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A Standardized Approach to Evaluating Lower Extremity Chronic Wounds Using a Checklist

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DO NOT DUPLICATE

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Abstract: As the population ages and more people live with diabetes, obesity, and vascular disease, chronic wounds have become more prevalent. Increasingly, wound care falls into the hands of clinicians who may be new to the specialty. To facilitate a better understanding of wounds and to ensure all integral items for best outcomes are considered, an interprofessional panel of wound care experts developed a checklist to aid in lower extremity wound identification, assessment, evaluation, and potential complication recognition. This checklist focuses on an evidence-based approach to obtaining a medical history, evaluating the wound, determining the etiology, and assessing perfusion, edema, infection, and neurologic status. The goal of this fundamental evaluation tool is to help the clinician move towards the next steps in optimizing patient care. Evidence-based support for each item on the checklist is reviewed and detailed for clinician reference.

Key Words: checklist, lower extremity, chronic wound, standardized approach, diagnosis, treatment

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Medical advances in the 21st century have increased life expectancy and survival from diseases that were uniformly fatal only a generation ago. The patient in the exam room today takes more medications and has multiple comorbidities, such as diabetes, obesity, and vascular disease.¹ A consequence of increased patient complexity is the development of difficult-to-heal wounds (ie, postoperative wounds, pressure ulcers, diabetic foot ulcers [DFUs], venous leg ulcers [VLUs], and arterial ulcers). Nussbaum et al² reports that 14% of Medicare beneficiaries were diagnosed with at least 1 type of wound or wound-related infection in 2014, with DFUs contributing 3.4% of the total. In addition, there has been a major shift in costs for wound care from the hospital inpatient to the outpatient setting.²

Thus, there is a need for additional training and education regarding appropriate wound care for generalists and clinicians new to the field.

Many high-risk industries, such as airlines, maritime transportation, power production, weapons systems, and space flight, have implemented safety checklists to mitigate human error.³ Though published procedural checklists are used in critical care and surgery,^{4,5} the medical field has been slow to adopt a checklist mentality.

In 2003, Peter Pronovost, MD, then a critical care specialist from The Johns Hopkins Hospital, developed a checklist for intensive care unit (ICU) teams to prevent central line infections.⁴ The list was so simple that it seemed obvious: wash hands with soap, clean the patient's skin with chlorhexidine, apply sterile drapes, don sterile clothing, wear

gloves and masks, and apply a sterile dressing over the line site after insertion.⁴ Central line infections dramatically decreased at his institution, and eventually, the checklist was adopted by other hospital ICU teams.⁴⁻⁶ While early adoption was noted to be associated with excellent outcomes, subsequent follow-up found erratic and inconsistent adherence to the checklist due to lack of infrastructure, equipment, and training. Regardless, authors^{7,8} have concluded that the use of these checklists improve teamwork and communication in many hospital areas, including the surgical suite.

Another approach to improving the delivery of health care is adopting the Six Sigma quality improvement model.⁹ The model consists of a 5-step problem-solving process known as Define, Measure, Analyze, Improve,

and Control (DMAIC). The process is data driven, and decisions are based on statistics and facts rather than instinct or past history. There are numerous potential applications of Six Sigma in health care, such as triage in the emergency department or optimizing clinic schedules.¹⁰ Extrapolating the use of the Six Sigma approach for specific disease management allows for creation of flexible structures for clinicians to engage in the design and implementation process, allocate time for practice, and provide resources to support continuous improvement.¹¹

There are an overwhelming number of clinical guidelines available for the general practitioner. In addition, these guidelines have gained some adoption because of the increased specialization in medicine, which now makes it extremely difficult to be proficient with every aspect involved in medicine. However, many guidelines are limited because they lack step-by-step processes to implement treatment plans.³

The wound care space is ideal for the development and implementation of checklists to be used in conjunction with established guidelines for initial evaluation, diagnosis, and ultimately appropriate treatment plans for patients with nonhealing wounds. A wound checklist is not a set of guidelines but a practical, rapid method of confirming all necessary components are evaluated to provide safe, efficient care. The checklist proposed herein provides evidence-based processes to ensure all elements and actions are addressed and simplifies the implementation of best practices and standard of care.³ From the presented checklist, clinicians can be prompted to perform a particular task and make decisions based on the individual patient, evidence-based standards, and available resources.

Wound care starts by developing a diagnostic process followed by management of comorbid and attributing factors and then treatment. A holistic approach to the treatment of wounds, based on diagnosis, principles of wound assessment, wound bed preparation, treatment, and follow-up, is the key to reaching optimal treatment outcomes.¹² First, a detailed history, physical examination, and review of systems must be obtained, with careful attention to factors contributing to delays in wound healing. Physical factors that may prevent wound healing include perfusion, neurologic status, infection, quality of the wound tissue and surrounding skin, and mechanical issues (eg, orthopedic deformities, edema, and pressure).

Most chronic wounds fall into the categories of postoperative or traumatic wounds, pressure ulcers, vascular ulcers (arterial and venous), DFUs, and atypical ulcers. Regardless of etiology, basic wound management tenets hold and have been summarized in the TIME¹³ or DIME¹⁴ concepts (Tissue or Debridement/Devitalized tissue, Infection or Inflammation, Moisture, and Edges). Wound management should include debridement of nonviable tissue, hydration, exudate management, bioburden reduction, and protection, with a goal toward granulation tissue formation, pain management, and ultimately epithelialization and wound healing.^{15,16} Clinicians new to wound care may not be aware of these concepts or may not have incorporated them into their practice. If a simple, straightforward checklist were available, patients with acute and chronic lower extremity wounds could receive an evidence-based approach to best practices.

For the purposes of this manuscript and checklist design, the words *wound* and *ulcer* are used interchangeably, ex-

cept when referring to diabetic, pressure, vascular, and atypical ulcers, specifically.

Methods

A panel of wound healing experts convened on December 14, 2018, in Miami, Florida, with the goal of creating a simplified checklist for wound management designed for those new to wound care. To set the stage, the checklist models described by Pronovost et al⁴ and Gawande et al⁵ were reviewed, as well as the Six Sigma model⁹ for improving process and service. Peer-reviewed articles were discussed. Notes from the meeting were recorded by a medical writer and transcripts were provided for accuracy. The final manuscript was evaluated and approved by all panel members.

The panel made clear that a checklist is not an algorithm. Instead, a checklist should challenge the clinician to think about or explain *why* they did or did not perform the items on the list and give the clinician flexibility to adjust the list to specific patients and available resources.¹¹ The checklist should serve as an aid for both novice and expert clinicians. It was agreed that the checklist should eliminate shortcuts and distractions and ensure the clinician does not miss critical information. The checklist should be evidence-based wherever possible. Checklists in other industries are utilized by certified users (eg, pilots); however, the target audience for the wound management checklist may not be certified in wound care. The goal of the tool is to be used by clinicians treating wounds, such as surgeons, podiatrists, nurses, advanced practice professionals, and hospitalists. The panel agreed that the risk of losing the clinician implementation increased with a greater specificity in the list. Therefore, the checklist was designed in general

“buckets” followed by more detailed recommendations to follow as needed.

Each “bucket” includes a question followed by wound evaluation tools substantiated by evidence. As the clinician moves through the checklist, there is an opportunity to return to the beginning if the wound is not progressing as expected. Along the way, there is always the option of referring to a specialist, and often, this is recommended. Although the checklist does not necessarily assist in making a diagnosis, it provides a primer to wound etiology and methods of identifying an appropriate management plan. The checklist can be modified to be used for follow-up visits, but the purpose of this checklist is to be used during the initial patient encounter.

Results

The following is a detailed description of the components of the checklist, panel discussion, and supporting evidence. The checklist is presented in **Table 1**.

History

Q: Did you obtain a complete medical history, including wound history?

Items deemed critical to assessing the wound history include wound location, duration, and previous wound care; treatment for cellulitis or other infections and antibiotics used; hospitalization and history of other similar wounds; risk factors for and symptoms of venous or arterial disease (lower extremity pain, heaviness, itching, fatigue, swelling)¹⁷; clotting disorders¹⁸; and amputations or vascular procedures. Contributing factors to wound healing difficulty include obesity, diabetes, infection, vascular disease, neuropathy, inflammatory/autoimmune/immunosuppressive states, malnutrition, nicotine use, renal dysfunction, edema, and history of radiation.¹⁹ Medications affecting wound healing include immunosuppressants,²⁰ nonsteroidal anti-inflammatory agents (NSAIDs),²¹ hydroxyurea, coumarins, and methotrexate.¹⁷ Other chronic disease states, such as sickle cell disease,

inflammatory bowel disease, rheumatoid arthritis, leukemia, thrombocytosis, neoplastic disease, and trauma, can cause wounds and contribute to a nonhealing state.^{19,22,23} Nutritional evaluation, including caloric and protein intake, is necessary.

Wound examination

Q: Did you assess the wound by measuring length by width by depth as well as evaluating wound tissue?

Prior to assessing the wound, a full set of vital signs should be obtained, including weight and calculation of body mass index (BMI). In addition, nutritional evaluation (temporal and thenar muscle wasting) should be evaluated. The examination should include measuring the length, width, and depth of the wound in centimeters²⁴ and documenting wound appearance. Color and character of the tissue and surrounding skin can determine a healthy or unhealthy wound. Necrotic tissue (eschar, slough) is nonviable and may

Table 1. Checklist proposed by the panel

CHECKLIST	YES	NO	IF NO, WHY?
Did you obtain a complete medical history, including wound history?			
Did you assess the wound by measuring length by width by depth as well as evaluating wound tissue?			
Did you determine the etiology of the wound and address comorbidities?			
Did you assess for pedal pulses and swelling?			
Did you assess for localized or systemic signs of infection?			
Did you plan to remove unhealthy tissue from the wound?			
Did you assess for sensation in the foot with a monofilament or other method?			
Did you assess if the patient requires offloading or compression?			
Did you assess pain?			
Did you educate the patient on wound etiology, treatment, and prevention?			
Did you consider referral to a specialist?			

be dry or moist; black, brown, tan, or yellow; fibrinous; or soft (**Figure 1**).

Moist necrotic tissue can harbor bacteria, which can increase the risk of in-

fection. Healthy granulation tissue is rich in collagen and bright red with a grainy appearance due to the budding growth of blood vessels within the tissue (**Figure 2**).

Hypergranulation tissue may signal an overgrowth of healthy tissue or neoplasm. Epithelialization is the growth of new skin over a wound and signifies the final stage of wound healing.^{24,25}

For suspected DFUs, Miller et al²⁶ developed a 3-minute diabetic foot exam based on the American Diabetes Association's Comprehensive Foot Examination and Risk Assessment.²⁷ The examination is comprised of a dermatologic exam (nail abnormalities, fungal infection, skin lesions, calluses, corns, open wounds, interdigital maceration), neurologic exam, musculoskeletal exam (joint range of motion, foot deformities, erythema, heat), and vascular exam (decreased or absent hair growth, palpable pulses, temperature differences between calves and feet or right and left foot). Patients with a suspected VLU should be examined while standing upright for edema, varicose veins, chronic venous skin changes (discoloration, inflammation, eczema, hyperpigmentation, atrophie blanche, lipodermatosclerosis), healed ulcers, palpable venous cord, and induration.¹⁸ The role of the wound care clinician is critical because early detection of venous skin changes increases the chance of preserving the tissues of the lower leg and preventing chronic ulcerations.²⁸ For recurrent ulcers, referral to a vascular specialist is warranted.

Etiology

Q: Did you determine the etiology of the wound and address comorbidities?

Diagnosing the etiology of a wound early and accurately is essential to effective treatment. The most common types of chronic wounds fall into basic categories: postoperative and traumatic wounds, pressure ulcers, DFUs (with or without adequate perfusion), vascular ulcers (venous, arterial, or mixed), and



Figure 1. Ankle wound with necrotic tissue.



Figure 2. Wound with healthy granulation tissue.

atypical (ulcers associated with inflammatory disease, vasculitis, autoimmune disease, hematological disease, primary skin diseases, etc).

The most common factors contributing to delayed healing of lower extremity wounds are chronic venous insufficiency, diabetes, and arterial insufficiency.²⁹ Large meta-analyses of wounds have shown that about 80% of leg ulcers have a vascular etiology (venous, peripheral arterial disease, or mixed) and 20% of wounds are from atypical causes (eg, inflammatory or autoimmune disease).³⁰ A large portion of a diagnosis can be based on medical history and with consideration of the physical exam.

Standard locations of DFUs are on weight-bearing surfaces of the foot or areas that may be exposed to pressure (**Figure 3**). The ulcer may be covered with or surrounded by callus or present as open full-thickness wounds. Depending on perfusion, the foot may be warm or cool to touch.

Venous ulcers are located in the gaiter region of the lower leg (area extending from just above the ankle to

below the knee) and can be painful (**Figure 4**). The leg is typically edematous and there can be mixed granulation and fibrinous tissue with moderate to heavy exudate.

In contrast, arterial ulcers are found over pressure points in which the pain is often severe and can be improved with dependency. These wounds are dry and the extremity is pale in appearance and cool to touch (**Figure 5**).

The National Pressure Ulcer Advisory Panel defines pressure ulcers as “localized damage to the skin and underlying soft tissue usually over a bony prominence or related to a medical or other device.”³¹ Further, pressure ulcers are staged according to depth and amount of tissue involvement¹⁸ (**Figure 6**). The pressure ulcer stages are described as follows: stage 1 is intact skin with nonblanchable redness; stage 2 is partial-thickness skin loss of the epidermis presenting as a shallow, open ulcer with or without slough; stage 3 is full-thickness skin loss with visible subcutaneous fat but not bone, tendon, or muscle; and stage 4 is full-thickness skin loss with exposed bone, tendon, or muscle.³¹

An unstageable ulcer is covered with slough or eschar, thus it is not possible to determine actual deep tissue involvement.³¹ In addition, pressure ulcers can be related to medical devices (ie, casts or respiratory equipment) or biomechanical abnormalities in patients with mobility deficits.³²

It is crucial to determine the etiology of a wound that does not fit into the major wound type categories and does not have a predictable healing trajectory.³⁰ The underlying medical condition, such as diabetes, hypertension, and inflammation, must be addressed in tandem with wound care to affect healing results. If the wound is on a nonweight-bearing surface or does not fit into the aforementioned categories, it can be classified as atypical. There are many disease processes that can cause wounds, such as skin neoplasm, hematologic disease (sickle cell, thrombocytosis, connective tissue disease [rheumatoid arthritis, systemic lupus erythematosus, systemic sclerosis]), graft versus host disease, calciphylaxis, and pyoderma gangrenosum.¹⁹ Also, immunosuppressive therapy and medications

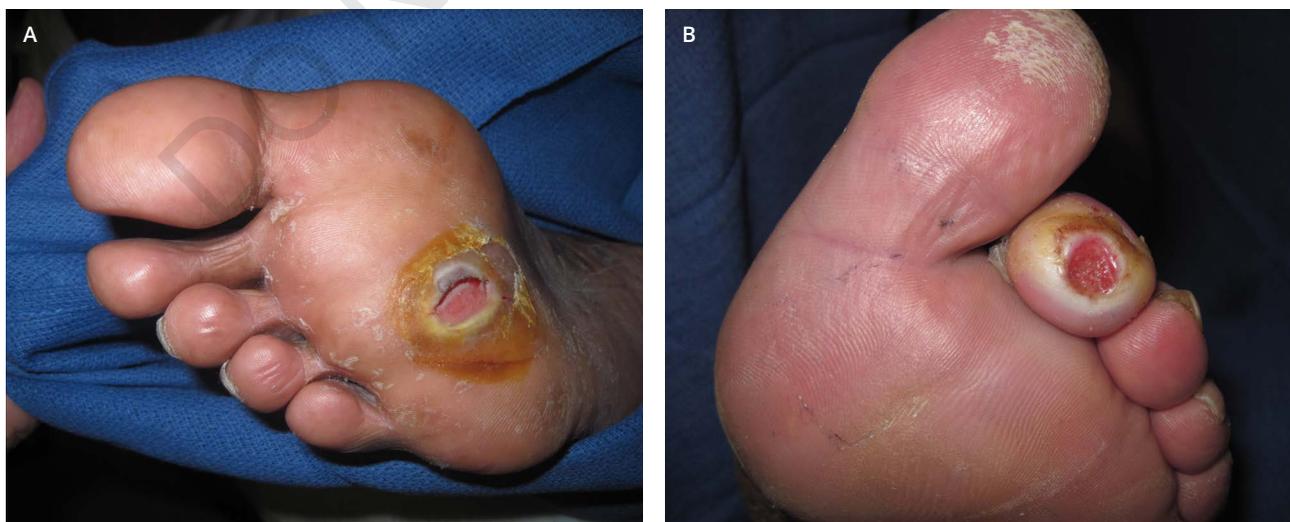


Figure 3. (A) Diabetic foot ulcer on the 4th metatarsal head; and (B) on a hammer toe.

Evaluating Lower Extremity Chronic Wounds

(hydroxyurea, chemotherapy) can contribute to chronic wound etiology.¹⁹ Although it is often very difficult, it is imperative that the underlying etiology of an atypical wound is elucidated and treated,¹⁹ to which the panel agreed.

The panel agreed that a tissue biopsy is indicated if the wound does not show evidence of healing within the first 4 weeks of presentation or if there are comorbid conditions present (as previously mentioned). A biopsy can be performed at the discretion of the clinician at the first visit or at any point in time. It is important to keep in mind that the clinician may opt to send the patient to an individual with the appropriate credentials and access to a pathologist in order to obtain the correct diagnosis.

Perfusion and edema

Q: Did you assess for pedal pulses and swelling?
All patients with lower extremity wounds, regardless of etiology, should be screened for arterial disease with an

objective measure of arterial flow. Palpating for the dorsalis pedis, anterior and posterior tibial, and peroneal pulses is mandatory and if not palpable, a Doppler is recommended if available. There

are many reasons that pulses may not be palpable, including diabetes, hypertension, nicotine use, and ankle-brachial index (ABI) < 0.9.³³ It is good to have a hand-held Doppler, but when used



Figure 4. Venous leg ulcer located in the gaiter region of the lower leg.



Figure 5. Arterial insufficiency of (A) foot and (B) leg ulcers.

by an untrained practitioner, a Doppler may provide inappropriate reassurance. If pulses cannot be palpated, the patient should be referred to a vascular surgeon or cardiovascular specialist as well as tested with a formal ABI in a vascular lab when services are available²² (Figure 7).

Representing the largest proportion of chronic lower extremity ulcers, VLU affect about 1% of the population.³⁴ Prevalence of VLUs increases as the population ages and obesity rates increase.³⁴ Other VLU risk factors include history of deep vein thrombo-

sis.³⁴ For a leg ulcer to be classified as a VLU, there must be clinical manifestations consistent with chronic venous disease, including edema, varicose veins, and chronic venous skin changes.¹⁷ In addition, 15% to 25% of patients with VLUs will have concomitant arterial disease.¹⁷

The presence of ischemia and peripheral artery disease (PAD) greatly impacts treatment outcomes of all lower extremity ulcers, perhaps most notably in DFUs. Peripheral artery disease in DFUs is associated with the most severe adverse outcomes, including delayed

healing, higher probability of ulcer recurrence, greater risk of amputations, and higher mortality.³⁵ Identifying critical limb-threatening ischemia is important for first-line clinicians and may be overlooked. The Society of Vascular Surgeons developed the Wound, Ischemia, foot Infection (WIFI) classification system that takes into consideration the clinical description of the ulcer, hemodynamic measurements, and signs of infection to determine a limb at risk.³⁶

The panel recommends that if a patient has suspected PAD or venous reflux, noninvasive arterial or venous



Figure 6. Pressure ulcers at stage (A) 1, (B) 2, (C) 3, and (D) 4.

studies are indicated, as is referral to a vascular specialist for vascular intervention (eg, percutaneous or open revascularization or appropriate venous reconstructive or ablation options).

Infection

Q: Did you assess for localized or systemic signs of infection?

Because most wounds are colonized with bacteria, the diagnosis of infection should be considered but only based on clinical signs. Indicators of invasive infection in DFUs include periwound induration, cellulitis extending > 2 cm beyond the wound margins, increased local warmth, pain on palpation, fever, chills, wound odor, and increased amount drainage.³⁷ These indicators also can be applied to all lower extremity wounds. Erythema from cellulitis

should not be confused with dependent rubor in patients with arterial insufficiency or dermatitis in patients with active venous stasis skin changes.³⁸ An infected wound also can exhibit friable and/or necrotic tissue.³⁹ Secondary signs of infection include wound deterioration and pain in an otherwise painless foot or limb, with the caveat that patients with neuropathy may not feel pain.⁴⁰ This is particularly important in the immunocompromised host. About half of patients may not have elevated temperatures, white blood cell count, or sedimentation rate, even with a severe wound infection.⁴⁰

The proposed checklist includes assessing whether a wound is infected and the level of severity. Wound cultures should be obtained only in the presence of local signs of infection; if

a culture is appropriate, a specimen should be taken from viable tissue after debridement, if performed, and not necrotic tissue or pooled fluid.⁴¹⁻⁴³ If there is a drainable abscess, an incision and drainage is recommended by the panel, with a sample sent for Gram stain and culture. Clinicians should consider obtaining a complete blood count for leukocytosis to rule out systemic infection. Empiric antibiotics should be prescribed for systemic or localized infection pending results of the culture. If there is a serious infection, as defined by the Infectious Diseases Society of America (IDSA) Clinical Practice Guideline for Diabetic Foot Infection (**Table 2**⁴²), referral to an infectious disease specialist may be warranted. The IDSA guidelines are a simple yet powerful tool for evaluating any infection.

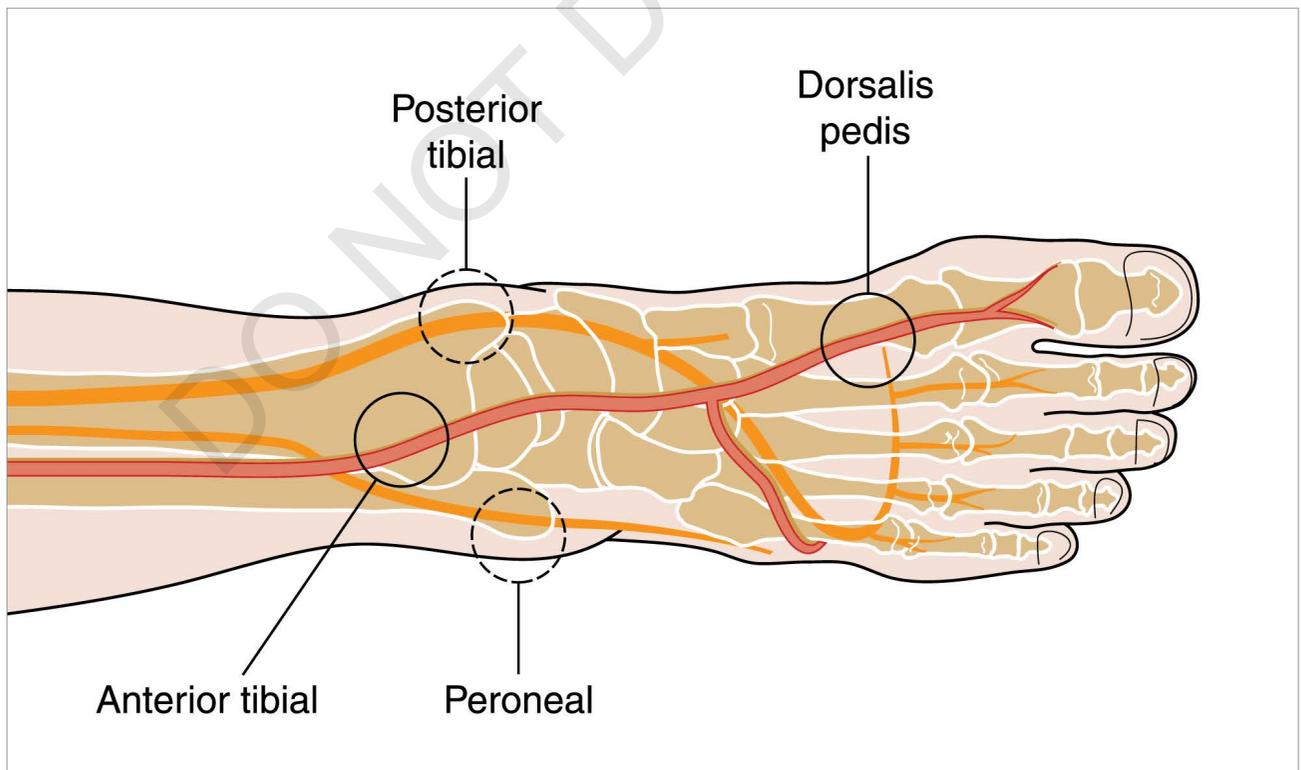


Figure 7. Location of pedal pulses for palpation.

The panel suggested clinicians treat the patient and not the culture when microbiology results do not necessarily match clinical findings after antibiotics have been prescribed.

If a wound is recalcitrant to antibiotics or antiseptics or exhibits cycles of recurrent infection, excessive exudate, inflammation, and erythema, it may be affected by biofilm or osteomyelitis. Wound bed preparation, including wound debridement and noncytotoxic topical antiseptics effective against biofilms, is the mainstay of treatment.⁴⁴ Topical antiseptics should be used only after the wound is debrided. Any wound near a bony prominence has the risk of resulting in osteomyelitis, which can cause a recurrence of an inflammatory reaction. Patients with diabetes and a history of a previously healed wound, recurrent wounds, or a wound that penetrates to bone or joint have an increased risk of de-

veloping osteomyelitis.⁴⁵ Examination of the wound for infection should include probing the wound with a sterile instrument for extension to bone and assessing for increased or purulent drainage. New pain also can signal an infection; although in the presence of neuropathy, the patient may not have pain or it may be altered or blunted. Radiographic images, magnetic resonance imaging, or computed tomography should be ordered to rule out deep abscess or osteomyelitis.

The panel identified 2 issues regarding assessment for infection: (1) reassessment of a wound that was initially infected and (2) reassessment of a previously noninfected chronic wound to be sure it does not become infected. While, to the best of the panel's knowledge, there are no documented protocols in the literature regarding follow-up of an infected wound, the panel suggests patients being treated for

infection should be reassessed within 48 to 72 hours of diagnosis, which coincides with the return of cultures and sensitivities to address antibiotic coverage. This is especially important in the presence of diabetes and/or neuropathy. For non-neuropathic ulcers, the panel recommends follow-up within a week following an infection diagnosis, with a shorter period of time if the infection was severe. The panel reminds the clinician that the most likely reason for a previously improving wound to worsen is a change in the wound's bacterial burden; other reasons for wound deterioration include a change in vascularity and noncompliance with dressings, offloading, or lifestyle change recommendations. If there is increased pain, drainage, or redness, patients should be encouraged to contact their clinician; more frequent follow-up may be warranted. Also, a repeat vascular evaluation should be performed.

Table 2. Infectious Diseases Society of America and International Working Group on the Diabetic Foot Classifications of Diabetic Foot Infection⁴²

IDSA Classification of Diabetic Foot Infection	
Infection present as defined by 2 of the following:	Local swelling or induration Erythema Local tenderness or pain Local warmth Purulent drainage
Mild Infection	Local infection involving skin and subcutaneous tissue Erythema >0.5cm to ≤2cm around ulcer
Moderate Infection	Local infection with erythema >2cm or involving structures deeper than skin and subcutaneous tissue and No systemic inflammatory response signs
Severe Infection	Local infection with signs of systemic inflammatory response and ≥2 of the following: Temperature >38°C or <36°C Heart rate >90 beats/min Respiratory rate >20 breaths/min or PaCO ₂ <32mmHg White blood cell count >12 000 or <4000 or ≥10% bands
IDSA: Infectious Diseases Society of America; PaCO ₂ : partial pressure of oxygen	

Debridement

Q: Did you plan to remove unhealthy tissue from the wound?

For any wound type, the goal of treatment is to create an environment that is favorable for wound healing. The presence of necrotic, or nonviable tissue, will determine whether a wound requires debridement. A wound with a healthy wound bed should heal without debridement. Chronic wounds become trapped in the inflammatory phase of the wound healing cascade.^{38,46} Debridement can transform the chronic wound into a wound with healing phenotypes, which can, in turn, advance the healing process.⁴⁶ The goal of wound debridement is to remove nonviable tissue until only normal, well-vascularized tissue remains.³⁸ Types of debridement include autolytic (when the body uses its own enzymes to break down nonviable tissue), mechanical (brush/sponge, pulsed lavage), enzymatic (chemical agents applied to the wound to break down the nonviable tissue), and sharp/surgical (using scalpel or scissors).⁴⁶ The panel agreed that using saline-moistened gauze dressings to facilitate mechanical debridement is only acceptable for a few days and should not be the long-term dressing of choice. Once the wound is free of necrotic tissue, more advanced dressings can be employed.

The panel agreed that sharp debridement should only be performed if it is within the comfortable skill set of the clinician as well as their licensure. Anything more than trimming loose tissue should be left to a specialist. Considerations prior to performing sharp debridement include pain control, availability of appropriate equipment (proper lighting and basic instruments, including forceps, scalpels, scissors, or curettes),³⁸ ability to assess the risk of

bleeding and mitigate bleeding if necessary, and wound perfusion. If there is exposed bone or tendon or abscess, management including debridement or incision and drainage should be left to a specialist.

Neuropathy

Q: Did you assess for sensation in the foot with a monofilament or other method?

Diabetes is the most common cause of peripheral neuropathy and those with diabetes are at risk of injury due to insensate feet. Recognition of peripheral neuropathy in patients with lower extremity, and especially foot, wounds is paramount to management. Annual screening for the development of peripheral neuropathy is recommended in patients with diabetes. Once a patient becomes neuropathic, there is no need to repeat the exam. Most recommendations for screening have employed light touch perception to a 10-g Semmes-Weinstein monofilament (**Figure 8**⁴⁷), vibration testing with a 128-Hz tuning fork, superficial pain (pinprick) perception, or testing of deep tendon reflexes with a neurologic hammer.⁴⁸

Other states resulting in neuropathy include vitamin B12 deficiency, dysproteinemias (most commonly monoclonal gammopathy of undetermined significance), inflammatory mediated (vasculitis, sarcoidosis), infectious (leprosy), and uncommonly, hypothyroidism, celiac disease, and copper and vitamin E deficiency. Toxic neuropathy from medications such as chemotherapeutic agents and long-term alcohol use also has been reported.⁴⁹ Inherited neuropathies (eg, Charcot-Marie-Tooth disease) can be overlooked etiologies of peripheral neuropathy.⁴⁸ Neuropathy treatment is beyond the scope of the checklist,

but recognizing the diagnosis is critical and thus included. Neurological status of patients with spinal cord injuries should be screened for level of paralysis, and these patients should be monitored for pressure ulcers.

Offloading and compression

Q: Did you assess if the patient requires offloading or compression?

At the initial visit, the panel suggested the clinician ask a series of questions that will quickly indicate whether the patient has a wound caused by or related to pressure. The clinician should evaluate whether the patient with a foot ulcer is ambulatory, and if so, what footwear or assistive devices are being used and if they are unstable while ambulating. If the ulcer is on another part of the body, it should be determined if the patient is immobile and confined to a wheelchair or bed. Any wound caused by pressure will need to have the pressure relieved or offloaded.

Offloading for foot wounds can be separated into removable (boots, shoes) and nonremovable devices. Nonremovable total contact casting (TCC) or a walker boot rendered nonremovable can more effectively heal neuropathic plantar forefoot ulcers than a removable offloading device without an increased incidence of complication.⁴⁹ Bus et al⁴⁹ suggested that if TCC is not available, a walker boot is a reasonable replacement. Other offloading techniques were reviewed, including felted foam, rocker shoes, crutches, and custom molded insoles. Most studies reviewed in the meta-analysis had some sort of selection bias. Preventing or healing foot ulcers is dependent on patient compliance; patients are likely to be noncompliant when using removable devices and may not have the upper body strength or balance to safely maneuver

in some types of offloading footwear, crutches, or canes.⁵⁰

Patients with lower extremity pressure ulcers should be routinely evaluated for appropriate seating and pressure-relieving mattresses as well as educated on frequent repositioning. Prevention of moisture-related skin ulceration and shear also is recommended.⁵¹ For all pressure ulcers, long-term offloading likely will be necessary and regular reevaluation by the clinician for continued surveillance is recommended. A referral to or collaboration with a specialist who can facilitate appropriate offloading may be required, as the process of obtaining appropriate footwear and other surfaces can be beyond the scope of the routine practitioner.

Compression is critical to treat most lower extremity wounds, as up to 40% of women and 17% of men are reported to have underlying venous insufficiency⁵² that may affect wound healing. Specific types of compression for VLU are beyond the scope of the checklist, but regardless of type, compression must be effective in reducing edema and should be at the maximum level that is comfortable and appropriate for the patient. Venous insufficiency is a chronic disease, with 60% of VLUs recurring within the first year.⁵³ The panel reiterated that compression should not be used until the patient's arterial status has been determined. Care must be taken with mixed venous and arterial disease. Compression therapy is considered to be contraindicated with an ABI

< 0.8. In elderly patients, patients with diabetes, or patients with an ABI > 1.2, a toe-brachial index > 0.6, or a transcutaneous oxygen pressure > 40 mm Hg may suggest an adequate arterial flow for safe compression.⁵³ Multilayer compression wraps are considered the mainstay of compression therapy.¹⁷

Pain

Q: Did you assess pain?

Wound pain can negatively affect both wound healing and patient quality of life. Components of pain experienced by patients include physiological pain from the underlying cause, anticipatory anxiety and pain, emotional distress, depression, interrupted sleep patterns, and hopelessness.⁵⁴ The patient's perception of pain can make establishing etiology



Figure 8. Sensation testing sites for Semmes-Weinstein monofilament (SWM) protocol using the 5.07 gauge, 10-g monofilament filament. Typical SWM testing sites are illustrated above. Sites typically vary from one examiner to another. Interpretations tend to be clouded by calluses, deformities, scars, cicatrix, soft tissue atrophy, and patient's anticipatory reaction. This necessitates testing each site more than once and, hence, can make the SWM testing time consuming as well as imprecise. The first webspace is a more usual site for SWM testing on the dorsum of the foot, although this figure depicts an additional mark more proximal and lateral to this. Note the bent monofilament in the left-hand figure, indicating loss of protective sensation. Unfortunately, interpretation may be clouded by callus in this area.

Figure originally published in *Wounds*.⁴⁷

difficult. Pain should be assessed using a validated scale such as the Wong-Baker FACES Pain Rating Scale.

Pain associated with PAD commonly is described by patients as cramping either with exercise (claudication) or at rest.⁵⁵ Claudication often is relieved with rest. Venous insufficiency pain often is described by patients as aching, deep, or intermittent stabbing pain, especially at night, and can be improved with limb elevation.⁵⁵ Patients with diabetes may feel neuropathic pain, not necessarily due to the ulcer. Pain with pressure ulcers may be related to unrelieved pressure, shearing, per ulcer irritation, incontinence, and deep infection.⁵⁵ The inflammatory nature of chronic wounds can be the basis of pharmacologic pain management, which includes diagnosing and treating the underlying disease, using NSAIDs, and then judiciously using more potent medications to control pain. Nonpharmacologic remedies such as acupuncture, physical activity, rest, and repositioning also can be used,⁵⁵ keeping in mind that patients with peripheral vascular disease may have increased pain with exercise. Although the panel was not tasked to comment on specific wound treatments, in some cases, pain can be managed with appropriate non-adherent and moist dressings, namely those that provide or maintain a moist wound environment.⁵⁶

Patient education

Q: Did you educate the patient on wound etiology, treatment, and prevention?

The panel agreed that patient education is paramount to successful wound treatment and prevention. Patients with chronic wounds, regardless of etiology, should be educated on the underlying disease and its relation to the wound and healing, treatment options, and prevention. Those with diabetes need

to understand the importance of glucose control, weight management, daily examination of the feet for signs of ulceration or infection, and offloading techniques. Patients with venous ulcers should know venous insufficiency is a chronic disease that requires lifetime compression. Those with arterial disease require counseling on smoking cessation and exercise as indicated. Patients who are infirm or immobile should learn about pressure-relieving techniques and signs of developing pressure ulcers.

Referral

Q: Did you consider referral to a specialist?

The panel concurs that it may be in the best interest of the patient with a difficult-to-heal wound to consult a specialist for proper diagnosis or treatment. As the clinician proceeds through the wound care checklist, there are various points in which the etiology or physical findings will warrant outside consultation. The wound should be assessed at frequent intervals for decrease in size, resolution of infection, necessity for wound debridement, and management of edema and pressure. A shift in wound biochemistry may be necessary to stimulate healing. Conditions such as arterial insufficiency, severe infections, osteomyelitis, dermatologic manifestations of disease, and skin neoplasms should be identified immediately and then proper referral made expeditiously. If the clinician is unsure of management and treatment, a referral to a specialist should be made as soon as possible.

A wound that worsens in size and symptoms despite treatment or is not healing by 50% after 4 weeks of treatment is unlikely to heal in 12 weeks⁵⁷ and the panel agreed this may indicate a misdiagnosis of etiology or the therapy should be reevaluated or referred to a

specialist. A retrospective analysis of intent-to-treat control patient data from 2 DFU trials noted for ulcers failing to progress or worsening after 4 to 6 weeks or those that fail to achieve 90% area reduction should be reevaluated, and the patient should be referred to the appropriate specialist.⁵⁷

Discussion

The consensus among panel members is that there is a definite need for a simple yet comprehensive mechanism for evaluating chronic wounds. The panel acknowledges that many clinicians, including general practitioners, podiatrists, surgeons, infectious disease specialists, rheumatologists, and others, see many patients with wounds and may overlook basic physical examination and historical elements critical to diagnosis and management. Further, the panel identified a list of items to comprise a checklist for clinicians (**Table 1**). Beginning with a complete history and physical, clinicians will work through the checklist to evaluate the wound bed, infection, perfusion, edema, debridement need, pain, and neuropathy. A plan for offloading, compression, and patient education needs to be developed to complete the more nonclinical, behavioral points on the checklist.

Patients with wounds can be medically complex, with various comorbidities that impair wound healing. The panel recognized early on that the endpoint of many of the checklist items might be a referral to a specialist. For example, a patient with significant arterial insufficiency may require vascular intervention in order to achieve wound healing or prevent amputation. A lack of knowledge on proper assessment of distal pedal pulses or ABI, even at the bedside, can result in the clinician missing an important component of the physical examination.

This group of patients should be referred to a vascular specialist for further testing. Identifying a wound infection also is essential to wound healing and the patient's safety. With the prevalence of antibiotic-resistant organisms and the risk of bone involvement in many wound types, a referral to an infectious disease specialist may be warranted. Deep pressure ulcers and DFUs may develop osteomyelitis and, in addition to an infectious disease consultation, may need a general, orthopedic, podiatric, or plastic surgeon to remove the affected bone and provide soft tissue coverage. Depending on the experience or comfort level of the clinician in performing bedside surgical procedures, a wound overwhelmed with necrotic tissue should be referred to a surgeon or advanced practitioner for sharp debridement. A wound identified as atypical may require additional medical management and need evaluation and management by a dermatologist or rheumatologist. If there is suspicion of skin cancer, the patient should be referred for a biopsy immediately.

The checklist can be modified over time based on the needs and expertise of the clinician. This checklist was designed as a guide to be useful for the majority of clinicians, realizing that some are more versed in the items than others. If a wound is not progressing, the panel recommends reverting to the beginning of the checklist to be sure nothing was missed, requiring further evaluation or reevaluation of the original wound etiology (Figure 9). Any responses of *no* to items should be reevaluated. Reassessment of the wound at regular intervals is necessary, and the wound should be assessed for decreased wound size, infection status, and additional debridement. If antibiotics have been used, it is important to be sure the bacteria were sensitive to the chosen

antibiotic and confirm the patient has filled the prescription and finished the antibiotic course completely. Park et al⁵⁸ analyzed electronic medical record (EMR)-linked data and found 24% to 27% of patients who were prescribed an antibiotic, antihypertensive, or diabetic medication had not filled their prescription within 90 days.

Limitations

There were several limitations to this checklist project. While the panel would like the checklist to be used as a guideline to aid in wound identification, assessment, evaluation, and recognition of potential complications, it does not address actual wound treatment. The panel decided wound treatment was beyond

the scope of this checklist, but treatment certainly could be detailed in the next rendition. There was specific and structured discussion regarding the target audience of the checklist, and although it is targeted toward a clinician who is new to wound care, it also can be helpful to the general practitioner. Due to the differences in medical competency in the wound care space, it was challenging to develop an appropriate checklist for all clinicians. The panel felt strongly that many times, the endpoint to the wound evaluation components of the checklist was to refer to a specialist. This further limited discussion about actual treatment modalities for more complicated patients with complex wounds. The panel envisioned the checklist being on

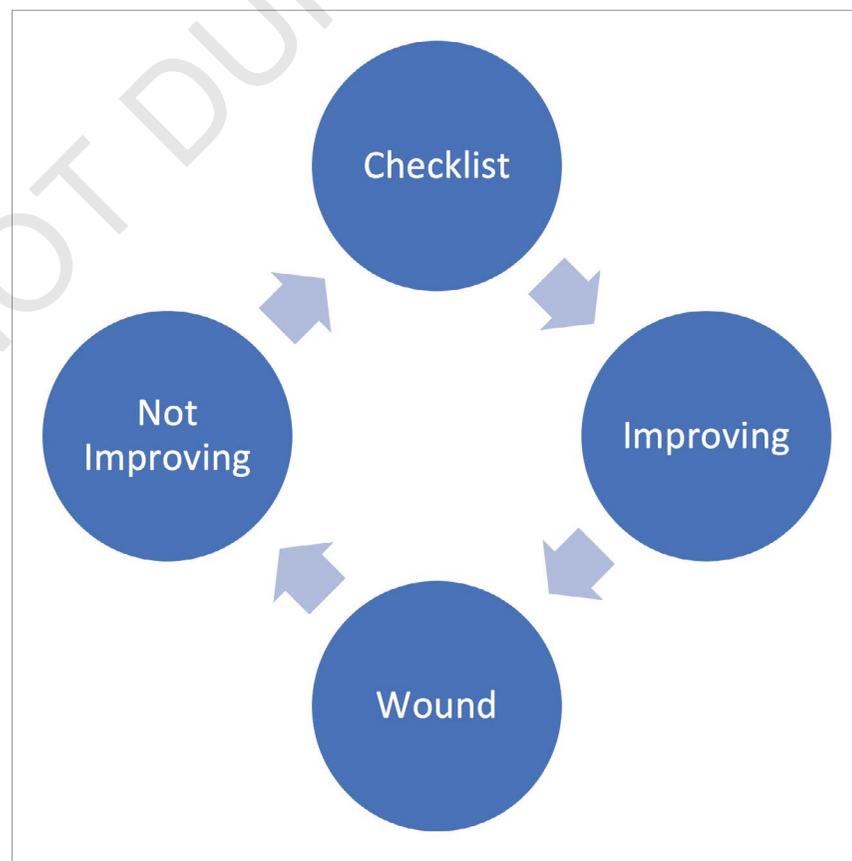


Figure 9. Refer back to the checklist if the wound is worsening or not improving.

paper for reference at any time during the course of a patient visit. Although it would be useful to be incorporated into an EMR as data to be referred to later, the panel felt it would be more useful as a hand-held tool. The panel intended the checklist to be a prelude to future wound management checklists. Even though the checklist is simple, the concepts of diagnosis and subsequent actions are more complex. This checklist should be validated by clinicians over time and modified if it appears too complicated or not specific enough.

Conclusions

Designing a checklist for the assessment of wounds gives clinicians a potentially powerful tool for the evaluation and management of their patients. The checklist is straightforward, and it should be easy to progress through the questions to be sure the patient is fully assessed. For more specific treatment options and further reading, additional websites and evidence-based manuscripts are provided in **Table 3**.^{26,59-63} Returning to

the beginning of the checklist or referral to a specialist is recommended when the wound is not improving.

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Table 3. Additional resources	
Vascular Ulcers	
Society for Vascular Surgery (SVS) ⁵⁹	vascular.org
Wifi calculator ⁵⁹	SVS Interactive Practice Guidelines App (SVS iPG App) at https://vascular.org
Diabetic Foot Ulcers	
American Diabetes Association ⁶⁰	www.diabetes.org
American Podiatric Medical Association: APMA ⁶¹	www.apma.org
Miller et al ²⁶	3-minute foot exam
Pressure Ulcers	
National Pressure Ulcer Advisory Panel ⁶²	www.NPUAP.org
Atypical Ulcers	
American Academy of Dermatology ⁶³	www.aad.org

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Table 1. Checklist proposed by the panel			
CHECKLIST	YES	NO	IF NO, WHY?
Did you obtain a complete medical history, including wound history?			
Did you assess the wound by measuring length by width by depth as well as evaluating wound tissue?			
Did you determine the etiology of the wound and address comorbidities?			
Did you assess for pedal pulses and swelling?			
Did you assess for localized or systemic signs of infection?			
Did you plan to remove unhealthy tissue from the wound?			
Did you assess for sensation in the foot with a monofilament or other method?			
Did you assess if the patient requires offloading or compression?			
Did you assess pain?			
Did you educate the patient on wound etiology, treatment, and prevention?			
Did you consider referral to a specialist?			

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