)

CLASSIFICATION AND TERMINOLOGY

The National Pressure Injury Advisory Panel (NPIAP) made changes to their classification in April 2016 and suggested using the terminology "pressure injury" instead of "pressure ulcer" to describe these wounds. Issues surrounding classification and terminology for pressure-induced

skin and soft tissue injury are reviewed separately. (See "Clinical staging and general management of pressure-induced skin and soft tissue injury", section on 'NPIAP staging'.)

RISK ASSESSMENT

Risk assessment, which includes a comprehensive history and physical examination, should identify patients at risk for pressure-induced skin and soft tissue injuries who will benefit from preventive measures as well as factors that are potentially correctable [10]. The pathogenesis, risk factors, and risk prediction tools for pressure-induced skin and soft tissue injuries are discussed in detail separately. (See "Epidemiology, pathogenesis, and risk assessment of pressure-induced skin and soft tissue injury", section on 'Risk factors' and "Epidemiology, pathogenesis, and risk assessment of pressure-induced skin and soft tissue injury", section on 'Risk prediction'.)

PRESSURE REDISTRIBUTION

Pressure redistribution is the most important factor in preventing pressure-induced skin or soft tissue injuries and may be accomplished in two ways: appropriate use of pressure-reducing devices and surfaces and proper patient positioning [10-12].

Support surfaces — Many pressure-reducing support surfaces and products are available. These products are classified as follows by the National Pressure Injury Advisory Panel Support Surface Standards Initiative [13]:

- **Reactive support surface** – A powered or nonpowered support surface with the capability to change its load distribution properties only in response to applied load.
- **Active support surfaces** – A powered support surface, with the capability to change its load distribution properties, with or without applied load.
- **Integrated bed system** – A bed frame and support surface that are combined into a single unit whereby the surface is unable to function separately.
- **Nonpowered support surface** – Any support surface not requiring or using external sources of energy.
- **Overlay** – An additional support surface designed to be placed directly on the top of an existing surface.

- **Mattress** – A support surface designed to be placed directly on the existing bed frame.

Features of a support surface that may assist in prevention include [13]:

- **Air fluidized** – Provides pressure redistribution through a fluid-like medium created by forcing air through beads. This is a type of reactive support surface.
- **Alternating pressure** – Provides pressure redistribution via cyclic changes in loading and unloading. This is an active support surface.
- **Lateral rotation** – Provides rotation about a longitudinal axis.
- **Low air loss** – Provides a flow of air to assist in managing the heat and humidity (ie, microenvironment) of the skin.
- **Multizoned** – Different segments of the support surface have different pressure redistribution characteristics.

The selection of device for prevention is balanced by a variety of considerations, including the risk of pressure induced injury, ease of use, other patient characteristics, and cost (special beds may cost up to several hundred dollars per day to rent). Inexpensive static devices or overlays are acceptable in most situations, whereas dynamic support surfaces may be more appropriate in patients who are at high risk. (See "Epidemiology, pathogenesis, and risk assessment of pressure-induced skin and soft tissue injury", section on 'Risk factors' and "Epidemiology, pathogenesis, and risk assessment of pressure-induced skin and soft tissue injury", section on 'Risk prediction'.)

Considerable caution is required in interpreting the literature on support surfaces, particularly older studies. Many studies compare a specialized support surface with a "standard" hospital mattress, but the modern "standard" hospital mattress differs from those used twenty years ago.

In a Cochrane review of support surfaces for prevention of pressure-induced injury, a total of 59 trials were included. There is reasonably good evidence to suggest that high-specification foam mattress or mattress overlays on operating tables and hospital beds reduce the incidence of pressure injuries compared with a standard hospital mattress and no overlay [13,14]. However, many of the included studies are old, raising the concern cited above regarding a "standard" mattress. Pressure-relieving overlays on the operating table reduced the incidence of postoperative pressure injuries. In a meta-analysis of two trials, the use of a micropulse overlay system in the operating room significantly reduced the incidence (relative risk [RR] 0.21, 95% CI

0.06-0.70) [14]. Two trials, though, indicated that foam overlays in the operating room caused adverse skin changes.

It is less clear how different classes of support surfaces, or different products within a class of support surfaces, compare. Systematic reviews and meta-analyses of randomized trials have not consistently demonstrated superiority of one product class over another [14,15]. Most studies only include two products out of the many possible comparisons. A network meta-analysis that considered all possible comparisons may then be helpful.

A review that included 68 studies with comparisons between 12 different types of support surfaces concluded that there is low-certainty evidence that reactive air surfaces, alternating air-pressure surfaces, and reactive gel surfaces reduce the incidence of pressure-induced injury compared with a foam mattress [15].

One particularly well-designed trial involving 1972 patients (PRESSURE trial) compared two dynamic devices, alternating pressure mattresses and alternating pressure overlays, and found no differences in the number of new pressure injuries (grade 2 or worse) or the median time for their development; patient satisfaction was higher for the mattress [16]. The PRESSURE 2 trial randomly assigned 2029 high-risk patients to a high-specification foam mattress or an alternating pressure mattress [17]. The overall rate of stage 2 or greater pressure injuries was 7.9 percent; the alternating power mattress was associated with a nonsignificant reduction in pressure injuries (hazard ratio 0.76, 95% CI 0.56-1.04). These two studies stand out for their large sample sizes and having sufficient power to address the study question.

Dynamic support devices in high-risk patients may be cost effective. In a trial that randomly assigned 100 intensive care unit patients to an air-suspension bed or standard bed, the risk of developing pressure injuries was lower in those using the air-suspension bed (odds ratio 0.18, 95% CI 0.08-0.41). In the PRESSURE 2 trial, the alternating pressure mattress had a 99 percent probability of being cost-effective at a threshold of 20,000 pounds per quality-adjusted life-year. The cost of dynamic support surfaces may be offset by reduced length of hospitalization, wound care that includes nursing time and wound care supplies, and possibly surgery [18]. One study of air suspension beds in an intensive care unit found that this intervention resulted in cost savings of over $700 per patient.

For patients who use wheelchairs, full-seat cushions are recommended. Donut cushions should **not** be used because they increase edema and venous congestion and concentrate the pressure to surrounding tissue [10]. Selection of customized chair cushions requires the services of a qualified seating specialist. The three main types of seat cushions include gel and foam seat cushions, nonpowered adjustable cushions, and powered adjustable seat cushions. Adjustable

seat cushions contain a honeycomb of air cells that are first fully inflated, placed under the patient and then partially deflated via a release valve to better conform to the patient's body; the patient essentially floats on a cushion of air while sitting in the chair. Powered seat cushions include a motorized blower to circulate the air within the cushion. In a study of 232 nonambulatory nursing home residents, significantly fewer pressure injuries developed in those randomly assigned to use a skin protection cushion (air, viscous fluid and foam, or gel and foam cushion) compared with a standard segmented foam cushion (10.6 versus 17.6 percent) [19].

Static positioning — Proper positioning, including repositioning with particular attention to vulnerable tissue overlying bony prominences (figure 1), is an integral component of prevention that is recommended for all individuals confined to a bed. Proper positioning and repositioning have a sound theoretical rationale, but available data are of low quality. In the absence of good-quality evidence, we position and reposition the patients as described below.

Position and inclination — The position and head inclination of individuals confined to a bed is likely to be important. It is recommended that:

- Pillows or foam wedges should be placed between the ankles and knees to avoid pressure at these sites when patients have no mobility at these areas.
- The heels require particular attention; pillows may be placed under the lower legs to elevate the heels, or special heel protectors can be used.
- Patients should be placed at an angle ≤30 degrees when lying on their side to avoid direct pressure over the greater trochanter or other bony prominences.
- The head of the bed should not be elevated more than 30 degrees to prevent sliding and friction injury.

Elevation of the head of the bed causes people to slide down in bed over 10 cm, resulting in friction and shear forces to tissues overlying the lower back and sacrum. Development of beds designed to reduce such migration is underway, and they are expected to be effective, especially when combined with proper positioning practices [20].

Repositioning and frequency — Turning should be performed successively from the back, to one side, and then to the other side. The aim of repositioning is to reduce interface pressure and maintain microcirculation to areas at risk for pressure-induced skin and soft tissue injury [21]. It is important that repositioning be done gently and properly, with the assistance of devices as necessary to avoid friction and shear forces. Timing and positioning should be

documented. Prevention of progression of a stage 1 pressure-induced injury may require more frequent repositioning [22].

Patients who use wheelchairs may generate considerable pressures over the ischial tuberosities; they should be repositioned at least every hour with wheelchair pushups or with tilting of the seat to reduce contact between the patient's buttocks and the seat [23]. Patients who are cognitively intact and are able to use their upper extremities can be trained to shift weight even more frequently, using monitoring devices as a reminder.

The increased need for prone positioning when managing respiratory failure may result in pressure injuries to atypical locations such as the face and genitalia. Careful attention to proper positioning and repositioning is essential to avoid prolonged pressure [24]. (See "Prone ventilation for adult patients with acute respiratory distress syndrome", section on 'Prone procedure' and "Patient positioning for surgery and anesthesia in adults", section on 'Prone'.)

Repositioning frequency should be based on a consideration of an individual's level of activity and ability to independently reposition. Typically, a two-hour interval is recommended for repositioning. It has been demonstrated that skin erythema and ischemic changes can occur in healthy adults in less than two hours on a standard mattress [25]. Skin and soft tissues with borderline perfusion at baseline can develop irreversible changes with even shorter intervals of pressure. Whether a two-hour frequency (versus a longer interval) is optimal is uncertain, particularly when a high-quality support surface is being used [26]. A Cochrane systematic review from 2020 included only three trials evaluating the effects of any repositioning schedule with respect to the incidence of pressure-induced skin and soft tissue injury in the adult population [27]. In one study, the incidence of new lesions was no different for repositioning every two versus every three hours on a standard mattress or between every four and every six hours on viscoelastic foam [28]. A later study of 942 at-risk nursing home residents managed on a high-density foam mattress found no differences in incidence for those turned at two-, three-, or four-hour intervals [29]. However, each of these studies were underpowered to detect meaningful differences. A later trial including 992 individuals who were not at severe risk of pressure injury from nine nursing homes managed on a high-density foam mattress compared repositioning intervals of two, three, and four hours [30]. No pressure injuries developed among the study participants, leading to the conclusion that the four-hour interval repositioning was not inferior, and that the two-hour repositioning interval can be relaxed for some nursing home residents.

Continuous rotation — Continuous lateral rotation was originally developed to enhance respiratory function in hospitalized patients but has been advocated by some for the prevention and management of pressure-induced skin and soft tissue injuries. Continuous lateral rotation

is achieved with a mechanized bed that continuously rotates around its longitudinal axis. Observational studies indicate modest improvements in healing rates when continuous lateral rotation is added to an advanced therapy surface [31]. Conceptually, the advantage gained by this automated approach to pressure reduction could be offset by the presence of continuous shearing forces. Technical parameters, such as bed rotation frequency and bed tilt angle, need to be better defined. Continuous rotation therapy is not likely to replace the need to reposition the patient every two hours, and there is insufficient evidence to support its use.

SUPPORTIVE INTERVENTIONS

In addition to positioning and pressure support devices, other preventive measures may be helpful and are indicated on the basis of individual patient assessment. There is minimal evidence from randomized trials to support many of these interventions.

Improve mobility — Encouraging patient mobility is key to the prevention of pressure-induced skin and soft tissue injuries. Several approaches may be helpful to minimize immobility, including:

- Implement an early mobilization program
- Immobilized patients may benefit from physical therapy.
- Severe spasticity may be relieved with muscle relaxant drugs or a nerve block. (See "Chronic complications of spinal cord injury and disease".)
- Medications contributing to immobility, such as sedatives, should be limited.

Improve skin perfusion — Pressure-induced skin and soft tissue injuries may be difficult, if not impossible, to prevent in patients with poor skin perfusion (eg, peripheral artery disease, hypotension); however, every effort should be made to identify and improve the quality of skin perfusion. This may include prompt treatment of hypotension, limiting vasoconstrictive agents, improving cardiac contractility, or revascularization for some patients with severe peripheral artery disease. (See "Epidemiology, pathogenesis, and risk assessment of pressure-induced skin and soft tissue injury", section on 'Reduced skin perfusion'.)

Provide proper skin care — Skin condition should be inspected and documented daily.

- Skin assessment should include skin temperature, color, turgor, moisture status, and integrity. Any changes should be recorded as soon as they are observed [32]. Devices that provide real-time information on interface pressure may be useful to aid monitoring [33].

- Keeping the skin clean and dry while avoiding excess dryness and scaling is the primary goal.
- Skin cleansing should be done with a pH-balanced cleansing agent that minimizes irritation.
- Hot water should be avoided.
- Vigorous massage over bony prominences should be avoided.
- Cleansings should be done at regular intervals to minimize exposure to excess moisture due to incontinence, perspiration, or wound drainage [10].
- Dry sacral skin is a risk factor for the development of pressure-induced skin and soft tissue injuries [34]. Lotions containing fatty acids may protect against friction and pressure as well as reduce hyperproliferative skin growth [35]. One study of 331 patients comparing hyperoxygenated fatty acid compound versus placebo in acute care and long-term care patients found that the fatty acid preparation significantly reduced the incidence of ulcers (7.3 percent in the intervention group versus 17.3 percent in the placebo group) [35].

Minimize excess temperature and moisture — Microclimate, the temperature, humidity, and airflow immediately adjacent to the skin, is increasingly being recognized as an important contributor to the development of pressure-induced skin and soft tissue injury.

Higher skin temperatures are directly transmitted to deeper tissues and increase the likelihood of more severe skin and soft tissue injury [36].

Excess moisture increases friction and contributes to shear forces being transmitted to deeper tissues, thus making the skin more susceptible to breakdown. Excess moisture may arise from other sources, including sweat and drainage from nearby wounds. In addition, chemicals in urine and feces may irritate skin. The use of proper dressing can help limit drainage. Specialized support surfaces, including low-air-loss and air-fluidized beds, can also help to control the microenvironment. (See "Basic principles of wound management", section on 'Wound dressings' and "Overview of treatment of chronic wounds".)

For patients who are incontinent, it is important to protect the skin from constant exposure to urine or feces. In general, underpads or adult briefs, combined with consistent skin cleansing, are adequate for managing incontinence. The tabs can be left open at the sides of the incontinence briefs to allow air circulation. An alternative method is to place absorptive pads under the patient without a diaper so that any incontinence episode can be readily detected and addressed.

Multilayer foam dressings — While dressings have traditionally been used as a treatment for existing ulcers, studies have examined the role of multilayer foam dressings in preventing pressure-induced injury [37-40]. These dressings, when used as a component of pressure-induced injury prevention strategies, are placed over a bony prominence and help mitigate loading forces applied to the skin.

- In a trial of 366 intensive care unit (ICU) patients, the occurrence of new pressure injuries was reduced by 88 percent with the addition of a soft silicone foam dressing over the sacrum to usual care [37].
- In a Australian trial that included 440 trauma and critically ill patients, the incidence of pressure injuries was significantly reduced with the use of preemptive dressings compared with no such dressings (3.1 versus 13.1 percent) [38]. The dressings were initiated in the emergency department and maintained throughout the hospital stay.
- In a German trial that included 422 ICU patients, the relative risk of pressure injury, stage 2 or higher, was reduced by 74 percent for prophylactic dressings applied on the sacrum and heels. This translated to a number needed to treat of 12.3 patients to prevent one pressure injury [39].

Correct malnutrition — Nutritional goals should address any documented nutritional compromise. Formal nutritional assessment should be carried out and a plan of support instituted to address any deficiencies. If dietary intake of protein or calories is inadequate, the factors compromising intake should be addressed as part of total patient care. (See "Nutrition support in critically ill adult patients: Initial evaluation and prescription".)

It is generally felt that adequate nutrition may both help prevent ulcer formation and promote healing of early-stage ulcers [10,22,41]. Unless there is a contraindication, individuals at risk of developing pressure-induced skin and soft tissue injury should have a protein intake of approximately 1.2 to 1.5 gm/kg body weight daily [22].

Studies evaluating nutritional supplements or enteral feedings for prevention have inconclusive results [12,42]. The effectiveness of specific nutritional interventions, such as tube feedings or dietary supplements, will depend on the baseline nutritional status of participants [10,43]. One study in critically ill older adult patients did find that patients who were only given a standard diet, compared with oral nutritional supplementation plus standard diet, were at increased risk, although questions have been raised about methodological aspects of this study [44]. Due to the many methodological problems in studies of nutritional interventions, systematic reviews have concluded that there is no clear evidence of benefit [12,42], but appropriate medical care would suggest that all nutritional deficiencies should be addressed.

Consider use of continuous bedside pressure mapping — Continuous bedside pressure mapping can serve as a real-time visual cue to staff about an individual's pressure points and the need for repositioning. Whereas one study in a medical intensive care unit demonstrated a benefit to continuous pressure mapping [45], another study on a geriatric/internal medicine ward found no benefit [46].

QUALITY INITIATIVES

Key components of successful prevention initiatives are listed below [47-49].

- Staff education on best prevention practices.
- Standardized forms for documenting ulcer appearance and interventions.
- One or more members of the nursing team designated as a skin care champion.
- Instituting prompts for turning patients at regular intervals. Musical cues played over the public address system at two-hour intervals were shown in one study to lower the odds of developing a pressure-induced skin and soft tissue injury [50].
- Minimizing barriers to obtaining necessary supplies such as special mattresses and overlays.
- Obtaining additional expertise through consultations.
- Use of audit and feedback.

Studies evaluating the implementation of quality improvement (QI) practices in nursing homes have shown a reduction in the rate of pressure injuries, although such efforts need ongoing maintenance to sustain results [51-55].

PROVIDER EDUCATION AND STAFFING

No single individual involved in patient care is able to prevent pressure-induced skin and soft tissue injuries. Rather, prevention requires a coordinated effort of multiple disciplines. Failures are less common when effective systems for staff education are in place [51]. When an ulcer does occur, problems contributing to its development should be identified and methods for solving these problems implemented.

Sufficient staffing levels are necessary for effective prevention, and it is easy to understand why some failures will inevitably occur given that each patient must be repositioned in bed over 4000 times per year [56]. Adequate staffing and the availability of resources in nursing facilities may depend upon the business model (for-profit versus not-for-profit) of the facility.

A systematic review and meta-analysis of randomized trials and observational studies found a significantly lower risk for not-for-profit facilities compared with for-profit facilities (odds ratio 0.91, 95% CI 0.83-0.98) [57]. The results were consistent with two other analyses [58,59]. For-profit facilities have strong incentives to minimize expenditures, and, although the average effect supported not-for-profit facilities, the authors noted variability in the quality of nursing home care due to a variety of factors, including managerial styles, business motivations, and organizational behavior. In an observational study of 12,473 certified nursing facilities in the United States evaluating over two million residents, the quality of nursing care was the primary factor contributing to an increased prevalence at facilities with a high concentration of patients from underserved populations [60].

FAILURE OF PREVENTIVE MEASURES

Although implementation of preventive practices can decrease the rate of pressure-induced skin and soft tissue injuries, some patients may be at such a high risk (eg, heart failure, terminal illness, impending death) that development cannot be avoided even if best practices have been implemented [61].

COST EFFECTIVENESS

Based upon cost modeling, several studies have found the use of pressure redistribution surfaces to be cost effective or even cost saving.

One study simulated admissions to an acute care hospital and compared enhanced prevention practices versus standard care [2]. Preventive measures resulted in greater quality-adjusted life-years (QALYs) and saved money. These findings were confirmed in a subsequent analysis showing that preventive measures targeted towards high-risk patients saved money while increasing QALYs; a strategy of prevention-for-all resulted in the greatest increase in QALYs at a cost of USD $2000 per QALY [6]. A randomized clinical trial of specialized beds in an intensive care unit that found fewer pressure injuries and lower costs associated with preventive intervention .

The cost effectiveness of using support surfaces on emergency department (ED) stretchers and beds as an early measure for prevention in older adult patients admitted through the ED was also studied [3]. The model projected an incidence of emergency department-acquired pressure injuries of 1.9 percent with current practice and 1.5 percent with early preventive strategies, which corresponded to a number-needed-to-treat of 238 patients. Early prevention was more effective and less costly than standard practice even for short emergency department stays (ie, one hour), with a mean cost-saving of $32 per patient.

Another study modelled the cost effectiveness of viscoelastic overlays in patients requiring surgical procedures lasting longer than 90 minutes [4]. An intraoperative prevention strategy that decreased the incidence by 0.51 percent corresponded to a number-needed-to-treat of 196 patients. The average cost of using the operating table overlay was calculated to be $1.66 per patient. For the projected decrease in the incidence, the cost savings averaged $46 per patient.

An evaluation of preventive strategies used in long-term nursing home care also found that support surfaces are cost effective [5]. Multiple strategies were evaluated, including pressure redistribution surfaces, oral nutritional supplements for high-risk residents with recent weight loss, skin emollients for high-risk residents with dry skin, and skin cleansing for high-risk residents requiring incontinence care. Preventive strategies cost, on average, $11.66 per resident per week. The lifetime risk of developing a pressure-induced injury was reduced with the use of preventive strategies, and the number-needed-to-treat was calculated to be 45 for pressure redistribution surfaces, 63 for skin cleansing, 158 for skin emollients, and 333 for nutritional supplementation. Pressure redistribution surfaces and skin cleansing reduced the mean lifetime cost by $115 and $179 per resident, respectively. The cost per Quality Adjusted Life Year (QALY) gained was less than $50,000 for support surfaces and skin cleansing but exceeded $50,000 for nutritional supplements and skin emollients.

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Open wound management" and "Society guideline links: Pressure-induced skin and soft tissue injury".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading

level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topic (see "Patient education: Pressure sores (The Basics)")

SUMMARY AND RECOMMENDATIONS

- **Pressure-induced skin and soft tissue injuries** – Pressure-induced skin and soft tissue injuries are among the most common conditions encountered in hospitalized patients or those requiring long-term institutional care. (See 'Introduction' above.)

- **Patient repositioning** – Pressure redistribution is the most important factor for prevention. For individuals who must stay in bed, we suggest repositioning at least every two hours to relieve tissue pressure (**Grade 2C**). Proper positioning and turning techniques should be used to minimize friction and shear forces. (See 'Static positioning' above.)

- **Pressure reduction** – For patients at increased risk (identified by clinical assessment or risk scales) for developing pressure-induced skin and soft tissue injuries, we recommend the use of pressure-reducing products (**Grade 1A**). The choice of product, including overlays, foam, gel supports, or dynamic devices, will depend upon patient risk factors and the availability of resources. Dynamic supports, such as air-fluidized beds, may be cost effective in high-risk patients. (See 'Support surfaces' above.)

- **Additional measures** – Other measures that may be helpful for prevention in selected patients include improving mobility (physical therapy, decreased use of sedatives), improving skin perfusion, providing proper skin care including minimizing excess moisture, correcting malnutrition, and possibly using preemptive dressings on areas of risk. (See 'Supportive interventions' above.)

- **Education and support** – Education of clinical staff and patients and their families or other caregivers along with a team staff approach and quality initiative policies are

essential to reduce the development of pressure sores. (See 'Provider education and staffing' above.)

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REFERENCES

1. de Laat EH, Pickkers P, Schoonhoven L, et al. Guideline implementation results in a decrease of pressure ulcer incidence in critically ill patients. Crit Care Med 2007; 35:815.
2. Padula WV, Mishra MK, Makic MB, Sullivan PW. Improving the quality of pressure ulcer care with prevention: a cost-effectiveness analysis. Med Care 2011; 49:385.
3. Pham B, Teague L, Mahoney J, et al. Early prevention of pressure ulcers among elderly patients admitted through emergency departments: a cost-effectiveness analysis. Ann Emerg Med 2011; 58:468.
4. Pham B, Teague L, Mahoney J, et al. Support surfaces for intraoperative prevention of pressure ulcers in patients undergoing surgery: a cost-effectiveness analysis. Surgery 2011; 150:122.
5. Pham B, Stern A, Chen W, et al. Preventing pressure ulcers in long-term care: a cost-effectiveness analysis. Arch Intern Med 2011; 171:1839.
6. Padula WV, Pronovost PJ, Makic MBF, et al. Value of hospital resources for effective pressure injury prevention: a cost-effectiveness analysis. BMJ Qual Saf 2019; 28:132.
7. Smith S, Snyder A, McMahon LF Jr, et al. Success In Hospital-Acquired Pressure Ulcer Prevention: A Tale In Two Data Sets. Health Aff (Millwood) 2018; 37:1787.
8. Pronovost PJ, Goeschel CA, Wachter RM. The wisdom and justice of not paying for "preventable complications". JAMA 2008; 299:2197.
9. Bennett RG, O'Sullivan J, DeVito EM, Remsburg R. The increasing medical malpractice risk related to pressure ulcers in the United States. J Am Geriatr Soc 2000; 48:73.
10. Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. The International Guideline. 3rd ed. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel, and Pan Pacific Pressure Injury Alliance. 2019. Available at: https://internationalguideline.com/.
11. Stansby G, Avital L, Jones K, et al. Prevention and management of pressure ulcers in primary and secondary care: summary of NICE guidance. BMJ 2014; 348:g2592.
12. Chou R, Dana T, Bougatsos C, et al. Pressure ulcer risk assessment and prevention: a systematic comparative effectiveness review. Ann Intern Med 2013; 159:28.

13. NPUAP Support Surface Standards Initiative: Terms and Definitions Related to Support Surfaces. https://cdn.ymaws.com/npiap.com/resource/resmgr/s3i_terms-and-defs-feb-5-201.pdf (Accessed on October 16, 2023).
14. McInnes E, Jammali-Blasi A, Bell-Syer SE, et al. Support surfaces for pressure ulcer prevention. Cochrane Database Syst Rev 2015; :CD001735.
15. 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:CD013761.
16. Nixon J, Cranny G, Iglesias C, et al. Randomised, controlled trial of alternating pressure mattresses compared with alternating pressure overlays for the prevention of pressure ulcers: PRESSURE (pressure relieving support surfaces) trial. BMJ 2006; 332:1413.
17. Nixon J, Smith IL, Brown S, et al. Pressure Relieving Support Surfaces for Pressure Ulcer Prevention (PRESSURE 2): Clinical and Health Economic Results of a Randomised Controlled Trial. EClinicalMedicine 2019; 14:42.
18. Iglesias C, Nixon J, Cranny G, et al. Pressure relieving support surfaces (PRESSURE) trial: cost effectiveness analysis. BMJ 2006; 332:1416.
19. Brienza D, Kelsey S, Karg P, et al. A randomized clinical trial on preventing pressure ulcers with wheelchair seat cushions. J Am Geriatr Soc 2010; 58:2308.
20. 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; 17:631.
21. Reddy M, Gill SS, Rochon PA. Preventing pressure ulcers: a systematic review. JAMA 2006; 296:974.
22. Thomas DR. The new F-tag 314: prevention and management of pressure ulcers. J Am Med Dir Assoc 2006; 7:523.
23. Makhsous M, Priebe M, Bankard J, et al. Measuring tissue perfusion during pressure relief maneuvers: insights into preventing pressure ulcers. J Spinal Cord Med 2007; 30:497.
24. National Pressure Injury Advisory Panel: Pressure injury prevention tips for prone positioning. https://cdn.ymaws.com/npiap.com/resource/resmgr/online_store/posters/npiap_pip_tips_-_proning_202.pdf (Accessed on November 01, 2021).
25. Knox DM, Anderson TM, Anderson PS. Effects of different turn intervals on skin of healthy older adults. Adv Wound Care 1994; 7:48.
26. Vanderwee K, Grypdonck MH, De Bacquer D, Defloor T. Effectiveness of turning with unequal time intervals on the incidence of pressure ulcer lesions. J Adv Nurs 2007; 57:59.

27. Gillespie BM, Walker RM, Latimer SL, et al. Repositioning for pressure injury prevention in adults. Cochrane Database Syst Rev 2020; 6:CD009958.
28. Defloor T, De Bacquer D, Grypdonck MH. The effect of various combinations of turning and pressure reducing devices on the incidence of pressure ulcers. Int J Nurs Stud 2005; 42:37.
29. Bergstrom N, Horn SD, Rapp MP, et al. Turning for Ulcer ReductioN: a multisite randomized clinical trial in nursing homes. J Am Geriatr Soc 2013; 61:1705.
30. 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; 35:315.
31. Anderson C, Rappl L. Lateral rotation mattresses for wound healing. Ostomy Wound Manage 2004; 50:50.
32. European Pressure Ulcer Advisory Panel (EPUAP). Guidelines on treatment of pressure ulcers. EPUAP Review 1999; 1:31.
33. Walia GS, Wong AL, Lo AY, et al. Efficacy of Monitoring Devices in Support of Prevention of Pressure Injuries: Systematic Review and Meta-analysis. Adv Skin Wound Care 2016; 29:567.
34. Allman RM, Goode PS, Patrick MM, et al. Pressure ulcer risk factors among hospitalized patients with activity limitation. JAMA 1995; 273:865.
35. Torra i Bou JE, Segovia Gómez T, Verdú Soriano J, et al. The effectiveness of a hyperoxygenated fatty acid compound in preventing pressure ulcers. J Wound Care 2005; 14:117.
36. Kottner J, Black J, Call E, et al. Microclimate: A critical review in the context of pressure ulcer prevention. Clin Biomech (Bristol, Avon) 2018; 59:62.
37. Kalowes P, Messina V, Li M. Five-Layered Soft Silicone Foam Dressing to Prevent Pressure Ulcers in the Intensive Care Unit. Am J Crit Care 2016; 25:e108.
38. Santamaria N, Gerdtz M, Sage S, et al. A randomised controlled trial of the effectiveness of soft silicone multi-layered foam dressings in the prevention of sacral and heel pressure ulcers in trauma and critically ill patients: the border trial. Int Wound J 2015; 12:302.
39. Hahnel E, El Genedy M, Tomova-Simitchieva T, et al. The effectiveness of two silicone dressings for sacral and heel pressure ulcer prevention compared with no dressings in high-risk intensive care unit patients: a randomized controlled parallel-group trial. Br J Dermatol 2020; 183:256.
40. Padula WV. Effectiveness and Value of Prophylactic 5-Layer Foam Sacral Dressings to Prevent Hospital-Acquired Pressure Injuries in Acute Care Hospitals: An Observational Cohort Study. J Wound Ostomy Continence Nurs 2017; 44:413.

41. Ohura T, Nakajo T, Okada S, et al. Evaluation of effects of nutrition intervention on healing of pressure ulcers and nutritional states (randomized controlled trial). Wound Repair Regen 2011; 19:330.
42. Langer G, Fink A. Nutritional interventions for preventing and treating pressure ulcers. Cochrane Database Syst Rev 2014; :CD003216.
43. Finucane TE. Malnutrition, tube feeding and pressure sores: data are incomplete. J Am Geriatr Soc 1995; 43:447.
44. Bourdel-Marchasson I, Barateau M, Rondeau V, et al. A multi-center trial of the effects of oral nutritional supplementation in critically ill older inpatients. GAGE Group. Groupe Aquitain Geriatrique d'Evaluation. Nutrition 2000; 16:1.
45. Behrendt R, Ghaznavi AM, Mahan M, et al. Continuous bedside pressure mapping and rates of hospital-associated pressure ulcers in a medical intensive care unit. Am J Crit Care 2014; 23:127.
46. Gunningberg L, Sedin IM, Andersson S, Pingel R. Pressure mapping to prevent pressure ulcers in a hospital setting: A pragmatic randomised controlled trial. Int J Nurs Stud 2017; 72:53.
47. Sullivan N, Schoelles KM. Preventing in-facility pressure ulcers as a patient safety strategy: a systematic review. Ann Intern Med 2013; 158:410.
48. Niederhauser A, VanDeusen Lukas C, Parker V, et al. Comprehensive programs for preventing pressure ulcers: a review of the literature. Adv Skin Wound Care 2012; 25:167.
49. Soban LM, Hempel S, Munjas BA, et al. Preventing pressure ulcers in hospitals: A systematic review of nurse-focused quality improvement interventions. Jt Comm J Qual Patient Saf 2011; 37:245.
50. Yap TL, Kennerly SM, Simmons MR, et al. Multidimensional team-based intervention using musical cues to reduce odds of facility-acquired pressure ulcers in long-term care: a paired randomized intervention study. J Am Geriatr Soc 2013; 61:1552.
51. Rosen J, Mittal V, Degenholtz H, et al. Ability, incentives, and management feedback: organizational change to reduce pressure ulcers in a nursing home. J Am Med Dir Assoc 2006; 7:141.
52. Zinn JS, Brannon D, Weech R. Quality improvement in nursing care facilities: extent, impetus, and impact. Am J Med Qual 1997; 12:51.
53. Baier RR, Gifford DR, Lyder CH, et al. Quality improvement for pressure ulcer care in the nursing home setting: the Northeast Pressure Ulcer Project. J Am Med Dir Assoc 2003; 4:291.

54. Berlowitz DR, Young GJ, Hickey EC, et al. Quality improvement implementation in the nursing home. Health Serv Res 2003; 38:65.
55. Rosen J, Mittal V, Degenholtz H, et al. Pressure ulcer prevention in black and white nursing home residents: A QI initiative of enhanced ability, incentives, and management feedback. Adv Skin Wound Care 2006; 19:262.
56. Horn SD, Buerhaus P, Bergstrom N, Smout RJ. RN staffing time and outcomes of long-stay nursing home residents: pressure ulcers and other adverse outcomes are less likely as RNs spend more time on direct patient care. Am J Nurs 2005; 105:58.
57. Comondore VR, Devereaux PJ, Zhou Q, et al. Quality of care in for-profit and not-for-profit nursing homes: systematic review and meta-analysis. BMJ 2009; 339:b2732.
58. Davis MA. On nursing home quality: a review and analysis. Med Care Rev 1991; 48:129.
59. Hillmer MP, Wodchis WP, Gill SS, et al. Nursing home profit status and quality of care: is there any evidence of an association? Med Care Res Rev 2005; 62:139.
60. Li Y, Yin J, Cai X, et al. Association of race and sites of care with pressure ulcers in high-risk nursing home residents. JAMA 2011; 306:179.
61. Black JM, Edsberg LE, Baharestani MM, et al. Pressure ulcers: avoidable or unavoidable? Results of the National Pressure Ulcer Advisory Panel Consensus Conference. Ostomy Wound Manage 2011; 57:24.

Topic 2885 Version 34.0

GRAPHICS

Staging of pressure-induced skin and soft tissue injuries[1]

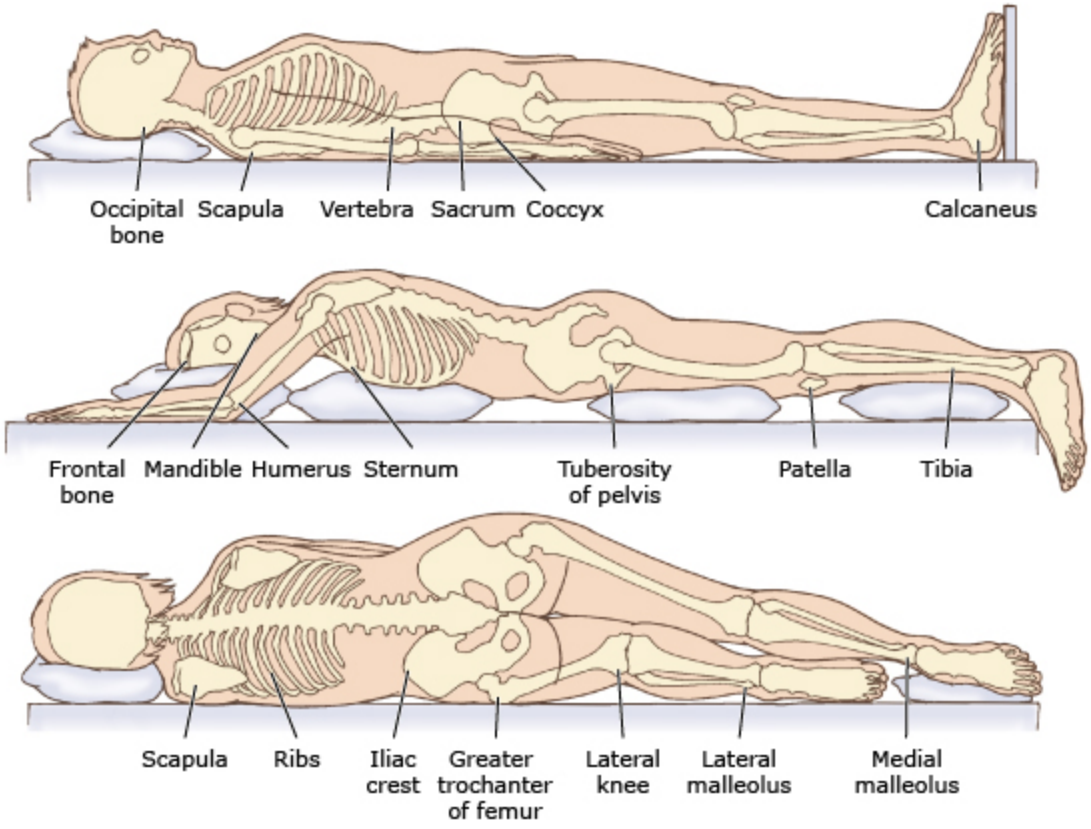
Stage	Description
1	Skin intact but with non-blanchable redness for >1 hour after relief of pressure.
2	Blister or other break in the dermis with partial thickness skin loss, with or without infection. Subcutaneous fat is not visible.
3	Full-thickness skin loss, with or without infection. Subcutaneous fat may be visible. Undermining and tunneling may be present.
4	Full-thickness skin and tissue loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage, or bone, with or without infection. Often includes undermining and tunneling.
Unstageable	Full-thickness skin and tissue loss in which the base of the ulcer is covered by slough and/or eschar in the wound bed.
Deep tissue pressure injury	Localized persistent, non-blanchable purple or maroon discolored, but intact skin or blood-filled blister. Due to damage of underlying tissue from prolonged pressure or shear at the bone-muscle interface.

Reference:

1. *National Pressure Injury Advisory Panel. NPIAP Pressure Injury Stages. Available at: https://npiap.com/page/PressureInjuryStages (Accessed on January 29, 2020).*

Graphic 62903 Version 6.0

Sites associated with pressure-induced injury



Common sites for development of pressure-induced skin and soft tissue injury.

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Contributor Disclosures

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