TREATMENT OF PRESSURE ULCER

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Hosp Sultanah Bahiyah
Alor Setar
WHY IS IT MY FAULT HE GOT A BED SORE?!

HE'S A ZOMBIE!! HE DOESN'T HAVE ANY CIRCULATION TO HIS SKIN!! HE DOESN'T HAVE ANY CIRCULATION!!

HE DIDN'T HAVE A PRESSURE ULCER ON ADMISSION

SHE'S MAKING MY HAIR FALL OUT TOO

WWW.GLOBALPERSNEL.DEPT

"DO YOU WORK WELL UNDER PRESSURE!"
Factors that can affect ulcer treatment and healing

- Physiologic factors
  - Previous skin breakdown at the same site or other skin-integrity problems (e.g. dermatitis)
  - Presence and severity of significant comorbidities (e.g. diabetes, fecal incontinence)
  - Presence of malnutrition or cachexia due to underlying disease
  - Presence of contractures
  - Use of medications (e.g. corticosteroids) that influence the immune system, host defenses, and skin characteristics
Framework of pressure ulcer treatment strategies
Pain assessment & Treatment

• Assess for Pressure Ulcer Pain
  - Assess all patients for pain related to a pressure ulcer using a scale that is valid and reliable
  - Assess for deterioration of the ulcer or possible infection when the patient reports increasing intensity of pain over time
Prevent Pressure Ulcer Pain

- Use a lift or transfer sheet to minimize friction and/or shear when repositioning a patient, keeping bed linens smooth and unwrinkled
- Position the position off the pressure ulcer whenever possible
- Avoid postures that increase pressure
Pain Management

- Organize care delivery to ensure that it is coordinated with pain medication administration and that minimal interruptions follow.
- Encourage patients to request a ‘time out’ during any procedure that causes pain.
- Reduce pressure ulcer pain by keeping the wound bed covered and moist, and using a non-adherent dressing.
Pain Management

- Select a wound dressing that requires less frequent changing and is less likely to cause pain.
- Consider the use of non-pharmacological pain management strategies to reduce pain.
- Encourage repositioning as a means to reduce pain, if consistent with the patient's wishes.
Pain Management

- Use adequate pain control measures, including additional dosing, prior to commencing wound care procedures
Clean vs Sterile Technique

- Present literature suggests that pressure ulcer dressing protocols may use clean technique rather than sterile

- Appropriate sterile technique may be needed for those wounds that recently have been surgically debrided or repaired
Wound care

- Cleanse most pressure ulcers with potable water (i.e., water suitable for drinking) or normal saline.
- Consider using an aseptic technique when the patient, the wound or the wound healing environment is compromised.
- Cleanse surrounding skin
Cleaning the wound

- An effective antiseptic should:
  - Act quickly
  - Be nonirritating
  - Be nontoxic to viable tissue
  - Have a broad spectrum of activity
  - Have low resistance potential; and
  - Work in the presence of blood, fibrin, pus, and slough
## Principles of Wound Bed Preparation

<table>
<thead>
<tr>
<th>Impairment</th>
<th>Debride Non-viable or deficient</th>
<th>Infection or inflammation</th>
<th>Moisture imbalance</th>
<th>Edge of wound non advancing or undermined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-viable tissue-defective matrix &amp; cell debris</td>
<td>High bacterial counts or prolonged inflammation</td>
<td>Desiccation or excess fluid</td>
<td>Non-migrating keratinocytes Non-responsive wound cells</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Debridement</th>
<th>Antimicrobials</th>
<th>Dressings Compression</th>
<th>Biological agents Adjunct Therapies Debridement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stimulate keratinocyte migration</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Restore wound base &amp; proteins</th>
<th>Low bacterial counts &amp; controlled inflammation</th>
<th>Restore cell migration Avoid maceration</th>
</tr>
</thead>
</table>
Framework

- Aims to optimize the wound bed by:
  - reducing edema and exudate
  - reducing the bacterial burden
  - correcting the abnormalities contributing to impaired healing


Preventive Skin Care

- Remove pressure, friction and sheer
- Stage III, IV ulcers should be covered
- Avoid positioning on area of erythema wherever possible
- Keep the skin clean and dry
Preventive Skin Care

- Do not massage or vigorously rub skin at risk of pressure ulcers
- Protect the skin from excessive moisture with a barrier product in order to reduce pressure damage
- Consider using skin moisturizer (barrier preparation) to hydrate dry skin to reduce risk of skin damage
Preventive Skin Care

- Consider using a barrier preparation to prevent skin damage in adults who are at high risk of developing a moisture lesion or incontinence-associated dermatitis, as identified by skin assessment (such as those with incontinence, oedema, dry or inflamed skin).
Ulcer Dressings

- The goals of dressing an ulcer are to
  - Keep the ulcer bed moist and the surrounding skin dry
  - Protect the ulcer from contamination
  - Promote healing
<table>
<thead>
<tr>
<th>Dressing type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic dressings</td>
<td></td>
</tr>
<tr>
<td>Gauze</td>
<td>Comes in woven and non-woven form and are usually made of from cotton, viscoe, polyester, or other suitable fibres. It is absorptive and permeable to water, water vapor, and oxygen.</td>
</tr>
<tr>
<td>Modern dressings</td>
<td></td>
</tr>
<tr>
<td>Hydrocolloid</td>
<td>Contains an elastomeric, adhesive, and gelling forming agent, such as carboxymethylcellulose, pectin or gelatin. It is often combined with adhesives and a tackiness agent and applied to a polyurethane foam or film carrier to create an absorbent, self-adhesive, waterproof sheet.</td>
</tr>
<tr>
<td>Foam</td>
<td>Cellulose or polyurethane dressing that can be impregnated or coated with other materials and has certain absorptive properties.</td>
</tr>
<tr>
<td>Polyurethane</td>
<td>It is a transparent, semi-permeable, and non-absorptive, polymer-based adhesive film.</td>
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<tr>
<td>Hydrofibre®</td>
<td>It has highly absorbent, with gelling properties derived from 100% sodium carboxymethylcellulose hydrocolloid polymers.</td>
</tr>
<tr>
<td>Collagen</td>
<td>Collagen is the most abundant protein in the human body and is a major component of the extracellular matrix. The dressing can be derived from bovine, porcine or avian sources.</td>
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<tr>
<td>Hydrogel</td>
<td>It consists of insoluble polymers which have a hydrophilic nature. When mixed with aqueous solutions, they will absorb water.</td>
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<tr>
<td>Impregnated gauze</td>
<td>Gauze that is impregnated with some other product such as paraffin or other products.</td>
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<tr>
<td>Poly-hema</td>
<td>A biocompatible, hydrophilic gel that is permeable to tissue fluids and functions as a hydrogel.</td>
</tr>
<tr>
<td>Amino acid co-polymer</td>
<td>It is permeable to water vapour. It does not allow microbial proliferation after in vitro inoculation. It is impermeable to bacteria, and supposed to increase epithelialisation. It is a skin substitute.</td>
</tr>
<tr>
<td>Alginate</td>
<td>These are derived from seaweed, usually prepared as the calcium salt of alginic acid. When in contact with serum, wound exudate or solutions containing the insoluble calcium alginate will partially convert to a soluble sodium salt, and produce a hydrophilic gel.</td>
</tr>
<tr>
<td>Charcoal</td>
<td>Activated carbon in dressing adsorbs bacteria and helps to reduce wound odor.</td>
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<tr>
<td>Dextranomer</td>
<td>It is a sterile, insoluble powder in the form of circular beads when dry. It is a long chain polysaccharide constructed in a three dimensional network of cross-linked dextran molecules. Dextranomer is highly hygroscopic due to its high hydroxyl group content and 1 g of it absorbs 4 ml of water and swells till it is saturated. The microorganisms and high molecular weight substances which get confined to the interspaces move at a faster rate due to capillary action.</td>
</tr>
<tr>
<td>Dressing type</td>
<td>Description</td>
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<td>-------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Protease modulating matrix</td>
<td>It consists of freeze-dried collagen and oxidised regenerated cellulose, which are brought on the market to bind and inactivates protease.</td>
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<tr>
<td>Silver dressing</td>
<td>The presence of silver ions should result in antimicrobial properties.</td>
</tr>
<tr>
<td>Sugar</td>
<td>Sugar is a highly osmotic product, which draws fluid out of the wound. Reducing fluid in the wound inhibits the growth of bacteria.</td>
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<tr>
<td>Honey</td>
<td>Honey's beneficial effects are thought to be due to the hydrogen peroxide production from the activity of the glucose oxidase enzyme. Honey is a highly osmotic product, which draws fluid out of the wound.</td>
</tr>
<tr>
<td>Platelet gel</td>
<td>Concentrated platelet, which should form granulation and more collagen fibers.</td>
</tr>
<tr>
<td>Hyaluronic acid</td>
<td>Hyaluronic acid is a natural substance widely distributed throughout our whole bodies. It is an important aspect of cartilage, synovial fluid (the lubricating fluid found between joints) and skin. Hyaluronic acid cannot be absorbed when applied topically, therefore sodium hyaluronate is added. Sodium hyaluronate is the salt of the hyaluronic acid and it has a much lower molecular size. Sodium hyaluronate can hold more than 1000 times its weight in water.</td>
</tr>
</tbody>
</table>

Source. References 8, 30, 86, 91, 92, 156, 167, 182
Guidelines

- Use a dressing that will maintain a **moist wound-healing environment**
  - eg; hydrogel/hydrocolloid dressing
- Use clinical judgment to select a moist wound dressing
  - 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
Guidelines

- Select a dressing that is cost effective
  - When determining cost efficacy, it is important to take into consideration health care provider time, patient care goals and resources, ease of use and healing rate, as well as the unit cost of the dressing
Factors to Consider When Selecting Ulcer Care Products

- Burden to patient (i.e., number of daily dressing changes required)
- Cost-effective
- Costs of ancillary supplies and equipment associated with treatment
- Ease of use and cost of staff time to use the product
- Safety, efficacy, and likelihood and potential severity of complications
- Ulcer characteristics (e.g., depth, condition of surrounding skin, location near sources of contamination, presence and amount of exudate)
Wound Dressing

- Select based on the:
  - ability to keep the wound bed moist
  - nature and volume of wound exudate
  - condition of the tissue in the ulcer bed
  - ulcer size, depth and location
  - bacterial bioburden (bacterial barrier)
  - provide for non traumatic removal
  - protect healthy cells
  - user friendly (frequency of dressing change)
  - pain and tolerance
Guidelines

- Select a dressing that will manage the wound exudate and protect the peri-ulcer skin
  - Peri-wound maceration and continuous contact with wound exudate can enlarge the wound and impede healing

- Select a dressing that remains in place and minimizes shear, friction, skin irritation, and additional pressure
  - 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
Wound Dressing

- Protect peri-ulcer skin
- Assess pressure ulcers at every wound dressing change and confirm the appropriateness of the current dressing regimen
- Change the wound dressing if faeces seep beneath the dressing
- Follow manufacturer recommendations, especially related to frequency of dressing change
Hydrogel Dressings

- usually clear or translucent and vary in viscosity or thickness
- providing moisture to the wound (moist healing environment) which promotes granulation, epithelialization, and autolytic debridement.
- designed to hold moisture in the surface of the wound, providing the ideal environment for both cleaning the wound, and allowing the body to rid itself of necrotic tissue.
- high moisture content so can prevent bacteria and oxygen from reaching the wound, providing a barrier for infections
Hydrogel Dressings

- Consider using hydrogel dressings on shallow, minimally exuding pressure ulcers, treatment of dry ulcer beds or painful pressure ulcers.
- Consider using amorphous hydrogel (free-flowing gel, packaged in tubes, foil packets, and spray bottles) for pressure ulcers with depth and contours and/or on body areas that are at risk for dressing migration.
- **NOT** recommended for wounds with heavy exudate.
Hydrocolloid Dressings

- Made from a layer of gel-forming material attached to a semi-permeable film or foam backing.
- The gel layer comprises an adhesive matrix that contains a combination of absorbent materials such as sodium carboxymethylcellulose, pectin and gelatin. The resulting dressing is absorbent and self adhesive, even in moist conditions.
- Fluid handling abilities can differ markedly.
- Reduce the coefficient of friction between the support surface and the patient, and so reduce the amount of shear and friction transmitted to the underlying skin.
Hydrocolloid Dressings

- Promote moist wound healing, manage exudate, aid autolytic debridement and assist with pain management.
- Use hydrocolloid dressings for clean Stage II pressure ulcers in body areas where they will not roll or melt.
- Consider using hydrocolloid dressing on non-infected, shallow Stage III pressure ulcers.
- Carefully remove hydrocolloid dressings on fragile skin to reduce skin trauma.
Difference of hydrogel/hydrocolloid

- Both are not appropriate for a very moist wound with lots of drainage
- Both main function is to keep the wound bed moist (optimal environment for wound healing)
- Hydrogels - need frequent dressing changes and are often an inhibiting factor to the healing process as the wound beds loses warmth with the changes
- Hydrocolloids - autolytic debridement (slowly) is possible with hydrocolloids, but not with hydrogels. Can be left on for up to 7 days
Alginate Dressings

- absorbent wound dressing
- can also be used to provide hemostasis
- Some alginates contain a silver compound, which provides antimicrobial protection (considered for an infected wound)
- the life of an alginate dressing is 3 days, although some dressings can be left in place for as long as 7 days
Alginate Dressings

- Consider using alginate dressings for treatment of moderately and heavily exuding pressure ulcers.
- Clinically infected pressure ulcers when there is appropriate concurrent treatment of infection.

- Gently remove the alginate dressing, irrigating it first to ease removal if necessary.
- Consider lengthening the interval between wound dressing changes or changing the type of wound dressing if the alginate dressing is still dry at the scheduled time for dressing change.
Silver Dressings

- provide additional benefits such as management of excessive exudate, maintenance of a moist wound environment, or facilitation of autolytic debridement
- antimicrobial action (reducing bioburden)
- act as an antimicrobial barrier for acute or chronic wounds at high risk of infection or re-infection
Medical grade honey dressings

- Honey is a topical antimicrobial agent that has been used for millennia in wound care (broad spectrum of activity against bacteria and fungi)
- filtered and gamma-irradiated to kill such pathogens as Clostridium botulinum
- inhibit biofilms
- use in infected or highly exuding wounds
Wound management

- Wound care may be broadly divided into non-operative and operative methods.
- For stage I and II pressure ulcers, wound care is usually conservative (ie, nonoperative).
- For stage III and IV lesions, surgical intervention (eg, flap reconstruction) may be required, though some of these lesions must be treated conservatively because of coexisting medical problems.
Surgical interventions

- Surgical debridement
- Diversion of the urinary or fecal stream
- Release of flexion contractures
- Wound closure
- Amputation
Other Surgical Options

- Direct closure (rarely usable)
- Skin grafts
- Skin flaps
- Myocutaneous (musculocutaneous) flaps
- Free flaps
Referral for the surgical treatment of pressure ulcers should be based on:

- Level of risk (anaesthesia and surgical intervention);
- Recurrence;
- Patient preferences (lifestyle, abilities and comfort);
- Ulcer assessment (e.g. anatomical site, staging);
- General skin assessment;
- General health status;
- Competing care needs;
- Assessment of psychosocial risk factors of recurrence;
- Previous success of surgical techniques;
- Failure of previous conservative management interventions.
Necrotic Tissue

- Pressure ulcer healing may be delayed by the presence of necrotic tissue, which also provides a medium for bacterial growth.
- Any necrotic tissue should be debrided, provided that this intervention is consistent with overall patient care goals.
Debridement Caveats

- Variety of methods available
  - Mechanical, sharp, surgical, enzymatic, autolytic
- Stable, dry, intact, and adherent eschar on the foot/heal should not be debrided unless signs/symptoms of local infection or instability
Debridement Caveats

- Wet-to-dry dressings (a form of debridement) or irrigations may be appropriate in *limited* circumstances, but repeated use may damage healthy granulation tissue and may lead to excessive bleeding and increased pain.
Debridement of an ulcer

- When choosing a debridement method, consider:
  - Ulcer size
  - Amount of slough and exudate
  - Presence and severity of pain associated either with the ulcer or with the method of debridement
  - Feasibility of performing sharp or surgical debridement
  - Risks of transporting the patient outside of the facility vs. the benefits of surgical debridement.
Debridement

- Debridement should only be performed when there is adequate perfusion to the wound
- Debride devitalized tissue within the wound bed or edge of pressure ulcers when appropriate to the individual’s condition and consistent with overall goals of care
- Debride the wound bed when the presence of biofilm is suspected or confirmed
- Manage pain associated with debridement
Debridement

- Use mechanical, autolytic, enzymatic, and/or biological methods of debridement when there is no urgent clinical need for drainage or removal of devitalized tissue.
- Surgical/sharp debridement is recommended in the presence of extensive necrosis, advancing cellulitis, crepitis, fluctuance, and/or sepsis secondary to ulcer-related infection.
Debridement

- Conservative sharp debridement and surgical/sharp debridement must be performed by specially trained, competent and qualified health professionals.
- Use sterile instruments for conservative sharp and surgical/sharp debridement.
- Use conservative sharp debridement with caution in the presence of:
  - immune incompetence, compromised vascular supply or lack of antibacterial coverage in systemic sepsis.
Debridement

- Perform a thorough vascular assessment prior to debridement of lower extremity pressure ulcers to determine whether arterial supply is sufficient to support healing of the debrided wound.
- Do not debride stable, hard, dry eschar in ischemic limbs.
- Perform maintenance debridement on a pressure ulcer until the wound bed is free of devitalized tissue and covered with granulation tissue.
ASSESSMENT AND TREATMENT OF INFECTION AND BIOFILMS
ASSESSMENT

- Have a high index of suspicion for local wound infection in patients with:
  - diabetes mellitus,
  - protein-calorie malnutrition,
  - hypoxia or poor tissue perfusion,
  - autoimmune disease, or
  - immunosuppression.
Assessment of High Risk Individuals with Pressure Ulcers

- Have a high index of suspicion of local infection in a pressure ulcer in the presence of:
  - lack of signs of healing for two weeks
  - friable granulation tissue
  - increased pain in the ulcer
  - increased heat in the tissue around the ulcer
  - increased drainage from the wound
  - an ominous change in the nature of the wound drainage (e.g., new onset of bloody drainage, purulent drainage)
  - increased necrotic tissue in the wound bed
• Have a high index of suspicion for the likelihood of infection in pressure ulcers that:
  - have necrotic tissue or a foreign body present
  - have been present for a long period of time
  - are large in size or deep
  - are likely to be repetitively contaminated (e.g., near the anus)
• Have a high index of suspicion of biofilm in a pressure ulcer that:
  - has been present for more than 4 weeks
  - lacks signs of any healing in the previous 2 weeks
  - displays clinical signs and symptoms of inflammation
  - does not respond to antimicrobial therapy
Consider a diagnosis of spreading acute infection if the pressure ulcer has local and/or systemic signs of acute infection, such as:

- erythema extending from the ulcer edge;
- induration;
- new or increasing pain or warmth;
- purulent drainage;
- increase in size;
- crepitus, fluctuance, or discoloration in the surrounding skin;
- fever, malaise, and lymph node enlargement; or
- confusion/delirium and anorexia (particularly in older adults).
Diagnosis of Infection

- Determine the bacterial bioburden of the pressure ulcer by tissue biopsy or quantitative swab technique
- Consider using tissue biopsy and microscopy to determine the presence of biofilm
Treatment

- Optimize the host response by:
  - evaluating nutritional status and addressing deficits;
  - stabilizing glycemic control;
  - improving arterial blood flow; and/or
  - reducing immunosuppressant therapy if possible.
- Prevent contamination of the pressure ulcer
- Reduce bacterial load and biofilm in the pressure ulcer
- Consider the use of tissue appropriate strength, non-toxic topical antiseptics for a limited time period to control bacterial bioburden
Treatment

- Consider the use of topical antiseptics in conjunction with maintenance debridement to control and eradicate suspected biofilm in wounds with delayed healing.
- Consider the use of topical antiseptics for pressure ulcers that are not expected to heal and are critically colonized/topically infected.
- Consider use of silver sulfadiazine or medical-grade honey in heavily contaminated or infected pressure ulcers until definitive debridement is accomplished.
Treatment

- Limit the use of topical antibiotics on infected pressure ulcers (in special situations where the benefit to the patient outweighs the risk of antibiotic side effects and resistance)
- Use systemic antibiotics for individuals with clinical evidence of systemic infection, such as positive blood cultures, cellulitis, fasciitis, osteomyelitis, systemic inflammatory response syndrome (SIRS), or sepsis.
- Evaluate the individual for osteomyelitis if exposed bone is present, the bone feels rough or soft, or the ulcer has failed to heal with prior therapy.
EMERGING THERAPIES
Microclimate Control

- Consider the need for additional features such as ability to control moisture and temperature when selecting a support surface.
- Do not apply heating devices (e.g., hot water bottles, heating pads, built-in bed warmers) directly on skin surfaces or pressure ulcers.
Prophylactic Dressings

• Consider applying a polyurethane foam dressing to bony prominences (e.g., heels, sacrum) for the prevention of pressure ulcers in anatomical areas frequently subjected to friction and shear

• Consider using silk-like fabrics rather than cotton or cotton-blend fabrics to reduce shear and friction

• When selecting a prophylactic dressing consider:
  - ability of the dressing to manage microclimate
  - ease of application and removal
  - ability to regularly assess the skin
  - anatomical location where the dressing will be applied
  - the correct dressing size
Electrical Stimulation of the Muscles (Electrotherapy)

- Consider the use of electrical stimulation for anatomical locations at risk of pressure ulcer development in spinal cord injury patients
  - induces intermittent tetanic muscle contractions
<table>
<thead>
<tr>
<th>Intervention</th>
<th>Strength of Evidence and Summary of Results for Wound Healing</th>
<th>Studies, Participants, and Study Duration for Wound Healing Analysis</th>
<th>Strength of Evidence for Harms</th>
<th>Studies and Participants for Harms Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Support surface</strong></td>
<td></td>
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<tr>
<td>AF beds vs. other surfaces:</td>
<td>Moderate</td>
<td>Insufficient harms for AF beds (rare or minor harms reported)</td>
<td>7 studies (for all support interventions) (n = 526)</td>
<td></td>
</tr>
<tr>
<td>(ulcer stage II, III, or IV and unstable)</td>
<td>Reduction in wound size: superior</td>
<td>5 studies (n = 908)</td>
<td>Duration: 4 d–36 wk</td>
<td></td>
</tr>
<tr>
<td>AP beds comparison of brands/forms (ulcer stage II, III, or IV)</td>
<td>Moderate</td>
<td>Insufficient harms for AP beds, comparison of brands (rare or minor harms reported)</td>
<td>Insufficient harms for AP beds, comparison of brands (rare or minor harms reported)</td>
<td></td>
</tr>
<tr>
<td>(ulcer stage II, III, or IV)</td>
<td>Complete wound healing: similar</td>
<td>4 studies (n = 369)</td>
<td>Duration: 4 wk–7 d</td>
<td>Discharge, healing, or death</td>
</tr>
<tr>
<td>AP beds vs. other surfaces</td>
<td>Low</td>
<td>Insufficient harms for AP beds vs. other surfaces (rare or minor harms reported)</td>
<td>4 studies (n = 368)</td>
<td>Duration: 2 wk–3 mo</td>
</tr>
<tr>
<td>(ulcer stage I, II, III, or IV)</td>
<td>Reduction in wound size: similar</td>
<td>Low</td>
<td>Insufficient harms for LAL beds (rare or minor harms reported)</td>
<td></td>
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<tr>
<td>LAL beds vs. other surfaces</td>
<td>Low</td>
<td>Insufficient harms for LAL beds (rare or minor harms reported)</td>
<td>5 studies (n = 329)</td>
<td>Duration: 1 wk–8 wk</td>
</tr>
<tr>
<td>(ulcer stage I, II, III, or IV)</td>
<td>Reduction in wound size: similar</td>
<td>Insufficient harms for vitamin C supplementation</td>
<td>1 study (n = 88)</td>
<td>Duration: 30 d–12 wk</td>
</tr>
<tr>
<td><strong>Nutrition</strong></td>
<td></td>
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<tr>
<td>Protein-containing nutritional supplements vs. standard diets or placebo (ulcer stage I, II, III, or IV)</td>
<td>Moderate</td>
<td>Insufficient harms of nutritional supplementation</td>
<td>7 studies (n = 448)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rate of reduction in wound size: superior</td>
<td>12 studies (n = 562)</td>
<td>Duration: 7 d–10 mo</td>
<td></td>
</tr>
<tr>
<td><strong>Vitamin C vs. placebo (ulcer stage I, II, III, or IV)</strong></td>
<td>Low</td>
<td>Insufficient harms of vitamin C supplementation</td>
<td>2 studies (n = 135)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rate of wound healing: similar</td>
<td>1 study (n = 88)</td>
<td>Duration: 30 d–12 wk</td>
<td></td>
</tr>
<tr>
<td><strong>Local wound applications</strong></td>
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</tr>
<tr>
<td>Hydrocolloid dressings vs. conventional care (ulcer stage I, II, III, or IV)</td>
<td>Low</td>
<td>Moderate hydrocolloid (rate of harms, 0%–16%): skin reactions (inflammation, erythema), maceration, pain, wound deterioration, and overgranulation</td>
<td>4 studies (n = 218)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduction in wound size: superior</td>
<td>10 studies (n = 560)</td>
<td>Duration: 3–12 wk</td>
<td></td>
</tr>
<tr>
<td>Hydrocolloid dressings vs. foam dressings (ulcer stage I, II, III, or IV)</td>
<td>Moderate</td>
<td>Moderate foam dressings (rate of harms, 0%–30%): bleeding, overgranulation, wound deterioration, maceration, tissue damage</td>
<td>4 studies (n = 230)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complete wound healing: equivalent</td>
<td>8 studies (n = 508)</td>
<td>Duration: 2–16 wk</td>
<td></td>
</tr>
<tr>
<td><strong>Radiant heat vs. other dressings</strong></td>
<td>Insufficient harms for radiant heat dressings</td>
<td>1 study (n = 50)</td>
<td>Moderate</td>
<td>4 studies (n = 230)</td>
</tr>
<tr>
<td>(ulcer stage III or IV)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>1 study (n = 50)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complete wound healing: similar</td>
<td>4 studies (n = 160)</td>
<td>Duration: 4–12 wk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rate of reduction in wound size: superior</td>
<td>Low</td>
<td>Dextranomer (rate of harms, 22%): minor infection, bleeding, overgranulation, and skin irritation</td>
<td>1 study (n = 92)</td>
</tr>
<tr>
<td></td>
<td>Reduction in wound size: superior</td>
<td>2 studies (n = 227)</td>
<td>Duration: 3–8 wk</td>
<td></td>
</tr>
<tr>
<td><strong>Topical collagen vs. hydrocolloid dressings or standard care (ulcer stage II, III, or IV)</strong></td>
<td>Insufficient harms for topical collagen</td>
<td>2 studies (n = 145)</td>
<td>Moderate</td>
<td>4 studies (n = 230)</td>
</tr>
<tr>
<td></td>
<td>Reduction in wound size: similar</td>
<td>3 studies (n = 160)</td>
<td>Duration: 2–8 wk</td>
<td></td>
</tr>
<tr>
<td><strong>PDGF vs. placebo (ulcer stage III or IV)</strong></td>
<td>Insufficient harms for PDGF</td>
<td>5 studies (n = 322)</td>
<td>Insufficient harms for PDGF</td>
<td>4 studies (n = 230)</td>
</tr>
<tr>
<td></td>
<td>Reduction in wound size: similar</td>
<td>4 studies (n = 209)</td>
<td>Duration: 4–16 wk</td>
<td></td>
</tr>
<tr>
<td><strong>Adjunctive therapy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical stimulation vs. sham (ulcer stage II, III, or IV)</td>
<td>Local skin irritation</td>
<td>3 studies (n = 146)</td>
<td>Insufficient harms for electrical stimulation</td>
<td>3 studies (n = 146)</td>
</tr>
<tr>
<td></td>
<td>Complete wound healing: similar</td>
<td>6 studies (n = 243)</td>
<td>Duration: 4–6 wk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rate of reduction in wound size: superior</td>
<td>9 studies (n = 397)</td>
<td>Duration: 3–16 wk</td>
<td></td>
</tr>
<tr>
<td>Electromagnetic therapy vs. sham (ulcer stage II, III, or IV)</td>
<td>Insufficient harms for electromagnetic therapy</td>
<td>1 study (n = 30)</td>
<td>Insufficient harms for electromagnetic therapy</td>
<td>1 study (n = 30)</td>
</tr>
<tr>
<td></td>
<td>Insufficient</td>
<td>4 studies (n = 112)</td>
<td>Duration: 2–12 wk</td>
<td></td>
</tr>
<tr>
<td>Therapeutic ultrasound vs. sham or standard care (ulcer stage II, III, or IV)</td>
<td>Insufficient</td>
<td>3 studies (n = 101)</td>
<td>Insufficient harms for therapeutic ultrasound</td>
<td>3 studies (n = 101)</td>
</tr>
<tr>
<td></td>
<td>Reduction in wound size: similar</td>
<td>3 studies (n = 148)</td>
<td>Duration: 2–13 wk</td>
<td></td>
</tr>
<tr>
<td><strong>NPWT vs. standard care or topical gel</strong></td>
<td>Insufficient harms for NPWT</td>
<td>2 studies (n = 77)</td>
<td>Insufficient</td>
<td>3 studies (n = 101)</td>
</tr>
<tr>
<td>(ulcer stage III or IV)</td>
<td>Reduction in wound size: similar</td>
<td>3 studies (n = 138)</td>
<td>Duration: 4–6 wk</td>
<td></td>
</tr>
<tr>
<td><strong>Light therapy vs. sham or standard care</strong></td>
<td>No clinically important harm reported</td>
<td>4 studies (n = 327)</td>
<td>Low</td>
<td>4 studies (n = 327)</td>
</tr>
<tr>
<td>(ulcer stage II, III, or IV)</td>
<td>Reduction in wound size: similar</td>
<td>2 studies (n = 317)</td>
<td>Duration: 12 wk</td>
<td></td>
</tr>
<tr>
<td><strong>Light therapy vs. sham or standard care</strong></td>
<td>No clinically important harm reported</td>
<td>4 studies (n = 327)</td>
<td>Low</td>
<td>4 studies (n = 327)</td>
</tr>
<tr>
<td>(ulcer stage I, II, III, or IV)</td>
<td>Reduction in wound size: superior</td>
<td>5 studies (n = 481)</td>
<td>Duration: 2–12 wk</td>
<td></td>
</tr>
<tr>
<td><strong>Laser therapy vs. sham or standard care</strong></td>
<td>No clinically important harm reported</td>
<td>4 studies (n = 137)</td>
<td>Insufficient</td>
<td>3 studies (n = 148)</td>
</tr>
<tr>
<td>(ulcer stage II, III, or IV)</td>
<td>Reduction in wound size: similar</td>
<td>3 studies (n = 137)</td>
<td>Duration: 5–6 wk</td>
<td></td>
</tr>
<tr>
<td><strong>Surgery</strong></td>
<td>Reoperation because of recurrence or flap failure: 12%–24%</td>
<td>2 studies (n = 255)</td>
<td>Insufficient</td>
<td>Insufficient</td>
</tr>
<tr>
<td>Cutaneous vs. fasciocutaneous vs. myocutaneous flaps (ulcer stage III or IV)</td>
<td></td>
<td>4 studies (n = 560)</td>
<td>Duration: 11 mo–20 y</td>
<td></td>
</tr>
<tr>
<td>Inconsistent results because of heterogeneity in patient populations and surgical procedures</td>
<td>Low</td>
<td>Insufficient harms for percutaneous &amp; topical gel</td>
<td>Insufficient harms for percutaneous &amp; topical gel</td>
<td>2 studies (n = 77)</td>
</tr>
<tr>
<td>Intervention</td>
<td>Strength of Evidence for Comparative Effectiveness</td>
<td>Studies and Participants for Comparative Effectiveness Analysis</td>
<td>Strength of Evidence for Harms</td>
<td>Studies and Participants for Harms Analysis</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td><strong>Features of pressure ulcers†</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anatomical site</td>
<td>Low Sacral pressure ulcers have lower recurrence rates after surgery than ischial pressure ulcers</td>
<td>4 studies (n = 560)</td>
<td>None reported</td>
<td>None reported</td>
</tr>
<tr>
<td>Severity at baseline</td>
<td>None reported</td>
<td>None reported</td>
<td>Low More harms with ischial vs. sacral and trochanteric surgical repairs</td>
<td>2 studies (n = 376)</td>
</tr>
<tr>
<td>Adjunctive Electrical stimulation vs. sham (ulcer stage II, III, or IV)</td>
<td>Low Rate of reduction in wound size: similar</td>
<td>5 studies (n = 197)</td>
<td>None reported</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Patient characteristics‡</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery Neurologic status (stage III or IV)</td>
<td>Low Recurrence rate: greater in patient with spinal cord injuries vs. other patients with pressure ulcers</td>
<td>1 study (n = 158)</td>
<td>None reported</td>
<td>None reported</td>
</tr>
<tr>
<td>Adjunctive Neurologic status</td>
<td>Low Rate of reduction in wound size: similar vs. other patients with pressure ulcers</td>
<td>4 studies (n = 138)</td>
<td>None reported</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Patient care settings§</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjunctive Hospital vs. rehabilitation center</td>
<td>Low Electrical stimulation produced similar results in a hospital vs. rehabilitation center</td>
<td>9 studies (n = 397)</td>
<td>None reported</td>
<td>None reported</td>
</tr>
</tbody>
</table>

* Results are for findings with moderate or low strength of evidence. Additional key questions are addressed in the full report (5).
† Key questions 1a and 2a: Such features as anatomical site or severity of ulcer at baseline.
‡ Key questions 1b and 2b: Patient characteristics, including but not limited to age; race or ethnicity; body weight; specific medical comorbid conditions; and known risk factors for pressure ulcers, such as functional ability, nutritional status, or incontinence.
§ Key questions 1c and 2c: Patient care settings, such as home, nursing facility, or hospital, or according to features of patient care settings, including but not limited to nurse–patient staffing ratio, staff education and training in wound care, the use of wound care teams, and home caregiver support and training.
THANK YOU FOR YOUR ATTENTION