

Being **DRRAFT**ed

This interdisciplinary team model is dedicated to rapid diagnosis and effective treatment.

BY RYAN FITZGERALD, DPM

Introduction

The incidence of diabetes mellitus worldwide has reached nearly epidemic proportions, with nearly 30 million affected by the disease in the United States alone and more than 366 million people worldwide.^{1,2} Current projections suggest that by 2030, at least 550 million people will have diabetes—approximately 10% of the world's adult population. In concert with this increasing incidence, there has been a significant rise in the observed co-morbidities commonly associated with the disease process in patients living with diabetes.³⁻⁶ Among these complications, lower extremity manifestations are a significant source of patient co-morbidity, mortality, and healthcare expense.

It has been estimated that the lifetime risk of developing diabetic foot ulceration (DFU) is as high as 25% in patients living with diabetes.^{1,7} In addition to the development of DFU, greater than 50% of these ulcerations will become infected, accounting for nearly 20% of all diabetes-related hospital admissions, and therefore a significant portion of healthcare-related costs, nearly \$11 billion in 2001.⁸⁻¹¹ In those patients presenting with infected DFUs, underlying osteomyelitis is observed in as many as 65% of cases, and these infected ulcers constitute a major risk factor for non-traumatic lower extremity amputation (LEA).^{7,11,12}

Indeed, nearly 83% of all non-traumatic lower extremity amputations in the United States are secondary to complications associated with diabetes mellitus.⁷ It has been well documented that the con-

sequences of major lower extremity amputation in diabetics are severe, with an estimated five-year post-operative survival rate of less than 50%, suggesting, in fact, that the mortality rate associated with diabetic LEAs exceeds that of most cancers.¹³ It is therefore vital to provide early and effective diagnosis and management of patients presenting with lower extremity complications of diabetes, in an effort to stem the current epidemic of limb loss.

Interdisciplinary models have been demonstrated to be highly ef-

fective in reducing the incidence of non-traumatic amputations in the diabetic population.¹⁴⁻¹⁹ Considering that the pathophysiology of lower extremity limb loss is multifactorial and that vasculopathy and neuropathy are critical contributors, it is appropriate to utilize an interdisciplinary team approach to specifically address the varying factors that combine to create this spiral of lower extremity ulceration, infection, and subsequent amputation. In 2009, the author defined seven vital abilities that a diabetic rapid response acute foot team (DRRAFT) should have in its armamentarium so that it might effectively manage the lower extremity complications of diabetes.²⁰ Five years later, it is now prudent to revisit this team

model to evaluate the efficacy and real-world effectiveness of such an interdisciplinary team.

A Model for Change: The Greenville Experience

The diabetic assessment rapid response team (DRRAFT) is an interdisciplinary team model whose core involves the ability to rapidly diagnose and provide effective treatment to patients presenting with lower extremity complications of diabetes utilizing basic skill-sets necessary for limb preservation. It has previously

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been advocated that the “irreducible minimum” regarding interdisciplinary units be oriented around treatment teams that are staffed by members of the vascular surgery and podiatric surgery specialties, with adjunctive team members being added as necessary via judicious use of consultation.^{14,16-18} The original DRRAFT concept is the natural extension of this premise: bringing the nuances from each individual specialty, the team collectively must possess the ability to perform the seven essential skills to be effective in promoting limb preservation.

In practice, however, an eighth skill has been identified as critical for successful long-term patient out-

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comes. The Greenville Health System (GHS) Center for Amputation Prevention in Greenville, SC, is an interdisciplinary limb salvage team that incorporates the elements of the original DRRAFT concept with a core component comprised of podiatric and vascular surgery working hand-in-hand, as was described in the original DRRAFT article. Unique in this model, however, is the addition of an embedded prosthetics and orthotics team who are uniquely skilled at providing appropriate shoes, insoles, and prosthetics to foster a long-lasting, healthy environment for patients with pre-dispositions to ulceration. An emphasis in aggressive and continued management of the patient's footwear from custom insole to Charcot Restrain Orthotic Walker (CROW) is critical to the long-term success for sustained wound remission and reduced re-occurrence rates. The literature demonstrates that wound re-occurrence rates can be staggering, and this is largely due, in part, to a failure to provide (or maintain) appropriate off-loading devices to the patient.

The New DRRAFT—8 Essential Skills for Limb Preservation

The management of the lower extremity manifestations of diabetes mellitus is a complex task. It is vital that practitioners involved in diabetic limb salvage address both the systemic and local factors that interact to generate significant co-morbidity and mortality in this patient population. The major factors include vasculopathy and neuropathy, often in combination with foot deformity, that lead to the development of DFUs.²¹⁻²³ The literature is clear that infected diabetic ulcerations present a major risk factor for lower extremity amputation, and therefore it is necessary to appropriately manage DFUs when they occur, including addressing the underlying etiology as well as dealing with an infection which may be present.²⁴ Eight essential skills have been identified which are utilized in combination by DRRAFT members to effectively manage DFUs when they occur and prevent progression to lower extremity amputation.

The DRRAFT team model was originally designed to provide for seven specific skill-sets: 1) The ability to perform hemodynamic and anatomic vascular assessment with revascularization, as necessary; 2) the ability to perform neurologic work-up; 3) the ability to perform site-appropriate culture technique; 4) the ability to perform wound assessment and staging/grading of infection and ischemia; 5) the ability to perform site-specific bedside and intra-operative incision and debridement; 6)

symptoms are involved on many levels in the development of lower extremity ulcerations. Perhaps the most widely recognized of the neurologic symptoms common to diabetics is sensory neuropathy with loss of protective sensation (LOPS).³⁹ These patients lose the “gift of pain.”

In the absence of pain, diabetic patients are far more likely to develop ulcerations due to this LOPS in the context of increased shearing forces. Additionally, motor neuropathy in the intrinsic musculature can

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The ability to initiate and modify culture-specific and patient-appropriate antibiotic therapy; and 7) the ability to perform appropriate post-operative monitoring to reduce risk of re-ulceration and infection. These skills address the predominant issues commonly observed in chronic, non-healing DFUs.

Patients with diabetes often suffer from peripheral arterial disease with elements of both micro-vascular and macro-vascular disease²⁵⁻²⁷, although it is predominantly macrovascular disease that produces critical limb ischemia (CLI). Patients with CLI are at significant risk for limb loss and require timely intervention to improve distal lower extremity perfusion.^{28,29} Delays in the recognition and treatment of macrovascular occlusive disease compromise outcomes, delay wound healing, prolong hospital stays, and unnecessarily increase the risk of major limb amputation.²⁵

It is important, therefore, that DRRAFT members be able to provide rapid diagnosis and intervention to address vascular compromise to reduce the risk of progression of CLI to limb loss.

In addition to circulatory issues, diabetic patients often develop neurologic symptoms as a consequence of long-standing hyperglycemia; these include motor, sensory, and autonomic neuropathy.^{21,22,36-38} These

lead to muscle imbalance, which creates deformity that, in conjunction with sensory neuropathy, can lead to the development of areas of increased forces which can progress to ulceration. DRRAFT members must be able to appropriately evaluate the patient's neurological status to establish loss of protective sensation (LOPS) via sensory neuropathy, as well as any elements of motor or autonomic neuropathy that may be present that can contribute to the development of lower extremity ulceration.^{1,40}

Considering the morbidity and mortality associated with infected DFUs, it is vital that the clinician be able to reliably obtain useful culture data. The literature demonstrates that diabetic lower extremity infections are often poly-microbial, with an average of 2.25 pathogens per patient.^{10,42} Furthermore, superficial swab cultures taken from a wound are notoriously unreliable; one study demonstrated that superficial swabs of infected ulcerations identified deep soft tissue pathogens in only 75% of cases.⁴³

The literature demonstrates that greater than 60% of chronic wounds are colonized, and that there is a certain level of colonization—dubbed “critical colonization”—that has been shown to inhibit wound healing via the development of biofilm. Therefore, the management of bacterial

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bioburden and the potential progression toward the development of biofilm has become part of the paradigm for wound healing. The literature demonstrates that wound infections are commonly preceded by the development of biofilm, and therefore, the capacity to manage bioburden prior to progression to infection is a necessary skill. For those patients who present with infection, or in whom colonization has progressed to infection, it is necessary that suitable deep cultures be obtained to appropriately direct antibiotic therapy.

Patients presenting with almost all mild and some moderate infections can be treated with oral antibiotics with fairly specific activity against aerobic gram positive organisms. Patients presenting with more severe infections should initially be placed on empiric, broad antibiotic coverage until more focused therapy can be initiated based on appropriate culture results.^{10,50}

Since the majority of the moderate to severe lower extremity infections in this patient population are polymicrobial, and considering the increasing rates of antibiotic-resistant strains of

all infected, nonviable, and necrotic soft tissue and bone. Such debridement allows the clinician to limit the proximal spread of infection, obtain deep specimens for culture, as well as allow for tissue demarcation in those zones of tissue compromise.^{15,22} Appropriate and timely tissue debridement has the ability to turn the tide of infection and to

vide continued and comprehensive off-loading solutions to provide the greatest risk reduction in terms of subsequent ulceration.

Conclusion

The DRRAFT model proposes the essential skills that form a necessary core of the interdisciplinary limb sal-

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set the patient down the road toward reconstructive efforts, particularly in the context of staged lower extremity reconstruction and wound healing.⁵³⁻⁵⁶

The War Rages On

Initial wound healing is winning the battle; however, the war rages on in high-risk patient populations, and it is necessary that DRRAFT members be able to provide continued off-loading solutions for high risk DFU patients. It is well understood in the literature that diabetic patients with previous ulceration are at significantly

vage model; this, however, is an ever-evolving process. Improvements in diagnostic technology, advances in wound healing modalities, and a better understanding of the nature of wound chronicity—the factors which influence wound senescence and preclude wound healing—have given those clinicians involved in the care of these high risk patients tremendous new and evolving opportunities to promote limb preservation.

The world is evolving, and consequently so must DRRAFT members to provide our patients with the highest quality, evidence-based approaches to wound healing. It's a brave new world, and the skills described above provide for the rapid diagnosis and timely surgical management of diabetic patients presenting with lower extremity compromise, and should be the foundation upon which any interdisciplinary team be built. As the population ages and lifestyles change, the incidence and prevalence of diabetes mellitus are increasing; therefore, it is incumbent upon clinicians involved in the care of patients living with diabetes to be adequately prepared to provide efficient, quality care to prevent lower extremity ulceration, infection, and progression toward amputation.

The development of an ulcer is a pivotal event in the life of the patient, much like receiving a cancer diagnosis; there is the time before, and the time after, but things are never the same. It is necessary that DRRAFT members be skilled to pro-

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The DRRAFT model proposes the essential skills that form a necessary core of the interdisciplinary limb salvage model; this, however, is an ever-evolving process.

pathogens, it is vital that these patients receive appropriate antibiotic coverage. Toward this end, it is vital that DRRAFT members be able to effectively select appropriate empirical therapy and modify the patient's antibiotic regimens in response to accurate culture and sensitivity data.

Following appropriate assessment of vascular status and assessment of potential bioburden or the presence of infection, it is necessary that DRRAFT members be able to provide timely incision and drainage to decompress areas of abscess formation as well as to provide appropriate debridement to remove

increased risk for re-ulceration, and it is necessary that DRRAFT members have the ability to actively follow these high-risk patients throughout the acute post-wound-healing phase into continued wound remission.⁵⁸⁻⁶⁰

The use of an in-house orthotic and prosthetic department, and embedded pedorthists and prosthetists, allow for protective off-loading through all phases of wound healing and subsequent wound remission. From custom off-loading insoles and offloading post-operative shoes to CROW boots and partial foot prostheses, these team members pro-

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vide the necessary management modalities to progress these high-risk patients through the necessary stages of wound healing to wound remission, and then to facilitate keeping those wounds healed. **PM**

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