Test Your Knowledge of the New IDSA Guidelines for Treatment of Diabetic Foot Infections (DFIs)

How familiar are you with these important standards?

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Goals and Objectives

Goal:

To familiarize the podiatrist with the 2012 IDSA clinical practice guidelines for the diagnosis and treatment of diabetic foot infections.

Objectives:

To provide the podiatrist with a brief highlight and summary of the key components as outlined by the IDSA. These components are listed as follows:

I. In which diabetic patients with a foot wound should I suspect infection, and how should I classify it?

II. How should I assess a diabetic patient presenting with a foot infection?

III. When and from whom should I request a consultation for a patient with a diabetic foot infection?

IV. Which patients with the diabetic foot infection should I hospitalize, and what criteria should they meet before I discharge them?

V. When and how should I obtain specimen(s) for culture from a patient with the diabetic foot wound?

VI. How should I initially select, and when should I modify, an antibiotic regimen for a diabetic foot infection?

VII. When should I consider imaging studies to evaluate a diabetic foot infection, and which should I select?

VIII. How should I diagnose and treat osteomyelitis of the foot and the patient with diabetes?

IX. In which patients with a diabetic foot infection should I consider surgical intervention, and what type of procedure may be appropriate?

X. What types of wound care techniques and dressings are appropriate for diabetic foot wounds?

By reading and reviewing the presented information the reader should be able to successfully answer the CME questions presented.

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*Following this article, an answer sheet and full set of instructions are provided (pg. 162).—**Editor***

In June 2012, the infectious disease Society of America (IDSA) published guidelines for the diagnosis and treatment of diabetic foot infections (DFI). It is imperative that doctors of podiatric medicine become aware of these guidelines and apply them to both clinical practice and patient documentation. The last IDSA guidelines were published in 2004. The new update will quickly become the new standard for care and will be referenced by both medical and legal experts.

Continued on page 152

IDSA Guidelines *(from page 151)*

There are 10 essential categories of questions outlined by the IDSA for the management of diabetic foot infections. They are as follows:

I. In which diabetic patients with a foot wound should I suspect infection, and how should I classify it?

II. How should I assess a diabetic patient presenting with a foot infection?

III. When and from whom should I request a consultation for a patient with a diabetic foot infection?

IV. Which patients with the diabetic foot infection should I hospitalize, and what criteria should they meet before I discharge them?

V. When and how should I obtain specimen (s) for culture from a patient with the diabetic foot wound?

VI. How should I initially select, and when should I modify, an antibiotic regimen for a diabetic foot infection?

VII. When should I consider imaging studies to evaluate a diabetic foot infection, and which should I select?

VIII. How should I diagnose and treat osteomyelitis of the foot and the patient with diabetes?

IX. In which patients with a diabetic foot infection should I consider surgical intervention, and what type of procedure may be appropriate?

X. What types of wound care techniques and dressings are appropriate for diabetic foot wounds?

In this brief overview, we will attempt to highlight and summarize the guidelines for all 10 question categories. At the end of this review there are 20 CME questions whose answers can be found in the context of this article. For complete information and content the reader is advised

Continued on page 153

TABLE 1:
Infectious Diseases Society of America and International Working Group on the Diabetic Foot Classifications of Diabetic Foot Infection

Clinical Manifestation of Infection	PEDIS Grade	IDSA Infection Severity
No symptoms or signs of infection	1	Uninfected
Infection present, as defined by the presence of at least 2 of the following items: • Local swelling or induration • Erythema • Local tenderness or pain • Local warmth • Purulent discharge (thick, opaque to white or sanguineous secretion)		
Local infection involving only the skin and the subcutaneous tissue (without involvement of deeper tissues and without systemic signs as described below). If erythema, must be >0.5 cm to ≤2 cm around the ulcer. Exclude other causes of an inflammatory response of the skin (eg, trauma, gout, acute Charcot neuro-osteoarthropathy, fracture, thrombosis, venous stasis).	2	Mild
Local infection (as described above) with erythema > 2 cm, or involving structures deeper than skin and subcutaneous tissues (eg, abscess, osteomyelitis, septic arthritis, fasciitis), **and** No systemic inflammatory response signs (as described below)	3	Moderate
Local infection (as described above) with the signs of SIRS, as manifested by ≥2 of the following: • Temperature >38°C or <36°C • Heart rate >90 beats/min • Respiratory rate >20 breaths/min or $PaCO_2$ <32 mm Hg • White blood cell count >12 000 or <4000 cells/μL or ≥10% immature (band) forms	4	Severe[a]

Abbreviations: IDSA, Infectious Diseases Society of America; $PaCO_2$, partial pressure of arterial carbon dioxide; PEDIS, perfusion, extent/size, depth/tissue loss, infection, and sensation; SIRS, systemic inflammatory response syndrome.

[a] Ischemia may increase the severity of any infection, and the presence of critical ischemia often makes the infection severe. Systemic infection may sometimes manifest with other clinical findings, such as hypotension, confusion, vomiting, or evidence of metabolic disturbances, such as acidosis, severe hyperglycemia, and new-onset azotemia.

IDSA Guidelines *(from page 152)*

to review the 2012 IDSA guidelines in its entirety. CID 2012:54 (15 June), Lipsky, et al.

In which diabetic patients with a foot wound should I suspect infection and how should I classify it?

Evidence of infection usually includes classic signs of inflammation (redness, warmth, swelling, tenderness or pain) or purulent secretions. Other factors such as non-purulent secretions, discolored or friable granulation tissue, undermining wound edges or foul odor may be contributory. Infections can be categorized as mild, moderate and severe.

Mild infection can be defined by the presence of two or more of the following items: local swelling or induration, erythema, local tenderness or pain, local warmth and purulent drainage (thick, opaque to white or sanguineous secretion). In mild infections, erythema must be greater than 0.5 cm to less than or equal to 2 cm surrounding the ulcer. If these signs do not exist, and there is no wound drainage, the wound should be considered uninfected.

Moderate infection is described with erythema greater or equal to 2 cm or involving structures deeper than skin and subcutaneous tissue (for example, abscess, osteomyelitis, septic arthritis, and fasciitis). There are no systemic inflammatory signs present.

Severe infection presents with all signs and symptoms above and manifested by greater than or equal to two of the following: temperature greater than 38° C or less than 36° C; heart rate greater than 90 bpm; respiratory rate greater than 20 breaths per minute or PaCO2 less than 32 mm HG; and white blood cell count greater than 12,000 (or less than 4000 cells/uL or greater than or equal to 10% immature band cells) (Table 1).

Physicians should also be aware of factors that increase the risk for DFI especially when other signs of infection are present. These include a wound for which the ulcer probes to bone (PTB), and ulceration present for greater than 30 days, a traumatic wound, the presence of peripheral vascular disease, a previous lower extremity amputation, loss of protective sensation, presence of renal insufficiency or a history of walking barefoot.

There are several classification systems for diabetic foot ulceration (DFU) in existence. It is imperative that clinicians document which classification system they are utilizing when documenting the presence or absence of DFU in their notes. The Wagner (Wagner-Meggitt) classification system is perhaps most widely used. It assesses the ulcer depth, presence or absence of infection, and levels of gangrene; with grades ranging from 0 to 5. Although widely used, it is extremely limited with regard to detail characteristics presenting within the ulcer and surrounding tissue. The University of Texas classification system has a combined matrix of four grades and four stages. It also predicts a correlation of likely complications and outcomes associated with DFU's. Although many other classification systems exist, the IDSA has developed a system of classifying diabetic foot wounds that uses the acronym PEDIS. This acronym stands for: Perfusion, Extent (size), Depth (tissue loss), Infection, and Sensation (neuropathy). Clinicians utilizing the PEDIS system are providing important information as well as a simple classification system which has been prospectively validated in the literature.

TABLE 2:

Interpretation of the Results of Ankle-Brachial Index Measurement

ABI[a]	Interpretation
>1.30	Poorly compressible vessels, arterial calcification
0.90–1.30	Normal
0.60–0.89	Mild arterial obstruction
0.40–0.59	Moderate obstruction
<0.40	Severe obstruction

Abbreviation: ABI, ankle-brachial index.

[a] Obtained by measuring the systolic blood pressure (using a properly sized sphygmomanometer) in the ankle divided by that in the brachial artery. The presence of arterial calcification can lead to an overestimate in the index.

How should I assess the diabetic patient presenting with a foot infection?

Podiatrists should evaluate a diabetic patient presenting with a foot wound at three levels: 1) The patient as a whole, 2) The affected foot or limb and 3) The infected wound.

Systemic symptoms and signs of infection include: fever, chills, delirium, diaphoresis, anorexia, fluid instability, acidosis, electrolyte abnormalities or worsening metabolic findings. Laboratory markers suggesting systemic infection include leukocytosis, a shift to the left, elevated sedimentation rates, and C-reactive protein. A recent study found elevated levels of pro-calcitonin to also correlate with evidence of systemic infection. In addition, studies have shown that fewer than 50% of diabetics with severe infection may present with normal body temperature and WBC levels.

The affected foot and limb should be assessed for peripheral arterial and peripheral venous disease. Peripheral arterial disease (PAD) is defined as ankle-brachial index (ABI) of less than 0.9. An ankle brachial index ranging from 0.60 to 0.89 is considered mild arterial obstruction. Moderate obstruction is considered 0.4 to 0.59 and severe obstruction is less than 0.40. All patients should be assessed for blood flow, tissue perfusion and capillary filling time (Table 2).

With regard to wound or foot

Continued on page 154

IDSA Guidelines (from page 153)

deformities, the clinician should be looking for proximal spread of infection, as well as signs of Charcot arthropathy, hammer toes, bunions or abnormal callosities. Altered biomechanics may also predispose the patient to foot ulceration and impair wound healing. Assessing the patient's arterial supply on a local level is also important. 20 to 30% of persons with diabetes have some signs of PAD and up to 40% of those present with diabetic foot infections. In addition to classic signs of infection, a diabetic foot ulceration (DFU) that probes to bone (PTB) and has been present for greater than 30 days has an increased incidence of infection and morbidity. In addition, patients who walk barefoot or are poorly compliant with footwear in association with pathomechanics and foot deformities have increased incidence of DFU.

When and from whom should I request a consultation for a patient with the diabetic foot infection?

With regard to diabetic foot infections, clinicians should attempt to provide a well coordinated approach by physicians with expertise in a variety of specialties. The multidisciplinary model has been shown in two studies to reduce the risk of amputation in patients with diabetic foot infections. Doctors without adequate training in wound debridement should seek consultation with physicians more familiar with this task.

In addition, a thorough knowledge of foot anatomy and biomechanics is extremely helpful when referring within the podiatric community. The IDSA recommends referring to clinicians who are familiar with offloading and pressure reduction type dressings for patients with recurring weight-bearing wounds. The presence of PAD in patients should necessitate a referral to a vascular specialist. Besides podiatrists, a variety of specialties may be included in the multidisciplinary team. These include, but are not limited to: endocrinology, general surgery, vascular surgery, plastic surgery, wound care specialists, orthopedists, psychologists and social workers.

The IDSA recommends that all patients with severe infections be admitted for hospitalization.

Although consultation and referral for diabetic foot infections is recommended, the timeliness of these referrals or consultations is perhaps more important. Both DFIs and DFUs should not be permitted to progress to the point where the treating physician feels uncomfortable or overwhelmed by the complexity and potential worsening of the patient's condition. By engaging a multidisciplinary team, the patient can usually enjoy prompt effective treatment as well as improved outcomes.

Which patients with the diabetic foot infection should I hospitalize, and what criteria should they meet before I discharge them?

The IDSA recommends that all patients with severe infections be admitted for hospitalization. In addition, those patients with moderate infections who also present with complicating factors should be considered candidates for hospitalization. These factors include: patients with severe PAD; patients with lack of home support; patients with psychological or social complicating factors and patients failing to improve with outpatient therapy.

Patients should be considered candidates for hospital discharge when the following criteria have been met: 1) the patient is clinically stable with any recommended surgical procedures completed, 2) acceptable glycemic control, 3) able to manage at home or in a rehabilitation facility, 4) a well-defined antibiotic regimen is in place 5) adequate offloading and specific wound care instructions have been given and 6) appropriate outpatient follow-up has been arranged.

Continued on page 155

TABLE 3:

Recommendations for Collection of Specimens for Culture from Diabetic Foot Wounds

Do

- Obtain an appropriate specimen for culture from almost all infected wounds
- Cleanse and debride the wound before obtaining specimen(s) for culture
- Obtain a tissue specimen for culture by scraping with a sterile scalpel or dermal curette (curettage) or biopsy from the base of a debrided ulcer
- Aspirate any purulent secretions using a sterile needle and syringe
- Promptly send specimens, in a sterile container or appropriate transport media, for aerobic and anaerobic culture (and Gram stain, if possible)

Do not

- Culture a clinically uninfected lesion, unless for specific epidemiological purposes
- Obtain a specimen for culture without first cleansing or debriding the wound
- Obtain a specimen for culture by swabbing the wound or wound drainage

IDSA Guidelines (from page 154)

When and how should I obtain specimen(s) for culture from a patient with a diabetic foot wound?

For clinically uninfected wounds, the IDSA recommends not collecting a specimen for culture. For infected wounds, they recommend that clinicians appropriately

Continued on page 156

TABLE 4:
Suggested Empiric Antibiotic Regimens Based on Clinical Severity for Diabetic Foot Infections[a]

Infection Severity	Probable Pathogen(s)	Antibiotic Agent	Comments
Mild (usually treated with oral agent[s])	*Staphylococcus aureus* (MSSA); Streptococcus spp	Dicloxacillin	Requires QID dosing; narrow-spectrum; inexpensive
		Clindamycin[b]	Usually active against community-associated MRSA, but check macrolide sensitivity and consider ordering a "D-test" before using for MRSA. Inhibits protein synthesis of some bacterial toxins
		Cephalexin[b]	Requires QID dosing; inexpensive
		Levofloxacin[b]	Once-daily dosing; suboptimal against *S. aureus*
		Amoxicillin-clavulanate[b]	Relatively broad-spectrum oral agent that includes anaerobic coverage
	Methicillin-resistant *S. aureus* (MRSA)	Doxycycline	Active against many MRSA & some gram-negatives; uncertain against streptococcus species
		Trimethoprim/ sulfamethoxazole	Active against many MRSA & some gram-negatives; uncertain activity against streptococci
Moderate (may be treated with oral or initial parenteral agent[s]) or severe (usually treated with parenteral agent[s])	MSSA; *Streptococcus* spp; Enterobacteriaceae; obligate anaerobes	Levofloxacin[b]	Once-daily dosing; suboptimal against *S. aureus*
		Cefoxitin[b]	Second-generation cephalosporin with anaerobic coverage
		Ceftriaxone	Once-daily dosing, third-generation cephalosporin
		Ampicillin-sulbactam[b]	Adequate if low suspicion of *P. aeruginosa*
		Moxifloxacin[b]	Once-daily oral dosing. Relatively broad-spectrum, including most obligate anaerobic organisms
		Ertapenem[b]	Once-daily dosing. Relatively broad-spectrum including anaerobes, but not active against *P. aeruginosa*

Continued on next page

IDSA Guidelines (from page 155)

obtain specimens for culture (Table 3). The IDSA recommends sending a specimen for culture that is from deep tissue, obtained by biopsy or curettage after the wound has been thoroughly cleansed and debrided. They specifically suggest avoiding swab specimens especially in inadequately debrided wounds and sinus tracts.

Continued on page 157

TABLE 4 *(Continued)*

Infection Severity	Probable Pathogen(s)	Antibiotic Agent	Comments
		Tigecycline[b]	Active against MRSA. Spectrum may be excessively broad. High rates of nausea and vomiting and increased mortality warning. Nonequivalent to ertapenem + vancomycin in 1 randomized clinical trial
		Levofloxacin[b] or ciprofloxacin[b] with clindamycin[b]	Limited evidence supporting clindamycin for severe *S. aureus* infections; PO & IV formulations for both drugs
		Imipenem-cilastatin[b]	Very broad-spectrum (but not against MRSA); use only when this is required. Consider when ESBL-producing pathogens suspected
	MRSA	*Linezolid[b]*	Expensive; increased risk of toxicities when used >2 wk
		Daptomycin[b]	Once-daily dosing. Requires serial monitoring of CPK
		Vancomycin[b]	Vancomycin MICs for MRSA are gradually increasing
	Pseudomonas aeruginosa	***Piperacillin-tazobactam[b]***	TID/QID dosing. Useful for broad-spectrum coverage. *P. aeruginosa* is an uncommon pathogen in diabetic foot infections except in special circumstances
	MRSA, Enterobacteriacae, *Pseudomonas,* and obligate anaerobes	Vancomycin[c], ceftazidime, cefepime, *piperacillin-tazobactam[b],* aztreonam[b], or a carbapenem[b]	Very broad-spectrum coverage; usually only used for empiric therapy of severe infection. Consider addition of obligate anaerobe coverage if ceftazidime, cefepime, or aztreonam selected

Agents in boldface type are those that have been most commonly used as comparators in clinical trials. The only agents currently specifically FDA approved for diabetic foot infections are shown in italics.

Narrow-spectrum agents (eg, vancomycin, linezolid, daptomycin) should be combined with other agents (eg, a fluoroquinolone) if a polymicrobial infection (especially moderate or severe) is suspected.

Use an agent active against MRSA for patients who have a severe infection, evidence of infection or colonization with this organism elsewhere, or epidemiological risk factors for MRSA infection.

Select definitive regimens after considering the results of culture and susceptibility tests from wound specimens, as well as the clinical response to the empiric regimen.

Similar agents of the same drug class can probably be substituted for suggested agents.

Some of these regimens do not have FDA approval for complicated skin and skin structure infections.

Abbreviations: CPK, creatine phosphokinase; ESBL, extended-spectrum β-lactamase; FDA, US Food and Drug Administration; IV, intravenous; MIC, minimum inhibitory concentration; MRSA, methicillin-resistant *Staphylococcus aureus;* MSSA, methicillin-sensitive *Staphylococcus aureus;* PO, oral; QID, 4 times a day; TID, 3 times a day.

[a] Agents approved for treating skin and skin structure infections on the basis of studies that excluded patients with diabetic foot infections (eg, ceftaroline, telavancin) are not included.

[b] Agents shown to be effective in clinical trials including patients with diabetic foot infections.

[c] Daptomycin or linezolid may be substituted for vancomycin.

IDSA Guidelines *(from page 156)*

How should I initially select, and when should I modify, an antibiotic regimen for a diabetic foot infection?

The IDSA recommends prescribing antibiotics for all infected wounds. They also clearly state that antibiotics may be insufficient unless combined with appropriate wound care. For mild and moderate infections in patients who have not recently received antibiotics, antibiotic therapy should be targeted at aerobic gram-positive cocci (namely, Staphylococcus aureus and streptococcus). Usually a brief course of 1-2 weeks is sufficient. For more severe infections, starting the patient on broad-spectrum antibiotic therapy (pending culture results and sensitivity) is recommended.

Empiric therapy directed at Pseudomonas aeruginosa is usually unnecessary except for patients with risk factors for this infection or prior history. P. Aeruginosa, although reported in many patients, is often a nonpathogenic colonizer when isolated from wounds. In northern countries, Pseudomonas aeruginosa has been reportedly isolated as a pathogen in fewer than 10% of wounds. It is more prevalent in countries with warm climates or if patients have been soaking their feet or maintained in a wet environment.

MRSA

Since the publications of the IDSA guidelines in 2004, the prevalence of methicillin resistant Staphylococcus aureus (MRSA) has greatly increased. Some studies have reported the presence of MRSA in almost 1/3 of all DFIs. In light of this, the IDSA currently recommends that patients presenting with DFI be empirically treated with antibiotics that cover MRSA in the following situations: 1) Patient has a history of previous MRSA infection or colonization within the past year, 2) The local prevalence of MRSA in your locale is high enough (perhaps 50% for mild and 30% for moderate soft tissue infection) that there is a reasonable probability of MRSA infection, 3) The current infection is sufficiently severe enough that failing to cover MRSA while awaiting definitive cultures would pose an unacceptable risk of treatment failure.

When there is a concern that MRSA is a pathogen in bone infection, the IDSA recommends obtaining a specimen of bone for culture. Antibiotic regimens should be modified and adjusted based upon clinical response and appropriately obtained culture and sensitivity results.

Based on results of available studies, there is no single drug or combination of agents that appears to be superior to any others. Table 4 provides some suggested antibiotic regimens based upon clinical severity of patients diabetic foot infection.

The duration of antibiotic therapy for DFI should be based on the severity of the infection, presence or absence of bone infection and a clinical response to therapy (Table 5). Most patients with skin and soft tissue infections (without bone infection) usually do well with a 1-2 week course of antibiotic treatment. There is no fixed duration of prolonged antibiotic therapy recommended. Unnecessary prolonged use may result in the increased potential for adverse drug-related events and the development of antibiotic resistance. Antibiotics can usually be discontinued once the clinical signs and symptoms of infection have resolved. There is no good evidence to support continuing antibiotic therapy until the wound is healed in order to either accelerate closure or prevent future infection.

When should I consider imaging studies to evaluate a diabetic foot infection, and which should I select?

The IDSA recommends that all patients presenting with a new diabetic foot infection should obtain plain radiographs. The purpose of this is to look for bony abnormalities as well as gas in the soft tissue and foreign bodies which may be present. The study of choice for patients who require additional imaging studies for soft tissue abscess or the diagnosis of uncertain osteomyelitis is MRI.

When MRI is unavailable or contraindicated, radionuclitide bone scanning (preferably labeled white blood cell scan) may be considered as an alternative. The presence of bone destruction directly underlying a foot ulceration should be considered as positive for osteomyelitis: and treated accordingly.

How should I diagnose and treat osteomyelitis of the foot in a patient with diabetes?

A positive probe to bone test (PTB) is not specific for osteomyelitis. Conversely, the diagnosis of osteomyelitis is unlikely if the PTB test is negative. Bone culture specimens provide more accurate microbiological data for defining diabetic foot osteomyelitis. Isolates from bone culture specimens correlate less than 50% of the time with those taken from soft tissue swabs. Bone culture and biopsy is most likely to be justified under the following circumstances:

1) Uncertainty regarding the diagnosis of osteomyelitis despite clinical and imaging evaluations, 2) An absence of or confusing culture data from soft tissue specimens, 3) Failure of the patient to respond to empiric antibiotic therapy, and 4) A desire to use antibiotic agents that may be especially effective for osteomyelitis but have a high potential for selecting resistant organisms (e.g., Rifampin, fluoroquinolones).

Recent studies have shown that a two-week antibiotic-free period prior to obtaining bone culture is best in order to avoid false positives. Although it is ideal to obtain bone culture and biopsy specimens prior to instituting antibiotic therapy, this is

Continued on page 158

The IDSA recommends that all patients presenting with a new diabetic foot infection should obtain plain radiographs.

IDSA Guidelines (from page 157)

often times impractical. Bone cultures can easily be obtained by various methods such as percutaneous bone cutting aspiration needles (Jamshidi, Ostycut) or intra-operatively under sterile conditions. When bone is removed or debrided to treat osteomyelitis the IDSA suggests sending a sample for culture and histology (Table 6).

Additional factors which may contribute to the presence of osteomyelitis in a wound include the following: wounds that extend to bone or joint; failure of the wound to heal after at least six weeks after appropriate wound care and offloading; elevated C-reactive protein greater than 3.2 mg/dL; and elevated ESR greater than 60 mm/hr.

Bone resection has been considered the essential treatment for curing chronic osteomyelitis. Surgeries such as ray resections and trans-metatarsal amputations, although effective, may risk architectural reorganization of the foot and result in altered biomechanics. Thorough knowledge of foot anatomy and biomechanics is essential for appropriate surgical removal of osteomyelitic bone. This is especially true for preventing or delaying recurrences of new pressure-related DFUs and future bone infection sites.

There are four situations in which non-surgical management of osteomyelitis might be considered: 1) There is no acceptable surgical target (radical cure of the infection would cause unacceptable loss of function), 2) The patient has limb ischemia caused by unreconstructable vascular disease but wishes to avoid amputation, 3) Infection is confined to the forefoot, and there is minimal soft tissue loss and 4) The patient and healthcare professional agree that surgical management carries excessive risk or is otherwise not appropriate or desirable (Table 7)

When surgical and nonsurgical therapy for osteomyelitis fails, clinicians should consider several possible reasons: 1) Was the original diagnosis correct? 2) Is there residual necrotic or infected bone or surgical hardware that should be resected or removed? 3) Did the selected antibiotic regimen likely cover the causative organism (s) and achieve adequate levels in bone, and was it administered for sufficient duration? and 4) Are non-infectious complications (inadequate offloading of the

Continued on page 159

TABLE 5:

Suggested Route, Setting, and Duration of Antibiotic Therapy, by Clinical Syndrome

Site of Infection, by Severity or Extent	Route of Administration	Setting	Duration of Therapy
Soft-tissue only			
Mild	Topical or oral	Outpatient	1–2 wk; may extend up to 4 wk if slow to resolve
Moderate	Oral (or initial parenteral)	Outpatient/ inpatient	1–3 wk
Severe	Initial parenteral, switch to oral when possible	Inpatient, then outpatient	2–4 wk
Bone or joint			
No residual infected tissue (eg, postamputation)	Parenteral or oral	…	2–5 d
Residual infected soft tissue (but not bone)	Parenteral or oral	…	1–3 wk
Residual infected (but viable) bone	Initial parenteral, then consider oral switch	…	4–6 wk
No surgery, or residual dead bone postoperatively	Initial parenteral, then consider oral switch	…	≥3 mo

IDSA Guidelines (from page 158)

wound, insufficient blood supply of the foot), rather than failure to eradicate bone infection, the real problem?

Selection of Antibiotics

Appropriate selection of antibiotic therapy for patients with DFO should be based on bone culture and sensitivity findings. The IDSA does not recommend, nor does data support, the superiority of any specific antibiotic agent or treatment strategy, including the route or duration of therapy. In addition the most appropriate duration of antibiotic therapy for any type of DFI is not well-defined.

Although there are no tests that have been proven to correlate with long-term resolution of osteomyelitis, the consensus of the IDSA panel is that the following are suggestive of a response: a decrease in previously elevated inflammatory markers (especially the ESR); resolution of any overlying soft tissue infection; healing of any wound; and evolution of radiographic changes that suggest healing.

In which patients with a diabetic foot infection should I consider surgical intervention, and what type of procedure may be appropriate?

The IDSA panel suggests that non-surgical clinicians consider requesting assessment by a surgeon for patients with a moderate or severe DFI. They also recommend urgent surgical intervention for foot infections accompanied by gas in the deep tissue, abscess, or necrotizing fasciitis. Surgical consultation and intervention is also recommended for less urgent surgery in wounds with substantial nonviable tissue or extensive bone or joint involvement. The absence of fever or leukocytosis should not dissuade the surgeon from considering exploration of a DFI. The most common site for severe foot infection is the plantar surface. A plantar wound accompanied by dorsal erythema or floctuance suggests that infection has passed through multiple fascial compartments. Various publications suggest that there are between 4 and 7 compartments in the foot (Figure 1). The key elements to releasing and draining infections of these compartments is to extend the exploration and debridement to levels of healthy tissue.

If the affected limb appears to be ischemic, the patient should be referred to a vascular surgeon. In most cases, ischemia is secondary to larger vessel atherosclerosis, rather than to "small vessel disease". In severe life and limb-threatening infections, debridement of necrotic and infected material should not be delayed while awaiting revascularization. In patients with noncritical ischemia (ABI of 0.4 to 0.9) the vascular surgeon may consider delaying invasive revascularization techniques if the wound responds to conventional antibiotic treatment. Usually, the vascular surgeon will opt for endovascular intervention or distal bypass procedures to provide revascularization of the limb. This can be performed in conjunction with appropriate surgical interven-

Continued on page 160

TABLE 6:
In Which Situations Is Diagnostic Bone Biopsy Most Recommended?

- Patient or provider prefers definitive diagnosis to justify choice of early surgery in favor of prolonged treatment
- Cultures of soft tissue or blood suggest high risk of osteomyelitis with antibiotic-resistant organism(s)
- There is progressive bony deterioration or persistently elevated inflammatory markers during empiric or culture-directed therapy (should consider surgical resection)
- Suspect bone is a planned target for insertion of orthopaedic metalware

TABLE 7:
Approach to Treating a Patient with Diabetic Foot Osteomyelitis

When to consider a trial of nonsurgical treatment

- No persisting sepsis (after 48–72 h if on treatment)
- Patient can receive and tolerate appropriate antibiotic therapy
- Degree of bony destruction has not caused irretrievable compromise to mechanics of foot (bearing in mind potential for bony reconstitution)
- Patient prefers to avoid surgery
- Patient comorbidities confer high risk to surgery
- No contraindications to prolonged antibiotic therapy (eg, high risk for *C. difficile* infection)
- Surgery not otherwise required to deal with adjacent soft tissue infection or necrosis

When to consider bone resection

- Persistent sepsis syndrome with no other explanation
- Inability to deliver or patient to tolerate appropriate antibiotic therapy
- Progressive bony deterioration despite appropriate therapy
- Degree of bony destruction irretrievably compromises mechanics of foot
- Patient prefers to avoid prolonged antibiotics or to hasten wound healing
- To achieve a manageable soft tissue wound or primary closure
- Prolonged antibiotic therapy is relatively contraindicated or is not likely to be effective (eg, presence of renal failure)

IDSA Guidelines (from page 159)

tion and wound debridement in a timely and effective manner.

What types of wound care techniques and dressings are appropriate for diabetic foot wounds?

According to the IDSA guidelines, diabetic patients with a foot wound should receive appropriate wound care which usually consists of the following:

1) Debridement aimed at removing debris, eschar and surrounding callus. Sharp debridement methods are usually best, however, mechanical, autolytic (larval) or enzymatic methods may be appropriate.

2) Off-loading (redistribution of pressure off the wound or to the entire weight-bearing surface of the foot).

3) Appropriate wound dressings that allow for moist wound healing and control of excess exudate. Dressings should be based on the size, depth and nature of the ulcer.

The IDSA does not advocate using topical antimicrobials for treating most clinically uninfected wounds. No adjunctive therapy has been proven to improve resolution of infection. However, for some selected diabetic foot wounds that are slow to heal, clinicians might consider using bioengineered skin equivalents, growth factors, granulocyte colony stimulating factors, negative pressure wound therapy and hyperbaric oxygen therapy.

This article is intended as a brief highlight and summary of the current IDSA guidelines (readers are encouraged to download and read the entire publication). They are also not meant to be an absolute final statement as to the only appropriate treatment for DFUs and DFIs. They are as stated—simply guidelines. Further research is needed to further establish protocols for the treatment of diabetic foot infections—particularly with regard to appropriate antibiotic therapy; length of antibiotic treatment; the need for/appropriateness of topical antibiotic therapy; and the appropriate route of antibiotic therapy which is most beneficial. In addition, further research is needed in the treatment of diabetic foot osteomyelitis (DFO)—particularly as to when a surgical resection of infected or necrotic bone is most appropriate; the required duration of antimicrobial therapy necessary for treatment of osteomyelitis; the best methods for obtaining bone specimen and bone imaging with regard to DFO.

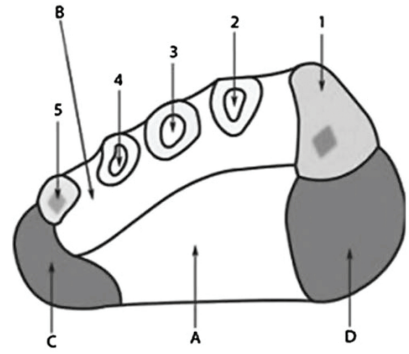

Figure 1: Schematic diagram of cross-section of the foot. Numbers 1-5 indicate metatarsal bones. A, central plantar space; B, deep inteross- eous space; C, lateral plantar space; D, medial plantar space.

Podiatrists should continue to read and review the literature with regard to the treatment and management of diabetic wounds and infections. By utilizing the current IDSA guidelines, an organized and logical approach to the surgical and non-surgical treatment of diabetic infections can be followed. **PM**

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Continuing Medical Education

SEE ANSWER SHEET ON PAGE 163.

1) All of the following are true regarding diabetic foot infections (DFI) EXCEPT:
- A) Most common causative organism is Staphylococcus.
- B) Most DFIs are poly microbial.
- C) Obligate anaerobes are co-pathogens when necrotic tissue and ischemia are present.
- D) Pseudomonas aeruginosa is the most common gram negative found in DFIs.

2) The most appropriate way to obtain a wound culture is to perform all of the following except:
- A) Clean and scrub the wound prior to culture and sensitivity.
- B) Obtain deep swab of sinus tract.
- C) Debride necrotic tissue prior to culture and sensitivity.
- D) Obtain and send a portion of wound tissue after performing letters A and C.

3) Which of the following statements is true according to the 2012 IDSA guidelines:
- A) Clinically uninfected wounds do not require antibiotics.
- B) Clinicians should culture all diabetic wounds.
- C) Doctors should culture suspected wounds prior to the debridement.
- D) There are currently no specific parameters to determine if a wound infection is present.

4) Which of the following is not likely a sign of infected wound:
- A) Local swelling or induration
- B) Erythema
- C) Chronic non-draining ulcer
- D) Local tenderness or pain

5) According to IDSA guidelines, mild infection is defined by two or more of the following items, EXCEPT:
- A) Local swelling
- B) Erythema around ulcer greater than 0.5 cm and less than or equal to 2 cm
- C) purulent discharge
- D) Body temperature greater than 38° C

6) Which of the following is NOT usually seen in a moderate infection (as defined by the IDSA guidelines):
- A) Involvement of structures deeper than skin and subcutaneous tissue.
- B) Erythema greater than 2 cm surrounding the wound
- C) White blood cell counts greater than 13,000
- D) Purulent drainage

7) According to IDSA guidelines, severe infections can usually manifest by which of the following:
- A) Body temperature greater than 38° C or less than 36° C
- B) White blood cell count greater than 12,000
- C) Loss of appetite
- D) All of the above

8) Factors that increase the risk of DFI include all the following EXCEPT:
- A) Wound is open less than 30 days
- B) Wound probes to bone (PTB)
- C) Peripheral vascular disease is also present
- D) Renal insufficiency

9) Which of the following statements is true regarding classification systems:
- A) Wagner classification scheme is the best system overall for documenting DFU (diabetic foot ulcers)
- B) The University of Texas classification system is too complex and complicated for classifying DFUs.
- C) The PEDIS classification system stands for perfusion, extent (size), depth, infection and sensation (neuropathy)
- D) Doctors need not indicate which classification system they are using when documenting DFUs

10) Diabetic patients presenting with a DFI should be assessed at which level?
- A) The patient as a whole systemically
- B) The affected limb for presence or absence of ischemia or venous insufficiency
- C) Presence or absence of protective sensation
- D) All the above

11) All the following are strong considerations for hospitalizing a patient with a DFI EXCEPT:
- A) Failure to close the wound after two weeks.
- B) Selected patients with moderate infection who also have complicating factors
- C) Need for intravenous antibiotics in a patient with WBC of 15,000
- D) Failure of the infection to respond to oral antibiotic therapy

12) Which of the following may increase a patient's risk of developing a MRSA (methicillin resistant Staphylococcus aureus) infection?
- A) Patient with prior history of MRSA infection
- B) Patient with history of multiple hospitalizations
- C) Patients treated for long-standing, non-healing ulcers with inappropriate oral antibiotic therapy
- D) All of the above

13) Which of the following statements is false:
- A) Pseudomonas infections are more prevalent in countries with warm climates
- B) All diabetic foot infections should be treated with anti-pseudomonal agents
- C) Coagulant negative Staphylococcus and Corynebacterium may be true pathogens in some DFIs
- D) Greater than 40% of patients with DFI's have peripheral artery disease

14) Which of the following statements is true:
- A) All patients with DFIs should get plain x-rays
- B) MRI is the imaging modality of choice for suspected soft tissue abscess and uncertainty of osteomyelitis
- C) Leukocyte or anti-granulocyte scans are preferred only when MRI is not available or contraindicated
- D) All the above

15) Bone biopsy for culture and histology is best indicated for which of the following:
- A) When uncertainty of

Continued on page 161

diagnosis of osteomyelitis is present despite clinical and imaging findings
B) Failure of the patient to respond to empiric antibiotic therapy based on soft tissue and micro and culture data
C) To determine need for early surgery in favor of prolonged antibiotic treatment
D) All of the above are correct indications

16) Which of the following laboratory findings may be positive in patients with severe DFI's?
A) Leukocytosis
B) Increased sedimentation rate
C) Increased C reactive protein
D) All of the above

17) Which of the following may be absent in up to 50% of patients admitted for severe DFI?
A) Increased body temperature
B) Abnormal WBC
C) Both A and B
D) Neither A nor B

18) All of the following are generally true for most DFIs EXCEPT:
A) Antibiotics should be continued 2-3 weeks after clinical symptoms and signs of infection have resolved
B) Wounds need to be properly dressed and offloaded
C) Most require some surgical intervention (ranging from minor debridement to major resection or amputation)
D) DFIs with associated ischemia may require revascularization

19) Which of the following are criteria for discharging the patient from the hospital with a DFI?
A) Clinically stable with all recommended surgery completed
B) A well-defined antibiotic post-hospitalization regimen
C) Effective off-loading with specific wound care follow-up
D) All the above

20) Which of the following statements are true?
A) Evidence-based studies show better outcomes in patients with DFIs treated with a multidisciplinary approach and appropriate consultation.
B) Evidence-based studies show no difference in outcomes in patients with DFIs treated with a multidisciplinary approach and appropriate consultation.
C) Foot patho-mechanics have minimal influence on the treatment and outcomes of diabetic foot ulcers (DFUs)
D) Off-loading DFUs is not an important factor in healing plantar wounds.

See answer sheet on page 163.

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EXAM #2/14
Test Your Knowledge of the New IDSA Guidelines for Treatment of Diabetic Foot Infections (DFIs) (Caprioli)

Circle:

1.	A	B	C	D	11.	A	B	C	D
2.	A	B	C	D	12.	A	B	C	D
3.	A	B	C	D	13.	A	B	C	D
4.	A	B	C	D	14.	A	B	C	D
5.	A	B	C	D	15.	A	B	C	D
6.	A	B	C	D	16.	A	B	C	D
7.	A	B	C	D	17.	A	B	C	D
8.	A	B	C	D	18.	A	B	C	D
9.	A	B	C	D	19.	A	B	C	D
10.	A	B	C	D	20.	A	B	C	D

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