AHD: Antibiotics

Facilitator Guide

Case 1

An 68 year-old male with congestive heart failure, atrial fibrillation, on warfarin, chronic lower extremity edema, diabetes mellitus and end-stage renal disease treated with intermittent hemodialysis through a tunneled right internal jugular central venous catheter presents to the emergency room with abrupt onset of right lower extremity pain associated with redness and swelling that evolved over a period of several hours

The patient has a low-grade temperature (99.9°F) at presentation but is otherwise hemodynamically stable. His white blood cell count (WBC) is slightly elevated (10.6 cells/µL)

1. **What is the most likely diagnosis? What else is on your differential?**

This patient has **non-purulent cellulitis**: Cellulitis manifest as areas of skin erythema, edema, and warmth; they develop as a result of bacterial entry via breaches in the skin barrier. Petechiae and/or hemorrhage can be seen in erythematous skin, and superficial bullae can occur. Fever and other systemic manifestations of infection may also be present. Cellulitis and erysipelas are nearly always unilateral, and the lower extremities are the most common site of; bilateral involvement should prompt consideration of alternative causes. Discuss the difference between purulent and non-purulent.

2. **How do you describe the pictures attached, which are more consistent with infection vs other etiologies?**

Deep venous thrombosis: Swelling or edema – 97 and 33 percent, Pain – 86 and 19 percent, Warmth – 72 and 48 percent. Use history to assist in this diagnosis/risk stratification

Venous stasis dermatitis: Stasis dermatitis typically presents with erythematous, scaling, and eczematous patches or plaques on chronically edematous legs. The medial ankle is most frequently and severely involved, although the skin changes may extend up to the knee and down to the foot. Pruritus is variable but, when present, results in lichenification from chronic scratching or rubbing.

3. **What is the most likely causative pathogen?**

The lesion's visual appearance coupled with rapidity of onset is most consistent with an infection caused by a streptococcal species (*S. pyogenes* >> Group B Strep > Group C Strep).

Cellulitis involves the deeper dermis and subcutaneous fat; **erysipelas** involves the upper dermis and superficial lymphatics. Cellulitis may present with or without purulence; erysipelas is nonpurulent. Patients with cellulitis tend to have a more indolent course with development of localized symptoms over a few days. **Patients with erysipelas generally have acute onset of symptoms with systemic manifestations, including fever, chills, severe malaise, and headache**; these can precede onset of local inflammatory signs and symptoms by minutes to hours. In erysipelas, there is clear demarcation between involved and uninvolved tissue.

4. **What other pieces of history would you want to obtain from this patient?**

Has he failed outpatient therapy, with what? Any additional risk factors for weird bugs: **Laceration in fresh water**: *Aeromonas hydrophila* **Laceration in brackish water with Liver Failure**: *Vibrio* species **Penetrating foot wounds**: *Pseudomonas aeruginosa*

5. **Does the patient need to be hospitalized?**

The decision to hospitalize a patient with cellulitis is influenced by patient comorbidity, presence/absence of systemic signs of infection as well as the need for IV therapy and skilled nursing care. Patients who lack systemic symptoms, altered mental status, or hemodynamic instability do not routinely require admission. **Admission should be considered if signs of more severe infection are present, there is concern for poor adherence to therapy, or if the patient has significant medical comorbidities.**

Due to our patient's medical comorbidities (congestive heart failure, diabetes mellitus and end-stage renal disease) and signs of systemic infection (elevated WBCs) it would be reasonable to admit him for observation

6. **What antibiotics should be used?**

<u>Oral regimens</u>

For this patient, we are concerned about gram positives, specifically Strep. Cephalexin would be DOC.

<u>IV regimens</u>

Using a narrow-spectrum beta-lactam agent such as penicillin, cefazolin or oxacillin (or clindamycin in a patient with a true penicillin allergy) are reasonable options for a hospitalized patient with non-purulent cellulitis.

Once-daily ceftriaxone is a consideration for ease-of-use in care settings with limited nursing resources (*e.g.*, home therapy, infusion clinics, long-term care settings) but is a broader regimen that may carry a higher risk of *C. difficile* infection. (BECAUSE IT KILLS YOUR GNRS IN GUT).

AVOID: Tetracycline-derivatives (doxycycline, minocycline) and (TMP-SMX), while having good oral bioavailability, are primarily staphylococcal drugs with poorly defined streptococcal activity. Consequently, they are not good choices for non-purulent cellulitis.

The respiratory fluoroquinolones (levofloxacin, moxifloxacin) have good activity against streptococci but are unnecessarily broad and pose a greater risk of subsequent *Clostridium difficile* infection than the beta-lactam options noted.

7. **When would you add coverage for MRSA?**

For patients with penetrating trauma, nasal colonization with MRSA, injection drug use, or signs of systemic infection, an agent effective against MRSA and streptococci (*i.e.*, vancomycin) is recommended. *Almost 50% of staph aureus in Cincinnati is MRSA. About 30% of Cincinnati MRSA is resistant to clindamycin*

8. **What else can we do to help him feel better and accelerate the clinical response?**

Minimization of edema is an important aspect of treating cellulitis. Elevate legs.

Compression stockings are often too painful to use with acute presentations but wraps with an ace bandage are generally well tolerated and should be applied before ambulating and whenever the patient will be immobile for prolonged periods of time.

9. **The above patient was started on intravenous cefazolin, they defervesced and remained clinically stable. After 48 hours of antibiotics, however, the redness and discomfort in the pre-tibial region and medial aspect of the thigh have not yet receded. What next?**

Continue current therapy. The tissue inflammation that occurs with cellulitis can persist, even after eradication of the causative pathogen. Tissue inflammation often worsens in the first 12-24 hours of therapy. Consider marking the area of involvement at initial presentation and reassessing the morning after initial presentation (which is generally <24 hours after starting antibiotic therapy). Remark the area if there has been some extension and simply continue to observe as long as the patient looks well otherwise.

10. **How long would you wait until you would consider expanding therapy?**

There is extension of inflammation beyond the second line of demarcation on day 2 of therapy. Progressive signs and symptoms of systemic infection. **The area of inflammation does not begin to recede after 72 hours of therapy.**

11. **How long should this infection be treated with antibiotics?**

There is only one published trial that has examined the length of treatment for cellulitis. This study found no difference in outcomes if patients were treated with antibiotics for 5 days versus 10 days. The vast majority of patients with non-purulent cellulitis can be treated with 5 days of therapy, even those who require hospitalization, as long as there has been a demonstrable response to therapy. The length of therapy should be extended if the infection has not improved in this time. It is not unusual for tissue inflammation to persist for weeks after the initial infection and in and of itself is not an indication to continue therapy

Signs of a demonstrable treatment response are:

1. Receding erythema (resolution not necessary);
2. Improvement in pain
3. Resolution of signs of systemic inflammation (fever, leukocytosis

12. **<u>Pretend they didn't get better</u>: After 36 hours on cefazolin, his area of swelling has worsened and he is still febrile. What do you think is happening and what will you do?**

"wrong bug, wrong drug, wrong diagnosis"

Wrong diagnosis: ***does he really have a DVT?*** *If he has not had a LE doppler yet, he should now.*

Ask them about nec fasc – how does it present, what exam findings and lab findings do you look for?

Nec Fasc is always a consideration in patients who present with a rapidly evolving skin/soft tissue process. Patients with necrotizing fasciitis are almost always systemically ill (often described as "out of proportion to exam findings") at presentation due to systemic release of pro-inflammatory cytokine-inducing exotoxins. While the patient in this scenario is suffering from a significant localized soft tissue process, he is not toxic appearing which argues against a diagnosis of necrotizing fasciitis.

- Pain out of proportion to physical exam
- Edema, induration or pain beyond area of apparent skin involvement
- Violaceous blisters or bullae, Pale or mottled skin, Skin Anesthesia, Crepitus, Skin necrosis or ecchymosis, Rapid progression, Failure to respond to initial antibiotics
- Systemic toxicity, Multi-organ failure

If you were worried about necrotizing fasciitis what labs would you get?

- **Elevated leukocyte count** non-specific but suggests presence of infection, with markedly elevated counts with left shift suggesting deep seated or aggressive infection. Thrombocytopenia suggests more severe infection
- **Elevated lactate** indicates presence tissue/organ underperfusion (e.g. sepsis) and/or possible tissue necrosis
- **Elevated CPK** indicates presence of myonecrosis and may be elevated in necrotizinog fasciitis. Also frequently elevated in Vibrio vulnificans infection

How would you change your plan?

- Initiate antibiotics and surgical debridement promptly'
- If uncertainty can get CT with contrast to evaluate further (but don't delay surgery consult!)
- Use broad spectrum empirical antibiotic therapy
- Add clindamycin to inhibit toxin production
- Obtain tissue cultures in the operating room to help guide definitive antimicrobial therapy
- Most patients will require multiple operations until all necrotic tissue has been debrided

13. ***His blood cultures are positive for MRSA. He should be switched to vancomycin.*** **He tells you last time he got vancomycin, he got a very hot rash and he doesn't think he should get it again. What are potential side effects? Can he get it? How do you dose and manage the vancomycin?**

- *Red man syndrome: histamine related reaction during infusion, can manage with Benadryl and slowing down rate*
- *Vancomycin is time and concentration-dependent. We want it to stay above the MIC.*
- ***Goal trough****:*
  - *10-15 should be adequate for soft tissue infections*
  - *15-20 for deep-seated infections and sepsis (endocarditis, osteomyelitis, meningitis).*

- *In patients with normal renal function, a reasonable starting regimen is 15mg/kg Q8H.*

14. **What other antibiotics can be used if they are allergic to Vanc or if it is VISA (Vanc intermediate Staph)?**

- *First, make sure they have a real allergy (not Red man)*
- *Linezolid – technically bacteriostatic but performed better head to head with daptomycin for enterococcus. However, no good data for Staph*
- *Daptomycin – where does this not work? In the lung because inactivated by surfactant*
- *Telavancin (no different from vanc in allergy or sensitivity), ceftaroline, minocycline*

Case 2

52 yo female with a PMH of HTN, COPD, DMII presents to the ED complaining of frequent urination, burning when she urinates and lower abdominal pain for the past 2 days. No fevers, chills, flank pain, nausea, vomiting or CVA tenderness. She has a normal renal panel. Based off her urinalysis and symptoms you diagnose her with acute uncomplicated cystitis.

1. **What are the most common organisms to cause uncomplicated cystitis?**

- *Escherichia coli (75 to 95 percent)*
- *Proteus mirabilis, Klebsiella pneumonia, or Staphylococcus saprophyticus*

2. **What are the recommendations for treating uncomplicated cystitis?**

COST SAVING: In healthy women without risk factors for infections with drug resistant organisms such as recent antibiotic use (e.g. within the last 3 months) a confirmatory urine culture may not be necessary. Clinical evidence indicates that women with >2 symptoms suggestive of a UTI as well as no evidence of vaginitis had a >90% probability of a UTI.

Generic Guidelines would say the following but remember all of this should be interpreted within the context of our Antibiograms at LHH:

- *Nitrofurantoin for 5 days,*
- *Bactrim for 3 days,*
- *Fosfomycin 3 g single dose*
- *Cipro and Levo are great but should be reserved for cases when you can't use above*
  - *FQ resistance rates as high as 50% at LHH*
- *Amoxicillin-clavulanate, cefpodoxime, cefdinir and cefaclor are ok for 7 days but not as effective*
- *Keflex even less studied, Amox – don't use*

3. **Name some factors (at least 10) that make a UTI complicated? What does a "complicated" UTI mean?**

"Complicated" means you are at Increased risk of failing therapy

- *Diabetes, Pregnancy, renal transplant or Immunosuppressed*
- *Symptoms for seven or more days before seeking care*
- *Hospital acquired, indwelling catheter, stent, nephrostomy tube, or recent instrumentation*
- *Renal failure, obstruction, functional or anatomic abnormality of the urinary tract,*
- *History of urinary tract infection in childhood*

4. **What additional bugs must you think about in complicated cystitis?**

- *Pseudomonas, Serratia, Providencia, enterococci, staphylococci*
- *Staph bacteruria represent staph bacteremia until proven otherwise*

5. **If she presented with fever and R-sided flank pain how would your differential and management change? How do you treat acute uncomplicated pyelonephritis?**

- Oral (PO) ciprofloxacin or levofloxacin 5-7d
- PO trimethoprim/sulfamethoxazole *is acceptable alternative but often they should receive an initial IV dose of Rocephin or aminoglycoside.*7-10d
- PO amoxicillin/clavulanate – 10-14d
- *REMEMBER: nitrofurantoin is not active in kidney tissue and cannot be used to treat pyelo*
- ***Inpatient** – FQ, aminoglycoside +/- ampicillin, extended spectrum penicillin, cephalosporin or carbapenem. Based on local resistance data.*

6. **The patient is unable to tolerate PO and appears significantly dehydrated. She is admitted for IV Antibiotics. Her blood cultures come back positive for Gram Negative Rods and later speciates to Pan Sensitive E. Coli. How does this change your management?**

This patient now has **Gram negative bacteremia.** The source is likely her pyelonephritis which would've been treated with a CTX for 5-7d, this will likely extend her duration of antibiotics.

Duration of therapy should be determined by the clinical response of the patient in addition to the primary source and extent of infection. In most cases, the duration of antibiotic therapy is 7 to 14 days. For patients with uncomplicated Enterobacteriaceae bacteremia who respond appropriately to antibiotic therapy (eg, no underlying endovascular, bone, joint, or CNS infection, no uncontrolled source of infection, no major immunocompromising condition, and with clinical improvement within 48 to 72 hours), we suggest a 7- rather than 14-day course. Initially, antibiotics should be given parenterally, but in select patients who have defervesced and remained afebrile for 48 hours, antibiotics may be switched to an oral agent with excellent bioavailability if the isolate is susceptible.

7. **How is the treatment of GN bacteremia different from GP bacteremia?**

Determination of treatment duration requires differentiation of patients with uncomplicated S aureus bacteremia (similar to Strep Bacteremia) (who may be cured with 14 days of intravenous therapy from the first negative blood culture) from patients with complicated S. aureus bacteremia (who require longer duration of intravenous treatment)

- Infective endocarditis has been excluded via echocardiography – all patient's with SA bacteremia
- No indwelling devices (such as prosthetic heart valves or vascular grafts) are present.
- Follow-up blood cultures drawn two to four days after initiating intravenous antistaphylococcal therapy and removing the presumed focus of infection (if present) are negative.
- The patient defervesced within 48 to 72 hours after initiating intravenous antistaphylococcal therapy and removal of the presumed focus of infection (such as debridement of soft tissue infection or intravascular catheter removal).
- There is no evidence of metastatic staphylococcal infection on physical examination.

Case 3

A healthy 24-year-old F student comes to your office complaining of localized pain and swelling over the medial aspect of her left forearm. She reports that she had a scratch injury to this area a few days before. She is otherwise healthy with no current medications or recent hospitalizations. On examination, you find a 7 cm localized area of tenderness and swelling. The central area is fluctuant, surrounded by an area of erythema and induration. Vitals are stable.

1. **What is the diagnosis and what is the best treatment?**

- *Abscess = area of induration with central fluctuance. Erythema, warmth, tenderness*
- *I&D is sufficient unless he is immunocompromised or area greater than 5 cm*

2. **In what cases would you recommend adding antibiotics?**

- *Severe or extensive disease (involving multiple sites of infection), Rapid progression with associated cellulitis, signs of sepsis, comorbidities or immunosuppression, extremes of age, areas difficult to drain, lack of response to the initial I&D, surrounding cellulitis >2cm.*

3. **If you plan to treat with antibiotics, what bugs are you targeting? What antibiotics would you use?**

Purulent SSTI more likely to be staphylococci, including MRSA.

Bactrim: *– inhibits folate and DNA synthesis. Bacteriocidal. Caution with renal insufficiency, can cause SJS, and marrow suppression.*
Clindamycin *– 50S ribosome. Bacteriostatic. GI side effects. Great tissue penetration.*
Doxycycline *– 50 and 30S ribosome. Bacteriostatic. Not good serum conc so not good for invasive infx. Poor Strep coverage. Does cross BBB.*
Linezolid *– inhibits 50S. Bacteriostatic. Great PO bioavailability. Weak inhibitor of MAO so beware of serotonin syndrome with SSRI's.*

4. ***You start bactrim and your patient has an increase in their creatinine, what should you do****?*

    - *TMP aspect of bactrim inhibits the secretion of creatinine and thus results in an elevated Cr (typically around 0.3) but does not represent a true change in GFR. It should reach a new steady state in 2-3 days. If not this would truly be worrisome.*

- Doxy/Bactrim have poor activity against streptococci, combining one of these drugs with an anti-streptococcal beta-lactam (penicillin, amoxicillin, dicloxacillin or cephalexin) would be appropriate if there were clinical concern for a streptococcal infection.

5. **How would your choice change if the person had an EF of 20%?**

Be cautious about giving them bactrim, in addition to affecting the Cr, it also interferes with potassium excretion, remind people that this EF implies that they are on and ACEi/ARB and Sprionolactone which puts them at significant risk for hyperkalemia.

Case 4

A 68-year-old nursing home resident is referred to you by her nurse for an ulcer on the bottom of her right foot. The resident has a history of poorly controlled diabetes complicated by stage III chronic kidney disease, retinopathy and neuropathy. She has experienced several foot infections involving both feet in the past with at least one of these infections caused by methicillin-resistant *Staphylococcus aureus* (MRSA). These healed without the need for surgical intervention. She reports long-standing callouses underneath the balls of both feet for several months.

On exam, the patient is afebrile and hemodynamically stable. Her foot reveals a 1x1.5cm ulcer underneath the 3rd MTP joint. There is no surrounding erythema, minimal wound drainage and an absence of any fullness in the midfoot.

1. **What would make you worry this ulcer/wound is infected?**

Review in Diabetes Care 2006 (Lavery et al.) that examined this by following 1600 diabetic patients, they found the following relative risk of an infection in a diabetic foot ulcer.

These were the strongest:

- Wound depth to bone by probe: RR = 6.7 (ask them what probe-to-bone means)
- Wound duration > 30 days: RR = 4.7
- Recurrent foot wound: RR = 2.4
- Traumatic wound etiology: RR = 2.4
- Peripheral vascular disease: RR = 1.9
- *Also RR > 2.0: Loss of protective sensation, history of walking barefoot, Renal insufficiency*

2. **How would you manage this patient?**

This resident has an **uninfected** diabetic foot ulcer. Antibiotics are not wound care agents and treating this patient with antibiotics would only unnecessarily expose her to adverse effects and risk of *Clostridium difficile* diarrhea. Non-antimicrobial management is a critical aspect of care, even in a people with clear evidence of infection. This should involve:

1. Careful measurement of wound size and depth

2. Adequate debridement of necrotic debris and surrounding callous

3. Selection of appropriate wound care, off-loading the involved area of the foot

5. Determining if arterial insufficiency is a contributing factor. If there are no palpable pulses Vascular should be consulted to discuss restoration of flow EVEN IF THERE IS A DOPPLERABLE PULSE

6. **Plain film imaging** - *All patients with infected diabetic foot ulcers should get plain radiographs to look* ***for bony abnormalities (deformity, destruction), soft tissue gas and radio-opaque foreign bodies***

Exam of the resident's extremity demonstrates intact dorsalis pedis and posterior tibial arterial pulses. Monofilament testing demonstrates loss of sensation to the pre-tibial region bilaterally. Her wound was sharply debrided in clinic and the callous on the contralateral foot was similarly debrided. Her wound was packed with an alginate primary dressing and sterile gauze secondary dressing and was scheduled to be changed every 48 hours.

Plain films of the foot are negative for subcutaneous gas, foreign body or any evidence of underlying osteomyelitis. She was also provided with a hind-foot walker shoe to offload the forefoot. At her 1-week

follow-up, the resident's wound was stable. A 2-week follow-up was cancelled and the resident now presents with redness and drainage from the wound.

By report, the resident's wound began to drain more about a week ago but this was not conveyed to her medical providers. Except for the erythema surrounding the wound, the resident's exam is otherwise unchanged. The resident is afebrile and hemodynamically stable with a borderline WBC count (10.3 cells/μL) and C-reactive protein (CRP; 2.5 mg/dL). Repeat plain films are unchanged from baseline.

3. **What is your clinical impression and how would you manage the patient now? What bugs are you covering for? What antibiotics would you consider?**

The resident has developed **a mild** diabetic foot ulcer (DFU) infection. Infections associated with new wounds are **almost always caused by gram-positive organisms**. Gram-negative organisms and anaerobes are more prevalent in chronic wounds as well as wounds associated with significant amounts of tissues maceration and necrosis.

IDSA Definition of DFI Severity

Mild DFI	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.
Moderate DFI	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
Severe DFI	Local and >2 SIRS criteria (Fever, tachycardia, tachypnea, leukocytosis)

IDSA Treatment Recs:

Mild-Moderate DFI	Recs to cover Staph/Strep (weak/low recommendation) in those who have not gotten abx. It is reasonable include coverage for non-pseudomonal gram-negative bacteria (amoxicillin-clavulanate OR a combination of an anti-staphylococcal beta-lactam plus TMP-SMX) in those patients whose wounds are macerated or exhibit significant amounts of necrotic debris. 1-2 weeks
Severe DFI	Broad spec and narrow based on culture results. 2-3 weeks
MRSA DFI	If prior history of MRSA, or high prevalence of MRSA in the community
Pseudomonal DFI	Empiric therapy unnecessary unless risk factors present: previous Pseudomonas infection, warm climate, frequent exposure of the foot to water.

4. **Should you culture the wound?**

Cultures of diabetic wounds are always colonized with bacteria and culturing wounds in patients without clinical findings suggestive of an infection is discouraged.

Wound cultures can be helpful in selecting antibiotic therapy in patients with signs/symptoms of infection, primarily for their negative predictive value. Providers can safely limit the use of anti-MRSA and anti-pseudomonal antibiotic therapy if wound cultures are negative for these organisms.

Good culture technique (*i.e.*, going after frank pus or deep tissue) is essential. Wound cultures should only be performed after debriding the wound.

Given the resident's prior history of MRSA, she was prescribed TMP-SMX alone and wound cultures were not obtained. Unfortunately, she did not improve and became increasingly confused leading to a transfer to the Emergency Department. On presentation, the resident was febrile (101.8°F) and tachycardic. There is new fullness in the midfoot on exam. Her WBCs are elevated (12.5 cell/µL) as is her CRP (8 mg/dL).

5. **How would you manage this patient now? What are you treating for? What antibiotics would you consider?**

She has a severe diabetic foot infection based on systemic symptoms, the extent of erythema and the presence of new fullness in the midfoot, which is concerning for an abscess. This resident should be admitted to the hospital for initiation of IV antibiotic therapy, imaging (MRI) to assess for an abscess, and surgical consultation for possible debridement. Prior to starting antibiotics, blood cultures and wound cultures should be collected.

Vancomycin + ceftriaxone (with metronidazole if there a significant amount of necrotic tissue present) is a good first-line regimen.

Vancomycin + ampicillin/sulbactam is a reasonable alternative.

Vanc + zosyn is ok but will put at risk of kidney injury.

Daptomycin can be used in place of vancomycin if the patient has a vancomycin allergy or fluctuating renal function that makes dosing of vancomycin difficult

6. **Do you need Pseudomonas coverage?**

Pseudomonas remains an unusual pathogen in most diabetic foot infections. It is not necessary to routinely utilize an anti-pseudomonal agent in patients with diabetic foot infections unless they are in septic shock, have exam features consistent with Pseudomonas (e.g., greenish exudate or copious sweetish smelling drainage) or have a recent history of cultures positive for Pseudomonas

Following surgical debridement and a brief hospitalization, the resident transfers back to the nursing home to complete the final 9 days of a 14-day course of amoxicillin/clavulanate. Cultures obtained at the hospital did not detect MRSA or Pseudomonas. Her wound heals well and she becomes an active participant in physical therapy.

Three months later, a wound on the lateral aspect of the right foot develops. Despite excellent wound care over the ensuing 3 months, the wound does not improve and plain films strongly suggest the presence of osteomyelitis. The resident remains clinically stable with a good appetite and is actively participating in social activities.

7. **What are your next steps in the management of this patient?**

Sometimes the results of diagnostic studies or cultures create pressure to treat or respond. The resident in this scenario is clinically stable and the wound has been present for months, suggesting that osteomyelitis, if present, is chronic rather than acute. Next steps in management would be:

a wound care evaluation; a PT/OT & podiatry assessment to identify strategies to pressure offload the affected area; an assessment to determine if comorbid arterial insufficiency is present; and referrals to a podiatrist/foot

surgeon for wound debridement and collection of a bone or deep tissue biopsy and an infectious disease provider to assess if there is a role for IV antibiotics.

8. **What is your plan for antibiotics in this scenario?**

Oral antibiotics play a limited role in the treatment of osteomyelitis and they should only be prescribed if there is concern for infection of the adjacent soft tissues.

Osteomyelitis typically requires a minimum of 6 weeks of intravenous antibiotics; collecting appropriate samples (*i.e.*, prior to starting antibiotics or several days after a previous antibiotics are stopped) permits pathogen-directed therapy, which is important for people who require long-term antibiotics.

Response to therapy is assessed by the clinical AND by following inflammatory markers (*i.e.*, CRP and erythrocyte sedimentation rate; ESR) over time.

Treatment failure rates among patients with chronic osteomyelitis of the feet remain disappointingly high and up to half of affected individuals will undergo below-the-knee amputation despite aggressive combined medical-surgical treatment.

Case 5

55 year old female with history of asthma and HTN presents to the hospital with non-localized pain, diarrhea and subjective fevers x 1 day. In the ER, T: 100.8, HR: 90, RR: 16, BP: 110/70. Labs: WBC: 18K cells/mm^3; the remainder of his labs are within normal limits.

1. **What is your differential for this patient's pain?**

    - Infectious – Diverticulitis, infectious colitis, appendicitis
    - IBD – Crohn's Dz, UC, ischemic colitis, radiation colitis
    - Non-inflammatory BD – IBS, intussusception, colorectal carcinoma, hernia, adhesions
    - Urogenital disease – Stones, Ovarian torsion, ruptured cyst, ectopic pregnancy
    - Other – thrombosis, vasculitis, hematoma

2. **What is your work up for this patient?**

    CT Scan with IV Contrast of abdomen/pelvis. Would cover ACR Appropriateness criteria for this particular patient to discuss how to determine best test to order. (QR Code – not given to Residents) A CT Scan will help differentiate a majority of the causes of the pain on the differential. It is important to note the need for IV contrast for this study. If the patient is not able to tolerate the contrast

CT Scan of the abdomen/pelvis with IV contrast shows a non-perforated diverticulitis. He is admitted to the hospital for antibiotics.

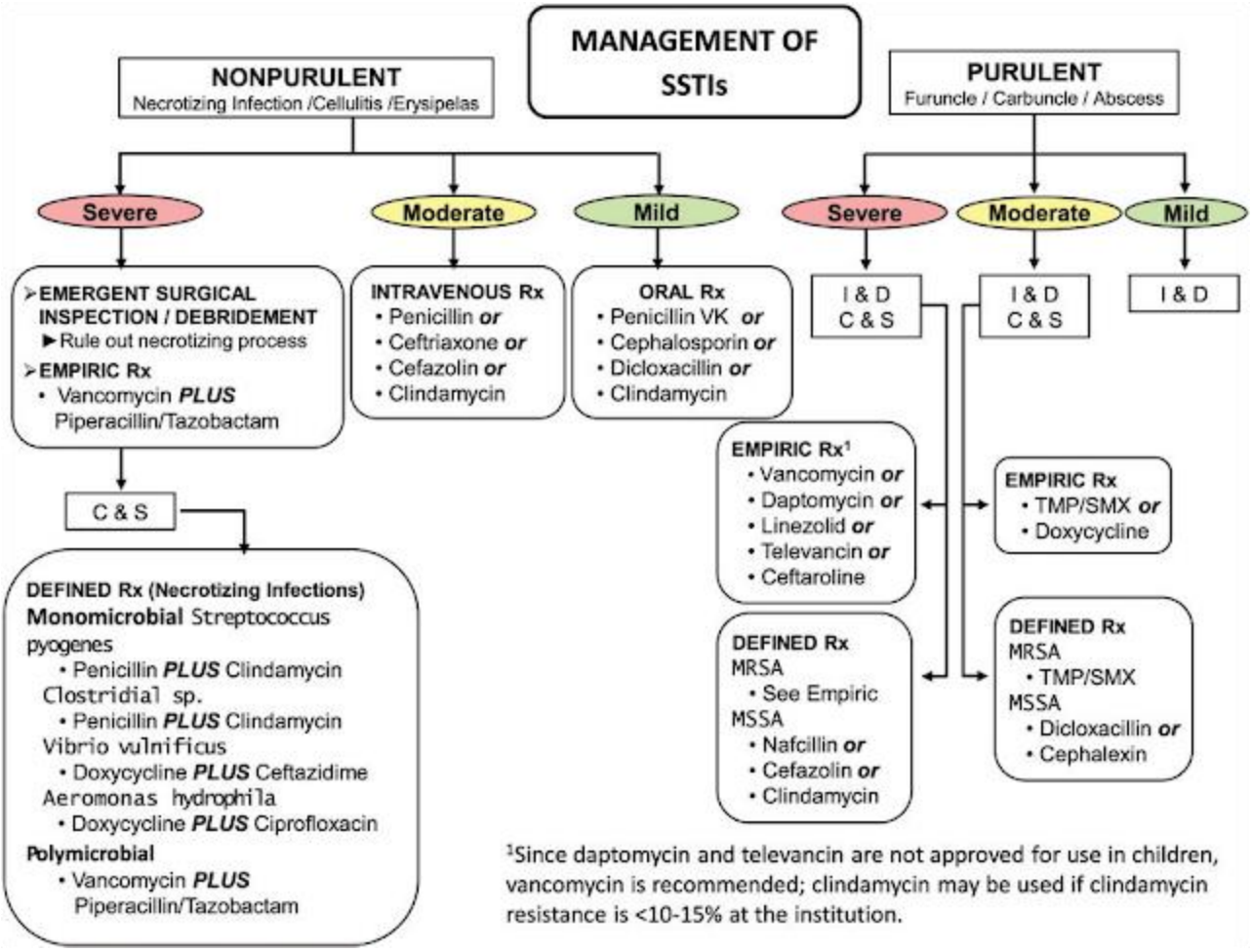
3. **What are microbiological pathogens you need to consider in this infection?**

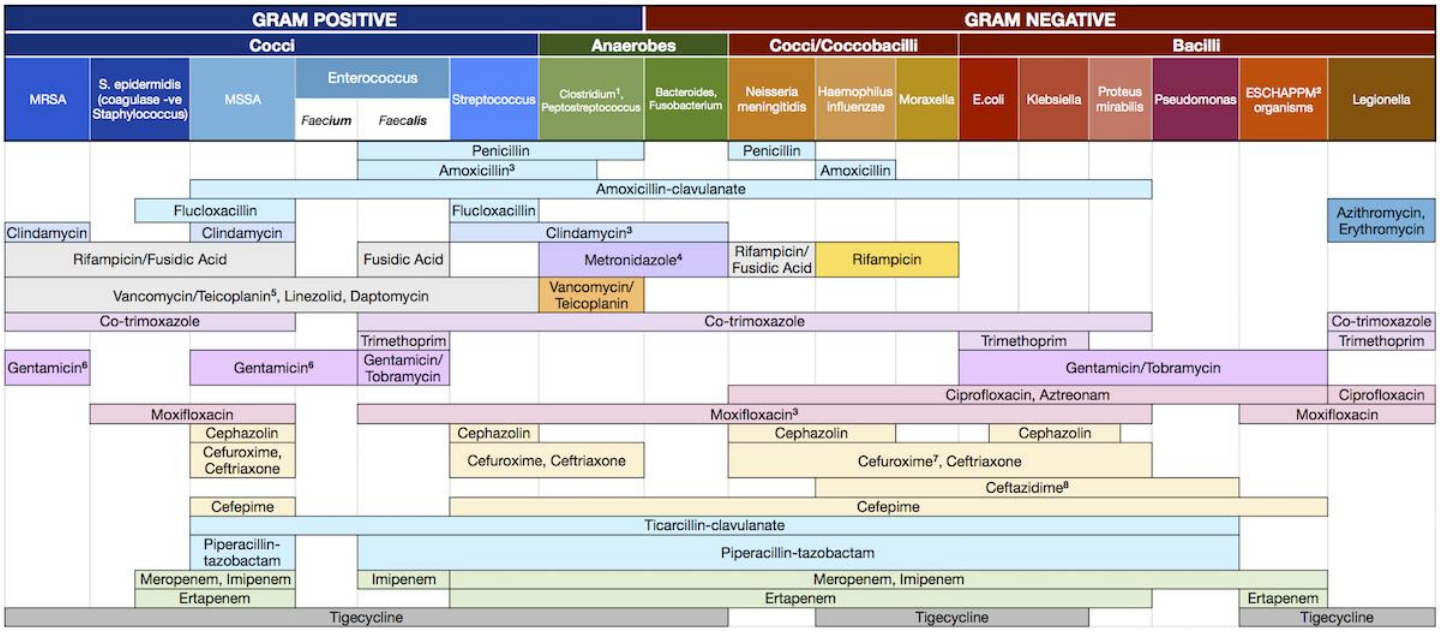
    The three most common organisms are *E. coli, K. pneumonaie*, and *B. fragilis* and these should be targeted for uncomplicated diverticulitis. For patients with complicated diverticulitis you may want to consider broader coverage for *Enterobacteriaceae* and *Pseudomonas*. In general S. aureus/MRSA is a very uncommon cause of diverticulitis.

4. What antibiotic(s) would you start empirically?

A good regimen will need good Gram Negative and Anaerobic coverage to hit the three most common bugs.

- Ceftriaxone + Flagyl – preferred agent for stable patients
- Meropenem – can be used for patient's that are in shock
- Zosyn – should be reserved for those cases where Enterobacteriaceae or Pseudomonas is suspected; however, have to be concerned about selecting for Zosyn resistant Pseudomonas
- Unasyn – does not have great Gram Negative coverage, there are better choices
- Clindamycin – high resistance for GI gram negatives
    - "Clindamycin above the belt, metronidazole below the belt" – this does not mean that metroniadazole would not work in the lungs and Clinda does not penetrate the GI tract. The real reason is GI anaerobes have high resistance to clindamycin and select oral/pulmonary anaerobes (i.e. actinomyces) are not covered by flagyl


MANAGEMENT OF SSTIs
NONPURULENT
Necrotizing Infection /Cellulitis /Erysipelas
PURULENT
Furuncle / Carbuncle / Abscess
Severe
Moderate
Mild
Severe
Moderate
Mild
➢EMERGENT SURGICAL INSPECTION / DEBRIDEMENT
►Rule out necrotizing process
➢EMPIRIC Rx
• Vancomycin PLUS Piperacillin/Tazobactam
INTRAVENOUS Rx
• Penicillin or
• Ceftriaxone or
• Cefazolin or
• Clindamycin
ORAL Rx
• Penicillin VK or
• Cephalosporin or
• Dicloxacillin or
• Clindamycin
I & D C & S
I & D C & S
I & D
C & S
DEFINED Rx (Necrotizing Infections)
Monomicrobial Streptococcus pyogenes
• Penicillin PLUS Clindamycin
Clostridial sp.
• Penicillin PLUS Clindamycin
Vibrio vulnificus
• Doxycycline PLUS Ceftazidime
Aeromonas hydrophila
• Doxycycline PLUS Ciprofloxacin
Polymicrobial
• Vancomycin PLUS Piperacillin/Tazobactam
EMPIRIC Rx[1]
• Vancomycin or
• Daptomycin or
• Linezolid or
• Televancin or
• Ceftaroline
EMPIRIC Rx
• TMP/SMX or
• Doxycycline
DEFINED Rx
MRSA
• See Empiric
MSSA
• Nafcillin or
• Cefazolin or
• Clindamycin
DEFINED Rx
MRSA
• TMP/SMX
MSSA
• Dicloxacillin or
• Cephalexin
[1]Since daptomycin and televancin are not approved for use in children, vancomycin is recommended; clindamycin may be used if clindamycin resistance is <10-15% at the institution.


GRAM POSITIVE
GRAM NEGATIVE
Cocci
Anaerobes
Cocci/Coccobacilli
Bacilli
MRSA
S. epidermidis (coagulase -ve Staphylococcus)
MSSA
Enterococcus
Faecium
Faecalis
Streptococcus
Clostridium[1], Peptostreptococcus
Bacteroides, Fusobacterium
Neisseria meningitidis
Haemophilus influenzae
Moraxella
E.coli
Klebsiella
Proteus mirabilis
Pseudomonas
ESCHAPPM[2] organisms
Legionella
Penicillin
Amoxicillin[3]
Penicillin
Amoxicillin
Amoxicillin-clavulanate
Flucloxacillin
Flucloxacillin
Azithromycin, Erythromycin
Clindamycin
Clindamycin
Clindamycin[3]
Rifampicin/Fusidic Acid
Fusidic Acid
Metronidazole[4]
Rifampicin/ Fusidic Acid
Rifampicin
Vancomycin/Teicoplanin[5], Linezolid, Daptomycin
Vancomycin/ Teicoplanin
Co-trimoxazole
Co-trimoxazole
Co-trimoxazole
Trimethoprim
Trimethoprim
Trimethoprim
Gentamicin[6]
Gentamicin[6]
Gentamicin/ Tobramycin
Gentamicin/Tobramycin
Ciprofloxacin, Aztreonam
Ciprofloxacin
Moxifloxacin
Moxifloxacin[3]
Moxifloxacin
Cephazolin
Cephazolin
Cephazolin
Cephazolin
Cefuroxime, Ceftriaxone
Cefuroxime, Ceftriaxone
Cefuroxime[7], Ceftriaxone
Ceftazidime[8]
Cefepime
Cefepime
Ticarcillin-clavulanate
Piperacillin-tazobactam
Piperacillin-tazobactam
Meropenem, Imipenem
Imipenem
Meropenem, Imipenem
Ertapenem
Ertapenem
Ertapenem
Tigecycline
Tigecycline
Tigecycline