The Association for the Advancement of Wound Care (AAWC) Venous and Pressure Ulcer Guidelines

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Abstract

Guidelines based on best available evidence to support pressure ulcer (PU) or venous ulcer (VU) management decisions can improve outcomes. Historically, such guidelines were consensus-based and differed in content and development methods used. Since 2002, the Association for the Advancement of Wound Care (AAWC) Guideline Task Force has used a systematic approach for developing "guidelines of guidelines" that unify and blend recommendations from relevant published guidelines while meeting Institute of Medicine and Agency for Healthcare Research and Quality standards. In addition to establishing the literature-based strength of each recommendation, guideline clinical relevance is examined using standard content validation procedures. All final recommendations included are clinically relevant and/or supported by the highest level of available evidence, cited with every recommendation. In addition, guideline implementation resources are provided. The most recent AAWC VU and PU guidelines and ongoing efforts for improving their clinical relevance are presented. The guideline development process must be transparent and guidelines must be updated regularly to maintain their relevance. In addition, end-user results and research studies to examine their construct and predictive validity are needed.

Keywords: practice guideline, evidence-based practice, methods, pressure ulcers, venous ulcers, content validity, clinical practice guidelines

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When used in clinical practice, evidence-based (EB) guidelines can improve outcomes. In wound care, implementing guidelines has been shown to derive important patient and wound benefits across the continuum of care.[1-5] The United States' value-based healthcare reform movement compels healthcare professionals to seek the safest, most efficient, evidence-based treatment to support patients and their caregivers in efforts to achieve optimal outcomes. Individual wound care professionals or healthcare systems may be tempted to make care decisions based on what is inexpensive, at-hand, or reimbursed, but research[6-9] has shown patient-focused wound care that heals wounds with minimal complications or, better yet, prevents them from occurring, is a wiser, more clinically sound, cost-effective investment of wound care resources. In addition, focus on prevention, wellness, and chronic disease management challenges wound care teams to have distilled, accurate, up-to-date guidelines and implementation tools to consider to better inform clinical judgment. Implementation of clinical practice guidelines in wound care advances the specialty by promoting the use of interventions of proven benefit while simultaneously discouraging ineffective therapeutic options. With many sources available for evidence, reliance on professional societies' practice guidelines, updated at regular intervals and developed according to accepted standards, provides a trusted resource for the wound care professional.[10]

By definition, EB practice includes clinical expertise, patient preferences, and research evidence.[11] EB clinical

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practice guidelines not only reduce the research-practice gap by providing summaries of available research evidence, but they also include systematically collected clinical expertise through face and content validation. The venous ulcer (VU)[12] and pressure ulcer (PU) guidelines[13] from the Association for the Advancement of Wound Care (AAWC) are presented, and major steps in their development summarized.

The AAWC Guideline Development Process

Since April 2002, the all-volunteer AAWC Guideline Task Force (GTF) has used a standardized process to develop comprehensive "guidelines of guidelines" (see Table 1). The methods and evidence criteria (Table 2) used were derived from prior content-validated, EB wound care guidelines that have survived the tests of time and continue to be honed to meet Agency for Healthcare Research and Quality (AHRQ) National Guideline Clearinghouse (NGC) inclusion criteria (see Table 3), as well as those subsequently published by the Appraisal of Guidelines for Research and Evaluation tool developers and the Conference on Guideline Standards.[14,15] Following separate examinations of all relevant published VU[16] and PU[17] guidelines, recommendations for managing the corresponding ulcer were compiled and examined and inconsistencies were clarified. The resulting comprehensive list of all recommendations was content-validated for the indicated ulcer etiology by independent wound care experts in an online survey. Concurrently, the AAWC GTF, using systematic literature search methods, identified best available evidence supporting each recommendation according to standardized strength-of-evidence criteria (see Table 2). After tabulating the content-validation results, a content validity index (CVI) was calculated for each recommendation using established methods.[18] A recommendation with a CVI of at least 0.75, (defined by at least 75% of wound care professional respondents rating as clinically relevant), was considered "content validated," reflecting a consolidated opinion of multidisciplinary wound care professionals that the recommendation was clinically relevant for the patient or patient's ulcer. Recommendations with A-level literature-based evidence, defined by support from at least two randomized controlled trials (RCTs) reporting significant ($P < 0.05$) benefits to patient or ulcer were considered to be EB.

This guideline development process clearly illuminated opportunities for research or education. When a recommendation's CVI was 0.75 or higher, but it had lower than A-level evidence, it was an opportunity for research.[19,20] For recommendations with A-level evidence and a CVI less than 0.75, evidence exceeded belief, presenting opportunities for education.[20,21] Each guideline was submitted to the US Department of Health and Human Services AHRQ NGC and approved for inclusion. The guidelines and accompanying implementation documents also are posted on the AAWC website (http://aawconline.org/professional-resources/resources/).

Value of Content Validation

Content validation by wound care professionals helps ensure guidelines meet clinical and patient relevance. Please watch for announcements to participate in content validation surveys.

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Key Points

- The venous and pressure ulcer guidelines developed by the Association for the Advancement of Wound Care (AAWC) continue to be updated and validated.
- The authors describe the development process of these guidelines and emphasize the importance of updates and efforts to improve their clinical relevance.

Guidelines

AAWC Venous Ulcer Guideline. The AAWC Venous Ulcer Guideline (see Appendix 1) was originally posted at the AHRQ NGC website in 2005 and was updated in 2010. Opportunities for VU research identified by recommendations lacking A-level evidence were published in 2013.[19] Most of the original 146 VU recommendations had both content validity and A-level evidence, but 32% offered opportunities for research, including the question of whether weekly clinic visits are the optimal frequency to support VU outcomes.[19] The updated AAWC Venous Ulcer Guidelines have face validity because they are based on recommendations from other guidelines. Although the original guidelines were content-validated, content validation of the 2010 version is planned for the near future using the same standardized online survey process used to content-validate the original guidelines with added opportunities to rate strength of recommendations (see Table 1).

AAWC Pressure Ulcer Guidelines. The AAWC Pressure Ulcer Guideline (see Appendix 2) was content-validated and completed with best available supporting evidence in 2010 and then posted at NGC and AAWC websites using standardized levels of evidence notations (see Table 2). Each PU recommendation in the AAWC Pressure Ulcer Guideline has a content validity ≥0.75 (based on ratings by the 32 multidisciplinary independent wound care experts completing the survey) and/or A-level evidence.

Collaborating members of the North American Wound Care Council (NAWCC) representing the National Pressure Ulcer Advisory Panel (NPUAP), the Canadian Association of Wound Care (CAWC), the Canadian Association of Enterostomal Therapists (CAET), and the Mexican Wound Healing Society (AMCICHAC), compared the CVI of each PU recommendation with its level of evidence to

Table 1. Synopsis of the guideline development process: Association for the Advancement of Wound Care Guideline Task Force steps for developing comprehensive, content-validated, evidence-based guidelines and implementation aids

Step	Function/Purpose
Compile master list of all unique recommendations in current relevant guidelines identified in searches of MEDLINE and/or the National Guideline Clearinghouse at www.guideline.gov	Makes the guideline comprehensive, unifies wound care across specialties
Clarify and condense redundant recommendations	Simplifies and clarifies recommendations
Conduct online survey to establish content validity of each recommendation.[16,17] The next update of these guidelines also will include ratings of "strength of recommendation"	Content validity establishes extent to which recommendations reflect the domain of the content. Strength of recommendation ratings address the Institute of Medicine[1] requirement to state whether benefits of each recommendation outweigh its costs, risks, or harm
Systematic literature searches are conducted during compilation of recommendations and continue post content validation. PubMed, CINAHL, or Cochrane databases were searched for up to five strongest available (as defined in Table 2) references supporting efficacy, safety or validity of acting on each original recommendation before its content validation	Best available evidence cited for each recommendation confers evidence-based status to the Guideline
Cited references are summarized in alphabetic order in each of the AAWC Guidelines' corresponding evidence tables. This and the following guideline-consistent implementation tools are accessible at aawconline.org	Supports transparency of guideline development and provides users with clinical, economic, and legal rationale for implementing each guideline recommendation
A one-page summary of the guideline is developed in an algorithm format. This will be featured as an action-based flowchart in future updates of each guideline	One page action-based overview simplifies implementation
A one-page Quick Reference Guide synopsis of the Guideline is written in narrative outline format	Useful to clinicians as a pocket guide
A one-page Guideline Checklist is developed	Checklists facilitate completion of all pertinent guideline processes and steps
A slide presentation summarizing the guideline is developed and also posted at aawconline.org	Facilitates education of staff and/or students
A patient/caregiver brochure consistent with each guideline's recommendations is prepared	Helps facilitate patient/care-giver education, an important recommendation in each of these guidelines

identify opportunities for research and education as previously described and jointly published resultant research and educational opportunities.[20,21] Most (93%) of the original 368 PU recommendations had content validity — 97 (26%) were supported by A-level evidence and 90 (24.5% of total) met both strong content validity and strong evidence criteria (criteria ready for implementation as standard of care). The majority of the PU recommendations (253, 68.8%) had content validity, but B- or C-level evidence represented opportunities for research. Seven (1.9%) of the recommendations had a low CVI with A-level evidence, suggesting a need to educate professionals who manage PUs.

Discussion

Wound care guidelines have experienced increasing collaboration and rigor of development. The process for recommendation validation has progressed from panel-derived consensus discussions to formal content validation studies. Content validity was introduced into general wound care during development of the Solutions® Wound Care Guidelines[22] in the late 1990s,[23] with wound healing improvement subsequently confirmed by the guideline's clinical use in supporting wound care decisions in home care, long-term care, and acute care.[24]

Since the pioneering guidelines for PU prediction and prevention[25] and treatment[26] were developed by the former

Table 2. Standardized evidence criteria used to develop the Association for the Advancement of Wound Care Pressure Ulcer and Venous Ulcer guidelines. Adapted from Agency for Healthcare Researchand Quality Pressure Ulcer Treatment Guidelines[25] to include diagnosis and risk assessment

Evidence level	Criteria[a]
A	**Results of a meta-analysis or two or more subject ulcer-related randomized controlled trials (RCT) on humans provide support (or for diagnostics or risk assessment: prospective cohort [CO] studies and/or controlled studies reporting recognized diagnostic or predictive validity measures)**
B	*Results of one subject ulcer-related RCT in humans plus two or more similar historically controlled trials (HCT) or convenience controlled trials (CCT) or one HCT and one CCT provide support; or when appropriate, results of two or more RCT in animal model validated as clinically relevant to the subject ulcer provide indirect support. For diagnostics or risk assessment, one subject ulcer-related prospective cohort CO study, and/or a controlled study reporting recognized diagnostic or predictive validity measures*
C	This rating requires one or more of the following:
C1	Results of one controlled trial on subject ulcer prevention or treatment — eg, RCT, CCT, or HCT (or for diagnostics or risk prediction, one prospective CO study may be substituted for a controlled trial)
C2	Results of at least two case series (CS) or descriptive studies or a cohort study in humans with at least one subject ulcer
C3	Expert opinion (EO)

[a]Bold font in table and guidelines indicates the highest A-level of evidence strength, and italic font indicates B-level or intermediate evidence strength.

Table 3. Summary of criteria for inclusion of a guideline in the Agency for Healthcare Research and Quality National Guideline Clearinghouse (www.guideline.gov/about/inclusion-criteria.aspx). Updated June 1, 2014

To qualify for inclusion on the National Guideline Clearinghouse, a guideline must be:
A clinical practice guideline containing systematically developed recommendations intended to assist health care practitioners in making decisions that optimize patient health care decisions for specific clinical circumstances
Produced or officially supported by a health care organization or plan, medical specialty, or other relevant professional, public, or private organization or government agency
Based on systematic literature review(s) with a clearly stated search strategy listing databases searched, search terms, inclusion and exclusion criteria, plus the number of studies identified in the search, the number included in the guideline, and a detailed description of evidence tables
A synthesis of evidence from the selected studies, relating the evidence to each recommendation in the guideline or, when evidence is lacking, identifies this gap
Replete with assessments of benefits and harms of recommended care and alternative options
Available to the public as the full-text guideline in English, upon request for a fee or for free, along with its supporting systematic review or other supporting documents
The most recent version of the guideline published, developed, reviewed or revised within the past 5 years as evidenced by appropriate documentation such as the systematic review or a detailed description of its methodology

Agency for Healthcare Policy and Research, levels of evidence supporting recommendations have been refined to include cohort or RCT evidence supporting prognostic, diagnostic, or screening indicator validity.[27] The Institute of Medicine[10] upgraded quality criteria for guideline development in 2011 to include clearly defined strength of recommendation measures reflecting benefits versus costs, risks, or harms associated with implementing each recommendation. In addition, guideline developers now are required to provide evidence of all systematic literature reviews conducted supporting each recommendation in the guideline; they also strive to adhere to transparency in providing conflicts of interest and disclosures.

Regrettably for patients, although guidelines are the foundation for healthcare planning, delivery, and quality improvement, they are not consistently implemented. There is growing emphasis on implementing guidelines in clinical practice and overcoming barriers to their use, such as lack of reimbursement, need for staff training, and confusion about how to apply guideline content and evaluate guideline quality.[28] Initiatives to overcome these barriers include, among others, EB practice models such as the Iowa Model of Evidence-Based Practice to Promote Quality Care,[29] American Nurses Credentialing Center Magnet Status requirements to focus on quality care,[30] and inclusion of EB practice courses in medical and nursing education. Clear, simple guideline implementation tools, such as those available for the AAWC VU and PU guidelines, also help take the guesswork out of guideline implementation by providing patient education brochures, professional education slide sets, checklists, quick reference guides, and flow charts or algorithms useful for professionals or patients in any setting.

The unification and testing of wound care guidelines also may facilitate implementation by saving the end-user valuable time assessing the evidence supporting each recommendation. An increasing number of organizations are collaborating on guideline initiatives. The NPUAP and the European Pressure Ulcer Advisory Panel (EPUAP) collaborated when developing their 2009 guidelines for PU prevention and treatment.[31] As described, NAWCC organization collaborators from the AAWC, AMCICHAC, CAWC, CAET, NPUAP, and the Wound Healing Society (WHS) published research and educational opportunities identified following the AAWC PU guideline development.

Obtaining end-user and patient feedback is recognized as vital to enhancing guideline value and sustainability during clinical use,[27] yet guideline developers rarely have an opportunity to learn from the professionals or patients they serve. The AAWC guidelines and implementation tools are readily available at guideline.gov and at http://aawconline.org/professional-resources/resources/. User feedback, encouraged via the AAWC website, is a vital component to continue the process of having guidelines that are EB, tested, and easy to implement. Future efforts to include patient inputs during guideline development should be considered.

Conclusion

Developed, updated, and tested over a period of 12 years, the AAWC VU and PU guidelines of guidelines help clinicians implement EB care into practice. The guideline development process must be transparent and guidelines must be updated regularly to maintain their relevance. In addition, end-user results and studies to examine their construct and predictive validity are needed. n

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Appendix 1. Association for the Advancement of Wound Care (AAWC) Venous Ulcer Guideline. Bold font indicates the highest A-level of evidence strength, *italic font indicates B-level or intermediate evidence strength,* and regular font is used for all C-level citations. Each recommendation has content validity >0.75 based on 31 multidisciplinary independent survey respondents.

I. Patient and Venous Ulcer Assessment

A. **Qualified professional multidisciplinary team evaluate and document VU patient diagnosis and risk factors for delayed healing or recurrence of VU to guide treatment plan**

1. **Patient history in context of physical examination including patient's condition, history of deep vein thrombosis (DVT), pulmonary embolism or malignancy, ulcer treatment history, medical and surgical history and medications: A** (Lee et al 2002; Nelzén and Fransson 2007; Szewczyk et al 2009)
    - **a. Post thrombotic syndrome (PTS) or venous insufficiency in superficial and/or deep vein systems and/or the perforating venous system: A** (Cushman et al 2010; Kahn et al 2005; Szewczyk et al 2009; Volikova et al 2009)
    - b. Ache, heaviness, pain, itching or tiredness in leg: C3 (ASPS 2010; Saedon and Stansby 2010)
    - **c. Chronicity of the VU (duration in years >6 months): A** (Kulkarni et al 2007; Margolis et al 2000)
    - **d. History vascular surgery, trauma, repeat intimal venous damage, or varicosities: A** (Mudge 1988; Nelzén and Fransson 2007; Nicolaides et al 2000)
    - **e. Family history venous ulcer: A** (Cushman et al 2010; Bérard et al 2002)
    - f. History of vigorous exercise: C (Berard et al 2002)
    - g. Multiple pregnancy: C (Berard et al 2002)
    - **h. Male gender: A** (Cushman 2007; Lee et al 2002; van Rijswijk et al 1993)
    - **i. Obesity: A** (Cushman et al 2010; Prandoni and Kahn 2009)
    - **j. Increasing age >50 years: A** (Cushman 2007; Cushman et al 2010; Kulkarni et al 2007)
2. **Physical exam**
    - **a. Clinical severity, etiology, anatomy, pathophysiology (CEAP Link: www.veithsymposium.org/pdf/avi/4304.pdf): A** (Carpentier et al 2003; Eklöf et al 2004; Nelzén and Fransson 2007; Vasquez et al 2010; Volikova et al 2009)
        - i. Venous clinical severity score (Link: www.venousinstitute.com/vein_treatment_revised_vcss.html) provides standard language for VU treatment assessment: C (Vasquez M et al 2010)
    - **b. Lower leg edema: A** (Burton 1993; Duby et al 1993; Ennis and Menesis 1995; Kahn et al 2005; Sampaio et al 2010)
    - *c. Growth of hair indicates adequate arterial supply and likely VU healing outcome: B* (Grey et al 2006; Powell 2010; Sampaio-Santos et al 2010)
    - d. **Increased dermal thickness, eg, >1.985 mm measured using high-frequency ultrasound: A (**Vesić et al 2008; Volikova et al 2009; Xia et al 2004)
    - e. **Stasis dermatitis including tan or red-brown skin color (hemosiderin deposits) usually at medial ankle, small erosions, may be open or crusted: A (**Alguire et al 1997**;** Burton 1993; Pappas et al 1997)
    - f. **Lipodermatosclerosis (fibrosis of dermis resulting in fibrosing panniculitis of leg with severe, chronic venous insufficiency**): **A (**Geyer et al 2004; Navarro et al 2002; Volikova et al 2009)
    - g. **Medial lower leg site, with slower healing in ulcers associated with VU location in back calf region**: **A** (McGuckin et al 2002; Pappas et al 1997; Szewczyk et al 2009)
    - h. Varicosities: C3 **(**Alguire et al 1997; Weiss 1995)
    - i. Atrophie blanche, a dermatologic condition associated with venous insufficiency, appears as atrophic plaques of ivory white skin with telangiectasias. C2 (Barron GS et al 2007; Maessen-Visch et al 1999; Amato et al 2006)
3. **Differential diagnosis to determine cause of ulceration**
    - **a. Ratio of systolic ankle divided by brachial blood pressure index (ABI) ratio <0.8 suggests referral to specialist to assess for arterial disease—by Doppler if feasible (**Link for professional instructions**: www.nursingtimes.net/nursing-practice-clinical-research/doppler-assessment-calculating-an-ankle-brachial-pressure-index/205076.article) (Link for interpretation: www.healthfair.com/ScreeningsOffered/Ankle-BrachialIndex.aspx: A** (American Society of Plastic Surgeons [ASPS] 2007; Bjellerup 2003; Forssgren et al 2008; Kjaer et al 2005; McGuckin et al 2002)
        - i. Venous ulcers can exist in the presence of mixed arterial/venous pathology. C3 (ASPS 2007; Bonham et al 2009; Falanga 1997; Kerstein 1996)

b. **Duplex scanning ultrasound to measure blood flow and venous reflux: A (**Ghauri et al 1998; Kjaer et al 2005; Lee et al 2002; Vesic et al 2008; Yosadhara et al 2003)
c. **Air plethysmography to monitor hemodynamic flow: A** (Cordts et al 1992; Garcia-Rinaldi et al 2002; Perrin et al 1999)
d. **Venous refill time (VRT>20 seconds) measured with a below-knee tourniquet and photoplethysmography to diagnose venous insufficiency and predict VU non-healing: A** (Heit et al 2001; Kulkarni et al 2007; Phillips 1999)
    i. **Increased VRT after vein surgery predicts VU healing and nonrecurrence: A (**Gohel et al 2007; Kulkarni et al 2007; Phillips 1999)
e. **Transcutaneous oxygen tension ($TCPO_{2}$) near VU >30 mmHg to rule out arterial disease or predict VU healing: A** (Alexanderhouse Group 1992; Belcaro et al 2003; Lo et al 2009; Stacey et al 1990)
f. **Hypercoagulation, including elevated factor VIII related antigen, von Willebrand factor (VWF), D-dimer and factor V Leiden**: **A** (Blomgren et al 2001; Cushman et al 2010; Fink et al 2002)
g. **Skin perfusion pressure >30 mm Hg to predict VU and other chronic leg ulcer healing: A** (Adera et al 1995; Lo et al 2009; Yamamada et al 2008)
h. **Elevated temperature >1.1˚ C periulcer predicts infection: A** (Woo and Sibbald 2009; Fierhaller and Sibbald 2010)
i. Leg ulcers that fail to improve within 6 weeks despite consistent evidence-based treatment may not be caused by venous insufficiency. Consider biopsy for histological diagnosis or other procedures to identify suspected malignancy, vasculitis, pyoderma gangrenosum, mycobacterial or fungal infection, or other atypical etiologies: C2 (Combemale et al 2007; Schnirring-Judge and Belpedio 2010; Shelling et al 2010)

B. Document VU wound characteristics; monitor and manage ulcer progress

1. **Document VU progress weekly or sooner if there is a significant change in ulcer status: A** (Bolton et al 2004; Kurd et al 2009; McGuckin et al 2002)
    a. **Use validated measures that include wound depth (ie, Bates-Jensen Wound Assessment Tool© or Wound Bed Score): A** (Bolton et al 2004; Falanga et al 2006; Keast et al 2004)
2. **Measure VU area or estimate it from longest length x width to assess healing progress: A** (Kantor and Margolis 1998; Kantor and Margolis 2000; McGuckin et al 2002)
    a. **If wound area has not decreased by at least 40% after 3 weeks of a treatment regimen, it is unlikely to heal. Inform caregivers. Re-evaluate diagnosis and/or care plan: A** (Phillips et al 2000; van Rijswijk et al 1993; Kurd et al 2009)
    b. **A multidisciplinary wound team or clinic can improve healing, pain, and other health-related quality-of-life outcomes, reducing costs of patient care and hospitalization: A** (Gottrup et al 2001; Marshall et al 2001; Moffat and Franks 2004; Van Hecke et al 2008; Vu et al 2007)
    c. **Community nursing interventions including peer support improve healing, functional ability, and health-related quality of life*:* A** (da Silva et al 2006; Edwards et al 2005; Edwards et al 2009; Forssgren et al 2008)
    d. Patients who visit the clinic at least once per week experience better and faster VU healing outcomes than those with biweekly visits: C1 (Warriner et al 2010)
3. If complications, nonadherence to protocol, or other issues arise, revise care plan or goals of treatment to address patient concerns: C (Registered Nurses Association of Ontario [RNAO] 2010; Lorimer et al 2003)
4. **Validated quality of care VU outcome indicators include healing, recurrence, health-related quality of life, and pain: A** (Clarke-Maloney et al 2005; Edwards et al 2009; Kjaer et al 2007)

C. Patient-oriented care to prevent or heal VU and prevent VU recurrence. Improve venous return and provide patient and skin care

1. **Patient education including cause of skin breakdown, smoking cessation, how and why to use compression and leg elevation: A** (Lorimer et al 2003; McGuckin et al 2002; Van Hecke et al 2009)
2. Lower leg elevation is associated with VU healing and reduced recurrence C1 (Abu-Own et al 1994; Collins and Seraj 2010; Xia et al 2004)
3. Ambulation or exercise to improve venous hemodynamics or calf muscle pump function C1 (Alexanderhouse Group 1992; Kerstein 1996; Padberg et al 2004)
4. **Safe, effective compression options to heal venous ulcers can be cost-effective: A** (Kerstein et al 2001; Korn et al 2002)**.** Reduce compression as medically needed based on skin condition, limb shape, neuropathy, and cardiovascular or mixed venous/arterial disease confirmed during diagnostic work-up: C3 (Bonham et al 2009; EWMA 2003; Moffatt et al 1992)

a. **Elastic compression bandage heals more than inelastic compression: A** (Callam et al 1992; Gould 1998; Northeast et al 1990)
b. **Multilayer sustained, elastic high-compression bandages, stockings, or tubular bandages afford similar VU healing efficacy, better than single layer compression systems. Ideally match compression to patient needs and calf circumference: A** (Milic et al 2010; O'Meara et al 2009; Szewczyk et al 2009)
    i. **Two-layer compression improves comfort or quality of life more than 4-layer or short-stretch: A** (Jünger et al 2009; Moffat et al 2008)
c. **Elastic compression stockings with moisture retaining dressing improve VU healing, pain, and application time compared to short-stretch compression bandages or Unna's Boot: A** (Amsler et al 2009; Aschwanden et al 2008; Brizzio et al 2010; Hendricks et al 1985; Koksal et al 2003; O'Meara et al 2009)
    i. **High or medium compression elastic stockings derive similar recurrence rates with more consistent use of medium compression. Nonuse of elastic compression or stockings is correlated with VU recurrence: A** (Nelson and Jones 2008)
d. **Duke Boot (ie, Unna Boot + elastic compression and a hydrocolloid primary dressing reduces VU-related pain and is effective for healing most VU): A** (Arnold et al 1994; Lyon et al 1998; Eriksson 1986)
e. Gradient compression better than uniform compression: C1 (Arnold et al 1994; Sigel et al 1975)
f. **Short-stretch bandage heals VU more than usual care: A** (Brizzio et al 2010; Gould et al 1998; Charles 1991)
g. **Unna boot zinc paste impregnated bandage heals VU more than no compression: A** (DePalma et al 1999; Kitka et al 1988; Rubin et al 1990)
h. **Intermittent pneumatic compression heals VU more than no compression A** (Nelson et al 2008; Pekanmaki et al 1991; Coleridge-Smith et al 1990). Use with caution if edema occurs centrally
i. **Nonelastic compression strapping device: A** (Blecken et al 2005; DePalma et al 1999; Spence and Cahall 1996)
j. **Sequential-gradient pneumatic compression: A** (Coleridge-Smith et al 1990; Nikolovska et al 2005)
k. **Standardized manual lymphatic massage: A** (Molski et al 2009; Pereira de Godoy 2008)

5. **Manage periwound skin**

    a. **Moisturize skin if dry: A** (Beitz and van Rijswijk 1999; Finlayson et al 2010; McGuckin et al 2002)

    b. **Protect skin from chemical or physical trauma: A** (Hansson et al 1998; Sayag et al 1996)

    c. **Manage periulcer skin infection, inflammation, edema, and circulation. Be alert to sensitization reactions: A** (Cameron et al 2005; Mayrovitz and Larsen 1994; Neander and Hesse 2003)

D. Local wound care

1. **Cleanse VU gently at low pressure (4–15psi) with safe, nonantimicrobial cleanser: A** (Chaby 2010; McGuckin et al 2002; Romanelli et al 2010)
2. **Debride nonvital tissue to promote chronic VU healing A** (Dumville et al 2009; Mulder et al 1993; Romanelli 1997)
    a. Sharp debridement with scalpel, curette or scissors. Evidence cited does not address sterile surgical debridement in the operating room: C2 **(**Cardinal et al 2009; Golinko et al 2009; Williams et al 2005)
    b. **Enzymatic: A** (Bergemann et al 1999; Romanelli 1997; Westerhof et al 1987)
    c. **Autolytic using hydrogel or hydrocolloid dressing: A** (Dumville et al 2009; Mulder et al 1993; Romanelli, 1997)
    d. **Larval therapy (bagged or loose) debrides faster, with more pain and similar healing or cost effectiveness to hydrogel: A** (Dumville et al 2009; Wayman et al 2000**)**
    e. **High-frequency ultrasound improves healing for 7–8 weeks but not 12 weeks: A** (Cullum et al 2010)
        i. Low-frequency ultrasound requires more evidence: C (Breuing et al 2005; Cullum et al 2010)
    f. Mechanical debridement can remove VU nonvital tissue and slough. It is less painful and progresses faster with EMLA cream: C (Donati et al 1994; Lok et al 1999)
3. Fill deep wounds: C (Beitz and van Rijswijk 1999)
4. For all patients with a VU including those unlikely to heal, manage wound pain and pain related to VU cleansing and dressing change: C2 (Chrisman et al 2010; Price et al 2008; Quintanal 1999)
5. **Manage excess exudate and associated odor, improve comfort and reduce dressing change frequency to support cost effective healing: A** (Franks et al 2007; Harding et al 2001; Lyon et al 1998)
    a. **Alginate: A** (Bergemann et al 1999; Sayag et al 1996)

   b. **Hydrofiber®: A** (Armstrong and Ruckley 1997; Harding et al 2001; Quintanal 1999)
   c. **Foam dressings: A** (Franks et al 2007; Gottrup et al 2008)
   d. **Composite dressing: A** (Daniels et al 2002; Jones 2003; Vanscheidt et al 2004)

6. **Maintain moist wound environment to support cost effective healing or to reduce venous ulcer pain: A** (Chaby et al 2007; Kerstein et al 2001)
   a. **Hydrocolloid dressings improve pain, healing and costs of care compared to gauze: A** (Chaby et al 2007; Kerstein et al 2001; Singh et al 2004)
   b. **Hydrogel healing effects compared to saline or enzymatic debridement: A** (He et al 2008; Romanelli 1997)
   c. Film dressings: C1 (Davis et al 1992)
7. **Additional local anesthetic or analgesic to manage wound-related pain in patients with a VU: A** (Briggs et al 2010)
   a. **Ibuprofen-containing foam dressings reduce VU pain more than same non-medicated foam in the first week of use: A** (Briggs et al 2010; Gottrup et al 2008; Jørgensen et al 2006; Romanelli et al 2009)
   b. **5% eutectic mixture of local anesthetics (EMLA) reduces debridement pain: A** (Briggs et al 2010; Lok et al 1999)

E. Adjunctive interventions to apply if conservative therapy does not work in 30 days

1. **Antimicrobial VU topical care if no healing is seen in 30 days: A** (O'Meara et al 2010)
   a. **Consider systemic antibiotic use only on VU with clinical signs of infection: A** (O'Meara et al 2010)
   b. **Cadexomer iodine dressings improves healing on clinically infected wounds: A** (Hansson et al 1998; O'Meara et al 2010)
   c. **Silver-containing foam or collagen/oxidized regenerated cellulose dressings: A** (Dimakakos et al 2009; Jørgensen et al 2005; Munter et al 2006)
2. Biologic dressings if no healing is seen in 30 days:
   a. Collagen or collagen combinations: C1 (Lanzara et al 2008; Vin et al 2002 [NS])
   b. Hyaluronic acid or other matrix molecular dressings may decrease VU size or fibrin slough: B (Meaume et al 2008; Ortonne 1996; Taddeucci et al 2004)
3. **Skin replacement and grafting options to cover wound if no healing is seen in 30 days, accompanied by proper compression: A (**Jones and Nelson 2007)
   a. Split-thickness cultured autografts: C2 (Puonti and Asko-Seljavara 1998; Turcynski and Tarpila 1999)
   b. Pinch grafts: C2 (Christiansen et al 1997; Oein et al 1998)
   c. Cultured epidermal autografts (autologous keratinocytes): B (Vanscheidt et al 2007; Liu et al 2004; Mol et al 1991)
   d. Allografts: C2 (Beele et al 2005; Bolivar-Flores 1999; Goedkoop et al 2010; Lingren et al 1998: only RCT reported no statistically significant healing effect)
   e. Bilayered bioengineered skin: A (Falanga et al 1998; Jones and Nelson 2007)
   f. Free flap microsurgical reconstruction: C2 (Steffe and Caffee 1998)
4. **Biophysical interventions: A**
   a. Electrical stimulation: A (Franek et al 2000; Houghton et al 2003; Janković and Binić 2008)
   b. Vacuum (negative pressure wound therapy [NPWT]) has limited evidence for preparing VU for autologous pinch grafting or in VU graft management: C1 (Mendonca et al 2006; Ubbink et al 2008; Vuerstaek et al 2006)
      i. Topical NPWT over skin grafts on chronic wounds may increase the graft quality without significantly affecting the quantity of graft take: C1 (Moisidis et al 2004)
      ii. Topical NPWT may increase the rate of depth, area, or volume reduction of chronic wounds compared to saline gauze. Research is needed on complete healing effects: C1 (Joseph et al 2000)
   c. Warming: C1 (Robinson and Santilli 1998; Santill et al 1999; Von Felbert et al 2007)
   d. Electromagnetic/Radiofrequency (RF) stimulation: A (Kenkre et al 1996; Ieran et al 1990; Stiller et al 1992)
   e. Laser, including infrared (IR) stimulation and monochromatic light stimulation: C1 (Flemming and Cullum, 2002b; Gupta et al 1998)
   f. Hyperbaric oxygen: C1 (Hammarlund and Sundberg 1994; Kranke et al 2004)
   g. Ultrasound stimulation: A (Al-Kurdi et al 2008; Flemming and Cullum 2002; Prescott et al 1987; Taradaj et al 2008)
   h. Whirlpool lacks evidence of efficacy for managing venous insufficiency: C2 (McCulloch and Boyd

1992)

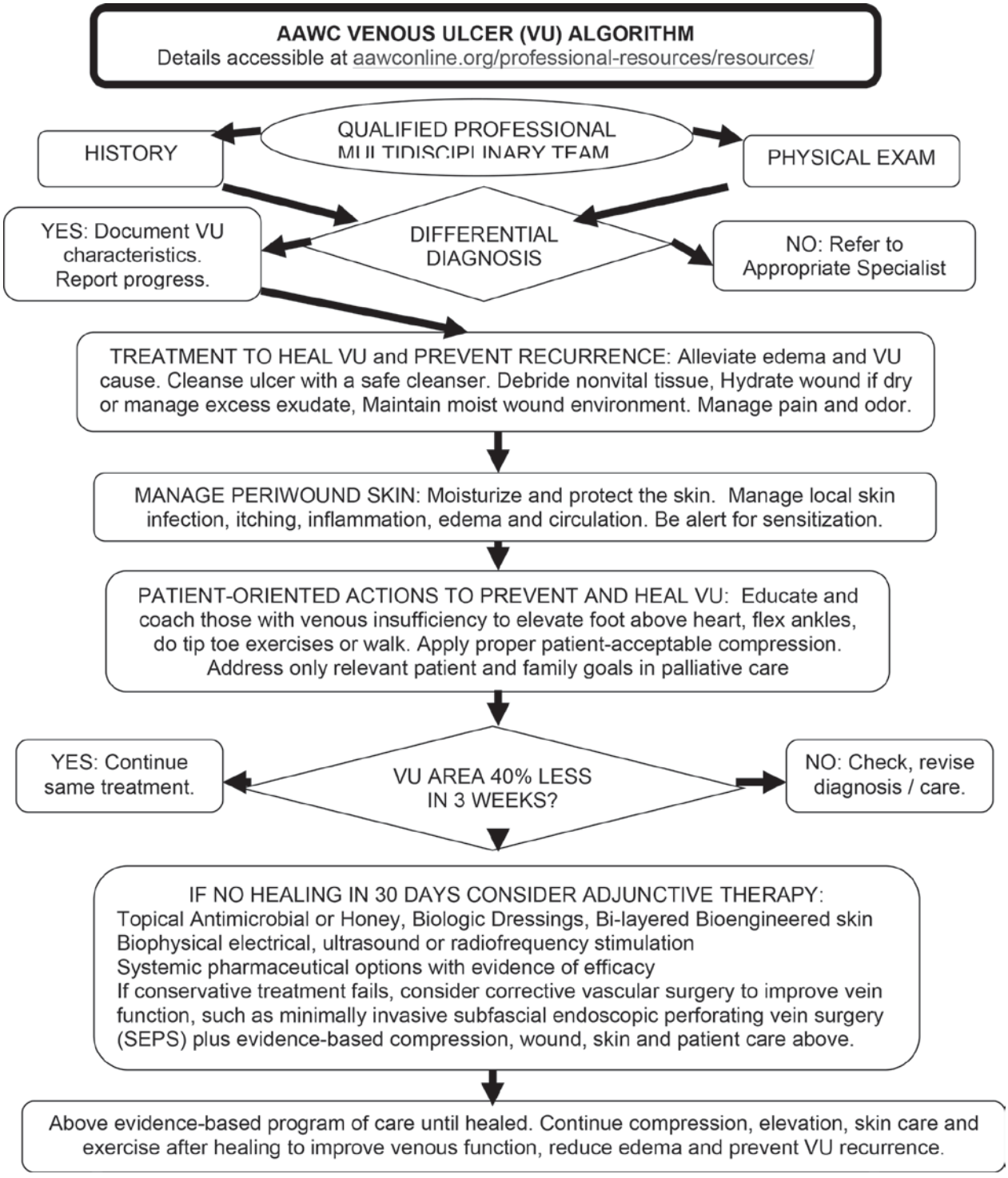
5. **Systemic pharmaceutical agents for VU healing or to prevent VU recurrence: A** (Coleridge-Smith 2005; Jull et al 2006)
    a. Defibrotide C1 (Jull et al 2006)
    b. Pentoxifylline: A (Collins and Seraj 2010; Falanga et al 1999; Jull et al 2006; Nelson et al 2007)
    c. Diosminhesperidin (Daflon 500 mg micronized purified flavonoid fraction): A (Coleridge-Smith 2005)
    d. Oxerutins (Horsechestnut seed extract) do not improve VU healing or recurrence: A (Leach et al 2006; Wright et al 1991)
    e. Stanozolol to reduce pain, edema or symptoms of venous insufficiency: B (Stacey et al 1990; Vesić et al 2008)
    f. Acetylsalicylic acid/aspirin: C1 (Layton et al 1994)
    g. Solcoseryl (topical + systemic): C1 (Biland et al 1985)
    h. Iloprost infused intravenously: C1 (Ferrara et al 2007)
6. **Topical interventions for VU healing or recurrence: A** (Gethin and Cowman 2008; 2009)
    a. Platelet-derived growth factor has shown no significant effects on VU: A (Wieman 2003)
    b. Cultured allogeneic keratinocyte lysate: C1 (Harding et al 2005)
    c. Manuka honey improves healing and pain in larger, longer-duration, sloughy VU compared to hydrogel: A (Gethin and Cowman, 2008, 2009)
    d. Mimosa extract 5% gel compared to hydrogel: C1 (Rivera-Arce et al 2007)
    e. Amelogenin extra-cellular matrix protein: C1 (Romanelli et al 2008)
    f. Thymosin-beta-4 has not yet significantly affected VU healing: C1 (Guarnera et al 2010)
7. **Corrective vascular surgery to improve vein function: A** (Gloviczki et al 2009)
    a. Minimally invasive subfascial endoscopic perforating vein surgery (SEPS) plus compression and wound care to heal VU and reduce VU recurrence compared to compression alone: A (Gohel et al 2007; Van Gent et al 2006; Wright 2009)
        i. SEPS results in lower incidence of wound infections, shorter hospital stays and lower VU recurrence rates than classic open vein surgery: A (Gloviczki et al 2009; Luebke et al 2009)
    b. Classic open vein surgery (Linton procedure: high ligation, division, and stripping of the saphenous vein) may be needed for some patients, reducing VU recurrence compared to compression alone: A (Barwell et al 2004; O'Donnell 2010)
    c. Thermal laser great or small saphenous vein coagulation or ablation: A (Gloviczki et al 2009; Viarengo et al 2007)
    d. Thermal radiofrequency vein ablation: A (Gloviczki et al 2009; Puggioni et al 2005)
    e. Sclerotherapy with compression requires more evidence: C1 (Hamel-Desnos et al 2010; O'Hare et al 2010)
    f. Venous valve repair or reconstruction: C2 (Maleti et al 2006; Perrin et al 1999)
    g. Transplant or graft valve: C2 (Garcia-Rinaldi et al 2002)
    h. Stenting of iliac vein for limbs with combined iliac vein obstruction and deep vein reflux: C2 (Raju et al 2010)

F. Local evidence-based wound care VU programs, pain management, and patient education until healed

1. **Compression, elevation, ambulation post healing to prevent recurrence: A** (McGuckin et al 2002; Nelson et al 2003)
2. *Elastic compression stocking use for 6 months after DVT may prevent PTS skin changes, but effects on VU remain to be clarified: B* (Prandoni and Kahn 2009; Aschwanden et al 2008)

G. Palliative care for patients with a VU

1. Establish individualized goals of care consistent with patient and family wishes and medical condition. Communicate to interdisciplinary team: C3 (Alvarez et al 2007; Chrisman 2010)
2. Continue evidence-based principles of VU care outlined in Sections A–E above to the extent acceptable to the patient and family, including correcting underlying pathology, addressing nutrition and other supportive aspects of care, and sensible, nonharmful local wound management: C (Alvarez et al 2007)
3. Attend to patient wound-related quality-of-life concerns including dressing comfort, wound fluid, odor, and bleeding: C3 (Alvarez et al 2007; Chrisman 2010; Price et al 2008)
4. Maintain individual dignity and provide psychosocial support to reduce isolation: C (Chrisman 2010)
5. If surgical management is considered, discuss benefits and risks with patient and family in terms of patient's condition and goals, presence of devitalized tissue, infection potential and underlying pathogenesis: C (Lee et al 2007)
    a. Healing may not be a realistic goal, but can occur, improving quality of life: C3 (Chrisman 2010)


AAWC VENOUS ULCER (VU) ALGORITHM
Details accessible at aawconline.org/professional-resources/resources/
QUALIFIED PROFESSIONAL
MULTIDISCIPLINARY TEAM
HISTORY
PHYSICAL EXAM
DIFFERENTIAL DIAGNOSIS
YES: Document VU characteristics. Report progress.
NO: Refer to Appropriate Specialist
TREATMENT TO HEAL VU and PREVENT RECURRENCE: Alleviate edema and VU cause. Cleanse ulcer with a safe cleanser. Debride nonvital tissue, Hydrate wound if dry or manage excess exudate, Maintain moist wound environment. Manage pain and odor.
MANAGE PERIWOUND SKIN: Moisturize and protect the skin. Manage local skin infection, itching, inflammation, edema and circulation. Be alert for sensitization.
PATIENT-ORIENTED ACTIONS TO PREVENT AND HEAL VU: Educate and coach those with venous insufficiency to elevate foot above heart, flex ankles, do tip toe exercises or walk. Apply proper patient-acceptable compression. Address only relevant patient and family goals in palliative care
VU AREA 40% LESS IN 3 WEEKS?
YES: Continue same treatment.
NO: Check, revise diagnosis / care.
IF NO HEALING IN 30 DAYS CONSIDER ADJUNCTIVE THERAPY:
Topical Antimicrobial or Honey, Biologic Dressings, Bi-layered Bioengineered skin
Biophysical electrical, ultrasound or radiofrequency stimulation
Systemic pharmaceutical options with evidence of efficacy
If conservative treatment fails, consider corrective vascular surgery to improve vein function, such as minimally invasive subfascial endoscopic perforating vein surgery (SEPS) plus evidence-based compression, wound, skin and patient care above.
Above evidence-based program of care until healed. Continue compression, elevation, skin care and exercise after healing to improve venous function, reduce edema and prevent VU recurrence.

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Appendix 2. The AAWC Pressure Ulcer Guidelines
Association for the Advancement of Wound Care Pressure Ulcer Guideline
Legend: Bold: Evidence Level A. *Italics = Level B*, Normal = Level C. Each recommendation has content validity >0.75 based on 31 multidisciplinary independent survey respondents.

I. Patient and Pressure Ulcer (PU) Assessment

A. **Patient and PU risk assessment for all settings**

1. **For all settings, a trained professional should assess and document PU risk within 72 hours of admission or on change of any PU risk factor, using a valid, reliable scale with good predictive validity for the setting and for patient age and cognition: A** (Comfort 2008; Magnan and Makelbust 2008; Makelbust and Magnan 2009)
    a. **Assess environmental/physical/medical/psychosocial factors, patient end-of-life goals: A** (Brink et al 2006; Baharestani 1994) — eg, **body mass index, skin, friction/shear potential, note surgical procedures: A** (Compton 2008; Fowler et al 2009; Schoonhoven et al 2006)
    b. **Extremes of age increase PU risk, especially for those over 62 years of age and neonates: A** (Fowler and McGuire 2008; Bergstrom and Braden1992; Bergstrom et al 2006; Champagne and Ruby 1996; Quigley and Curley 1996)
    c. Previous or current ulcer increases PU risk: C1 (Guihan et al 2008)
2. **Braden scale has highest inter-rater reliability** (Kottner et al 2008**) and percent correct predictions: A** (Ayello and Braden 2002; Pancorbo-Hidalgo et al 2006; Bolton 2007) **Norton and Waterlow Scales are also valid: A** (see Table 1)

Table 1. Published scores for some validated scales corresponding to levels of pressure ulcer risk

Pressure ulcer risk assessment scale	Mild or low risk	Moderate risk	High risk	Very high
Braden	15–18	13–14	10–12	< 9
Braden Q (Pediatric 21 days to 8 years)	22–25	17–21	<16	
Norton	>18	14–18	10–14	< 10

3. **Continue risk assessments routinely according to setting protocols and changes in patient PU risk: A** (Brandeis et al 1995; Berlowitz et al 1997; Ayello and Braden 2002)
4. **If PU risk assessment is inappropriate for a patient, document why: A** (Brandeis et al 1995; Berlowitz et al 1997; Ayello and Braden 2002)
5. **Use clinical judgment and institutional protocols to implement patient-appropriate interventions indicated by risk scores: A** (Comfort 2008; Magnan and Makelbust 2008; Makelbust and Magnan 2009) and to identify factors affecting PU risk (Wound Ostomy Continence Nurses Society [WOCN] 2010, Nursing Institute for Continuing Education [NICE] 2005) in each of the following settings:
    a. Acute care: *Reassess every 48 hours and on transfer to higher care level: B* (Fowler et al 2009)
    b. Long-term care: Reassess weekly or on status change: C2 (WOCN 2010; Registered Nurses Association of Ontario [RNAO] 2005; Tippet 2009)
    c. Home care: Reassess at each visit, weekly and on resumed care or recertification: C3 (Ayello and Braden 2002)
    d. Hospice care: Reassess weekly for 4 weeks, then monthly: A (Henoch and Gustaffson 2003; Seaman and Shively 2000)

B. Patient nutritional assessment

1. **Properly trained staff should assess nutritional parameters with a validated measure: A** (Hengstermann et al 2007; Lindgren et al 2005; Pinchofsky-Devin 1986; Scott et al 1999; Uzun and Tan 2007) **on admission, at change in condition, and as needed based on medical status or if ulcer is not decreasing in size. Inform appropriate dietary professional of results: A** (Guenter et al 2000; Langer et al 2003; Reed et al 2003; Pinchofsky-Devin 1986)
    a. **Document adequate protein, calorie, and fluid intake as well as feasible— eg, 3-day calorie count, intake record: A** (Guenter et al 2000; Langer et al 2003; Pinchofsky-Devin 1986)
    b. **Record current and usual weight, height as baseline to set goals or estimate body mass index (BMI) (kg/m^2) as weight (kg) divided by square of height (m^2): A** (Guenter 2000; Kernozek, 2002; Uzun and Tan 2007) (see Table 2)

Table 2. Standard body mass index (BMI) adult values

Weight category:	Underweight	Normal	Overweight	Obese
Body mass index	**<18.5**	**18.5–24.9**	**25–29.9**	**>30**

Other factors for nutritional risk may include history of involuntary weight loss; compromised oral, dental, gastrointestinal, and/or swallowing status; medical/surgical history or interventions influencing intake or absorption of nutrients; drug-nutrient interactions — eg, chemotherapy agents causing nausea, agents to correct hyperkalemia causing diarrhea or other related conditions or medications: C2 (Pinchofsky-Devin 1986)

2. Assess nutritional laboratory parameters regularly for patients with documented deficiencies or in those at high PU risk: C (Baranoski, Ayello 2004; NPUAP 2009; WOCN 2010). Example values are presented in Table 3.

Table 3. Normal values for some parameters correlated with pressure ulcer development

Parameter: normal value	Adult	Child	Infant/Neonate
Prealbumin	10–40mg/dL	16–28.1mg/dL	10.4–11.4mg/dL.
Total protein	6–8g/dL	4.3–7.6 g/dL	6.2–8.0 g/dL
Serum albumin	3.4–5.0g/dL	3.2–5.1 g/dL	3.2–4.8mg/dL
Hematocrit (%)	Female: 35%–47% Male: 37%–51%	31%–43%	42%–68%
Transferrin	200–400mg/dL		130–275mg/dL
Total lymphocyte count	2500/µL	350–400/µL	1100–1200/µL

C. Medical/Surgical history

1. *Document unstable or significant intrinsic risk factors and comorbidities that impede healing or contribute to altered tissue tolerance or integrity: B* (Fowler et al 2008; Milne et al 2009) Perform or obtain initial comprehensive systems assessment on individuals with a PU if feasible: C2 (Chacon et al 2010; Konishi et al 2008)
   a. Malignancy (Institute for Healthcare Improvement [IHI] 2007) or *severe chronic or terminal disease: B* (Fowler et al 2008)
   b. **Diabetes, with Hb A1c <6.5 to document blood glucose control: A** (Fowler et al 2008; DeLaat et al 2007)
   c. **Cardiovascular disease or condition including cardiovascular accident (CVA) leading to altered sensation or ability to move: A** (Fowler et al 2008; DeLaat et al 2007; IHI 2007)
   d. Gastrointestinal, genitourinary, renal, endocrine or pulmonary disease or condition: C2 (IHI 2007; Chacon et al 2010; Konishi et al 2008)
   e. **Peripheral vascular disease/condition: assess lower extremity arterial disease or edema as comorbidity for lower extremity PU: A** (Fowler et al 2008; DeLaat et al 2007; IHI 2007) **Tests may include:**
      i. **Pulses, capillary refill time, edema or mobility**
      ii. **Ankle/Brachial Systolic Blood Pressure >0.9 to rule out arterial disease in a heel pressure ulcer**
   f. Sensory deficits, bowel and bladder habits: C2 (Chacon et al 2010; Konishi et al 2008)
   g. *Malnutrition, dehydration, failure to thrive, severe chronic or terminal disease: B* (Fowler et al 2008; IHI 2007)
   h. **Neuromuscular system: spasticity, peripheral neuropathy, spinal cord injury, multiple sclerosis, Parkinson's disease, or similar neurologic conditions**: **A** (Chacon et al 2010; Fowler et al 2008; IHI 2007)
   i. *Conditions like severe arthritis that prohibit repositioning/pressure redistribution: B* (Fowler et al 2008; IHI 2007)
2. **Smoking or conditions that affect skin interface pressure, temperature, moisture: A** (Cackmak et al 2009; Smith et al 2008; Suriadi et al 2007). Consider other substance abuse issues that may affect skin PU risk
3. **Review medications — eg, sedation, steroid, immunosuppressive, anticancer, or anti-embolic agent use: A** (Chacon et al 2010; Fowler et al 2008; IHI 2007)
4. **Record recent surgical procedures, falls, or traumatic injury: A** (Fowler et al 2008; IHI 2007; Manesse et al 1994)
5. **Document details of prior PU. Include treatments or surgical interventions: A** (Fowler et al 2008; IHI 2007)
   a. **Obtain history of restricted mobility related to care, treatment, procedure, or falls: A** (Manesse et al 1994): **time spent immobile, room temperature, pressure-reducing surfaces used and repositioning considerations if appropriate to patient for all settings: including acute care, Emergency Department: A** (Schoonhoven et al 2006; Langemo et al 2006; Linares et al 1987; Lyder et al 2001)
   b. **Long-term care A:** (Bergstrom and Braden 1992; Bergstrom, Braden, Kemp et al 1998)

c. **Operating room and post-anesthesia care unit A:** (Schoonhoven et al 2006; Aronovich 2007)
d. Procedural lab — eg, for oncology, radiological or catheter-related procedures such as dialysis: C1 (Reed et al 2003)
e. Long ambulance or air transfers: C2 (Baharestani 1994)

D. Psychosocial and quality-of-life assessment: C3 (Brink et al 2006; Langemo et al 2010; Letizia et al 2010)
1. Assess psychological conditions including the following: C3 (Langemo 2010)
   a. Goals and motivation of patient, family and care provider(s) to participate in care: C3 (Brink et al 2006; Letizia et al 2010)
   b. Adherence to health management protocols: C3 (Brink et al 2006; WOCN 2010)
   c. Cognition and ability to comprehend or retain information: C3 (Langemo et al 2010)
   d. Behavioral disorders that may affect capacity to engage in self care: C3 (Langemo et al 2010)
   e. **Pay special attention to those with more richly pigmented skin or with little social support: A** (Saladin et al 2009; Redeling et al 2005). Culture or ethnicity can be related to risk of developing a PU: C (Saladin et al 2009) or increased likelihood of mortality in patients with a PU: C (Redeling et al 2005)
2. Assess social support systems, including family or partner: C2 (Baharestani 1994; Saladin et al 2009)
3. Assess financial resources, access to equipment, and related reimbursement limitations, and caregiver availability, skills, knowledge, and capacity to provide consistent quality care: C2 (Baharestani 1994)

E. Environmental assessment
1. Assess posturing irregularities/abnormalities: habitual positioning, paralysis, contractures, amputation, rigid or spastic condition: C3 (RNAO 2005)
2. Assess for ineffective positioning techniques: C3 (RNAO 2005)
   a. Assess for pressure, sheer or friction in all positions, all environments and during lift, turn, repositioning and transfer events: C3 (RNAO 2005)
3. Monitor and document adherence to prescribed offloading regimen and proper use of equipment or adaptive aids: C3 (NICE 2005; RNAO 2005; WOCN 2010)
4. Assess for ill-fitting devices, braces, seating and ineffective equipment/assistive devices: C3 (John Hartford Foundation 2003; RNAO 2005)
   a. Evaluate offloading equipment quality, efficiency, proper use, effectiveness (eg, feel for "bottoming out" or observe for PU development): C3 (Rithalia 2001; Brienza et al 2005)
   b. Observe seating and brace or other device accommodation to body size and/or contours while assessing skin areas affected for potential breakdown: C3 (RNAO 2005)

F. Physical exam
Perform head-to-toe assessment with attention to bony prominences and any skin surfaces in contact with removable devices (AHCPR 1992; RNAO 2005) (see Table 4 for areas at risk in common positions)

Table 4. Pressure points to examine if patient has spent time in indicated position (RNAO 2005)

Patient position	Sites to examine, including all other sites at pressure ulcer risk
Supine	Occipital areas, sacrum, scapula(e) and heels
Prone	Chest, anterior superior iliac crests, symphysis, pubis, patella, anterior tibial regions
Sitting	Ischium, coccyx, elbow, trochanter
Side-lying	Trochanter, lateral foot, ankle, knee, ear
All positions: skeletal deviation areas	Bunion, kyphosis, lordosis, pelvic obliquity

2. **Document alterations in skin sites at risk of developing a PU for the following characteristics:**
   a. **Color: A** (Bates-Jenson 1997; Sprigle et al 2001)
   b. **Texture — eg, unusual hardness (induration), softness, or rough surface for this site: A** (Bates-Jenson 1997)
   c. **Sensation: A** (Braden et al 1994; Copeland-Fields and Hoshiko1989)
   d. **Skin temperature at and around site: A** (Nakagami et al 2009; Sae-Sia et al 2005, 2007; Sprigle et al 2001)
3. **Assess and document the following wound features:**
   a. **Anatomic location: A** (Bates-Jenson 1997; Gardner et al 2005)

b. **Size (PU length, width, depth) measure using consistent, reliable method within and across institutions: A** (Bates-Jenson 1997; Gardner et al 2005)
   i. **Lack of area reduction in 2–4 weeks of care is a valid predictor of nonhealing for PU: A** (van Rijswijk and Polansky 1994) **and other chronic wound: A** (Kantor and Margolis 1998; Sheehan 2003)
   ii. **Reliable estimates of wound area are a) longest length x longest perpendicular width: A** (Bates-Jensen 1997; Buntix et al 1996; NICE 2005; Sanada et al 2004); or **b) head-toe length and side-side width: A** (Gunes 2009; Stotts et al 2001)
c. **Exudate type — eg, bloody, serous, purulent, foul) and amount (eg, none, moist, small, moderate or large amount of exudate) usually based on appearance of dressing: A** (Bates-Jenson 1997; Stotts et al 2001)
d. **Infection signs (eg, erythema, edema, odor, purulent or foul-smelling exudate, increase in ulcer pain, exudate, fever, friable or irregular granulation tissue): A** (Bates-Jensen 1997; Gardner et al 2001)
e. **Undermining, sinus tracts, and tunneling: A** (Bates-Jensen 1997; Stotts et al 2001)
f. Stage of PU: deep tissue injury, I, II, III, IV, Unstageable: C1 (Konishi et al 2008; RNAO 2005; National Pressure Ulcer Advisory Panel [NPUAP] 2009)
g. **Tissue types and amounts (eg, epithelium, granulation, yellow/white fibrin/slough, or black, brown, or gray necrotic tissue): A** (Bates-Jensen 1997; Stotts et al 2001)
   i. **Ulcer margin abnormalities — eg, epiboly, exuberant granulation: A** (Bates-Jensen 1997; Stotts et al 2001)
   ii. **Periwound skin (eg, erythema or edema): A** (Bates-Jensen 1997; Stotts et al 2001)

4. Evaluate for complications as indicated by ulcer severity or chronicity, and if treated, document treatment and its duration — eg, **osteomyelitis, bacteremia: A (**Bryan et al 1983; Lewis et al 1988**)**, fistulae, abscesses, cellulitis, cancer, heterotopic bone formation: C1 (Milne et al 2009)
5. For individuals with a PU, it is important to perform differential diagnoses (eg, skin tear, herpes lesions, incontinence-associated dermatitis, candidiasis, arterial insufficiency ulcer) to improve accuracy of pressure ulcer diagnosis: C2 (Chacon et al 2010; Konishi et al 2008)
6. **Conduct a pain assessment using an age-appropriate validated pain scale: A** (Chang et al 1998; Flock 2003; Gardner et al 2001; Heyneman et al 2008)
7. Repeat above assessments regularly at same intervals as PU risk assessment based on patient risk and institutional guidelines or on any change in patient condition: C2 (Chacon et al 2010; Konishi et al 2008)

G. Diagnostic tests

1. Use appropriate vascular laboratory consult as needed to assess tissue perfusion if limited vascular perfusion is suspected. Consider appropriate vascular laboratory consult or a bedside ankle-brachial index to assist in differential diagnosis: C2 (Chernecky et al 2004; Rennert et al 2009) (see Table 5)

Table 5. Systolic ankle/brachial blood pressure (ABI) differential diagnosis

Arterial disease severity	Ankle-brachial index (ABI) value
No disease: normal arterial perfusion	At least 0.86
Mild arterial disease	0.75–0.85
Intermittent claudication (walking capacity limited)	0.50–0.75
Severe arterial disease	0.20–0.50
Gangrene	< 0.20

2. **Obtain quantitative tissue, swab, or bone culture in suspected infection, obvious cellulitis or on nonhealing wounds if consistent with treatment goal**: **A** (Gardner et al 2006; Rennert et al 2009)
3. Biopsy chronic nonhealing ulcers for suspected malignancy if no healing is observed in response to optimal care during 12 weeks: C2 (Whitney et al 2006)
4. Obtain bone imaging using a patient-compatible method — eg, MRI/CT scan/nuclear scan/PET) in suspected osteomyelitis: C2 (Strobel and Stumpe 2007; Rennert et al 2009; Boutin et al 1998)
5. Obtain blood analysis as indicated to establish baseline values, assist in diagnosis of infection and/or reflect status of comorbid conditions affecting wound status — eg, CBC/diff, PT/PTT, metabolic panel, lipid profile, HbA1c, hepatic function panel, pre-albumin, CRP, ESR, blood culture, TSH: C2 (Rennert et al 2009)

H. Documentation and communication

1. Document all assessments and findings on approved forms or tools: C2 (Milne et al 2009)
2. Ensure all members of interdisciplinary team have access to all formal assessments: C1 (Milne et al 2009; Powers 1997)

II. Prevent Pressure Ulcer Occurrence or Recurrence

A. Skin inspection and maintenance

1. *Perform comprehensive visual and tactile skin inspections during patient care and regularly according to institutional guidelines: B* (Schonhoven et al 2006; Bergstrom and Braden 1992)
   a. Remove all special garments, protectors and devices, as medically feasible, to assess skin: C2 (AHCPR Prevention Guideline 1992; RNAO 2005; Bergstrom and Braden 1992)
   b. Assess splints, casts, tubes and other devices as potential sites for pressure as feasible: C3 (RNAO 2005)
2. Manage excess moisture at affected sites, including areas affected by incontinence or perspiration, and skin folds in bariatric patients: C2 (RNAO 2005**;** Lyder et al 2002)
   a. Manage skin temperature elevation at the support surface interface with the patient's skin: C3 (RNAO 2005; AHCPR 1992; Consortium for Spinal Cord Medicine 2000)
   b. Select effective underpads and/or briefs to wick incontinence and moisture away from skin; avoid trapping moisture against skin, use appropriate skin protectants: C3 (RNAO 2005)
3. *Clean and dry skin using nonfriction bathing standards with a slightly warm, nonirritating, nonsensitizing, pH-balanced no-rinse skin cleanser avoiding saline or soap regularly and after each incontinence episode: B* (Bergstrom et al 2005; Hodgkinson 2007; Lyder et al 2002)
   a. Maintain skin hydration: C3 (RNAO 2005) *with nonsensitizing, pH-balanced lubricating agents*: *B* (Bergstrom et al 2005; Hodgkinson 2007; Lyder et al 2002)
4. Establish an individualized bowel and bladder program for patients with incontinence: C3 (RNAO 2005; WOCN 2010)
   a. Determine the type of fecal or urinary incontinence based on symptoms and history; consider onset, duration, aggravating and relieving factors: C3 (WOCN 2010) Consider referral to a continence specialist if appropriate: C3 (RNAO 2005)
   b. Use incontinence skin barriers as needed to protect and maintain skin integrity: C2 (Lyder et al 2002; RNAO 2005; WOCN 2010)
   c. Consider pouching system or collection device to contain urine or stool and protect skin from effluent: C3 (RNAO 2005; WOCN 2010) or indwelling catheter for brief periods if urine contributes to skin breakdown: C3 (WOCN 2010)
5. *Reduce friction and shear: B* (Lyder et al 2002; AHCPR 1992; RNAO 2005; WOCN 2010)
   a. *Apply lubricants, transparent film or hydrocolloid dressings, or other topical friction or shear reduction agents to bony prominences to reduce mechanical injury from friction or shear: B* (Flam and Raab 1991; Milne et al 1999; Ohura 2005; Weng et al 2008)
   b. *Avoid vigorous massage over bony prominences: B* (Ek et al 1985; Dyson 1978)
6. Document any skin changes. Record and notify patient care team of changes to care plan resulting from the change(s) in the skin condition: C1 (Schoonhoven et al 2006; Milne et al 2009)

B. Hydration and nutrition plan of care

1. **Maintain or restore adequate nutrition to maintain skin integrity as feasible and as compatible with patient and family wishes or condition: A** (Reed et al 2003; Stratford et al 2005; Theilla et al 2007)
   a. **Restorative dining program if appropriate, providing foods with high nutritive value or nutrition supplements with or between meals if needed: A** (Stratford et al 2005; Desneves et al 2005)
   b. **Enteral nutrition only if medically needed to maintain adequate nutrition. This should be consistent with patient and family wishes: A** (Bergstrom et al 2006; Stratford et al 2005; Theilla et al 2007)
   c. Parenteral nutrition only if medically needed to maintain adequate nutrition and enteral nutrition is not an option and if consistent with patient and family wishes: C1 (Compton 2008)
   d. Offer hydrating fluids with repositioning schedule. Offer additional fluids if medically appropriate and patient has dehydration, fever, diaphoresis, diarrhea, or heavily draining wounds. Document fluid intake in patients unable to hydrate themselves: C3 (RNAO 2005)

C. Rehabilitative and restorative programs

1. Address immobility and/or inactivity in bed- or chair-bound patients: C1 (Allman 1987; Berlowitz and Wilking 1989; Goode et al 1995)
   a. Begin progressive mobility program as soon as condition allows: C3 (RNAO 2005)
   b. Implement ongoing exercise programs to maintain or restore mobility and activity, increase strength and improve cardiovascular endurance: C2 (Rennert et al 2009)
2. Manage muscle spasms appropriately: C3 (Whitney et al 2007)

D. Positioning standards of care to manage pressure/shear/friction

1. Vulnerable individuals should be repositioned to reduce pressure, friction, and shear. Individual status should determine frequency, not a ritualistic schedule: C3 (National Collaborating Centre for Nursing and Supportive Care and National Institute for Clinical Excellence ([NCCNS]/NICE) 2003)
2. Turn or reposition at least every 2–3 hours when on pressure redistributing surface if patient can tolerate this: C1 (Defloor and Grypdonck 2005)
3. Avoid folding and stretching of soft tissues when repositioned: C3 (RNAO 2005)
4. Use lift sheets or devices to turn and transfer dependent patients, avoid dragging: C3 (NPUAP 2009)
   a. When using mechanical handling devices remove slings/sleeves from under patient after maneuvering is complete, according to device instructions: C3 (NCCNS/NICE 2003)
5. Use trapeze or side rails to facilitate patient independence with bed mobility: C3 (RNAO 2005)
6. Apply pillows and cushions or other appropriate devices such as foot orthoses to prevent bony prominences from contacting each other (ie, between knees, ankles, feet): C3 (RNAO 2005)
7. Maintain head of bed at or below 30˚ or at the lowest degree of elevation consistent with medical condition: C3 (Bergstrom et al 1992; RNAO 2005)
8. **Relieve pressure under heels by suspension, support surfaces: A** (Reddy et al 2006), **pressure-distributing dressings: A** (Bots and Apotheker, 2004)**, or other devices: A (**Cheney 1993; Cheneworth 1994; Zernike 1994)
9. Avoid positioning directly on trochanter; when side-lying, use a 30˚ laterally inclined position: C3 (RNAO 2005)
10. Instruct in self-performing pressure relief exercises every 15 minutes in chair-bound persons; if unable, reposition every hour when in chair: C3 (RNAO 2005)
    a. Avoid prolonged sitting intervals (eg, intervals >4 hours) for at-risk individuals: C1 (Defloor et al 2005; Whitney et al 2006)
11. Utilize small frequent position changes to redistribute pressure on bony areas: C3 (RNAO 2005)
12. When utilizing heating/cooling blankets place on top of an individual. Avoid positioning these devices underneath weight-bearing zones: C1 (Reger et al 2007)

E. Offloading equipment including chairs and in operating rooms

1. Avoid doughnut-shaped pressure redistribution devices (except on plantar surface of the foot): C3 (AHCPR 1992; NPUAP 2009; Whitney et al 2005)
2. *Avoid use of sheepskin for pressure reduction without added heel and elbow protection*: *B* (Reddy et al 2006)
3. **Avoid standard (spring-style) mattresses: A** (Reddy 2006)
4. **All individuals vulnerable to PUs require a patient-acceptable support surface — eg, high-specification foam mattress, static air mattress, overlay, low-air-loss or alternating-pressure mattress, alternating-pressure overlay and regular repositioning at a minimum. Support surface should prevent "bottoming out": A** (Defloor et al 2005; McInnes et al 2008; Nicosia et al 2007; Nixon et al 2006; Reddy 2006)
   a. Use holistic assessment to determine supportive devices; risk level, general health status, comfort, skin assess, lifestyle and abilities, critical care needs and acceptability by patient/caregiver: C1 (Konishi et al 2008; NPUAP and EPUAP 2009)
5. **Use devices such as a low-air-loss mattress, high-density air flotation, high-specification foam, or similar pressure-redistribution replacement mattress if patient has PU history, elevated risk score, if indicated by clinical condition or when a less effective device has failed to prevent a PU: A** (Pemberton et al 2009; Russell et al 2003; Sterzi et al 2003; Vanderwee et al 2008)
   a. Assess and review support surfaces regularly; consider clinical outcomes, comfort, abilities, changes in general status: C1 (Konishi et al 2008; NICE 2003)
6. **Use pressure-redistribution devices intra-operatively for individuals assessed to be at risk for PU development: A** (Bots and Apotheker 2004; Reddy et al 2006)
7. **Use heel/foot/elbow area offloading devices to augment support surfaces — eg, pressure-distributing heel dress-**

ings: A (Reddy 2006)

8. Ensure regular repositioning according to institutional guidelines and provision of support surfaces or devices, incontinence pads, and positioning devices are available in all at-risk environments for all surfaces used by patients: C1 (Konishi et al 2008; NICE/ NCCNSC 2003)
9. Position all chair-bound patients with attention to anatomy, postural alignment, and distribution of weight, foot support, balance, and stability. Educate personnel on assessing proper support surface function: C1 (Bergstrom et al 1994; Milne et al 2009; NPUAP/EPUAP 2009)
   a. *Seating assessments for cushions, supportive aids and equipment should be carried out by trained assessors with specific knowledge and expertise on effective weight redistribution principles: B* (Magnan and Makelbust 2009; Makelbust and Magnan 2009; Milne et al 2009)
10. Provide an individually prescribed wheelchair and pressure redistribution surface for wheelchair-bound individuals with severe mobility or positioning deficits: C3 (RNAO 2005)
    a. Prescribe wheelchairs and seating systems according to individualized anthropometric, ergonomic, and functional principles: C3 (RNAO 2005)
    b. Measure the effects of posture and deformity on interface pressure distribution if feasible. Use clinical judgment and objective data in determining the compatibility of individuals shape or posture with seating system: C3 (RNAO 2005)
    c. Use power weight shifting wheelchair system for individuals who are unable to independently perform effective weight shift: C3 (RNAO 2005)
    d. Inspect and maintain functionality of a wheelchair support surface at regularly scheduled intervals, including 3–4" high-density foam, static air cushions, or other therapeutic cushion designed for pressure redistribution: C1 (Defloor and Grykdonck 2000; Brienza and Karg 2005)

F. Interdisciplinary approach**:** C1 **(**Bogie and Ho 2007; Granick and Ladin 1998; Powers 1997; Milne et al 2009)

1. Utilize a multidisciplinary team for development of an individualized plan of care based on intrinsic and extrinsic PU risk factors and risk score data: C1 (Bogie and Ho 2007; Konishi et al 2008; Powers 1997; Milne et al 2009)
   a. Have available a position statement on the benefits of team care with references, such as the AAWC *Statement on Benefits of Team Care*: C1 (Milne et al 2009)
2. **Assign specific healthcare professionals trained in the principles of offloading to select and implement appropriate pressure redistribution devices for beds, chairs, and wheelchairs for all "at-risk" individuals: A** (Allman et al 1987; Cullum et al 2004; Makelbust and Magnan 2009; Milne et al 2009)
3. **Consult a dietitian in cases of malnutrition or suspected malnutrition or for patients assessed at risk for PUs: A** (Langer et al 2003; Reed et al 2003; van Rijswijk and Polansky 1994)
4. Determine need for referral to continence care specialist: C3 (Horn et al 2010; RNAO 2005)
5. Consult Occupational or Physical Therapy seating specialist for wheelchair-bound individuals: C3 (RNAO 2005)

G. Education

1. *Develop and implement organized, structured and comprehensive training programs for healthcare personnel, patients, families and all care givers for prevention and treatment of PUs*: *B* (Horn et al 2010; Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009; Tippet 2009) Include:
   a. Instruct on negative impact of smoking, alcohol, and drug abuse on PU prevention and treatment: C2 (Rosen et al 2006; Milne et al 2009; Rennert et al 2009)
   b. Principles of PU prevention: C2 (Horn et al 2010; Milne et al 2009)
   c. Individualized interventions to reduce pressure, shear, friction: C2 (Horn et al 2010; Milne et al 2009)
   d. Skin inspection methods and maintenance care: C2 (Horn et al 2010; Milne et al 2009)
   e. Use and maintenance of pressure-redistribution devices: C2 (Cheney 1993; Horn et al 2010; Milne et al 2009)
   f. Available resources for assistance and advice: C2 (Horn et al 2010; Milne et al 2009)
   g. Signs and symptoms of infection, or other complications: C2 (Milne et al 2009)
   h. Nutrition and hydration interventions: C2 (Horn et al 2010; Milne et al 2009)
2. *Develop organized, structured, and comprehensive healthcare personnel training programs including the following: B* (Horn et al 2010; Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009) *Include*:
   a. *Risk assessment factors and patient assessment tool: B* (Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009)
   b. *Pressure ulcer pathophysiology and prevention strategies: B* (Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009)

c. *Skin and wound assessment parameters: B* (Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009)
d. *Roles and responsibilities related to assessment and prevention: B* (Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009)
e. *Development and implementation of individualized plan of care: B* (Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009)
f. *Selection, use and maintenance of pressure redistribution devices: B* (Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009)
g. *Patient education and information giving techniques: B* (Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009)
h. Accurate documentation of pertinent data: C2 (Horn et al)
i. Demonstration of positioning and transferring techniques: C2 (Horn et al 2010)

III. PU Treatment Strategies

A. *Implement or continue all measures to prevent new PUs and optimize wound healing: B* (Milne et al 2009)
1. *Evaluate effectiveness of previous and current preventive or treatment programs: B* (Horn et al 2010; Magnan and Makelbust 2008; Makelbust and Magnan 2009; Milne et al 2009)
2. Set treatment goals consistent with patient's goals, values, and lifestyle: C3 (RNAO 2007)

B. Remove or alleviate all causes of PU damage: C2 (Milne et al 2009)
1. Use a pressure-redistribution product with verified functionality for individuals with unstageable, deep tissue injury, Stage III, Stage IV, or multiple ulcers over several turning surfaces: C3 (NPUAP 2009; NICE 2003)
    a. *Select a static support surface for individuals who can be positioned without weight bearing on an ulcer and without bottoming out on the support surface: B* (Cheney 1993; Cheneworth 1994; Cullum et al 2004). *There is insufficient evidence for differences PU outcomes using different types of static devices: B* (Cullum et al 2004)
    b. Select a dynamic air support surface if individual cannot be positioned without pressure on an ulcer, when a static support surface bottoms out, if no evidence of healing or if new ulcers develop: A (Cullum et al 2004; Ferrell 1993; Rosenthal et al 2003)
    c. Use support surfaces with verified functionality such as dynamic air flotation, algorithm sensing technology support system, low-air-loss or air-fluidized bed in the treatment of PUs or unstageable deep tissue injury on multiple surfaces, compromised skin, or for temperature and moisture control in the presence of large Stage III or Stage IV PUs or for surgical graft sites: A (Allman et al 1987; Cullum et al 2004; Ferrell et al 1993; Economides 1995; Rosenthal et al 2003)
2. Avoid positioning directly on PU when on bed surface: C3 (AHCPR 1994; NPUAP 2009)
    a. Use cushions and positioning aids to relieve PUs or vulnerable skin by elevating the skin or ulcer away from the support surface: C3 (AHCPR 1994; NPUAP 2009)
3. Avoid positioning a wheelchair-seated individual directly on a PU: C3 (AHCPR 1994; NPUAP 2009)
    a. Allow limited sitting if individual is capable of performing weight shifts every 15 minutes; use power weight-shifting wheelchair system for individuals who are unable to independently perform effective weight shifts: C3 (AHCPR 1994; NPUAP 2009)
    b. Reposition at least every hour; if not possible, return individual to bed: C3 (AHCPR 1994; NPUAP 2009)

C. Manage local and systemic factors: debride, cleanse, and dress wound
1. Debride PU areas with eschar and/or devitalized tissue to manage bacterial load: C1 (Burgos et al 2000 *B*); Jones and Fennie 2007; Rennert et al 2009). **Choose a debridement method appropriate to PU status, individual condition, and goals of care: A** (Alvarez et al 2002; Burgos et al 2000 (B); Jones and Fennie 2007; Rennert et al 2009)
    a. Autolytic debridement (Barr et al 1995; Jones and Fennie 2007; Sayag 1988) **is as effective** (Burgos et al 2000) **or more so** (Konig et al 2005) **than enzymatic debridement with collagenase: A**
    b. Enzymatic debridement efficacy and safety varies with different enzymes. Collagenase efficacy has been shown better than placebo: A (Ramundo and Gray 2008), similar to some enzymes: C1 (Püllen et al 2002) or autolytic debridement: C1 (Burgos et al 2000) and less effective than papain-urea, with similar healing results: C1 (Alvarez et al 2002)
    c. Mechanical debridement (AHCPR 1994; RNAO 2007) using wet-to-dry gauze is considered substandard practice: C1 (Jones and Fennie 2007; NICE 2005)
    d. Surgical debridement, including conservative sharp debridement, is indicated to achieve rapid removal of

necrotic tissue. If debriding large amounts of necrotic tissue use the operating room: C1 (Barr et al 1995; Bluestein and Javasheri 2008; Chow et al 1977; Golinko et al 2009; Gordon 1996; Ramundo and Gray 2008; Rennert et al 2009; Whitney et al 2006)

e. High-flow irrigation: C2 (Fujioka et al 2008; Whitney et al 2006)
f. Biological debridement with maggots: C1 (Gray 2008)
g. Contraindications for debridement include compromised vascular circulation at ulcer site; stable heel eschar or gravely palliative or critically unstable patients: C3 (Bluestein and Javaheri 2008; Langemo et al 2010; NPUAP 2009)

2. Cleanse all wounds at each dressing change using a cleansing method to optimize removal of debris and prevent trauma: C2 (Bergstrom et al 2006; Rodeheaver and Ratliff 2007)
   a. Optimal irrigation pressure of 4–15 psi may be obtained using a 35-cc syringe with 19- gauge angiocath: B (Bergstrom et al 1994; Rodeheaver and Ratliff 2007*)* or a single-use 100-mL saline squeeze bottle: C3 (Rodeheaver and Ratliff 2007)
   b. Cleansing may also be performed during hydrotherapy: C1 (Burke et al 1998; Rodeheaver and Ratliff 2007)
   c. Avoid manual trauma or scrubbing the wound vigorously: C3 (Rodeheaver and Ratliff 2007)
   d. Wound cleansing solutions may be normal saline, sterile water, Ringer's lactate, or tap water: B (Bergstrom et al 1994; Moore and Cowman 2008; Rodeheaver and Ratliff 2007)
   e. Use safe wound cleansers with surfactants for heavy exudate or adherent material: B (Bergstrom et al 1994; Bolton et al 2004; Rodeheaver and Ratliff 2007)
   f. Avoid topical antiseptic or cytotoxic agents: B (Bergstrom et al 1994; Bluestein and Javaheri 2008; Rodeheaver and Ratliff 2007)
   g. Cleanse the ulcer and perimeter with enough irrigant for the wound size, depth and condition (usually 100–150 mL) warmed to room temperature: C3 (Rodeheaver and Ratliff 2007)
3. Manage bacterial colonization and infection: C2 (RNAO 2007; Whitney et al 2006)
   a. Implement appropriate clean or sterile technique, with standards and universal precautions for wound management: hand washing, protective equipment, dressing disposal appropriate for the patient and isolation as indicated: C3 (RNAO 2007)
   b. Evaluate ulcer for signs and symptoms of clinical infection at each dressing change: C1 (Gardner et al 2006; RNAO 2007)
   c. If ulcer infection is suspected based on clinical signs of infection and/or if wound regresses or plateaus despite appropriate preventive and treatment measures, determine type and level of micro-organisms by validated quantitative swab cultures (Gardner et al 2006; RNAO 2007)
      i. Irrigate wound with normal saline before obtaining swab culture, swab 1 cm viable wound area, avoid eschar/slough/surface exudate/edges: C3 (Gardner et al 2006; RNAO 2007)
   d. If osteomyelitis is suspected, obtain a tissue and/or a bone biopsy: A (Lewis et al 1988; Rennert et al 2009; Whitney et al 2006)
      i. Conservatively debride bone; excise ulcer necrotic tissue; C2 (Chow et al 1977; Rennert et al 2009)
      ii. Remove underlying bony prominence and fibrotic bursa cavities if indicated: C2 (Rennert et al 2009)
   e. Use systemic antibiotics specific to sensitivity report for bacteremia, sepsis, advancing cellulitis, osteomyelitis: A (Bergstrom et al 1994; Chow et al 1977; Rennert et al 2009; RNAO 2007)
   f. Treat distant infections such as urinary tract, pneumonia, cranial sinus or cardiac valves in patients with or at risk of developing a pressure ulcer: B (Whitney et al 2006)
   g. Use topical antimicrobial cleansing solutions, dressings, gels, ointments, creams and aqueous preparations effective against Gram-negative, Gram-positive, and anaerobic organisms — eg, with safe, sustained release of ionic silver, iodine, or other agents with evidence of safety on PU: C3 (Bluestein and Javaheri 2008; RNAO 2007)
      i. Initiate on clean ulcers with delayed healing despite 2–4 weeks of optimal care: C3 (RNAO 2007)
      ii. Re-evaluate use after 2 weeks and discontinue use as infection abates: C3 (RNAO 2007)
4. **Select and apply appropriate ulcer dressing(s) to protect PU and surrounding skin from friction, shear, pressure and physical or chemical trauma and to manage exudate and prevent ulcer drying, injury or maceration: A** (Bots and Apotheker 2004; Bouza et al 2005; Cullum and Petherick 2008; DeLaat 2005; Heyneman et al 2008)
   a. Manage excess ulcer drainage with absorptive dressings: B (Barr et al 1995; Bolton et al 2004*;* Payne et al 2009; Smitten et al 2005)
   b. Maintain moist ulcer environment — eg, with hydrocolloid, foam, hydrogel or similar moisture retentive dressing: A (Bouza et al 2005; Cullum and Petherick 2008; DeLaat 2005; Heyneman et al 2008)
   c. Hydrate dry ulcers — eg, with hydrogel dressings: A (Heyneman et al 2008), except in case of a stable

ischemic heel eschar

d. Fill ulcer cavities to reduce dead space: C2 (Bolton et al 2004)
e. Provide thermal insulation and ulcer temperature stability: C3 (RNAO 2007)
f. Choose the most appropriate dressing consistent with principles of ulcer care, patient needs, individual ulcer status, cost/availability and caregiver ability: A (Heyneman et al 2008; Kerstein et al 2001; Payne et al 2009) (see Table 6 for levels of support for dressing study evidence mainly compared to saline or ointment in gauze. Please see product package inserts for individual claims for specific dressings

Table 6. Pressure ulcer studies supporting comparative dressing outcomes (Bold: A Level; *Italics*: *B Level;* Normal print: C level; Underlined contains cost analysis)

Dressing category	Faster healing than gauze	Less pain than gauze	Fewer infections than gauze	Lower cost than gauze
Alginate primary dressing alone or with hydrocolloid secondary dressing or to control minor bleeding				
Primary alone: C1	Sayag et al 1996			
Primary under hydrocolloid: C1	Bolton et al 2004 Thomas et al 2005			
Before 4-week: C1 hydrocolloid]	Belmin et al 2002			
With silver: C1	Maume et al 2005			
Foam dressings including polyurethane and silicone foams				
Primary dressing	Heyneman et al 2008 Maume et al 2003 Sopata et al 2002		Sopata et al 2002	Heyneman et al 2008 Payne et al 2009
Hydrocolloid primary dressings				
Primary dressing	Bouza et al 2005 Gorse andMessner 1987 Heyneman et al 2008 Hollisaz et al 2004 Kerstein et al 2001 Regan et al 2009	Chang et al 1998 Heyneman et al 2008	Hutchinson and McGuckin 1990	Colwell et al 1993 Gorse and Messner 1987 Graumlich et al 2003 Heyneman et al 2008 Kerstein et al 2001 Xakellis et al 1992
Hydrofiber				
Primary dressing	Ohura et al, 2004 Teot 1997			Ohura et al 2004
Hydrogels or hydrocolloid-based wound fillers				
Primary dressing	Heyneman et al 2008 Sopata et al 2002		Hutchinson and McGuckin, 1990 Sopata et al 2002	Heyneman et al 2008
Other Primary Dressings with at least one randomized, controlled trial on pressure ulcers				
Chitosan	Kordestani et al 2008			
Silver hydro-alginate	Meaume et al 2005			
Honey	Gunes and Eser 2007			

i. Avoid gauze use as a primary PU dressing. It delays healing, increases pain and infection rates: A (Hutchinson and McGuckin 1990) **and dressing change frequency and is not cost effective: A** (Heyneman et al 2008; Kerstein et al 2001)

g. Monitor dressing site daily; schedule change frequency based on assessment of patient, ulcer status, dressing condition and package insert instructions. Manage hypergranulation; record wound status at each dressing change and revise dressings according to ulcer outcomes and patient goals: C3 (Paralyzed Veterans of America

2000; RNAO 2007)

5. **Manage pressure ulcer-related pain: A** (de Laat et al 2005)
   - **a. Maintain a moist ulcer environment: A** (Kerstein et al 2001; Maume et al 2003)
   - **b. Use topical analgesics, such as EMLA cream: A** (Evans and Gray 2005) **or anesthetics when appropriate: A** (de Laat et al 2005)
   - c. Refer patient to pain specialist and use systemic pain medications when appropriate: C3 (Reddy et al 2003)
   - d. Correct patient posture and use support surfaces to minimize pain: C3 (Reddy et al 2003)
   - e. Use meditation or diversion techniques or refer patient for psychosocial interventions if appropriate: C3 (Reddy et al 2003)
   - f. Refer patient for massage if needed to manage muscle cramping or lymphatic conditions but avoid massage over reddened bony prominences: C2 (RNAO 2007)
6. **Implement nutritional interventions: A** (Langer et al 2003; Lee et al 2006; Thiella et al 2007)
   - a. **Ensure adequate nutrient and fluid intake to maximize potential for wound healing: A** (Langer et al 2003; van Rijswijk and Polansky 1994)
     - i. **Calories (35–40 kcal/kg/day): A** (Cereda et al 2009; Langer et al 2003; Pinchofsky-Devin 1986)
     - ii. **Protein (1.0–1.5 g protein/kg/day**): **A** (Cereda et al 2009; Langer et al 2003; Lee et al 2006; Reddy et al 2009)
     - iii. **Micronutrients; If vitamin or mineral deficiencies are confirmed or suspected, provide appropriate supplements: A** (Cereda et al 2009; Desneves et al 2005; Thiella et al 2007) **— eg, zinc**, **amino acids, vitamin C (A)**. Also vitamins A and E.
     - iv. Hydration program 30–35 cc/kg of body weight or as medically indicated: C3 (RNAO 2007)
   - b. **If underweight or losing weight, enhance intake to place the individual into positive nitrogen balance: A** (Cereda et al 2009; Lanter et al 2003; Phinchofsky-Devin 1986)
     - i. Anabolic agents or appetite stimulants may be used: C2 (Spungin 2001)
   - c. Evaluate effectiveness of nutritional interventions regularly: C2 (Pinchofsky-Devin 1986; van Rijswijk and Polansky 1994)

D. Advanced or adjunctive interventions if PU is unresponsive to A-level management

Note: Modalities below were not compared in a randomized, controlled trial on PUs to any dressing with A-Level evidence in Table 6.

1. **Electrical stimulation: A** (Gardner et al 1999; Feedar et al 1991; Wood et al 1993; Mulder 1991)
2. Hyperbaric oxygen therapy: C3 (Kranke et al 2004 — no studies supported PU effect, but may be useful if ischemic condition or osteomyelitis is present)
3. *Negative pressure wound therapy — no consistent effect on PU healing*: *B* (Gregor et al 2008; Ubbink et al 2008). Increased granulation, less fibrin compared to Redon drain: C2 (Wild 2008), earlier use may shorter home care stays: C2 (Baharestani et al 2008). Lower cost than gauze: C (Mody et al 2008). The FDA has advised caution in selecting patients for this therapy due to serious, occasionally fatal, complications. Please read the FDA notice at: www.fda.gov/MedicalDevices/Safety/AlertsandNotices/PublicHealthNotifications/ucm190658.htm
4. Therapeutic ultrasound; contact or noncontact — no PU randomized, controlled trials supported healing or debridement: C3 (Baba-Akbari et al 2006; Ramundo and Gray 2008)
5. Ultraviolet light/ or multi-wavelength phototherapy: C1 (Taly AB et al 2004)
6. **Growth factors are not indicated for PU use at this time. They have been compared to gauze primary dressings: A** (Rees et al 1999; Robson et al 1992), **which are recognized as substandard practice: A** (deLaat et al 2005; Kerstein et al 2001; Maume et al 2003). No PU randomized, controlled trails compared a growth factor to dressings with A-Level evidence in Table 6
7. **Infrared or monochromatic light stimulation: A** (Dehlin et al 2007; Durovic et al 2008; Schubert 2001)
8. Allograft: C3 (RNAO 2007)

E. *Surgical interventions: B* (Brown et al 2007; Isik et al 1997; Wong and Ip 2006; Yamamoto et al 1997)

1. Direct closure (Whitney et al 2006) seldom helps unless pressure source is eliminated and PU is small: C3 (Brown et al 2007)
2. *Flaps: myocutaneous free, fasciocutaneous, cutaneous: B* (Ichioka et al 2007; Lemaire et al 2008; Wong and Ip 2006; Rennert et al 2009; Yamamoto et al 1997)
3. Skin grafts (Whitney et al 2006) though they exhibit "poor take" over exposed bone: C3 (Brown et al 2007)
4. Apply periopertive interventions according to appropriate institutional protocols,
   - a. including: preoperative: smoking cessation, bowel regulation, managing infection, spasms or contractures, as-

suring the patient is medically stable and adequately nourished and hydrated : C3 (Brown et al 2007; Whitney et al 2006). *Reduce ulcer bacterial burden to <10^5 colony forming units per g of sample before surgical closure: B* (Brown et al 2007; Murphy et al 1986; Whitney et al 2006)

b. Postoperatively: use highly effective support surface (eg, air-fluidized bed), increase mobility to sitting over 4–8 weeks. Educate patient and caregiver regarding re-injury and recurrence. Conduct daily skin examination and provide intermittent pressure relief techniques and patient-oriented nutrition and hydration: C1 (Isik et al 1997; Milne et al 2009)

c. Evaluate patient for and address surgical complications such as wound dehiscence, infection, abscess, hematoma/seroma, procedure-related pain: C1 (Isik et al 1997)

F. Documentation of patient response to treatment program: C1 (Milne et al 2009; Sanada et al 2004)

1. Measure ulcer and document overall progress weekly or sooner if there is a significant change in ulcer status on an approved data collection form, with wound photograph if feasible. Consider validated tools such as the BWAT® (Bates-Jensen Wound Assessment Tool©) DESIGN Tool or PUSH© (Pressure Ulcer Scale for Healing): C1 (Bolton et al 2004; Milne et al 2009; Sanada et al 2004)
2. If there is no significant reduction in wound area after 2–4 weeks of a treatment regimen, re-evaluate diagnosis and/or care plan: C2 (van Rijswijk 1993; van Rijswijk and Polansky 1994) Note: Kurd et al 2009 reported **improved healing outcomes in two multicenter RCTs on venous leg ulcers and diabetic foot ulcers if wound care providers received feedback of 4-week healing rates**. There is not yet a corresponding randomized controlled trail for pressure ulcers (Level A for chronic wounds pending PU study)
3. If complications, nonadherence to protocol, or nutritional concerns arise, revise plan of care or goals of treatment to address patient issues: C2 (Pinchofsky-Devin 1986; Reed et al 2003)

G. Palliative care for the medically unstable individual: C3 (NPUAP 2009)

1. *Assess skin for signs of terminal ulcer in gravely ill individuals: B* (Langemo et al 2006; Kennedy 1989)
2. Establish individualized goals of care as determined by patient wishes and medical condition: C2 (Alvarez et al 2007) including the following (McDonald and Lesage 2006):
   a. Stabilize and manage all PU and surrounding skin as much as possible while optimizing patient comfort: C2 (Langemo et al 2010; Letizia et al 2010; McDonald and Lesage 2006)
   b. *Assess individual comorbid conditions and address PU causes to prevent new pressure and surrounding skin breakdown by using methods and materials consistent with patient and family wishes to protect skin — eg, heel protection and maintain patient hydration, nutrition as in Section II of this Guideline: B* (Langemo et al 2010; Letizia et al 2010; McDonald and Lesage 2006)
   c. **Minimize or eliminate odor including wound odor: A** (Paul and Peiper 2008) due to infection or incontinence (Langemo et al 2010; Letizia et al 2010; McDonald and Lesage 2006)
   d. *Assess each PU regularly using reliable, valid scale* including *PU pain every shift or at dressing change. Manage pain with an effective analgesic (eg, as in Section IIIC4 of this Guideline or with topical diamorphine hydrogel) and by keeping wound bed moist while adhering to PU prevention principles in Section II above that are acceptable to the patient: B* (Langemo et al 2010; Letizia et al 2010; McDonald and Lesage 2006)
   e. Prevent and manage PU infection to extent acceptable to patient and family: C2 (Langemo et al 2010; Letizia et al 2010; McDonald and Lesage 2006)
   f. *Absorb exudate — eg, with a foam or hydrocolloid dressing — that lengthens dressing wear time. This minimizes dressing change frequency while keeping wound bed moist to reduce pain of dressing removal*: *B* (Langemo et al 2010; Letizia et al 2010; McDonald and Lesage 2006)
   g. Maintain individual dignity and provide psychosocial support to reduce isolation: C2 (Letizia et al 20 10; McDonald and Lesage 2006)

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