Pressure ulcers affect 3 million adults in the United States across health care settings. They have a major impact on health status, quality of life, and health care costs. Treatment of pressure ulcers is critical to promote healing and minimize the risk for complications. Treatment interventions include management of conditions that give rise to pressure ulcers (support surfaces and nutritional support), protection and promotion of wound healing (wound dressings; topical applications; and various adjunctive therapies that are used in addition to standard pressure ulcer care, such as vacuum-assisted closure, ultrasound therapy, electrical stimulation, and hyperbaric oxygen therapy), and surgical repair of the wound (1) (Table 1). Treatment of pressure ulcers often requires a multidisciplinary approach involving nurses, physicians, and other members of a care team.

The purpose of this American College of Physicians (ACP) guideline is to present the available evidence on the comparative effectiveness of treatments for pressure ulcers. The target audience for this guideline includes all clinicians, including physicians, nurses, dietitians, and physical therapists. The target patient population comprises adults with pressure ulcers. For recommendations on the risk assessment and prevention of pressure ulcers, please refer to the accompanying ACP guideline (2).

METHODS
This guideline is based on a systematic evidence review (3), an updated evidence review (Supplement, available at www.annals.org), and an evidence report sponsored by the Agency for Healthcare Research and Quality (AHRQ) (1) that addressed the following key questions:

1. In adults with pressure ulcers, what is the comparative effectiveness of treatment strategies for improved health outcomes, including but not limited to complete wound healing, healing time, reduced wound surface area, pain, and prevention of serious complications of infection? Does the comparative effect-

**see also:**
Editorial comment ............... 387
Summary for Patients ............... I-38
Web-Only
Supplement
CME quiz

© 2015 American College of Physicians

*This paper, written by Amir Qaseem, MD, PhD, MHA; Linda L. Humphrey, MD, MPH; Mary Ann Forciea, MD; Melissa Starkey, PhD; and Thomas D. Denberg, MD, PhD, was developed for the Clinical Guidelines Committee of the American College of Physicians. Individuals who served on the Clinical Guidelines Committee from initiation of the project until its approval were Thomas D. Denberg, MD, PhD (Chair); Michael J. Barry, MD; Molly Cooke, MD; Paul Dallas, MD; Nick Fitterman, MD; Mary Ann Forciea, MD; Russell P. Harris, MD, MPH; Linda L. Humphrey, MD, MPH; Tanveer P. Mir, MD; Holger J. Schümann, MD, PhD; J. Sanford Schwartz, MD; Paul Shekelle, MD, PhD; and Timothy Wilt, MD, MPH. Approved by the ACP Board of Regents on 26 July 2014.
Table 1. Selected Pressure Ulcer Treatment Interventions

<table>
<thead>
<tr>
<th>Intervention*</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-fluidized bed†</td>
<td>Redistributes pressure by forcing air through small beads in the mattress, generating a fluid-like surface</td>
</tr>
<tr>
<td>Alternating-air bed‡</td>
<td>Changes the distribution of pressure by inflating or deflating cells within the mattress</td>
</tr>
<tr>
<td>Low-air-loss bed§</td>
<td>Regulates heat and humidity by flowing air and, sometimes, pressure adjustments</td>
</tr>
<tr>
<td>Hydrocolloid dressing</td>
<td>Adheres to the skin and absorbs wound exudates, forming a protective gel around the wound</td>
</tr>
<tr>
<td>Radiant heat dressing</td>
<td>Administers heat to the wound site to increase capillary blood flow and promote wound healing</td>
</tr>
<tr>
<td>Dextranomer paste</td>
<td>Topical paste used to absorb wound exudates</td>
</tr>
<tr>
<td>Oxandrolone</td>
<td>An anabolic steroid that increases protein production and is used to promote healing and weight gain</td>
</tr>
<tr>
<td>PDGF</td>
<td>A glycoprotein that has been shown to accelerate wound healing in animal models</td>
</tr>
<tr>
<td>Electrical stimulation</td>
<td>Uses surface electrodes to deliver high-voltage electric current through the wound and is believed to promote cell growth and differentiation</td>
</tr>
<tr>
<td>Electromagnetic therapy</td>
<td>Delivers an electric and magnetic field to the wound and is believed to promote healing by altering the cell membrane (§)</td>
</tr>
<tr>
<td>Therapeutic ultrasound</td>
<td>Application of low-frequency sound waves to damaged tissue; believed to improve wound healing</td>
</tr>
<tr>
<td>Negative-pressure wound therapy</td>
<td>Application of negative pressure to the wound site that causes a vacuum and removes exudates while maintaining a moist environment; believed to promote wound healing</td>
</tr>
<tr>
<td>Light therapy</td>
<td>Application of energy from the infrared, visible, or ultraviolet spectrum to the wound site to promote healing</td>
</tr>
<tr>
<td>Laser therapy</td>
<td>Amplifies light with a high level of spatial and temporal coherence and is believed to improve wound healing</td>
</tr>
</tbody>
</table>

PDGF = platelet-derived growth factor.

* Brand-name products are listed as examples only and should not be considered endorsements from the American College of Physicians.
† Clinitor (Hill-Rom).
‡ Duo 2 (Hill-Rom), Lapidus Airlift System (American Hospital Supply), MicroPulse, Trinova (Pegasus Healthcare), TriCell and AlphaXcell (ArjoHuntleigh Getinge Group), and Air Doctor.
§ TheraPulse (KCI) and KinAir (ArjoHuntleigh Getinge Group).

Tiveness of treatment strategies differs on the basis of features (anatomical site or severity) of the pressure ulcers, patient characteristics, and health care settings?

2. What are the harms of treatments for pressure ulcers? Do the harms differ on the basis of features (anatomical site or severity) of the pressure ulcers, patient characteristics, and health care settings?

We searched MEDLINE, EMBASE, CINAHL, EBM Reviews, the Cochrane Central Register of Controlled Trials, the Cochrane Database of Systematic Reviews, the Database of Abstracts of Reviews of Effects, and the Health Technology Assessment database through February 2014 for studies in English. The primary outcomes of interest for this guideline include complete wound healing and wound size (surface area, volume, and depth) reduction. Additional outcomes include pain, prevention of sepsis, prevention of osteomyelitis, recurrence rate, and harms of treatment (including but not limited to pain, dermatologic complications, bleeding, and infection). Although most studies reported statistical significance of various outcomes, the guideline panel assessed clinically significant changes when evaluating the evidence.

Further details about the methods and inclusion and exclusion criteria applied in the evidence review are available in the full AHRQ report (1) and the Supplement. This guideline rates the quality of evidence and strength of recommendations by using ACP’s guideline grading system (Table 2). Details of the ACP guideline development process can be found in ACP’s methods paper (4).

Benefits and Comparative Effectiveness of Pressure Ulcer Treatment Strategies

Most studies reported on only 1 outcome each (such as reduction of pressure ulcer size, improved wound healing, or rate of wound healing). Complete wound healing was reported in few studies; intermediate outcomes, such as reduction of wound size and rate of wound healing, were used to assess efficacy of the interventions. Some improvements were seen only in patients with large ulcers (>7 cm). Table 1 provides descriptions of the various treatment strategies, and Table 2 summarizes the evidence. Moderate-quality evidence showed that air-fluidized beds reduced pressure ulcer size compared with other surfaces (6–10), but pressure ulcer outcomes did not differ in comparisons of other support surfaces (low- to moderate-quality evidence) (11–14, 21–25). Moderate-quality evidence showed that protein-containing supplements improved wound healing (27–40), although vitamin C supplementation did not (low-quality evidence) (26). Low-quality evidence showed that hydrocolloid dressings reduced ulcer size compared with gauze dressings (42–51) and that platelet-derived growth factor (PDGF) improved wound healing (69–73). Findings were mixed or did not differ for hydrocolloid compared with foam dressings (moderate-quality evidence) (52–59), radiant heat (moderate-quality evidence) (60–63), topical collagen (low-quality evidence) (42, 66–68), and oxandrolone (41). Low-quality evidence showed that dextranomer paste was inferior to other wound dressings for

| Table 2. The American College of Physicians’ Guideline Grading System* |
|----------------|-----------------------------|
| Quality of Evidence | Strength of Recommendation |
| Benefits Clearly Outweigh Risks and Burden | Benefits Finely Balanced With Risks and Burden |
| Clearly Outweigh Benefits | Clearly Outweigh Benefits |
| High | Moderate |
| Strong | Strong |
| Moderate | Weak |
| Low | Insufficient evidence to determine net benefits or risks |

* Adopted from the classification developed by the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) workgroup.

www.annals.org

Annals of Internal Medicine • Vol. 162 No. 5 • 3 March 2015 371

Downloaded From: http://annals.org/ on 03/18/2015
**Table 3. Evidence for Pressure Ulcer Treatment Strategies**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Quality of Evidence</th>
<th>Overall Treatment Effect vs. Comparator*</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Support surfaces</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air-fluidized beds vs. other</td>
<td>Moderate</td>
<td>Improved</td>
<td>Air-fluidized beds reduced pressure ulcer size compared with other</td>
</tr>
<tr>
<td>surfaces</td>
<td></td>
<td></td>
<td>surfaces; 1 good-quality, 3 fair-quality, and 1 poor-quality studies</td>
</tr>
<tr>
<td>Alternating-air beds vs. other</td>
<td>Low</td>
<td>No difference</td>
<td>Similar efficacy in pressure ulcer size reduction compared with other</td>
</tr>
<tr>
<td>surfaces</td>
<td></td>
<td></td>
<td>surfaces; 2 fair-quality and 2 poor-quality studies (11-14)</td>
</tr>
<tr>
<td>Different brands of alternating-</td>
<td>Moderate</td>
<td>No difference</td>
<td>Similar efficacy in complete wound healing and wound size reduction</td>
</tr>
<tr>
<td>air beds</td>
<td></td>
<td></td>
<td>among different brands; 2 good-quality and 2 fair-quality studies</td>
</tr>
<tr>
<td>Low-air-loss beds vs. other</td>
<td>Low</td>
<td>No difference</td>
<td>Similar efficacy in wound size reduction; 1 good-quality and 4 poor-</td>
</tr>
<tr>
<td>surfaces</td>
<td></td>
<td></td>
<td>quality studies (21-25)</td>
</tr>
<tr>
<td><strong>Nutrition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin C supplementation</td>
<td>Low</td>
<td>No difference</td>
<td>No improvement in rate of pressure ulcer healing; 1 good-quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>study (26)</td>
</tr>
<tr>
<td>Protein supplementation</td>
<td>Moderate</td>
<td>Improved</td>
<td>Protein supplementation improved wound healing (most often reported</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>as decreased ulcer size); 2 good-quality, 5 fair-quality, and 7 poor-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>quality studies (27-40)</td>
</tr>
<tr>
<td><strong>Medications</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxandrolone vs. placebo</td>
<td>Low</td>
<td>No difference</td>
<td>No difference for complete wound healing (24% vs. 30%) or percentage of</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ulcers remaining healed at 8-wk follow-up (17% vs. 15%); more patients</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>had elevated liver enzyme levels (32.4% vs. 2.9%; P &lt;0.001); 1 good-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>quality study (41)</td>
</tr>
<tr>
<td><strong>Local wound applications</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocolloid dressings vs. usual</td>
<td>Low</td>
<td>Improved</td>
<td>Hydrocolloid dressings resulted in reduced wound size compared with</td>
</tr>
<tr>
<td>care</td>
<td></td>
<td></td>
<td>usual care; 1 good-quality, 2 fair-quality, and 7 poor-quality studies</td>
</tr>
<tr>
<td>Hydrocolloid dressings vs. foam</td>
<td>Moderate</td>
<td>No difference</td>
<td>Similar efficacy in complete wound healing: RR, 1.12 (95% CI, 0.88</td>
</tr>
<tr>
<td>dressings</td>
<td></td>
<td></td>
<td>to 1.41); 3 fair-quality and 5 poor-quality studies (52-59)</td>
</tr>
<tr>
<td>Radiant heat dressings vs. other</td>
<td>Moderate</td>
<td>Mixed results</td>
<td>Radiant heat dressings resulted in a faster wound healing rate and</td>
</tr>
<tr>
<td>dressings</td>
<td></td>
<td></td>
<td>similar complete wound healing (RR, 1.32 [CI, 0.88 to 1.98]) compared</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>with other dressings; 2 good-quality and 2 fair-quality studies (60-63)</td>
</tr>
<tr>
<td>Dextranomer paste vs. wound</td>
<td>Low</td>
<td>Worsened</td>
<td>Dextranomer paste was inferior to other dressings for reducing wound</td>
</tr>
<tr>
<td>dressings</td>
<td></td>
<td></td>
<td>area; 1 good-quality and 1 poor-quality study (64, 65)</td>
</tr>
<tr>
<td>Topical collagen vs. hydrocolloid</td>
<td>Low</td>
<td>No difference</td>
<td>Similar efficacy in reducing wound size compared with other dressings;</td>
</tr>
<tr>
<td>dressings or usual care</td>
<td></td>
<td></td>
<td>1 good-quality, 1 fair-quality, and 2 poor-quality studies (42, 66-68)</td>
</tr>
<tr>
<td>PDGF vs. placebo</td>
<td>Low</td>
<td>Improved</td>
<td>PDGF improved wound healing compared with placebo; 1 fair-quality and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 poor-quality studies (69-73)</td>
</tr>
<tr>
<td><strong>Adjuvant therapies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical stimulation vs. sham</td>
<td>Moderate</td>
<td>Improved</td>
<td>Electrical stimulation accelerated wound healing compared with sham</td>
</tr>
<tr>
<td>treatment</td>
<td></td>
<td></td>
<td>treatment, but no evidence was found for improved complete wound</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>healing; adverse events were more common in elderly patients than</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>younger patients; 1 good-quality and 8 fair-quality studies (74-83)</td>
</tr>
<tr>
<td>Electromagnetic therapy vs. sham</td>
<td>Low</td>
<td>No difference</td>
<td>Similar efficacy in reducing wound size for stage 2 to 4 pressure</td>
</tr>
<tr>
<td>treatment</td>
<td></td>
<td></td>
<td>ulcers compared with sham treatment; 4 fair-quality studies (84-87)</td>
</tr>
<tr>
<td>Therapeutic ultrasound vs. sham</td>
<td>Low</td>
<td>No difference</td>
<td>Similar efficacy in complete wound healing or healing rate compared</td>
</tr>
<tr>
<td>treatment</td>
<td></td>
<td></td>
<td>with sham treatment; 2 good-quality and 1 fair-quality studies (88-90)</td>
</tr>
<tr>
<td>Negative-pressure wound</td>
<td>Low</td>
<td>No difference</td>
<td>Similar efficacy in reducing wound size compared with standard care;</td>
</tr>
<tr>
<td>therapy vs. usual care</td>
<td></td>
<td></td>
<td>3 fair-quality studies (91-93)</td>
</tr>
<tr>
<td>Light therapy vs. sham treatment</td>
<td>Low</td>
<td>Mixed results</td>
<td>Light therapy reduced ulcer surface area compared with sham treatment</td>
</tr>
<tr>
<td>or usual care</td>
<td></td>
<td></td>
<td>or usual care but showed no improvement in complete wound healing;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6 fair-quality studies (94-99)</td>
</tr>
<tr>
<td>Laser therapy vs. sham treatment</td>
<td>Low</td>
<td>No difference</td>
<td>Similar efficacy in reducing wound size compared with sham treatment;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 good-quality and 3 fair-quality studies (100-103)</td>
</tr>
</tbody>
</table>

PDGF = platelet-derived growth factor; RR = relative risk.

* "Improved" denotes that the intervention provided benefit compared with control. "Worsened" indicates that the intervention was worse than control. "No difference" indicates that the intervention was similar to control. "Mixed results" denotes inconsistent results for different outcomes.

Reducing ulcer area (64, 65). Moderate-quality evidence showed that electrical stimulation accelerated wound healing as an adjunctive therapy (74–83), and low-quality evidence showed no difference or mixed findings for the other adjunctive therapies assessed, including electromagnetic therapy (84–87), therapeutic ultrasound (88–90), negative-pressure wound therapy (91–93), light therapy (94–96), and laser therapy (100–103).

**Effectiveness of Pressure Ulcer Treatment Strategies Based on Pressure Ulcer Features, Patient Characteristics, and Health Care Settings**

Low-quality evidence from 3 fair-quality retrospective studies showed that patients with sacral pressure ulcers had a lower recurrence rate after surgery than those with ischial pressure ulcers (104–106).
Low-quality evidence from 1 fair-quality study showed that patients with spinal cord injury had a higher rate of recurrent pressure ulcers after surgical flap closure than other patients with pressure ulcers (104).

Low-quality evidence from 1 good-quality and 3 fair-quality studies showed that electrical stimulation was similarly effective in patients with spinal cord injuries compared with other patients (74, 78, 80, 81).

Low-quality evidence from 1 good-quality and 8 fair-quality studies showed that electrical stimulation produced similar results in a hospital and a rehabilitation center (74–83).

**Harms of Pressure Ulcer Treatment Strategies**

**Reporting of harms was sparse, and comparison among trials was difficult because of heterogeneity of treatments or populations.**

**Support Surfaces**

Evidence was insufficient to conclude about harms for various support surfaces because few studies reported adverse events and those that reported them mostly found no statistically significant difference compared with controls.

**Nutrition**

Evidence was insufficient to conclude about harms for nutritional supplementation because adverse event reporting was poor for these studies.

**Medications**

More patients had elevated liver enzyme levels (32.4% vs. 2.9%; P < 0.001) with oxandrolone than with placebo, but there was no difference in withdrawals due to adverse events (19% vs. 18%) (41).

**Local Wound Applications**

Skin irritation, inflammation, and tissue damage and maceration were the most commonly reported harms for various dressings and topical therapies (moderate-quality evidence). Evidence was insufficient to determine whether specific dressings or topical therapies resulted in less harm than others. Evidence was also insufficient to conclude about harms for biological agents because few harms were reported and the studies lacked precision.

**Surgery**

The most commonly reported harm from surgery was dehiscence. Reoperation due to recurrence or flap (tissue placed over the open wound) failure ranged from 12% to 24% among patients treated with surgery (low-quality evidence) (105, 107). Low-quality evidence from 1 intervention series showed a 21% complication rate for all skin flap surgeries and showed that tensor fascia lata flaps were associated with higher complication rates (49%), whereas rotation flaps were associated with the lowest complication rates (12%) compared with other surgical flap procedures (108).

**Adjunctive Therapies**

The most common adverse effect reported with electrical stimulation was skin irritation (low-quality evidence) (75, 79, 81). No substantial adverse effects were reported for light therapy (94, 95, 97, 98) or laser therapy (100–103) (low-quality evidence).

**Harms of Pressure Ulcer Treatments Based on Pressure Ulcer Features, Patient Characteristics, and Health Care Settings**

Dehiscence was more common if bone was removed during the surgery (low-quality evidence) (105), and patients with ischial ulcers had higher complication rates than those with sacral or trochanteric ulcers (low-quality evidence) (107, 109).

Low-quality evidence showed that frail elderly patients had more adverse events associated with electrical stimulation than younger patients (75, 79, 81).

**Summary**

Treatment of pressure ulcers involves multiple methods intended to alleviate the conditions contributing to ulcer development (support surfaces, repositioning, and nutritional support), protection of the wound from contamination and creation of a clean wound environment, promotion of tissue healing (local wound applications, debridement, and wound cleansing), adjunctive therapies, and consideration for surgical repair. Evidence showed that many interventions were similar to controls for alleviation of pressure ulcers. Air-fluidized beds were superior to other support surfaces (primarily standard hospital beds) for reducing pressure ulcer size. Alternating-air beds and low-air-loss mattresses did not differ substantially from other surfaces for reducing wound size. Overall, few harms were reported for support surfaces.

Nutritional supplementation with protein or amino acids improved the rate of wound healing.

Hydrocolloid dressings were superior to gauze dressings for reducing wound size and were equivalent to foam dressings for complete wound healing. Although radiant heat dressings accelerated wound healing, there was no evidence that they improved complete wound healing compared with other dressings. Dextranomer paste was inferior to other dressings for reducing wound size. Platelet-derived growth factor improved ulcer healing compared with placebo for more severe ulcers, and evidence was insufficient to determine the effect of other biological agents. The most commonly reported harms for local wound applications included skin irritation, inflammation, and tissue damage and maceration.

Adjunctive therapies, including electromagnetic therapy, negative-pressure wound therapy, therapeutic ultrasound, and laser therapy, were similar to controls for ulcer alleviation. Electrical stimulation accelerated wound healing compared with control, but there was
### SUMMARY OF THE AMERICAN COLLEGE OF PHYSICIANS GUIDELINE ON TREATMENT OF PRESSURE ULCERS

#### Disease/Condition
- Pressure ulcers

#### Target Audience
- Internists, family physicians, and other clinicians

#### Target Patient Population
- Patients with pressure ulcers

#### Interventions Evaluated
- **Support surfaces**: air-fluidized beds, alternating-air beds, low-air-loss beds, alternating-air chair cushions
- **Nutrition**: protein or amino acid supplementation, vitamin C supplementation, zinc supplementation
- **Medication**: oxandrolone
- **Local wound applications**: hydrocolloid dressings, foam dressings, debriding enzymes, radiant heat dressings, dextranomer paste, topical collagen, PDGF, topical phenytoin, maggots therapy, other biological agents (fibroblast, nerve, and macrophage suspension)
- **Surgery**
- **Adjunctive therapies**: electrical stimulation, electromagnetic therapy, therapeutic ultrasound, negative-pressure wound therapy, light therapy, laser therapy, hydrotherapy

#### Outcomes Evaluated
- **Effectiveness of wound healing**:
  - Wound improvement: determined by complete wound healing, healing rate or time, reduction in wound size (surface area, volume, depth)
  - Reduction in pain
  - Prevention of serious complications (sepsis or osteomyelitis)
  - Recurrence rate
- **Harms**:
  - Pain
  - Dermatologic complications
  - Bleeding
  - Infection

#### Benefits
- **Support surfaces**: air-fluidized beds: reduced pressure ulcer size
- **Nutrition**: protein or amino acid supplementation: improved wound healing (most often reported as decreased ulcer size)
- **Local wound applications**:
  - Hydrocolloid dressings: improved wound healing
  - Radiant heat dressings: resulted in faster wound healing rate
  - PDGF: improved wound healing
- **Adjunctive therapies**:
  - Electrical stimulation: accelerated wound healing
  - Light therapy: reduced ulcer surface area

#### Harms
- **Local wound applications**:
  - Dressings and topical therapies: skin irritation, inflammation, and tissue damage and maceration
- **Medication**: elevated liver enzyme levels associated with oxandrolone
- **Adjunctive therapies**: electrical stimulation: skin irritation
- **Surgery**: dehiscence, reoperation due to recurrence, or surgical flap failure
- Limited evidence or no harms reported for other interventions

#### Recommendations
- **Recommendation 1**: ACP recommends that clinicians use protein or amino acid supplementation in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)
- **Recommendation 2**: ACP recommends that clinicians use hydrocolloid or foam dressings in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)
- **Recommendation 3**: ACP recommends that clinicians use electrical stimulation as adjunctive therapy in patients with pressure ulcers to accelerate wound healing. (Grade: weak recommendation, moderate-quality evidence)

#### Inconclusive Areas of Evidence
- Evidence was insufficient to determine the effectiveness or comparative effectiveness of alternating-air chair cushions, 3-dimensional polyester overlay vs. gel overlay, zinc supplementation, β-carnosine supplementation, comparisons of wound dressings other than those addressed above, debriding enzymes compared with dressings or other topical therapies, topical application of phenytoin to promote healing, maggot therapy, biological agents other than PDGF (fibroblast, nerve, and macrophage suspension), surgical techniques, or hydrotherapy (wound cleansing with whirlpool or pulsed lavage) for treatment of pressure ulcers.

#### High-Value Care
- ACP does not recommend the use of various advanced support surfaces, including alternating-air and low-air-loss beds, because the quality of evidence for these surfaces was limited and the harms from these types of beds were poorly reported and could be significant given the immobility of the patient. Furthermore, the use of advanced support surfaces adds unnecessary costs to health care systems. In addition, although low-quality evidence suggests that dressings containing PDGF promote healing, ACP supports the use of other dressings, such as hydrocolloid and foam dressings, which are effective at promoting healing and cost less than PDGF dressings.

#### Clinical Considerations
- Assessment and staging of pressure ulcers is the first step before starting treatment. The most commonly used staging system is from the National Pressure Ulcer Advisory Panel (110).
- Patient progress should be monitored on a regular basis, including the status of the dressing, the area surrounding the ulcer, pain, and possible infection.
- Frail elderly patients may be more susceptible to adverse effects from electrical stimulation.

---

*PDGF = platelet-derived growth factor.*
no evidence that it was superior for complete wound healing. The most common adverse effect for this treatment was skin irritation, and frail elderly patients were more susceptible to adverse events associated with electrical stimulation. Light therapy resulted in reduced ulcer size compared with control and was not associated with any substantial adverse events; however, it was equivalent to sham treatment for complete wound healing.

Although surgery is considered an option for advanced-stage pressure ulcers, evidence was insufficient to determine the superiority of one surgical technique over another for wound closure. Dehiscence, a commonly reported adverse event, was more common when bone was removed and in patients with ischial ulcers.

RECOMMENDATIONS

Recommendation 1: ACP recommends that clinicians use protein or amino acid supplementation in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)

Evidence showed that nutritional supplementation with protein or amino acids reduced pressure ulcer wound size, but evidence for the optimal dose or form of protein was insufficient. Protein supplementation was assessed in conjunction with standard therapies, such as dressings or support surfaces. Also, the trials generally included patients with nutritional deficiencies, and the evidence may not be generalizable to all patients with pressure ulcers because they may not benefit from nutritional supplementation. Evidence also did not show any benefit of vitamin C supplementation compared with placebo. Data are insufficient to comment on complete wound healing. The relationship between reduction in wound size or rate of healing and eventual complete healing has not been well-defined.

Recommendation 2: ACP recommends that clinicians use hydrocolloid or foam dressings in patients with pressure ulcers to reduce wound size. (Grade: weak recommendation, low-quality evidence)

Low-quality evidence showed that hydrocolloid dressings are better than gauze dressings for reducing wound size. In addition, moderate-quality evidence showed that hydrocolloid dressings resulted in complete wound healing similar to that of foam dressings (hydrocellular or polyurethane). Evidence was insufficient to determine whether specific dressings resulted in fewer harms than others. Data are insufficient to comment on complete wound healing. The relationship between reduction in wound size or rate of healing and eventual complete healing has not been well-defined.

Recommendation 3: ACP recommends that clinicians use electrical stimulation as adjunctive therapy in patients with pressure ulcers to accelerate wound healing. (Grade: weak recommendation, moderate-quality evidence)

Moderate-quality evidence supports the use of electrical stimulation in addition to standard treatment because it has been shown to accelerate the healing rate of stage 2 to 4 ulcers. Data are insufficient to comment on complete wound healing. The relationship between reduction in wound size or rate of healing and eventual complete healing has not been well-defined.

The Figure summarizes the recommendations and clinical considerations.

INCONCLUSIVE AREAS OF EVIDENCE

Evidence was insufficient to determine the effectiveness or comparative effectiveness of alternating-air chair cushions, 3-dimensional polyester overlays versus gel overlays, zinc supplementation, l-carnosine supplementation, comparisons of different wound dressings other than those addressed earlier, debriding enzymes compared with dressings or other topical therapies, topical application of phenytoin to promote healing, maggots, biological agents other than PDGF (fibroblast, nerve, and macrophage suspension), surgical techniques, or hydrotherapy (wound cleansing using whirlpool or pulsed lavage) for treatment of pressure ulcers (1) (Supplement). Evidence was also insufficient to balance the benefits and harms of various support surfaces to treat pressure ulcers. Many studies assessed reduction in wound size or rate of healing rather than complete wound healing, and more evidence is needed on intermediate outcomes as predictors of complete healing, the most important outcome. Although hyperbaric oxygen therapy is often used to treat pressure ulcers in hospitals, we found insufficient evidence to assess its safety and efficacy.

HIGH-VALUE CARE

ACP does not recommend the use of various advanced support surfaces, including alternating-air and low-air-loss beds, because the quality of evidence for these surfaces was limited and the harms were poorly reported and could be significant given the immobility of the patient. Furthermore, due to their expense, the use of advanced support surfaces adds unnecessary costs to health care systems. In addition, although low-quality evidence showed that dressings containing PDGF promoted healing, ACP supports the use of other dressings, such as hydrocolloid and foam dressings, which are effective at promoting healing and cost less than PDGF dressings.

From the American College of Physicians and University of Pennsylvania Health System, Philadelphia, Pennsylvania; Oregon Health & Science University, Portland, Oregon; and Carilion Clinic, Roanoke, Virginia.

Note: Clinical practice guidelines are “guides” only and may not apply to all patients and all clinical situations. Thus, they are not intended to override clinicians’ judgment. All ACP clinical practice guidelines are considered automatically withdrawn or invalid 5 years after publication or once an update has been issued.

Disclaimer: The authors of this article are responsible for its contents, including any clinical or treatment recommendations.

www.annals.org
Acknowledgment: The authors thank M.E. Beth Smith, DO, for updating the literature from the evidence review for the development of this guideline.

Financial Support: Financial support for the development of this guideline comes exclusively from the ACP operating budget.

Disclosures: Dr. Barry reports grants and salaries from the Informed Medical Decisions Foundation and Healthwise outside the submitted work. Dr. Cooke reports support for travel to meetings for the study or other purposes from the American College of Physicians; board membership with the National Board of Medical Examiners; a consultancy for the University of Texas; employment with the University of California, San Francisco; and travel, accommodation, or meeting expenses from the American Board of Internal Medicine and the Accreditation Council for Graduate Medical Education outside the submitted work. Dr. Dallas reports support for travel to meetings for the study or other purposes from the American College of Physicians and stock ownership in Pfizer, Ortho Pharmaceutical, Sanofi-Aventis, GlaxoSmithKline, and Merck. Dr. Schwartz reports services from the National Heart, Lung, and Blood Institute during the conduct of the study; personal fees from Allergan, Bayer, Blue Cross Blue Shield Association, General Electric, UBC, and Genentech outside the submitted work; and a grant from Pfizer outside the submitted work. Dr. Shkekelle reports personal fees from the ECRI Institute during the conduct of the study and royalties from UpToDate. Authors followed the policy regarding conflicts of interest described at www.annals.org/article.aspx?articleId=745942. Disclosures can also be viewed at www.acponline.org/authors/cmje/ConflictOfInterestForms.do?msNum=M14-1568. A record of conflicts of interest is kept for each Clinical Guidelines Committee meeting and conference call and can be viewed at www.acponline.org/clinical_information/guidelines/guidelines/conflicts_cgc.htm.

Requests for Single Reprints: Amir Qaseem, MD, PhD, MHA, American College of Physicians, 190 N. Independence Mall West, Philadelphia, PA 19106; e-mail, aqaseem@acponline.org.

Current author addresses and author contributions are available at www.annals.org.

References
9. Ochs RF, Horn SD, van Rijswijk L, Pietsch C, Smout RJ. Comparison of an air-fluidized therapy with other support surfaces used to treat pressure ulcers in nursing home residents. Ostomy Wound Manage. 2005;51:38-68. [PMID: 15699554]


Current Author Addresses: Drs. Qaseem and Starkey: American College of Physicians, 190 N. Independence Mall West, Philadelphia, PA 19106.
Dr. Humphrey: Oregon Health & Science University, 3710 SW U.S. Veterans Hospital, Portland, OR 97201.
Dr. Forciea: University of Pennsylvania Health System, 3615 Chestnut Street, Philadelphia, PA 19104.
Dr. Denberg: Carilion Clinic, PO Box 13727, Roanoke, VA 24036.

Author Contributions: Conception and design: A. Qaseem.
Drafting of the article: A. Qaseem, M.A. Forciea, M. Starkey, T.D. Denberg.
Critical revision of the article for important intellectual content: A. Qaseem, L.L. Humphrey, M.A. Forciea, M. Starkey, T.D. Denberg.
Final approval of the article: A. Qaseem, L.L. Humphrey, M.A. Forciea, T.D. Denberg.
Statistical expertise: A. Qaseem.
Administrative, technical, or logistic support: A. Qaseem, M. Starkey, T.D. Denberg.
Collection and assembly of data: A. Qaseem, M. Starkey.