Antibiotic Therapy for Diabetic Foot Infection

ACP Montana Chapter Scientific Meeting
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Antibiotic Therapy for Diabetic Foot Infection

- Disclosure: none
2012 Infectious Diseases Society of America Clinical Practice Guideline for the Diagnosis and Treatment of Diabetic Foot Infections

Benjamin A. Lipsky,1 Anthony R. Berendt,2 Paul B. Cornia,3 James C. Pile,4 Edgar J. G. Peters,5 David G. Armstrong,6 H. Gunner Deery,7 John M. Embil,8 Warren S. Joseph,9 Adolf W. Karchmer,10 Michael S. Pinzur,11 and Eric J. Senneville12

1Department of Medicine, University of Washington, Veterans Affairs Puget Sound Health Care System, Seattle; 2Bone Infection Unit, Nuffield Orthopaedic Centre, Oxford University Hospitals NHS Trust, Oxford; 3Department of Medicine, University of Washington, Veteran Affairs Puget Sound Health Care System, Seattle; 4Divisions of Hospital Medicine and Infectious Diseases, MetroHealth Medical Center, Cleveland, Ohio; 5Department of Internal Medicine, VU University Medical Center, Amsterdam, The Netherlands; 6Southern Arizona Limb Salvage Alliance, Department of Surgery, University of Arizona, Tucson; 7Northern Michigan Infectious Diseases, Petoskey; 8Department of Medicine, University of Manitoba, Winnipeg, Canada; 9Division of Pediatric Surgery, Department of Surgery, Roxborough Memorial Hospital, Philadelphia, Pennsylvania; 10Department of Medicine, Division of Infectious Diseases, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts; 11Department of Orthopaedic Surgery and Rehabilitation, Loyola University Medical Center, Maywood, Illinois; and 12Department of Infectious Diseases, Don Hospital, Tours, France
Mr. Jones is a pleasant gentleman with type I diabetes mellitus, known for peripheral vascular disease, who comes to the clinic today to talk about his left foot.
I. In which diabetic patients with a foot wound should I suspect infection, and how should I classify it?
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- Any foot wound!
- Can present with typical signs of inflammation, or can be subtle, such as increased secretions, undermining wound edges, foul odor
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- Left foot peripheral pulses barely palpable
- No systemic toxicity
- No fall odor
- Cloudy drainage from ulcer
## Antibiotic Therapy for Diabetic Foot Infection

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

<table>
<thead>
<tr>
<th>Clinical Manifestation of Infection</th>
<th>PEDIS Grade</th>
<th>IDSA Infection Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>No symptoms or signs of infection</td>
<td>1</td>
<td>Uninfected</td>
</tr>
</tbody>
</table>

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-ostearthropathy, fracture, thrombosis, venous stasis).

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)

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 PaCO₂ <32 mm Hg
- White blood cell count >12 000 or <4000 cells/μL or ≥10% immature (band) forms

<table>
<thead>
<tr>
<th>PEDIS Grade</th>
<th>IDSA Infection Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Mild</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>4</td>
<td>Severe*</td>
</tr>
</tbody>
</table>

Abbreviations: IDSA, Infectious Diseases Society of America; PaCO₂, partial pressure of arterial carbon dioxide; PEDIS, perfusion, extent/size, depth/tissue loss, infection, and sensation; SIRS, systemic inflammatory response syndrome.

* 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 [29, 43, 44].
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- Importantly, the IDSA classification has been prospectively validated [13, 42, 43] as predicting the need for hospitalization (in one study, 0 for no infection, 4% for mild, 52% for moderate, and 89% for severe infection) and for limb amputation (3% for no infection, 3% for mild, 46% for moderate, and 70% for severe infection) [42].
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• Severity of infection: mild to moderate
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II. How should I assess a diabetic patient presenting with a foot infection?

6. We recommend assessing the affected limb and foot for arterial ischemia (strong, moderate), venous insufficiency, presence of protective sensation, and biomechanical problems (strong, low).

7. Clinicians should debride any wound that has necrotic tissue or surrounding callus; the required procedure may range from minor to extensive (strong, low).

LET THE PROS HANDLE THIS!!!!
V. When and how should I obtain specimen(s) for culture from a patient with a diabetic foot wound?

Recommendations

16. For clinically uninfected wounds, we recommend not collecting a specimen for culture (strong, low).

17. For infected wounds, we recommend that clinicians send appropriately obtained specimens for culture prior to starting empiric antibiotic therapy, if possible. Cultures may be unnecessary for a mild infection in a patient who has not recently received antibiotic therapy (strong, low).
18. We recommend sending a specimen for culture that is from deep tissue, obtained by biopsy or curettage after the wound has been cleansed and debrided. We suggest avoiding swab specimens, especially of inadequately debrided wounds, as they provide less accurate results (strong, moderate).

LET THE PROS HANDLE THIS!!!!
Antibiotic Therapy for Diabetic Foot Infection

• Next step: clean with alcohol and unroof lesion, obtain deep swab vs empiric therapy
VI. How should I initially select, and when should I modify, an antibiotic regimen for a diabetic foot infection?

Recommendations

19. We recommend that clinically unininfected wounds not be treated with antibiotic therapy (strong, low).

20. We recommend prescribing antibiotic therapy for all infected wounds, but caution that this is often insufficient unless combined with appropriate wound care (strong, low).
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21. We recommend that clinicians select an empiric antibiotic regimen on the basis of the severity of the infection and the likely etiologic agent(s) (strong, low).
   - For mild to moderate infections in patients who have not recently received antibiotic treatment, we suggest that therapy just targeting aerobic GPC is sufficient (weak, low).
   - For most severe infections, we recommend starting broad-spectrum empiric antibiotic therapy, pending culture results and antibiotic susceptibility data (strong, low).
   - Empiric therapy directed at *Pseudomonas aeruginosa* is usually unnecessary except for patients with risk factors for true infection with this organism (strong, low).
   - Consider providing empiric therapy directed against methicillin-resistant *Staphylococcus aureus* (MRSA) in a patient with a prior history of MRSA infection; when the local prevalence of MRSA colonization or infection is high; or if the infection is clinically severe (weak, low).
23. We suggest basing the route of therapy largely on infection severity. We prefer parenteral therapy for all severe, and some moderate, DFIs, at least initially (weak, low), with a switch to oral agents when the patient is systemically well and culture results are available. Clinicians can probably use highly bioavailable oral antibiotics alone in most mild, and in many moderate, infections and topical therapy for selected mild superficial infections (strong, moderate).

24. We suggest continuing antibiotic therapy until, but not beyond, resolution of findings of infection, but not through complete healing of the wound (weak, low). We suggest an initial antibiotic course for a soft tissue infection of about 1–2 weeks for mild infections and 2–3 weeks for moderate to severe infections (weak, low).
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Table 6. Antibiotic Selection Overview: Questions a Clinician Should Consider

<table>
<thead>
<tr>
<th>Question</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there clinical evidence of infection?</td>
<td>Do not treat clinically uninfected wounds with antibiotics</td>
</tr>
<tr>
<td>For clinically infected wounds consider the questions below:</td>
<td></td>
</tr>
<tr>
<td>- Is there high risk of MRSA?</td>
<td>Include anti-MRSA therapy in empiric regimen if the risk is high (see Table 7) or the infection is severe</td>
</tr>
<tr>
<td>- Has patient received antibiotics in the past month?</td>
<td></td>
</tr>
<tr>
<td>If so, include agents active against gram-negative bacilli in regimen</td>
<td></td>
</tr>
<tr>
<td>If not, agents targeted against just aerobic gram-positive cocci may be sufficient</td>
<td></td>
</tr>
<tr>
<td>- Are there risk factors for <em>Pseudomonas</em> infection?^a</td>
<td></td>
</tr>
<tr>
<td>If so, consider empiric antipseudomonal agent</td>
<td></td>
</tr>
<tr>
<td>If not, empiric antipseudomonal treatment is rarely needed</td>
<td></td>
</tr>
<tr>
<td>- What is the infection severity status?</td>
<td></td>
</tr>
<tr>
<td>See Table 9 for suggested regimens for mild versus moderate/severe infections</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: MRSA, methicillin-resistant *Staphylococcus aureus*.
^a Such as high local prevalence of *Pseudomonas* infection, warm climate, frequent exposure of the foot to water.
# Antibiotic Therapy for Diabetic Foot Infection

## Table 8. Suggested Empiric Antibiotic Regimens Based on Clinical Severity for Diabetic Foot Infections

<table>
<thead>
<tr>
<th>Infection Severity</th>
<th>Probable Pathogen(s)</th>
<th>Antibiotic Agent</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild (usually treated with oral agent[s])</td>
<td><em>Staphylococcus aureus</em> (MSSA); <em>Streptococcus</em> spp</td>
<td>Dicloxacillin</td>
<td>Requires QID dosing; narrow-spectrum; inexpensive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clindamycin(^b)</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Cephalexin</em>(^b)</td>
<td>Requires QID dosing; inexpensive</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Levofloxacin</em>(^b)</td>
<td>Once-daily dosing; suboptimal against <em>S. aureus</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Amoxicillin-clavulanate</em>(^b)</td>
<td>Relatively broad-spectrum oral agent that includes anaerobic coverage</td>
</tr>
<tr>
<td>Methicillin-resistant <em>S. aureus</em> (MRSA)</td>
<td></td>
<td>Doxycycline</td>
<td>Active against many MRSA &amp; some gram-negatives; uncertain against streptococcus species</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trimethoprim/sulfamethoxazole</td>
<td>Active against many MRSA &amp; some gram-negatives; uncertain activity against streptococci</td>
</tr>
</tbody>
</table>
Antibiotic Therapy for Diabetic Foot Infection

- 1 week later
- Culture grew mixed skin flora
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- 2 weeks later
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- 4 weeks later
VIII. How should I diagnose and treat osteomyelitis of the foot in a patient with diabetes?

Recommendations

28. Clinicians should consider osteomyelitis as a potential complication of any infected, deep, or large foot ulcer, especially one that is chronic or overlies a bony prominence (strong, moderate).

29. We suggest doing a PTB test for any DFI with an open wound. When properly conducted and interpreted, it can help to diagnose (when the likelihood is high) or exclude (when the likelihood is low) diabetic foot osteomyelitis (DFO) (strong, moderate).
Diagnostic Accuracy of Probe to Bone to Detect Osteomyelitis in the Diabetic Foot: A Systematic Review

Kenrick Lam,1 Suzanne A. V. van Asten,1,2 Tea Nguyen,1 Javier La Fontaine,1 and Lawrence A. Lavery1

1Department of Plastic Surgery, University of Texas Southwestern Medical Center, Dallas; and 2Department of Internal Medicine, VU University Medical Center, Amsterdam, The Netherlands

(See the Editorial Commentary by Senneville on pages 949–50.)

The probe-to-bone (PTB) test is a commonly used clinical test for osteomyelitis (OM), but its utility has been questioned in clinical settings where the prevalence of OM is low. This article aims to systematically review the accuracy of the PTB test to diagnose diabetic foot OM. We searched Ovid Medline and Scopus databases for studies using the keywords “probe to bone,” “osteomyelitis,” and “diabetic foot” from 1946 to May 2015. We summarized characteristics of the included studies and pooled the accuracy numbers using a bivariate random-effects model. Seven studies met our inclusion criteria. Pooled sensitivity and specificity for the PTB test was 0.87 (95% confidence interval [CI], .75–.93) and 0.83 (95% CI, .65–.93), respectively. We conclude that the PTB test can accurately rule in diabetic foot OM in the high-risk patients and rule out OM in low-risk patients.
Figure 2. Calculated positive and negative predictive values given pooled sensitivity and specificity. An increase in prevalence results in a decrease in negative predictive value (NPV), but an increase in positive predictive value (PPV). The opposite occurs with decreasing prevalence.
31. For a diagnostic imaging test for DFO, we recommend using MRI (strong, moderate). However, MRI is not always necessary for diagnosing or managing DFO (strong, low).

32. If MRI is unavailable or contraindicated, clinicians might consider a leukocyte or antigranulocyte scan, preferably combined with a bone scan (weak, moderate). We do not recommend any other type of nuclear medicine investigations (weak, moderate).
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33. We suggest that the most definitive way to diagnose DFO is by the combined findings on bone culture and histology (strong, moderate). When bone is debrided to treat osteomyelitis, we suggest sending a sample for culture and histology (strong, low).

34. For patients not undergoing bone debridement, we suggest that clinicians consider obtaining a diagnostic bone biopsy when faced with specific circumstances, eg, diagnostic uncertainty, inadequate culture information, failure of response to empiric treatment (weak, low).
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- MRI suggestive of osteomyelitis
- Patient admitted to the hospital for surgery
- Empiric antibiotic regimen?
# Antibiotic Therapy for Diabetic Foot Infection

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Pathogens</th>
<th>Antibiotics</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate (may be treated with oral or initial parenteral agent[s]) or severe (usually treated with parenteral agent[s])</td>
<td>MSSA; <em>Streptococcus</em> spp; Enterobacteriaceae; obligate anaerobes</td>
<td>Levofloxacin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Once-daily dosing; suboptimal against <em>S. aureus</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cefoxitin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Second-generation cephalosporin with anaerobic coverage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ceftriaxone</td>
<td>Once-daily dosing, third-generation cephalosporin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ampicillin-sulbactam&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Adequate if low suspicion of <em>P. aeruginosa</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moxifloxacin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Once-daily oral dosing. Relatively broad-spectrum, including most obligate anaerobic organisms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ertapenem&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Once-daily dosing. Relatively broad-spectrum including anaerobes, but not active against <em>P. aeruginosa</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tigecycline&lt;sup&gt;b&lt;/sup&gt;</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Levofloxacin&lt;sup&gt;b&lt;/sup&gt; or ciprofloxacin&lt;sup&gt;b&lt;/sup&gt; with clindamycin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Limited evidence supporting clindamycin for severe <em>S. aureus</em> infections; PO &amp; IV formulations for both drugs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Imipenem-cilastatin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Very broad-spectrum (but not against MRSA); use only when this is required. Consider when ESBL-producing pathogens suspected</td>
</tr>
</tbody>
</table>
## Antibiotic Therapy for Diabetic Foot Infection

<table>
<thead>
<tr>
<th>MRSA</th>
<th>Linezolid&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Expensive; increased risk of toxicities when used &gt;2 wk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daptomycin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Once-daily dosing. Requires serial monitoring of CPK</td>
</tr>
<tr>
<td>Vancomycin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Vancomycin MICs for MRSA are gradually increasing</td>
<td></td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>Piperacillin-tazobactam&lt;sup&gt;b&lt;/sup&gt;</td>
<td>TID/QID dosing. Useful for broad-spectrum coverage. <em>P. aeruginosa</em> is an uncommon pathogen in diabetic foot infections except in special circumstances (2)</td>
</tr>
</tbody>
</table>

### IDSA Guideline for Diabetic Foot Infections • CID 2012:54 (15 June) • e151

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<table>
<thead>
<tr>
<th></th>
<th>Enterococcus</th>
<th>Staphylococcus IV</th>
<th>Staphylococcus Oral</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AMPICILLIN</td>
<td>VANCOMYCIN</td>
<td>OXAICILLIN</td>
</tr>
<tr>
<td>Enterococcus species (n=163)</td>
<td>94%</td>
<td>95%</td>
<td>-</td>
</tr>
<tr>
<td>Enterococcus faecalis (n=18)</td>
<td>100%</td>
<td>88%</td>
<td>-</td>
</tr>
<tr>
<td>Enterococcus faecium (n=7)</td>
<td>0%</td>
<td>28%</td>
<td>-</td>
</tr>
<tr>
<td>Staphylococcus aureus (n=291)</td>
<td>-</td>
<td>100%</td>
<td>72%</td>
</tr>
<tr>
<td>Staphylococcus aureus - MRSA (n=75)</td>
<td>-</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>Staphylococcus aureus - MSSA (n=216)</td>
<td>-</td>
<td>100%</td>
<td>85%</td>
</tr>
</tbody>
</table>

GRAM POSITIVE ORGANISMS

* Includes hospital and community isolates from all human sources. Duplicates have been removed.

† Indicates antibiotic resistance.
Antibiotic Therapy for Diabetic Foot Infection

<table>
<thead>
<tr>
<th>Gram Negative Organisms</th>
<th>Cefazolin</th>
<th>Ampicillin</th>
<th>Ceftriaxone</th>
<th>Ampicillin/ Sulbactam (Unasyn)</th>
<th>Levofloxacin</th>
<th>Piperacillin Tazo</th>
<th>Ceftazidime</th>
<th>Meropenem</th>
<th>Gentamicin</th>
<th>Tobramycin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli (n=561)</td>
<td>90%</td>
<td>61%</td>
<td>97%</td>
<td>62%</td>
<td>86%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Klebsiella species (n=155)</td>
<td>90%</td>
<td>-</td>
<td>97%</td>
<td>81%</td>
<td>97%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Proteus species (n=35)</td>
<td>93%</td>
<td>79%</td>
<td>98%</td>
<td>89%</td>
<td>88%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Serratia species (n=10)</td>
<td>-</td>
<td>-</td>
<td>100%</td>
<td>-</td>
<td>100%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Haemophilus influenza (n=33)</td>
<td>33% (11/33) identified as β-lactamase positive</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Enterobacter species (n=60, cloacae = 49)</td>
<td>-</td>
<td>-</td>
<td>79%</td>
<td>-</td>
<td>100%</td>
<td>-</td>
<td>77%</td>
<td>98%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa (n=85)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>90%</td>
<td>-</td>
<td>97%</td>
<td>100%</td>
<td>96%</td>
<td>97%</td>
</tr>
</tbody>
</table>
Secondary Skin and Soft Tissue Infection: Diabetic Foot Infections

Diabetic Foot Infections (DFI)
Defined to include the following factors:
• Wound
• Neuropathy
• Poor glycemic control
• Vascular insufficiency
*If patient does not meet criteria: treat with Primary ABSSTI Algorithm

Nonpharmacological Therapy
• Cleansing, debridement, and culture
• Assessment of underlying issues (e.g., osteomyelitis, vascular insufficiency etc.)
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Mild DFI: erythema <2cm around ulcer

No MRSA Risk
- Dicloxacillin or
- Cephalexin or
- Cefuroxime
- Severe allergy to Beta-Lactam use
- Clindamycin

MRSA Risk
- Sulfamethoxazole/Trim plus Amoxicillin/Clav
- Doxycycline plus Amoxicillin/Clav
- Severe allergy to β-lactam and Sulfa, call ID
Antibiotic Therapy for Diabetic Foot Infection

Moderate DFI/ Erythema > 2 cm around ulcer or involving structures deeper than skin/ Consider hospitalization or first dose to be IV

- No MRSA Risk
  - PO: Sulfamethoxazole/Trim plus either Amoxicillin/Clav or Clinda (in case of severe allergy to Beta-lactam)
  - In case of Pseudomonas risk factors or severe allergy to Sulfa: use Cipro instead of Sulfamethoxazole/Trim

- MRSA Risk
  - PO: Either Sulfamethoxazole/Trim or Doxycycline plus either Amoxicillin/Clav or Clinda (in case of severe allergy to Beta-lactam)
  - In case of Pseudomonas risk factors or severe allergy to Sulfa: use Cipro instead of Sulfamethoxazole/Trim or Doxy

IV therapy for moderate infections:
- Ampicillin/Sulbactam alone or Ceftriaxone plus Metronidazole
  - In case of Pseudomonas risk factors
- Piperacillin/Tazobactam alone or Cefepime plus Metronidazole
  - Add Vanco in case of MRSA risk factors
  - Severe allergy to Beta-lactam, consider ID consult
Antibiotic Therapy for Diabetic Foot Infection

**DEFINITION OF SEVERE:**
- Immunocompromised: patients with malignancy on chemotherapy, neutropenia, severe cell-mediated immunodeficiency
- Deep infection
- Immersion injuries
- Sepsis or Shock
- Organ dysfunction
- Failed oral therapy/ I&D

**Severe DFI: limb or life threatening**

- Vancomycin plus Piperacillin/Tazobactam
- Vancomycin plus Cefepime plus Metronidazole
- Severe allergy\(^3\) to Beta-lactam, consider ID consult
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1. MRSA risk: history of MRSA infection, antibiotic use or previous hospitalization within 1-3 months, hemodialysis, HIV infection, IVD, residence in a long-term care facility.
2. To provide Streptococcus coverage.
3. Severe Allergy reactions: hives, swelling of tongue, lips, eyes, nasal passages or throat, wheezing/shortness of breath, anaphylaxis, documented arrhythmias or hypotension or unknown or does not remember.
4. Previous Pseudomonas infection, warm climate, frequent exposure of the foot to water such as soaking.
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- Patient undergoes revision of transmetatarsal amputation, with clean bone margin, no residual osteomyelitis
- Definitive therapy?

![Table showing antibiotic susceptibilities for Staphylococcus lugdunensis](image)
Antibiotic Therapy for Diabetic Foot Infection

Table 11. Suggested Route, Setting, and Duration of Antibiotic Therapy, by Clinical Syndrome

<table>
<thead>
<tr>
<th>Site of Infection, by Severity or Extent</th>
<th>Route of Administration</th>
<th>Setting</th>
<th>Duration of Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft-tissue only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>Topical or oral</td>
<td>Outpatient</td>
<td>1–2 wk; may extend up to 4 wk if slow to resolve</td>
</tr>
<tr>
<td>Moderate</td>
<td>Oral (or initial parenteral)</td>
<td>Outpatient/ inpatient</td>
<td>1–3 wk</td>
</tr>
<tr>
<td>Severe</td>
<td>Initial parenteral, switch to oral when possible</td>
<td>Inpatient, then outpatient</td>
<td>2–4 wk</td>
</tr>
</tbody>
</table>
### Antibiotic Therapy for Diabetic Foot Infection

<table>
<thead>
<tr>
<th>Bone or joint</th>
<th>Possible</th>
<th>Therapy</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>No residual infected tissue (eg, postamputation)</td>
<td></td>
<td>Parenteral or oral</td>
<td>2–5 d</td>
</tr>
<tr>
<td>Residual infected soft tissue (but not bone)</td>
<td></td>
<td>Parenteral or oral</td>
<td>1–3 wk</td>
</tr>
<tr>
<td>Residual infected (but viable) bone</td>
<td></td>
<td>Initial parenteral, then consider oral switch</td>
<td>4–6 wk</td>
</tr>
<tr>
<td>No surgery, or residual dead bone postoperatively</td>
<td></td>
<td>Initial parenteral, then consider oral switch</td>
<td>≥3 mo</td>
</tr>
</tbody>
</table>
Antibiotic Therapy for Diabetic Foot Infection
Antibiotic Therapy for Diabetic Foot Infection

- 2 days later
Antibiotic Therapy for Diabetic Foot Infection

- 1 week later
Patient admitted to the hospital for surgery
Empiric antibiotic regimen?
Antibiotic Therapy for Diabetic Foot Infection

Moderate DFI / Erythema > 2 cm around ulcer or involving structures deeper than skin / Consider hospitalization or first dose to be IV

No MRSA Risk

- PO: Sulfamethoxazole/Trim plus either Amoxicillin/Clav or Clinda (in case of severe allergy to Beta-lactam)
- In case of Pseudomonas risk factors or severe allergy to Sulfa: use Cipro instead of Sulfamethoxazole/Trim

MRSA Risk

- PO: Either Sulfamethoxazole/Trim or Doxycycline plus either Amoxicillin/Clav or Clinda (in case of severe allergy to Beta-lactam)
- In case of Pseudomonas risk factors or severe allergy to Sulfa: use Cipro instead of Sulfamethoxazole/Trim or Doxy

IV therapy for moderate infections:

- Ampicillin/Sulbactam alone or Ceftriaxone plus Metronidazole
- In case of Pseudomonas risk factors
- Piperacillin/Tazobactam alone or Cefepime plus Metronidazole
- Add Vanco in case of MRSA risk factors
- Severe allergy to Beta-lactam, consider ID consult
Antibiotic Therapy for Diabetic Foot Infection

- Patient started on Unasyn
- Patient undergoes revision amputation of distal phalanx of right great toe
- Definitive therapy?
Antibiotic Therapy for Diabetic Foot Infection

Culture
- 2+ Brevundimonas species
- 2+ Mixed flora (multiple morphologies present)
  Consistent with skin flora.

BREVUNDIMONAS SP ARE KNOWN PLANT PATHOGENS AND INFREQUENTLY CAUSE HUMAN INFECTION. B.VESICULARIS BACTEREMIA HAS BEEN REPORTED IN PATIENTS WITH UNDERLYING ILLNESS. B.DIMUNTA HAS BEEN RECOVERED FROM BLOOD, URINE, AND PLEURAL FLUID FROM PATIENTS WITH CANCER.
Antibiotic Therapy for Diabetic Foot Infection
Antibiotic Therapy for Diabetic Foot Infection

- Treatment?
Antibiotic Therapy for Diabetic Foot Infection

- 1 month later…
- Acute onset of redness, pain
- Admitted to the hospital with purulent drainage
- Empiric therapy?
Antibiotic Therapy for Diabetic Foot Infection

Moderate DFI/ Erythema > 2 cm around ulcer or involving structures deeper than skin/ Consider hospitalization or first dose to be IV

No MRSA Risk
- PO: Sulfamethoxazole/Trim plus either Amoxicillin/Clav or Clinda (in case of severe allergy to Beta-lactam)
  - In case of Pseudomonas risk factors or severe allergy to Sulfa: use Cipro instead of Sulfamethoxazole/Trim

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- Piperacillin/Tazobactam alone or Cefepime plus Metronidazole
  - Add Vanco in case of MRSA risk factors
  - Severe allergy to Beta-lactam, consider ID consult
Antibiotic Therapy for Diabetic Foot Infection

- S/p partial 5th ray amputation with residual osteomyelitis
- Therapy?
Antibiotic Therapy for Diabetic Foot Infection

Culture

4+ Corynebacterium striatum !
2+ Enterococcus species !

Corynebacterium striatum:
C. STRIATUM ARE PART OF THE NORMAL SKIN FLORA BUT CAN BE IMPORTANT OPPORTUNISTIC PATHOGENS, ESPECIALLY IN DIABETIC CHRONIC WOUNDS AND OSTEOMYELITIS.

Stain

2+ Gram positive cocci in pairs
1+ White blood cells, polymorphonuclear

Resulting Agency: MSP

Susceptibility

<table>
<thead>
<tr>
<th>Enterococcus species</th>
<th>Ampicillin</th>
<th>Erythromycin</th>
<th>Penicillin G</th>
<th>Vancomycin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Specified</td>
<td>&lt;=2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Sensitive</td>
<td>Intermediate</td>
<td>Sensitive</td>
<td>Sensitive</td>
</tr>
</tbody>
</table>
Antibiotic Therapy for Diabetic Foot Infection

- 2 weeks later
- Treatment?
Antibiotic Therapy for Diabetic Foot Infection

**DEFINITION OF SEVERE:**

- Immunocompromised: patients with malignancy on chemotherapy, neutropenia, severe cell-mediated immunodeficiency
- Deep infection
- Immersion injuries
- Sepsis or shock
- Organ dysfunction
- Failed oral therapy/ I&D

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**Severe DFI: limb or life threatening**

- Vancomycin plus Piperacillin/Tazobactam
- Vancomycin plus Cefepime plus Metronidazole
- Severe allergy³ to Beta-lactam, consider ID consult
Antibiotic Therapy for Diabetic Foot Infection

- Started on Vancomycin and Unasyn
- Culture growing non-lactose fermenting gram negative rods
- ABX adjustments?
**Antibiotic Therapy for Diabetic Foot Infection**

### Culture

3+ *Pseudomonas aeruginosa*

Consider therapy with maximum doses of an anti-pseudomonal penicillin (carboxypenicillin or ureidopenicillin) or ceftazidime in combination with an aminoglycoside for serious infections. This organism is known to possess inducible beta-lactamases. Isolates may become resistant to all cephalosporins after initiation of therapy. Avoid beta-lactam/beta-lactamase inhibitor combinations.

### Stain

1+ Gram negative rods
3+ White Blood Cells
No squamous epithelial cells seen

**Resulting Agency:** MSP

### Susceptibility

<table>
<thead>
<tr>
<th></th>
<th>Pseudomonas aeruginosa</th>
<th>Serratia marcescens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not Specified</td>
<td>Not Specified</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>&lt;=1 Sensitive</td>
<td>&lt;=1 Sensitive</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>&gt;=4 Resistant</td>
<td>&gt;=4 Resistant</td>
</tr>
<tr>
<td>Cefepime</td>
<td>&lt;=1 Sensitive</td>
<td>&lt;=1 Sensitive</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>&lt;=1 Sensitive</td>
<td>&lt;=1 Sensitive</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>32 Resistant</td>
<td>&lt;=1 Sensitive</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>&lt;=1 Sensitive</td>
<td>&lt;=1 Sensitive</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>0.5 Sensitive</td>
<td>1 Sensitive</td>
</tr>
<tr>
<td>Meropenem</td>
<td>0.5 Sensitive</td>
<td>&lt;=0.25 Sensitive</td>
</tr>
<tr>
<td>Piperacillin + Tazobactam</td>
<td>&lt;=4 Sensitive</td>
<td>&lt;=4 Sensitive</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>&lt;=1 Sensitive</td>
<td>&lt;=1 Sensitive</td>
</tr>
<tr>
<td>Trimethoprim + Sulfamethoxazole</td>
<td>&lt;=20 Sensitive</td>
<td>&lt;=20 Sensitive</td>
</tr>
</tbody>
</table>
Antibiotic Therapy for Diabetic Foot Infection

- PROCEDURES:
  - 1. Revision partial forefoot amputation with resection 4th toe and distal metatarsal and plastic revision closure of wound after debridement and copious irrigation.
  - 2. Left foot ulcer site plastic revision closure after debridement and lavage.
  - No residual bone infection
  - Treatment?
Antibiotic Therapy for Diabetic Foot Infection

- Assess all diabetics for wound infection
- Antibiotic therapy tailored to clinical presentation
- Assess for underlying osteomyelitis in case of non-healing wound
- Assess all patient for peripheral vascular disease