2018
Mercy Medical Center
Antibiogram
&
Antibiotic Quick Reference
## 4 Moments of Antibiotic Decision Making

1. Does my patient have an infection that requires antibiotics?
2. Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate?
3. A day or more has passed. Can I stop antibiotics? Can I narrow therapy or change from IV to oral therapy?
4. What duration of therapy is needed for my patient’s diagnosis?

Reference: AHRQ Safety Program for Improving Antibiotic Use

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### Formulary antimicrobials that may require adjustment for impaired renal function:

- Aminoglycosides: gentamicin, tobramycin
- Anti-fungals: fluconazole, voriconazole (IV only)
- Anti-virals: acyclovir, valacyclovir, ganciclovir, oseltamivir, amantadine
- Beta-lactam/beta-lactamase inhibitor combos: amoxicillin/clavulanate, ampicillin/sulbactam, piperacillin/tazobactam
- Carbapenems: meropenem, ertapenem
- Cephalosporins: cefazolin, cefotetan, cephalexin, cefuroxime, cefdinir, cefepime, ceftaroline, cefotaxime, ceftolozane/tazobactam
- Fluoroquinolones: levofloxacin (ciprofloxacin)
- Glycopeptides: vancomycin, daptomycin, dalbavancin
- Monobactam: aztreonam
- Macrolides: clarithromycin, erythromycin
- Miscellaneous: metronidazole, fosfomycin, nitrofurantoin
- Penicillins: ampicillin, amoxicillin, penicillin
- Sulfas: sulfamethoxazole/trimethoprim

* Pharmacy will automatically adjust for renal function per protocol for inpatients (unless DAW indicated or prior to admission medication).
* In the outpatient setting, consult appropriate drug information reference or pharmacy if needed.

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### Formulary Injectable Anti-Infective Cost

<table>
<thead>
<tr>
<th>Anti-infective</th>
<th>Usual injectable dose*</th>
<th>Cost per day**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyclovir</td>
<td>5-10 mg/kg Q 8h (ideal body weight)</td>
<td>$</td>
</tr>
<tr>
<td>Amphotericin B liposomal</td>
<td>5 mg/kg/day Q 24h</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>1 to 2 g Q 4-6h</td>
<td>$</td>
</tr>
<tr>
<td>Ampicillin/sulbactam</td>
<td>1.5 to 3 g Q 6h</td>
<td>$</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>500 mg Q 24h</td>
<td>$</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>1 to 2 g Q 8-12h</td>
<td>$-$-$</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>1 to 2 g Q 8h</td>
<td>$</td>
</tr>
<tr>
<td>Cefepime</td>
<td>1 to 2 g Q8-12h</td>
<td>$-$-$</td>
</tr>
<tr>
<td>Ceftaroline</td>
<td>600 mg Q 12h</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Ceftolozane/tazobactam</td>
<td>1.5 g Q 8h</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>1 to 2 g Q 24h</td>
<td>$</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>600 to 900 mg Q 8h</td>
<td>$</td>
</tr>
<tr>
<td>Dalbavancin</td>
<td>1500 mg x 1 dose</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Daptomycin</td>
<td>4 to 8 mg/kg Q 24h</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>100 mg Q 12h</td>
<td>$</td>
</tr>
<tr>
<td>Ertapenem</td>
<td>1 g Q 24h</td>
<td>$</td>
</tr>
<tr>
<td>Fluconazole</td>
<td>100 to 400 mg Q 24h</td>
<td>$</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>7 mg/kg Q 24-48h****^</td>
<td>$</td>
</tr>
<tr>
<td>Levofoxacin</td>
<td>500 to 750 mg Q 24h</td>
<td>$</td>
</tr>
<tr>
<td>Linezolid</td>
<td>600 mg Q 12h</td>
<td>$</td>
</tr>
<tr>
<td>Meropenem</td>
<td>500 mg Q 6h</td>
<td>$</td>
</tr>
<tr>
<td>Micafungin</td>
<td>100 to 150 mg Q 24h</td>
<td>$</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>500 mg Q 8h</td>
<td>$</td>
</tr>
<tr>
<td>Nafcillin</td>
<td>1 to 2 g Q 4-6h</td>
<td>$-$-$</td>
</tr>
<tr>
<td>Penicillin G</td>
<td>1 to 2 million units Q 4h</td>
<td>$</td>
</tr>
<tr>
<td>Piperacillin/tazobactam</td>
<td>3.375 g Q 8h over 4 hours</td>
<td>$</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>7 mg/kg Q 24-48h****^</td>
<td>$</td>
</tr>
<tr>
<td>Sulfamethoxazole/trimethoprim</td>
<td>800 mg/160 mg Q 12h, up to 15-20 mg/kg/day of TMP</td>
<td>$-$-$</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>15-20 mg/kg Q 12-24h****^</td>
<td>$</td>
</tr>
<tr>
<td>Voriconazole</td>
<td>6 mg/kg Q 12h x 2 doses, then 4 mg/kg Q 12h</td>
<td>$$$$</td>
</tr>
</tbody>
</table>

** KEY: $ = < 40, $$ = 40-100, $$$ = 101-150, $$$$ = 151-200, $$$$$ = > 200**

* Dosing for renal/hepatic impairment not listed
** Relative cost per day reflects the hospital’s acquisition cost of the drug for a 70 kg patient.
*** Hartford nomogram dosing. Barnes-Jewish nomogram or traditional dosing should be used in certain patients.
^ Cost of monitoring drug levels not included. Pharmacy consult for dosing recommended.
### Gram Negative Organisms

| Organism                          | Ampicillin | Amoxicillin-Clavulanate | Aztreonam | Cefazolin | Cefepime | Cefotaxime | Ceftriaxone | Ceftazidim | Cefepime | Ciprofloxin | Ertapenem | Gentamicin | Levofloxacin | Linezolid | Meropenem | Moxifloxacin | Pip-Tazo | Tobramycin | Trimeth-Sulfa | Vancomycin |
|----------------------------------|------------|-------------------------|-----------|-----------|----------|------------|-------------|-------------|-----------|-----------|------------|-----------|------------|-------------|-----------|------------|----------------|----------|------------|---------------|-----------|
| Acinetobacter baumannii complex  | 11 R 91 R  R 82 | 27 100 R R 100 | 91 100 R 100 | 91 100 R 100 | 82 100 | 82 | 100 | 100 | 100 | 100 | 50 | 82 | 100 | R |
| Citrobacter freundii             | 73 R 100 R 100 | 88 | 100 | R 100 | 99 | 100 | R 96 | R 92 | 99 | 92 | R | 92 | 99 | 92 | R |
| Citrobacter koseri               | 54 R 98 98 98 75 | 98 | 98 | R 100 | 100 | 98 | R 100 | R 100 | 100 | 100 | R | 100 | 100 | R |
| Enterobacter cloacae complex     | 93 R 95 82 | 99 | 100 | R 100 | 99 | 99 | R 86 | R 83 | 99 | 96 | R | 99 | 96 | R |
| Escherichia coli - Urine         | 2966 63 68 90 | 97 | 87 | R 100 | 94 | 87 | R 98 | 95 | 95 | 82 | R | 95 | 95 | 82 | R |
| Escherichia coli - Non-Urine     | 178 52 57 86 95 | 95 | 78 | 86 | 100 | 96 | 78 | 100 | 92 | 92 | 76 | R | 95 | 76 | R |
| Haemophilus influenzae           | 41 51 51 | 100 | 100 | R | 56 | 56 | R |
| Klebsiella (Enterobacter) aerogenes | 60 R 97 | 92 | 100 | R 100 | 100 | 100 | R 20 | R 86 | 100 | 100 | R |
| Klebsiella oxytoca               | 63 R 68 47 | 100 | 100 | R 100 | 100 | 100 | 100 | 87 | R 94 | 100 | 98 | R |
| Klebsiella pneumoniae            | 479 R 90 99 | 99 | 98 | R 100 | 98 | 99 | R 34 | R 98 | 99 | 96 | R |
| Morganella morganii              | 32 R 13 100 | 100 | 75 | R 100 | 81 | 75 | R 100 | 97 | 97 | 78 | R |
| Proteus mirabilis                | 240 87 93 94 | 96 | 87 | R 100 | 95 | 88 R 99 | R 99 | 95 | 85 | R |
| Providencia species              | 17 R 100 | 100 | 76 | R 100 | 65 | R | R | R | R | 94 | 65 | 82 | R |
| Pseudomonas aeruginosa           | 250 R 96 90 | 90 | 96 | R 96 | 89 R 98 | R 96 | R 95 | 99 | 96 | R |
| Serratia marcescens              | 21 R 100 | 100 | 95 | R 100 | 95 | R | R | R | R | 75 | 100 | R |
| Stenotrophomonas maltophilia     | 16 R 88 100 | R | R | R | R | R | R | R | R | R | R | R | 84 | R |

### Gram Positive Organisms

| Organism                        | Ampicillin | Amoxicillin-Clavulanate | Aztreonam | Cefazolin | Cefepime | Cefotaxime | Ceftriaxone | Ceftazidim | Cefepime | Ciprofloxin | Ertapenem | Gentamicin | Levofloxacin | Linezolid | Meropenem | Moxifloxacin | Pip-Tazo | Tobramycin | Trimeth-Sulfa | Vancomycin |
|---------------------------------|------------|-------------------------|-----------|-----------|----------|------------|-------------|-------------|-----------|-----------|------------|-----------|------------|-------------|-----------|------------|----------------|----------|------------|---------------|-----------|
| Enterococcus faecalis           | 405 100 | R R R R 82 | 100 | 82 | 100 | 99 | 24 | R 100 | |
| Enterococcus faecium            | 26 62 | R R R R R 50 | R 100 | 48 | 100 | 35 | 38 | R 100 | |
| VRE (Enterococcus faecium)      | 25 0 R R R | R 100 | 96 | 43 | R |
| MRSA                            | 352 R R R R R 73 | 100 | R | 100 | R | R | R | 93 | 97 | 100 | |
| Staphylococcus aureus           | 638 | R 75 | 100 | 100 | 93 | 98 | 100 | |
| Staphylococcus epidermidis      | 284 | R 63 | 100 | 100 | 81 | 100 | |
| Staphylococcus lugdunensis      | 52 | R 82 | 100 | 100 | 94 | 100 | |
| Streptococcus agalactiae (group B Strep, non-urine) | 30 100 R 100 100 33 | 96 | 100 | 100 | 100 | 100 | |
| Streptococcus pneumoniae (mening/nonmening) | 45 R 98 98 98 98 | 98 | 74 | 78 | 71 | 100 | |

* Iso numbers lower than 30 may not give accurate information.
* R = Intrinsically Resistant to the antibiotic
* **98% of isolates susceptible to amoxicillin/clavulanate; ampicillin/sulbactam not directly tested
* ↓ = significant decrease in susceptibility from previous year
* 3% of E. coli and 2% of K. pneumoniae were ESBL positive
* Fluoroquinolones for treatment of Enterococci should only be considered for urine isolates (NOT first line).
* Penicillin and ampicillin are drugs of choice for β-hemolytic Strep (Strep groups A, B, C, and G). Routine susceptibility testing is not performed because non-susceptible isolates are extremely rare.
Asymptomatic Bacteriuria

Diagnosis

- Asymptomatic bacteriuria (ASB) is a positive urine culture in a patient with no signs or symptoms of a urinary tract infection (e.g., dysuria, frequency, urgency, fever, flank pain).

- Asymptomatic bacteriuria (ASB) is common and often associated with pyuria (urine containing ≥10 white blood cells per high-powered field).

<table>
<thead>
<tr>
<th>Population</th>
<th>Prevalence of ASB</th>
<th>Prevalence of Pyuria in Persons With ASB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy premenopausal women</td>
<td>&lt; 5%</td>
<td>32%</td>
</tr>
<tr>
<td>Women 65-90 years old</td>
<td>6-16%</td>
<td></td>
</tr>
<tr>
<td>Women &gt; 90 years old</td>
<td>22-43%</td>
<td></td>
</tr>
<tr>
<td>Diabetic women</td>
<td>9-27%</td>
<td>70%</td>
</tr>
<tr>
<td>People receiving hemodialysis</td>
<td>28%</td>
<td>90%</td>
</tr>
<tr>
<td>Female long-term care residents</td>
<td>25-50%</td>
<td>90%</td>
</tr>
<tr>
<td>Male long-term care residents</td>
<td>15-35%</td>
<td>90%</td>
</tr>
<tr>
<td>Presence of indwelling urinary catheter</td>
<td>100%</td>
<td>50-100%</td>
</tr>
</tbody>
</table>

Treatment

- The majority of patients with ASB and/or asymptomatic pyuria SHOULD NOT be treated.
- Studies have demonstrated that treatment of ASB does not prevent urinary tract infections (UTIs), but is associated with adverse events related to antibiotic use and the development of future UTIs that are antibiotic resistant.
- Exceptions
  o Pregnant patients: treatment prevents preterm labor and pyelonephritis.
  o Patients about to undergo a urologic procedure in which mucosal bleeding is expected (not urinary catheter placement): treatment prevents urosepsis.

How can I prevent unnecessary treatment of asymptomatic bacteriuria?

- Do not order urine cultures unless your patient has signs and symptoms of a UTI, including in patients undergoing preoperative evaluation or patients with urinary catheters (except in pregnant patients or those about to undergo a urologic procedure in which mucosal bleeding is expected).

  Note:
  o Foul-smelling or cloudy urine does not indicate a UTI.
  o Mental status change alone does not indicate a UTI.
Urinary Tract Infections

Diagnosis

- First, ask about SYMPTOMS
  - Acute cystitis: dysuria, frequency, urgency, suprapubic pain
  - Pyelonephritis: fever, flank pain
  - Catheter-associated UTI (CAUTI): main symptoms are suprapubic pain and fever; patients with catheters may not report dysuria, frequency, or urgency

- If a person has symptoms, obtain a urinalysis (UA) and culture
  - A positive UA shows evidence of inflammation (e.g., elevated white blood cells)
  - A positive urine culture is defined as ≥10,000-100,000 CFU/mL of a urinary pathogen (≥ 1,000 in patients with urinary catheters)

- If a chronic indwelling catheter is in place, remove and replace it before sending UA and culture

- Do not start antibiotics in patients with a positive UA and/or culture until asking about symptoms

Treatment: Assess prior urine culture data, as previous susceptibility patterns can help guide antibiotic choice.

- **Uncomplicated acute cystitis** (cystitis in a female without urologic abnormality or catheter):
  - Oral therapy preferred (no need for IV unless patient cannot take oral therapy); avoid fluoroquinolones
  - Nitrofurantoin (delayed-release formulation, Macrobid®): 100 mg PO twice daily
  - Trimethoprim/sulfamethoxazole (TMP/SMX): one double-strength tablet (160/800 mg) PO twice daily
  - Cefalexin 500 mg PO QID
  - If patient cannot tolerate oral therapy: cefazolin 1 g IV every 12 hours

- **Uncomplicated pyelonephritis in women**
  - Fluoroquinolones and TMP/SMX are preferred given excellent penetration into the kidney when susceptible
  - Outpatient (no admission): TMP/SMX one double-strength tablet PO twice daily or levofloxacin 750 mg PO daily/ciprofloxacin 500 mg PO twice daily (can consider oral cefalexin if prior cultures with resistance to these agents)
  - Inpatient: ceftriaxone 1 g IV daily or levofloxacin 750 mg IV/PO daily (history of/concern for ESBL-producing organisms, ertapenem 1 g IV daily)
  - Inpatient oral step-down: TMP/SMX one double-strength tablet PO twice daily, levofloxacin 750 mg PO daily, cefalexin 500 mg PO QID, or cefdinir 300 mg PO BID

- **Complicated UTI** (UTI occurring in the presence of urologic abnormality, pregnancy, or urinary catheter or UTI in men)
  - UTI in men in the absence of obstructive pathology (e.g., renal stone, stricture, enlarged prostate) or urinary catheter is uncommon
  - Remove and do not replace urinary catheters whenever possible
  - Lower tract infection: ceftriaxone or levofloxacin (same doses as uncomplicated pyelonephritis); ertapenem if history of/concern for ESBL-producing organisms
  - Upper tract infection/suspected urosepsis: piperacillin/tazobactam 3.375 g IV every 8 hours (extended infusion), cefepime 1 g IV every 6 hours, or if severe PCN allergy, aztreonam 2 g IV every 8 hours (consider addition of vancomycin if severe sepsis)
  - Oral step-down: TMP/SMX, levofloxacin, or oral cefalexin (same options/dosing as uncomplicated pyelonephritis); TMP/SMX or levofloxacin preferred if bacteremia present (high bioavailability)

Duration: NOTE—if a patient has been on IV therapy, these days should be counted when determining total duration of therapy

<table>
<thead>
<tr>
<th>Uncomplicated acute cystitis</th>
<th>Nitrofurantoin or cephalexin: 5 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TMP/SMX: 3 days</td>
</tr>
<tr>
<td>Uncomplicated pyelonephritis</td>
<td>Fluoroquinolone: ciprofloxacin 7 days, levofloxacin 5-7 days</td>
</tr>
<tr>
<td></td>
<td>TMP/SMX or IV cephalexin: 7-14 days (shorter course if early response)</td>
</tr>
<tr>
<td></td>
<td>Oral cephalexin: 10-14 days</td>
</tr>
<tr>
<td>Complicated UTI (including CAUTI)</td>
<td>3 days if lower tract CAUTI in women ≤ 65 years if catheter is removed/not replaced</td>
</tr>
<tr>
<td></td>
<td>7 days if prompt resolution of symptoms</td>
</tr>
<tr>
<td></td>
<td>10-14 days if delayed response, obstruction or other urologic abnormality</td>
</tr>
</tbody>
</table>
Community-Acquired Pneumonia (CAP)

**Diagnosis**

- Most patients have fever, cough and sputum production; many will also have chills (50%), tachypnea (45%), or pleuritic chest pain (30%)
- If symptoms are present, a CXR should be obtained; the absence of an infiltrate makes the diagnosis unlikely
- Infiltrate on CXR or chest CT without signs and symptoms of CAP is unlikely to represent CAP
- Microbiology: *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Legionella pneumophila*
- Obtain sputum Gram-stain and culture, *S. pneumoniae* urinary antigen
- Obtain *Legionella* urinary antigen in patients with moderate to severe illness, smoking, age > 50, or significant immunocompromise
- Obtain blood cultures in patients with moderate to severe illness or with evidence of abscess or parapneumonic effusion
- Obtain viral respiratory testing during respiratory virus season

**Treatment**

**Empiric therapy**

- Avoidance of antibiotics with strong association with *Clostridium difficile* infection is recommended (e.g., fluoroquinolones > ceftriaxone > ampicillin/sublactam)
- Ceftriaxone 1 g IV daily (children: 75 mg/kg/dose IV daily) OR ampicillin/sublactam 3 g IV every 6 hours (children: 50 mg ampicillin/kg/dose IV every 6 hours) PLUS azithromycin 500 mg IV/PO daily OR doxycycline 100 mg PO twice daily
  - Consider ampicillin for mild/moderate disease in otherwise healthy children/appropriately vaccinated children who have not recently received amoxicillin/ampicillin: 50 mg/kg/dose IV every 6 hours
  - Atypical coverage not needed for children; consider no atypical coverage for adults unless severe
- Severe PCN allergy: levofloxacin 750 mg IV/PO daily (children: 10 mg/kg/dose IV/PO daily)
- Consider coverage of *Staphylococcus aureus*, including methicillin-resistant *S. aureus* (MRSA), in addition to standard CAP antibiotics in patient with a recent respiratory viral infection presenting with new pneumonia
- Vancomycin, pharmacy to dose consult
- Consider coverage for *Pseudomonas aeruginosa* and MRSA based on severity of pneumonia and risk factors for resistant organisms (recent hospitalization ≥2 days in past 90 days, immunosuppression, broad-spectrum antibiotic exposure in past 90 days, history of resistant pathogen infection within last year, residence in a long-term care facility, bronchiectasis/moderate to severe structural lung disease)
  - Severe pneumonia (ICU admission, hemodynamically unstable, or high O₂ requirements/mechanical ventilation) plus ≥ 1 risk factor OR nonsevere pneumonia plus ≥ 2 risk factors: antipseudomonal + anti-MRSA therapy
    - Vancomycin plus one of the following: piperacillin/tazobactam 3.375 g IV every 8 hours (extended infusion) OR cefepime 1 g IV every 6 hours OR if severe PCN allergy, levofloxacin 750 mg IV/PO daily PLUS aztreonam 2 g IV every 8 hours
  - Non-severe pneumonia plus only 1 risk factor: treat with standard CAP antibiotics as above

**Narrowing and oral therapy**

- After clinical improvement is observed, convert from IV to PO therapy
- Use sputum culture results to narrow therapy; if organism is susceptible to ampicillin, switch to ampicillin 1 g IV every 6 hours or amoxicillin 1 g PO TID (children: 90 mg/kg/day PO divided every 12 hours). If *S. pneumoniae* urinary antigen is positive, stop atypical coverage.
- Stop azithromycin after 3 days unless treating *Legionella*
- If cultures are negative or not obtained, narrow to amoxicillin/clavulanate or oral second-/third-generation cephalexopins (reserve levofloxacin for severe PCN allergy or patients at risk for resistant organisms)
  - Amoxicillin/clavulanate XR 2000 mg (two tablets) PO BID OR 875-125 mg PO BID (children: 90 mg amoxicillin/kg/day PO divided every 12 hours, 600 mg/5 ml suspension)
  - Cefuroxime 500 mg PO BID (children: 15 mg/kg/dose PO BID) or cefdinir 300 mg PO BID (children: 7 mg/kg/dose PO BID)
- Utilize the MRSA nasal PCR to aid in discontinuation of anti-MRSA therapy (negative=99% negative predictive value for MRSA pneumonia; positive does not correlate to high positive predictive value)
- In most cases, stop antibiotics if viral respiratory testing is positive

**Duration**

- 5 days if clinical response by day 3 for most patients
- 7 days if patient is immunocompromised, has underlying structural lung disease or didn’t have clinical response by day 3
- If the patient has *Legionella*, *P. aeruginosa*, or *S. aureus*, longer durations of therapy are usually required, particularly if there is associated bacteremia
Aspiration Pneumonitis

Diagnosis

- Aspiration pneumonitis is an abrupt chemical injury caused by inhalation of gastric contents.
  - It can progress quickly to a decline in respiratory status followed by rapid improvement within 48 hours of the insult.
  - Chest x rays can look like multifocal pneumonia is present.
- Patients with aspiration events are usually unlikely to produce significant sputum, making the utility of sputum cultures low.
  - Sputum Gram-stain and cultures should be considered when the diagnosis is unclear, if purulent sputum is being produced, or if antibiotic treatment is initiated in a hemodynamically unstable patient.

Treatment

- Hemodynamically stable patients with aspiration events
  - Antibiotics are not warranted, and supportive care is the mainstay of therapy.
  - Prophylactic antibiotics have not been shown to be helpful in preventing the development of pneumonia after aspiration events.

- Hemodynamically unstable patients with aspiration events
  - Treat with regimens for community-acquired pneumonia (CAP) (e.g., ampicillin-sulbactam, ceftriaxone) if the event occurred within 48 hours of admission to a health care facility.
  - Treat with regimens for healthcare-acquired pneumonia (HAP) (e.g., piperacillin-tazobactam, cefepime PLUS vancomycin) if the event occurred 48 hours after admission to a health care facility.
  - It is not necessary to add additional anaerobic or atypical coverage.
  - Reassess at 48 hours.
    - If clinical symptoms resolve, antibiotics can be discontinued.
    - If no or minimal improvement and bacterial pneumonia is suspected, treat for 5–7 days.

- Patients with aspiration events not treated initially with no improvement in 48–72 hours
  - A small proportion of patients (10–20%) may develop bacterial pneumonia 48–72 hours after an aspiration event.
  - If there is no improvement or there is clinical worsening within the first 48–72 hours, consider a course of antibiotic therapy (as above).
**Cellulitis**

### Diagnosis
- Relatively sudden onset of redness, warmth, tenderness, and swelling of the skin
  - **Nonpurulent:** no evidence of abscess/phlegmon; most cases caused by β-hemolytic streptococci (usually group A strep but also B, C, G) that are susceptible to penicillin; ~10% of cases caused by methicillin-susceptible *Staphylococcus aureus* (MSSA)
  - **Purulent:** evidence of abscess/phlegmon; caused by *S. aureus*, often MRSA
- Almost always unilateral
- Fever in 22-71%; elevated white blood cell count in 35-50%
- Usually associated with skin surface disruption due to recent trauma, tinea pedis, cutaneous ulcer, past saphenous venectomy, or impaired venous or lymphatic drainage
- Blood cultures are low yield; consider for patients with severe illness or immunocompromise
- Obtain wound culture if purulence is present
- Obtain ultrasound if concern for abscess/phlegmon and physical exam is equivocal

*Note: Several noninfectious conditions can mimic cellulitis including venous stasis dermatitis which is often bilateral, associated with skin hyperpigmentation, pitting edema, serous drainage, itchiness; minimal pain and absence of fever*

### Treatment
Elevate the affected extremity and treat underlying predisposing conditions.

**Nonpurulent cellulitis**
- Moderate infection: cover β-hemolytic strep and MSSA; MRSA coverage is not routinely indicated
  - Cefazolin 1 to 2 g IV every 8 hours or ampicillin/sulbactam 1.5 to 3 g IV every 6 hours (use higher dosing in obese patients)
  - If severe β-lactam allergy: vancomycin IV, pharmacy consult to dose
- Severe infection: immunocompromised patients or clinical signs of deeper infection. Assess for need for surgical debridement.
  - Piperacillin/tazobactam 3.375 g IV every 8 hours plus vancomycin IV (pharmacy to dose)
  - Non-severe β-lactam allergy: cefepime 1 g IV every 6 hours plus metronidazole 500 mg IV every 8 hours plus vancomycin IV, pharmacy consult to dose
  - Severe β-lactam allergy: levofloxacin 750 mg IV every 24 hours plus metronidazole 500 mg IV every 8 hours plus vancomycin IV, pharmacy consult to dose

**Purulent cellulitis**
- Cover *S. aureus*, including MRSA
- Skin abscess with minimal cellulitis: antibiotics are of modest benefit with drained abscesses; antibiotics are recommended for patients with associated systemic illness, diabetes, severe immunocompromise, extremes of age, or location of abscess in area where drainage is difficult
  - Vancomycin IV, pharmacy consult to dose

**Narrowing and oral therapy**
- Narrow based on available culture results
- Transition to oral therapy when patient has clinical improvement; erythema may initially persist or extend despite appropriate therapy but overall improvement (e.g., reduction of erythema and local inflammation and resolution of fevers) generally occurs by day 3
- Nonpurulent (non-severe infection): cephalexin 500 mg PO four times daily or amoxicillin/clavulanate 875-125 mg PO twice daily. If severe β-lactam allergy: clindamycin 300 mg PO three times daily (ensure *S. aureus* susceptibility if causative organism)
- Purulent: Trimethoprim/sulfamethoxazole one DS tablet PO twice daily (can consider 2 tablets in obese patients) or doxycycline 100 mg PO twice daily

*Note: Patients with aquatic injuries, bites, and cellulitis associated with long-standing diabetic foot ulcers may require alternative antibiotics. Discuss these cases with the infectious diseases consultant if needed.*

### Duration
- For non-severe infections: 5-7 days if clinical response by day 3. Severe infections: dependent on extent of infection and patient response.
References

**Asymptomatic bacteriuria**


**Urinary tract infections**


**CAP**


**Aspiration pneumonia**


**Cellulitis**


