Treatment of diabetic foot ulcers is a challenge caregivers are facing on a daily basis, and the bottom line is: we need to do better. The question is: what can be done to improve the outcomes of wound care and ultimately reduce the associated patient morbidity? Fortunately, evidence-based studies allow us to develop a simple approach that should be applied to every patient with a diabetic foot ulcer.

The complex nature of diabetic foot ulcers has been well documented, and yet many health professionals may be stunned by the magnitude of the disease. Diabetes is the seventh leading cause of death nationally—over 233,000 deaths per year. The National Center for Health Statistics reports that diabetes is the only major disease besides Alzheimer’s with a death rate that continues to rise, and since 1990 has climbed 22%. An overview of statistical data shows that 29% of all diabetic patients will go blind, and 35% will require dialysis. Dialysis-dependent patients have a mortality rate of 20% per year. The mortality rate of diabetic patients is 47% higher than non-diabetics, and 65% of this patient population will die from a cardiac incident.

The good news is that we are making a difference. Massive global efforts in limb salvage over the past 10 years significantly decreased the incidence of lower extremity amputations despite the total increase in the number of diabetics. In order to further improve the outcomes, we should not only understand the nature of the disease, but also have realistic expectations.

Previous data collected for patients in the U.S. reveals that 25% of diabetic foot ulcers will become infected and 8% will require hospitalization. 4.3% of all diabetics will undergo an amputation and 20% of this population will die from a direct complication of diabetes. Moreover, diabetic patients with a history of a foot ulcer have a 13.8% higher mortality rate when compared to the diabetic individuals with no history of a foot ulcer. Given this data, we are obligated to attend to the entire patient while treating and healing their wounds. A multi-disciplinary approach should be applied to every patient, and proper referrals and communication are essential for patient care.

So how should we approach these wounds? The initial step is to identify the etiology of the wound and the barriers to wound healing at each visit. The value of an accurate history cannot be underestimated. Appropriate evaluation should include the presence of co-morbidities that may affect wound healing, such as end-stage renal disease, cardiovas-

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cicular, peripheral vascular, and pulmonary disease.

Wound Age
The age of the wound is important. Accurate identification of the wound age allows for prediction of healing potential, complications, and the probability of healing. Chronic and acute wounds differ in biochemical composition; hence they require a different approach to treatment. Previous studies have shown that change in size of the wound over time is an excellent predictor of healing or complications; therefore, accurate measurement of the wound should be implemented and recorded weekly. A 50% decrease in the size of the wound in a four-week period serves as a reliable predictor of healing potential, regardless of the size of the wound. Additionally, a 20% increase in size over two weeks has shown to be a very dependable indicator of underlying infection.

Risk Assessment
Proper risk assessment should be performed, and any wound changes indicative of infection should be rapidly addressed with effective treatment. The depth of the wound needs to be ascertained rapidly, with the use of a probe to bone test to assist in identifying the possibility of osteomyelitis. If there is an index of suspicion, further testing and bone biopsy are warranted. Physicians should have a high index of suspicion when changes in the wound behavior are noted. Typically, we would expect an infected ulcer to present with erythema, edema, and purulent drainage. However, that may not always be the case. The presence of bacteria impedes wound healing and increases the incidence of complications; therefore an increase in the size of the wound should be alarming, even in the absence of a typical clinical presentation of infection.

Anti-microbial Agents
Appropriate anti-microbial agents should be selected to help decrease the bio-burden. A vast array of topical anti-bacterial agents is available to healthcare providers. A current review of literature shows lack of clinical evidence for the benefit of topical agents containing silver as well as silver based wound dressings in reduction of infection and enhancing wound healing. The literature supports the use of systemic agents to eliminate bacteria.

Tissue Perfusion
Adequate tissue perfusion should be noted prior to treatment, and is a prerequisite for wound healing; therefore, regular monitoring of the patient’s vascular status is essential. Ankle brachial index is a simple, non-invasive test that can be routinely performed at an office setting. Any indication of compromised perfusion should warrant non-invasive arterial studies or transcutaneous oxygen studies. Suspicions of limb ischemia should be addressed with proper referral and intervention. Modalities such as hyperbaric oxygen therapy are also available and indicated in cases of progressive necrotizing infections (necrotizing fasciitis), as well as chronic refractory osteomyelitis unresponsive to conventional medical and surgical management, and preservation of compromised skin grafts.

Proper Off-Loading
Proper off-loading is another essential requirement for improving the outcomes of wound healing. By definition, strain rate is equal to force applied uniformly over a surface divided by time. The duration of stress is very important in determining the strain behavior. The relationship between the shear stress and the rate of strain is linear. Reproducible wound healing results require that the strain rate be reduced, not just the pressure decreased. What does it mean for the patient? The easiest way to decrease force over time is to decelerate the foot into the ground and shorten the time the foot is on the ground. The most common gear currently used for healing wounds consists of shoes and insoles. Yet the literature reports that shoes are ineffective and, at best, far less likely to heal wounds when compared to devices that control ankle motion. For best strain reduction and predictable outcomes, the use of devices like shoes with an AFO, CROW walkers, CAM walkers, or a total contact cast is recommended.

Patient-Dependent Variables
The success of treatment and wound healing outcomes depends on many variables, some of which are

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Patient-dependent. Based on the data available from a previous study, the odds of healing a diabetic foot ulcer decreased 14.3% for every 1% increase in hemoglobin A1c. These results provide support that wound healing may be adversely affected in the setting of higher hemoglobin A1c levels. Proper nutrition should be discussed with the patient and caregivers. Albumin and pre-albumin levels should be measured frequently, and nutritional supplements should be added to the patient’s diet if malnutrition is suspected. Tobacco smoking and alcohol intake should be taken into consideration as factors impeding tissue healing; therefore, the importance of social history cannot be overlooked.

Non-Responsive Wounds
So, we have identified and addressed the wound etiology and the number of barriers to wound healing, but the wound is not responding. What do we do now? Multiple references advocate the use of an advanced therapy such as bioengineered skin substitute to stimulate healing in

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non-responding wounds after four weeks of treatment and the velocity goal is not met. Only a small handful of wound care technologies have proven their value in accelerating diabetic foot ulcer healing in prospective and randomized trials. These three advanced technologies are Derma- graft, Apligraf and Regranex. “The panel recognizes the prognostic value of 50% area reduction of the wound at four weeks and recommends utilization of this parameter as a clinical decision point for the use of advanced therapies in healing diabetic foot ulcers. Use of advanced modalities, when indicated, should be viewed as a standard of care and these advanced modalities should not be a ‘last resort’ in the treatment of diabetic foot ulcers” (Snyder, et al., Ostomy Wound Management. 2010;56:44).

A closer look at the wound care challenges brings to attention a simple but often overlooked fact: things change. Understanding what the wound environment is telling us on a weekly basis is critical to selecting a proper approach to treatment. Proper understanding of descriptive terms and methodology, as well as communication between healthcare professionals, care givers, staff, and the patient are necessary, along with photographs and detailed descriptive medical records. Everyone involved in the patient care should understand the subtleties of the wound. Proper communication between all professionals involved leads to understanding the wound environment, better avoidance of barrier to healing, faster wound closure, and decrease in complications and preventing premature mortality.

Multi-Disciplinary Approach

Limb salvage can be complicated and requires many levels of expertise. Recognizing the complexity of diabetes and complications associated with it, a multi-disciplinary approach to patient care is a key to success. A comprehensive team of medical professionals who have special interest in this at-risk population will produce better wound healing results and improve the outcomes of treatment. The use of highly skilled wound care specialists, cardiol- ogists, nephrologists, endocrinologists, ophthalmologists, infectious disease specialists, nutritionists and orthotists as a team can reduce complications and decrease mortality. PM

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