CSiM | CENTER FOR STEWARDSHIP IN MEDICINE

Antibiotic GUIDE

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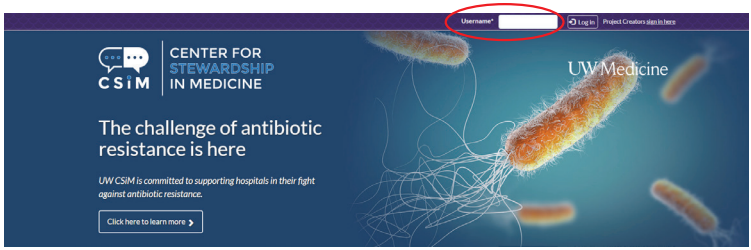
The University of Washington Center for Stewardship in Medicine (UW CSiM) empowers antimicrobial stewardship teams by providing education, mentoring, community building, and resource sharing. By combining the resources available in our urban academic setting with the expertise of rural health providers, antimicrobial stewardship program implementation has been accelerated throughout the region with far reaching benefits to our community.

UW CSiM has created the UW CSiM Antibiotic Guide to provide prescribers with a tool to guide prescribing based on local resistance based data and expert opinion. General treatment principles and guidance are relevant to antimicrobial stewardship teams regardless of geography. Specific antibiotic recommendations are based upon bacterial resistance patterns seen in the Pacific Northwest region of the United States but may be applicable to sites outside of the region depending on local microbiology. Antibiotics listed should be compared to local bacterial resistance trends found in your antibiogram to determine applicability.

These guidelines are intended to support clinical decision-making but should not replace individual patient assessment or provider judgment. We encourage clinical discretion and welcome any feedback to improve these guidelines for future iterations. For more information, please login to the UW CSiM website at **www.uwcsim.org**. Your username is on the cover of this guide.

Enter the username at the top right of the UW CSiM homepage, please see the image below for detail.



Washington State Department of Health UW Medicine

ANTIMICROBIAL STEWARDSHIP: GENERAL PRINCIPLES AND APPROACHES

The Agency for Healthcare Research and Quality (AHRQ) identifies 4 key moments in the decision making process to prescribe antimicrobials. This easy to remember approach can be used in most clinical settings and is outlined below.

CONSIDER THE FOUR MOMENTS OF ANTIBIOTIC DECISION MAKING

MOMENT 1: The Diagnosis

"Does this patient have an infection that requires antibiotics?"

Isolated changes in clinical status, lab values or vital signs ALONE should not trigger initiation of antibiotics. This is the time to pause and consider infectious and alternative non-infectious causes. Delirium in the elderly, aspiration pneumonitis, atelectasis, congestive heart failure, venous stasis, emboli, asymptomatic bacteriuria and/or pyuria are common examples of non-infectious conditions.

MOMENT 2: Initial Steps

"Have I obtained appropriate cultures before starting antibiotics?"

"What empiric antibiotic therapy should I initiate?"

"How do I ensure timely administration of appropriate empiric antibiotic therapy?"

Many community acquired infections can be treated empirically using local or regional guidelines tuned to surveillance microbiology data (i.e. antibiograms). Complicated, high-risk cases, recurrent infections, or patients at risk for drug resistant infections are most likely to benefit from reliable and timely microbiology. A standardized or institutional approach to treating common infections minimizes the delay to appropriate therapy.

NOTE *Procedures for optimal culture ordering, collection and reporting are detailed in the Guide to Utilization of the Microbiology Laboratory for Diagnosis of Infectious Diseases: 2018 Update by the Infectious Diseases Society of America and the American Society for Microbiology. The UW TASP guide does highlight some organism and syndrome-specific notes pertinent to empiric antimicrobial selection.*

MOMENT 3: Modification/De-escalation

"A day or more has passed. Can I stop antibiotics?"

"Can I narrow therapy?"

"Can I change from intravenous to oral therapy?"

Performing a regular antibiotic time-out for every patient on antibiotics with review of available microbiological data is the standard of care. Documentation in the medical record should include the anti-infective regimen, indication, the day of treatment, reasoning behind continuation or modification to regimen, plan for narrowing or transitioning to oral, and anticipated total duration. "The antibiotic time out" is best achieved through input by those involved in the prescribing, dispensing, administration and monitoring of antibiotics and hospital/clinic wide implementation. A team approach with comprehensive and clear documentation ensures the survival of the therapeutic plan through all transitions of care.

NOTE *Rapid diagnostics using molecular platforms and disease markers like procalcitonin have shortened the time from days to hours for usable lab/microbiology data. However, it is helpful to know your local lab tools and institutional protocols for result turn around and result interpretation.*

MOMENT 4: Duration

"What duration of antibiotic therapy is needed for this patient's diagnosis?"

Evidence supports shorter durations for common conditions. Most infections can be treated in 7 days or fewer. The total antibiotic duration count should include the first day appropriate empiric therapy was provided plus the days of targeted therapy. Minimizing excessive antibiotic exposure reduces the likelihood of drug side-effects, drug-drug interactions, antibiotic associated diarrhea including *C. difficile*, and resistance. Durations should be based on the current literature and initial clinical response.

NOTE *Because the majority of antibiotic prescribing in hospitals is for community-acquired pneumonia, ventilator-associated pneumonia, intra-abdominal infections, urinary tract infections, and cellulitis, these syndromes and their durations are specifically addressed in this guide. Duration updates are also highlighted in ambulatory conditions for upper and lower respiratory tract syndromes.*

ANTIBIOTIC RESISTANCE PEARLS

Regional resistance trends were utilized to drive agent selection for the UW TASP Antibiotic guide. Some customization of this guide may be warranted based upon your local antibiogram or drug formulary.

To learn more about regional antibiotic resistance, visit your state's Department of Health website for posted regional antibiograms or your local hospital antibiogram.

https://doh.wa.gov/public-health-healthcare-providers/healthcare-professions-and-facilities/healthcare-associated-infections/antibiotic-resistance/stewardship/antibiograms

Following is a summary of observations for drugs and bugs that may help you in antibiotic selection:

GRAM-NEGATIVE BACTERIA AND ANTIMICROBIAL RESISTANCE:

Gram-negative bacteria like *E. coli, Klebsiella spp., Enterobacter, Acinetobacter,* and *Pseudomonas* are becoming increasingly drug resistant. Some of these organisms are intrinsically resistant due to structure or the production of specific beta-lactamases, but, over time, the repeated introduction of new genes on mobile plasmids is increasing the risk of unanticipated resistance. This is especially concerning for empiric therapy for community-acquired infections since that therapy needs to cover essentially all probable bacterial pathogens. Although this is a very broad and complex topic, we are including a few examples below to help as you think through potential treatment options and/or interpret guidelines.

There has been a slow increase in resistance to the fluoroquinolone class of antimicrobials over the last 10-15 years. When considering treatment for empiric treatment options like complicated UTIs or gastrointestinal infections, fluoroquinolones may not be the best option. Surveillance data for Washington State demonstrates >15% fluoroquinolone resistance in *E. coli*, the most common community-acquired Gram-negative pathogen. Treatment guidelines discourage empiric use of TMP/SMX for *E.coli* coverage when local susceptibility trends demonstrate resistance rates ≥20%, which is consistently observed in the Pacific NW. Similarly, ampicillin/sulbactam is no longer reliable for empiric coverage of *E. coli* due to rates of resistance commonly in the 30-40% range.

ESBL (extended spectrum beta-lactamase) Producers

Typical organisms: *E.coli, Klebsiella spp., Proteus*

Incidence: Accounts for at least 32% of *Enterobacterales* such as E. coli in US hospitals according to a CDC report published in 2022.

Resistance pattern: Can be susceptible to cephamycins (cefoxitin and cefotetan) and resistant to first and third generation cephalosporins

Recommended treatment: Although cephamycins show in-vitro susceptibility, they are **NOT** used for clinical ESBL infections. For serious infections due to ESBL-producing bacteria, carbapenems appear to be the best option, even if the organism is susceptible to drugs like piperacillin-tazobactam or cefepime.

Penicillin or cephalosporin allergy (including anaphylaxis): carbapenems are safe

For patients with severe penicillin allergy with delayed, severe cutaneous reactions (DRESS, SJS): use non-beta lactam antibiotics such as fluoroquinolones, based on local susceptibility patterns (consider risks/benefits, including double coverage while awaiting susceptibility testing)

GRAM-POSITIVE BACTERIA AND ANTIMICROBIAL RESISTANCE:

Drug-resistance in Gram-positives is consistent with a longer history of resistance going back to at least the 1990s, most commonly in *Staphylococcus aureus* and *Enterococcus faecium*.

Staphylococcus aureus

S.a*ureus* are considered highly virulent organisms and can cause a variety of clinical syndromes from mild skin and soft tissue infections to life-threatening endovascular infections.

Methicillin-sensitive *Staphylococcus* aureus (MSSA)

Resistance pattern: *S. aureus* isolates sensitive to methicillin/oxacillin are also sensitive to nafcillin, ampicillin-sulbactam, amoxicillin-clavulanate, cefazolin and cephalexin. Often remains highly sensitive to the tetracycline class and TMP-SMX.

Recommended treatment: Nafcillin or cefazolin are appropriate first line therapies for treatment of serious MSSA infections. Although ceftriaxone is active against MSSA, it should not be used first line as clinical failures have been reported in the literature. The preferred oral agents for MSSA infections are cephalexin (should be avoided in serious infections such as endocarditis or osteomyelitis), dicloxacillin or TMP-SMX.

Penicillin allergy (including anaphylaxis): Cefazolin is safe (IV), consider TMP-SMX for oral therapy

For patients with severe penicillin allergy with delayed, severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Vancomycin (IV) or TMP-SMX (PO)

Methicillin-resistant *Staphylococcus* aureus (MRSA)

Resistance pattern: MRSA are resistant to essentially all beta-lactams, including cefazolin. Clindamycin susceptibility is variable and differences are often observed between MRSA isolates obtained in the hospital versus the community.

Recommended treatment: Vancomycin remains the drug of choice to treat hospitalized patients for MRSA infections. TMP-SMX maintains good susceptibility and is the preferred drug for ambulatory patients. The tetracycline class has remained relatively effective against MRSA, making doxycycline a reasonable choice for mild infections in patients with a sulfonamide allergy. Susceptibility results should be reviewed to ensure a negative D-test (indicating inducible clindamycin resistance) prior to utilization of clindamycin for definitive therapy for serious infections. Linezolid has reliable MRSA coverage but should be reserved for situations where intolerance or elevated MICs to vancomycin have been demonstrated or as an oral option for MRSA pneumonia. Extended duration of therapy (>10 days) with linezolid is cautioned due to increased risk of leukopenia, anemia, thrombocytopenia, lactic acidosis, and vision loss.

NOTE

- *Ceftaroline, a newer cephalosporin with anti-MRSA activity, may be warranted in patients with persistent bacteremia, often in combination with other agents. Cases with persistent bacteremia may benefit from expert ID consultation.*
- *Staphylococcus lugdenensis is a coagulase-negative staphylococcus but has more invasive potential. It can cause infections similar to Staph aureus, and it should not be treated as a contaminant until proven otherwise in clinical specimens*

Rifampin should not be used as monotherapy for *S.aureus* due to rapid development of resistance and subsequent clinical failure. Rifampin may be an attractive option for *S.aureus* coverage in infections where biofilm production is concerning such as line sepsis or orthopedic post-operative infections with retained hardware, but only in combination with other anti-*S.aureus* agents.

Streptococci

Among *Streptococcus pneumoniae* in the United States, the reported rate of resistance to macrolides is 29.3%, resistance to TMP-SMX is 20.3%, and tetracycline is 12%. As a result, azithromycin and TMP-SMX are not recommended for empiric treatment options where coverage for *S. pneumoniae* is critical, such as most pediatric upper respiratory infections.

Groups A, B, C and G Streptococci are universally susceptible to penicillin and cefazolin; therefore, local testing and reporting is not necessary.

Streptococcus pyogenes (Group A strep) and *S. agalactiae* (Group B strep) may exhibit inducible clindamycin resistance in up to >20% of cases, and up to 50% in certain areas. Confirm clindamycin susceptibility in these streptococcal infections prior to use.

Penicillin allergy (including anaphylaxis): Cefazolin is safe, consider clindamycin for outpatient therapy

For patients with severe penicillin allergy with delayed, severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Clindamycin

Enterococcus

Enterococci are usually low virulence organisms and often over treated with antibiotics when isolated in non-sterile cultures. Urinary tract infections due to enterococci are often catheter or instrumentation-associated and bacteremia from a urinary source occurs infrequently. *Enterococcus* is a component of mixed flora in intra-abdominal and pelvic cultures and therapy specifically directed against this pathogen may not be warranted. Non-antimicrobial treatments for enterococcal infections include catheter removal, percutaneous or surgical drainage, I&D and debridement.

Enterococcus faecalis

Resistance pattern: remain highly sensitive to ampicillin, nitrofurantoin, and vancomycin. Piperacillin and amoxicillin activity can be extrapolated from ampicillin susceptibility. Note that trimethoprim-sulfamethoxazole (TMP-SMX) has unreliable activity against enterococci and is not tested due to the inherent ability of the organisms to take up exogenous folate.

Recommended treatment: cephalosporins and nafcillin **cannot** be used to treat enterococcal infections due to intrinsic resistance. Ampicillin alone is reasonable treatment for most *E. faecalis* infections. The combination of ampicillin + gentamicin, ampicillin + ceftriaxone or vancomycin + gentamicin may be considered for endocarditis.

Penicillin allergy: Consider vancomycin (if susceptible), otherwise daptomycin or linezolid

Enterococcus faecium

Resistance pattern: high-level beta-lactam resistance is common. Intrinsic resistance to cephalosporins and most carbapenems is the rule due to inner cell wall penicillin binding proteins (PBP). These organisms are often resistant to vancomycin as well, otherwise known as vancomycin-resistant enterococci (VRE).

Recommended treatment: Linezolid or daptomycin should be reserved for complicated VRE infections with or without bacteremia. Higher doses of daptomycin (10-12mg/kg) are recommended when used for severe enterococcal infections.

NOTE

- *Daptomycin should not be used to treat pneumonias due to drug degradation in the presence of surfactant.*

IS IT REALLY A PENICILLIN ALLERGY?

An accurate medication allergy history is the responsibility of every health care provider. It is imperative that antibiotic allergies be clarified, captured and, when appropriate, corrected in the electronic medical record. Here we will focus on a Type I allergic reaction, which is an immunoglobulin E-mediated adverse reaction that would be expected to be reproducible upon re-challenge. A credible antibiotic allergy history includes two elements:

1. A specific recollection of the drug taken, the time elapsed between drug administration and drug reaction, and a specific description of symptoms that occurred during the drug reaction, AND
2. The symptoms during drug reaction being consistent with a serious hypersensitivity reaction. The more specific the symptoms of a drug reaction resemble an anaphylactic reaction, the more concerning and "credible" the history.

FACTS ABOUT PENICILLIN ALLERGY (TYPE 1, IMMUNOGLOBULIN E (IGE)-MEDIATED)

1. Approximately 10% of all U.S. patients report having an allergic reaction to a penicillin class antibiotic in their past.
2. However, many patients who report penicillin allergies do not have true IgE-mediated reactions. When evaluated, fewer than 1% of the population are truly allergic to penicillins.
3. Approximately 80% of patients with IgE-mediated penicillin allergy lose their sensitivity after 10 years.
4. Broad-spectrum antibiotics are often used as an alternative to penicillins. The use of broad-spectrum antibiotics in patients labeled "penicillin-allergic" is associated with adverse drug effects, sub-optimal antibiotic therapy, higher healthcare costs, and an increased risk for antibiotic resistance. Patients with a reported penicillin allergy had a 50% increased risk of developing a surgical site infection, attributable to the receipt of second-line perioperative antibiotics.
5. Correctly identifying those who are not truly penicillin allergic can decrease unnecessary and inappropriate use of antimicrobials.
6. Updated national expert Allergy guidelines state that cephalosporins with dissimilar side chains can be safely given to patients with a penicillin allergy (even if there is a history of anaphylaxis).

TAKING A HISTORY

Before prescribing, administering, or considering broad-spectrum antibiotics to a patient thought to be penicillin-allergic, evaluate the patient for true penicillin allergy (Ig-E mediated) by conducting a history.

Questions to ask to understand a patient's penicillin allergy:

- What medication were you taking when the reaction occurred?
- What kind of reaction occurred and how soon after taking the medication did the reaction occur?
- How long ago did the reaction occur?
- How was the reaction managed?
- What was the outcome?
- Have you ever received amoxicillin, ampicillin or penicillin since having the allergy?

Characteristics of an Immediate, IgE-mediated (Type 1) reaction:

Reactions that generally occur within 1 hour, but in some cases ≤6 hours after drug exposure. Phenotypically, these reactions may present with:

- Hives: Multiple pink/red raised areas of skin that are intensely itchy
- Angioedema: Localized edema without hives affecting the abdomen, face, extremities, genitalia, oropharynx, or larynx
- Bronchospasm: Wheezing and shortness of breath

Anaphylaxis is an acute, life-threatening, systemic IgE mediated reaction that occurs minutes and within 6 hours of exposure. Though several diagnostic criteria exist, anaphylaxis is likely if two or more of the following suddenly occur after exposure to likely allergen:

1) Skin or mucosal symptoms: generalized hives, itch-flush, swollen lips-tongue-uvula
2) Respiratory symptoms: shortness of breath, wheezing, cough, stridor, hypoxemia
3) Reduced blood pressure or symptoms of end-organ dysfunction: collapse, incontinence
4) Gastrointestinal symptoms: crampy abdominal pain, vomiting

Characteristics of a Delayed, T Cell-mediated reaction:

Reactions that generally evolve over days to weeks following exposure to the drug. These reactions may present as:

- Benign exanthems: morbilliform drug eruption
- Drug reaction with eosinophilia and systematic symptoms (DRESS)
- Stevens-Johnson Syndrome (SJS)
- Toxic epidermal necrolysis (TEN)

Guidance on the evaluation and management of delayed hypersensitivity reactions will not be discussed in this review. Consult Allergy/Immunology and Infectious Disease if a delayed cutaneous reaction is suspected.

Figure 1: Assessment of a Patient Reported Penicillin Allergy

*HSR: Hypersensitivity reaction. **See below for inpatient test dose procedure. For outpatient test dose and skin testing, refer to allergy clinic. Cefazolin in Penicillin allergy - see reference 13 and 14. ** See beta lactam cross-reactivity table

BETA-LACTAM CROSS REACTIVITY

Cross-reactivity refers to drugs with similar chemical structures that can cause similar allergic reactions. Penicillin and cephalosporins share common structures and cross-reactivity is largely based on the agent's R1 side chains. Structurally similar and/or identical R1 side chains between various beta-lactams puts patients are risk for cross-reactivity. Beta-lactams with dissimilar R1 side chains are at a low risk for cross-reactivity. Figure 2 describes the risk of cross-reactivity between R-side chains of beta-lactam antibiotics.

NOTE *Patients with more severe delayed hypersensitivity reactions — SJS, TEN, serum sickness, acute interstitial nephritis, hemolytic anemia, and DRESS—should not use the offending drug in the future.*

How to safely give beta-lactams in patients with penicillin allergies

Cephalosporins

Soon after the introduction of cephalosporins, anaphylaxis was reported in patients with prior reactions to penicillin. In the 1970s, a number of reviews examined the rate of allergic reactions to cephalosporins in penicillin allergic patients. One study found that 4.5% of about 16,000

patients exposed to penicillin had an allergy history; of the patients with allergy histories, 8% had a reaction to a cephalosporin. The 8% figure, rounded to 10%, has often been cited as the "rate" of cross-reactivity. However, a number of more recent observations discredit the magnitude of this figure.

If a patient reports an allergy to penicillin, and a cephalosporin is ordered, the following recommendations can be made:

1. For a patient with a non-anaphylactic penicillin reaction (such as non-severe type IV reaction like maculopapular rash anytime in the past, non-anaphylactic IgE mediated reactions like isolated hives or swelling not affecting the airway >5 years ago, itching with no rash) cephalosporins can be given safely. This is especially true for a history of skin eruptions that do not involve itching or edematous wheals .
2. For patients with a history of a severe IgE-mediated penicillin reaction, the risk of a repeat reaction to an agent with a similar side chain is about 0.4% . The risk is nearly zero with agents with dissimilar side chains, therefore ***most*** cephalosporins can be given normally. If a cephalosporin with a structurally similar side chain is desired in a patient with a severe IgE-mediated penicillin allergy, penicillin skin testing, if available, should be utilized to guide further treatment.

NOTE *The cephalosporins that share the same side chain with ampicillin or amoxicillin include cefaclor, cefadroxil, and cephalexin. Therefore, these agents should not be given to patients with a history of anaphylaxis to ampicillin or amoxicillin.*

NOTE *Cefotaxime, cefpodoxime, ceftriaxone and cefepime share the same side chains and have the potential for cross-reactivity amongst the third and fourth generation cephalosporins also due to side chain cross-reactivity, but do not have cross-reactivity with penicillin or amoxicillin.*

NOTE *Cefazolin has a unique side chain and does not cross-react with penicillins.*

3. For patients with a history of severe delayed hypersensitivity reactions (SJS, TEN, DRESS, hemolytic anemia, serum sickness), avoidance of all beta-lactam agents is recommended. Skin testing and drug challenges are also not appropriate in this setting.

Piperacillin-tazobactam

Some patients can be specifically allergic to piperacillin-tazobactam but tolerate other penicillins. Since this requires additional testing, the conservative approach remains to avoid other penicillin antibiotics such as ampicillin, amoxicillin, cefadroxil, cephalexin, cefaclor, or cefprozil. See Figure 2.

Carbapenems

The risk of cross-reactivity between penicillin and any carbapenem is low. A recent systematic review including 1127 penicillin-allergic patients demonstrated a 0.87% risk of cross-reactivity. Patients with a penicillin or cephalosporin allergy (excluding those with a severe delayed cutaneous or

organ-involved reaction) can safely receive any carbapenem without prior testing.

Aztreonam

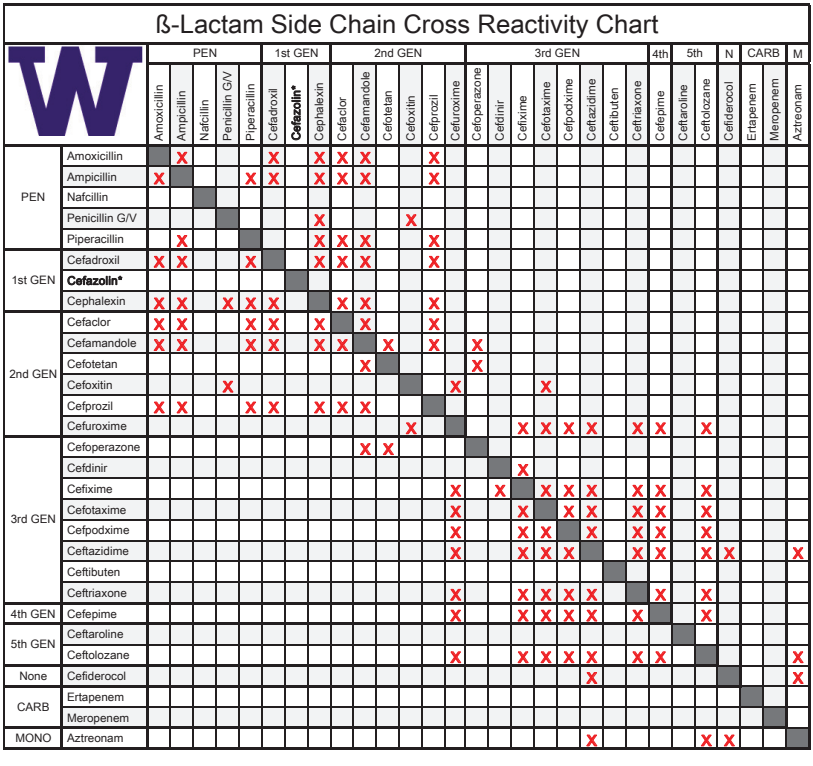
Aztreonam is a monobactam with no risk of cross-reactivity for IgE or T-cell mediated hypersensitivity reactions between penicillins or cephalosporins, except for ceftazidime (due to the shared R1 side chain). Patients with a penicillin or cephalosporin allergy, except for ceftazidime, can safely receive aztreonam without prior testing.

NOTE *Aztreonam does not have activity against aerobic and anaerobic gram-positive bacteria.*

ANTIMICROBIAL DENSENSITIZATION AND DRUG CHALLENGE

Guidance on induction of tolerance (ie desensitization) and drug challenges (ie test doses) are not discussed in this review. Please refer to Drug Allergy Update 2022.

Figure 2: Beta-lactam R1 Side Chain Cross-reactivity Matrix



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x = identical or similar R1 or R2 side chains at risk for cross reactivity

blank = not cross reactive

* cefazolin has unique side chains that do not cross react with any beta-lactams

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SYMPTOMS AND/OR RISK FACTORS

Differential Diagnosis Details / non-AOM Conditions

- Middle ear effusion without inflammation suggests Otitis Media with Effusion (OME), a collection of non-infected fluid in the middle ear that may be due to viral URI, allergies, irritant exposure, eustachian tube dysfunction, or resolving AOM.
- Pain with mild traction to outer ear and normal appearing ear drum may indicate otitis externa. Inflammation of ear canal may be present but does not warrant systemic antibiotics.

AOM

- New onset otorrhea (not due to acute otitis externa)
- Mild bulging tympanic membrane and recent (less than 48 hours) onset of ear pain
- Moderate to severe bulging tympanic membrane
- Intense erythema of the tympanic membrane with presence of middle ear effusion
- Non-severe AOM is defined as mild otalgia for < 48 hours and temperature < 39°C (102°F)
- Severe AOM is defined as toxic-appearing child, moderate or severe otalgia, otalgia for > 48 hours, or temperature > 39°C (102°F) in past 48 hours
- Recurrent AOM (> 2 episodes in 6 months or > 3 episodes in 1 year) in children is an indication for referral for tympanostomy tube placement.

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

High-dose amoxicillin is recommended for pediatric otitis media because >10% *Strep pneumoniae* surveillance isolates are intermediate in Washington.

Culture of ear fluid is not typically indicated.

RECOMMENDED TREATMENT AND DURATION

The following cases should always be treated with antibiotics:

- AOM with otorrhea
- Severe AOM (unilateral or bilateral)
- Bilateral non-severe AOM without otorrhea in children 6-23 months
- Any AOM in infants < 6 months (infants < 2 months may require additional infectious work up)

FIRST LINE:

Amoxicillin (high-dose) 45 mg/kg PO BID (max 2000mg per dose)

NOTE: *For children with AOM and concurrent purulent conjunctivitis, use of amoxicillin in prior month, or history of recurrent treatment failures on amoxicillin, prescribe amoxicillin-clavulanate or a 2nd or 3rd generation cephalosporin.*

SECOND LINE:

Amoxicillin-clavulanate (ES 600mg/42.9mg) 45mg/kg PO BID (max 2000mg/dose)

Penicillin Allergy (including anaphylaxis): Cefprozil 15mg/kg PO BID (max 500mg/dose); Cefdinir 14mg/kg PO daily or 7mg/kg BID (max 600mg/day); Cefpodoxime 5mg/kg PO BID (max 200mg/dose); Cefuroxime (Infants > 2 months) 15mg/kg PO BID (max 500mg/ dose); Ceftriaxone 50mg/kg IM/IV daily (max 2gm/dose)

NOTE: *For children experiencing treatment failure (48-72 hours after initial antibiotic) alternatives include amoxicillin-clavulanate or ceftriaxone or clindamycin 10mg/kg PO TID (max 450mg/dose) or clindamycin PLUS 2nd or 3rd generation cephalosporin.*

DURATION:

- 1-3 days if treating with ceftriaxone IM/IV daily
- 5 days for non-severe AOM and age 2-5 years
- 7 days for non-severe AOM and > 6 years
- 10 days for severe AOM or age < 2 years

Consider watchful waiting without antibiotic therapy:

- For children > 23 months with either bilateral non-severe AOM without otorrhea or unilateral non-severe AOM without otorrhea.
- For children 6-23 months with unilateral non-severe AOM without otorrhea.

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

NOTE: *When watchful waiting is used, ensure follow-up and begin antibiotic therapy if patient is worsening or not improving within 48-72 hours*

SYMPTOMATIC TREATMENT for all patients:

- Extra rest, warm drinks, oral hydration
- Analgesics/antipyretics, as needed
  - Acetaminophen 15mg/kg PO q4-6hr PRN pain or fever, not to exceed 75mg/kg in 24 hours (max 3200 mg in 24 hours)
  - Ibuprofen 5-10mg/kg PO q8hr PRN pain or fever, not to exceed 30mg/kg in 24 hours (max 400mg/dose; 2400mg/day)
- Avoid cigarette smoke; offer smoking cessation resources to family members, if indicated

CONSIDERATIONS

- Ensure vaccinations are up to date.
- Cefuroxime oral suspension has been discontinued, consider cefprozil 15mg/kg PO BID (max dose 500mg) in children >6 months of age needing liquid antibiotic.
- Cefdinir, cefuroxime, cefpodoxime, cefprozil and ceftriaxone are highly unlikely to be associated with cross-reactivity with penicillin allergy on the basis of their distinct chemical structures.
- Consider ENT referral if no sign of improvement after 48-72 hours WITH failure of alternative agent.
- It is reasonable to treat AOM in adults with the same approach as pediatrics using adult dosing strategies for outlined regimens.

Best practices for communicating with patients

- Identify and validate patient and parent concerns.
- Provide clear recommendations including specific symptom treatment and contingency plan for if symptoms worsen.
- Confirm agreement and answer questions.
- Provide education about antibiotic use and associated risks, including bacterial resistance, and C. difficile.
- Visit CDC's Common Illnesses index at *https://go.usa.gov/xRPXH* for patient education materials.

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SYMPTOMS AND/OR RISK FACTORS

Cardinal Criteria for Bacterial Sinusitis

Must have purulent nasal discharge

PLUS

Nasal obstruction AND/OR facial pain/pressure/fullness

AND

Persistent & not improving (>10 days) OR symptoms worsen within 10 days after initial improvement from a typical upper respiratory infection that lasted 5-6 days

NOTE: *thick, colored, or purulent nasal secretions do NOT necessarily indicate bacterial infection*

Items to consider for Risk of Antibiotic Resistance:

- Prior Abx in past 30 days
- Age <2 or >65
- Comorbidities
- Prior hospitalization in past 5 days
- Attend daycare
- Immunocompromised
- Moderate to severe or prolonged signs and symptoms
  - Failure of prior ABX treatment
- Frontal or sphenoidal sinusitis

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

- > 95% of cases are of viral origin and do not warrant antibiotics.
- Approximately 1⁄4 of *H. influenza* isolates produce beta- lactamases and are resistant to amoxicillin.
- > 10% of *Strep pneumoniae* surveillance isolates are non- susceptible to standard dosing of amoxicillin warranting higher dose in select patients.
- Macrolides are NOT recommended for empiric therapy due to high rates of resistance among *S. pneumoniae*.
- Sulfamethoxazole/Trimethoprim is NOT recommended for empiric therapy due to high rates of resistance to *S. pneumoniae* and *H. influenzae*.

- Routine coverage for MRSA is NOT recommended for initial empiric therapy.

NOTE: *Endoscopic-guided culture and/or empiric Staphylococcus aureus (trimethoprim-sulfamethoxazole or doxycycline) should be considered in patients who have had recent sinus surgery.*

RECOMMENDED TREATMENT AND DURATION

Watchful waiting:

- Acceptable to observe mild bacterial sinusitis for 7 additional days before prescribing antibiotic if follow up is assured and focus instead on symptomatic treatment.
- Consider delaying the initiation of antibiotics for any severity of symptoms.
- Initiate treatment if condition fails to improve by 3 days in children or 7 days in adults.
- Consider wait-and-see-prescription (WASP).

Exceptions to watchful waiting:

- Patients with Chronic Rhinosinusitis or recurrent Acute Rhinosinusitis in multiple chronic conditions such as: asthma, ciliary dyskinesia, cystic fibrosis, or immunocompromised state.
- Watchful waiting may not be reasonable for advanced age, impaired cardiopulmonary status or multiple co-morbidities and overall poor general health.

If cardinal criteria are met and at least 10 days of symptoms or double worsening occurs:

FIRST LINE ADULT:

Amoxicillin-clavulanate 875mg/125mg PO BID x 5 days

SECOND LINE ADULT:

Penicillin allergy (including anaphylaxis): Cefpodoxime 200mg PO BID x 5 days

For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Doxycycline 100mg PO BID; or Levofloxacin 500mg PO Q 24 Hours x 5 days

At Risk for Antibiotic resistance: Amoxicillin-clavulanate 2gm PO BID; if high-dose extended release formulation not available: Amoxicillin-clavulanate 875mg/125mg PO BID plus Amoxicillin 1gm PO BID x 5 days; or Levofloxacin 500mg PO Q 24 Hours

UPDATE: *Fluoroquinolone FDA Safety Alert: Disabling & potentially permanent adverse effects outweigh benefit in sinusitis. Only use levofloxacin when no other alternatives exist.*

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

FIRST LINE PEDIATRIC:

Amoxicillin (high-dose) 45 mg/kg PO BID (max 2000mg per dose) x 10 days

SECOND LINE PEDIATRIC:

Penicillin allergy (including anaphylaxis): Cefdinir 14mg/kg/day x 10 days

For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies Levofloxacin [max dose of 500mg] 6 months to 5 years old: 8-10mg/kg PO BID x 10 days or 5 to 16 years of age: 8-10mg/ kg PO Q 24 Hours x 10 days

At Risk for Antibiotic resistance: Amoxicillin-clavulanate (High dose-ES 600mg/42.5mg/5mL) 45mg/kg PO BID x 10 days or use second line options listed above.

NOTE: *In children < 2 years with a penicillin allergy and more severe sinusitis, it may be prudent to use a combination of clindamycin 10mg/kg PO TID plus cefdinir 14 mg/kg/day x 10 days*

Symptomatic Relief/ Adjunctive Treatment:

- Intranasal saline irrigation is safe and effective for symptom relief & does not lead to resistance.
- Intranasal corticosteroids are recommended for patients with h/o allergic rhinitis at standard approved dosing strategies.
- Control pain/fever with ibuprofen or acetaminophen.
- Nasal decongestants like oxymetazoline 1-3 sprays each nostril daily for up to 1 week if used concomitantly with intranasal steroids are safe and effective in adults with sinusitis.

CONSIDERATIONS

Identify and validate patient's concerns and provide clear recommendations including specific symptom treatment and contingency plan for if symptoms worsen.

During follow-up, if patient worsens or lack of improvement at 7 days from presentation:

- Reassess and confirm diagnosis, exclude other causes, and detect complications
- If watch and wait management, initiate FIRST LINE treatment
- If FIRST LINE treatment already completed, consider treatment from "At risk for ABX resistance" above

During follow-up, if NO improvement after 2 courses of antibiotics or if concern for orbital/CNS complications of bacterial sinusitis, order contrast-enhanced CT scan (preferred) or MRI of the paranasal sinuses and refer to the appropriate specialist.

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(adopted and updated from WS DOH 420-194 Nov 2017)

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SYMPTOMS AND/OR RISK FACTORS

Symptoms

- Abrupt onset of sore throat
- Headache
- Myalgia
- Occasionally nausea/vomiting/abdominal pain followed by spontaneous resolution in 2-5 days

Physical Exam consistent with Bacterial Pharyngitis

- Patchy tonsillopharyngeal exudate
- Anterior cervical adenitis (tender nodes)
- Tonsillopharyngeal inflammation
- Fever >100.4 F
- Palatal Petechia
- Scarlatiniform rash
- Absence of cough

NOTE: *If severe signs/symptoms (drooling, dysphonia, "potato" voice, neck swelling) consider: epiglottitis, peritonsillar abscess, retropharyngeal abscess, submandibular space infections, or primary HIV. Obtain lateral neck x-ray, and consider transfer to the emergency department.*

Viral Features

- Conjunctivitis
- Rhinorrhea
- Coryza
- Cough
- Oral ulcers
- Hoarseness (laryngitis)
- Viral exanthema
- Diarrhea
- Ear pain

NOTE: *> 95% of pharyngitis cases are of viral etiology and do not require antibiotics. Provide symptomatic relief.*

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

Test:

- Testing for Group A Streptococcus (GAS) is NOT recommended for acute pharyngitis with clinical & epidemiologic features that strongly suggest a VIRAL etiology.
- Routine use of back up throat cultures for those with a negative RADT is NOT necessary for adults; there is a low incidence of GAS pharyngitis in adults & risk of subsequent acute rheumatic fever is exceptionally low.
- Rapid Diagnostic Test (RADT) Recommended for adults with two or more symptoms and for children with signs and symptoms of strep throat who do not have viral symptoms.
- Reflex/Back up throat culture for negative RADT is only indicated in children/adolescence (3-15 years), patients at high-risk for severe disease (eg. poorly controlled diabetes, immunocompromised, on chronic corticosteroids), or those in close contact with elderly, infants or immunocompromised individuals.

NOTE: *It is NOT recommended to test for GAS under the age of 3 years.*

RECOMMENDED TREATMENT AND DURATION

NOTE: *treat patients who are RADT or throat culture positive or those with known exposure 2 weeks prior to symptom onset.*

FIRST LINE PEDIATRIC:

- Pen VK 250mg PO BID - TID (>27kg 500mg BID - TID) x 10 days
- Amoxicillin 50mg/kg PO daily or divided in 2 doses (MAX 1gm/ day) x 10 days
- Penicillin G Benzathine (<27kg) single IM dose 600,000 units x 1 dose

  UPDATE: *Drug shortage of IM Penicillin G Benzathine warrants oral treatment options as first line consideration.*

SECOND LINE PEDIATRIC:

- For patients with penicillin allergy (NOT including anaphylaxis): Cephalexin 20mg/kg PO BID (MAX 500mg/dose) x 10 days
- Anaphylaxis to penicillin or severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Azithromycin (2-15 years of age) 12mg/kg PO once, then 6mg/kg PO daily days 2-5 (MAX 500mg/ dose); Azithromycin 20mg/kg PO once daily (max 1000mg/ dose) x 3 days; or Clindamycin 7mg/kg PO TID (MAX 300mg/ dose) x 10 days

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

FIRST LINE ADULT:

- Pen VK 500mg PO BID-TID x 10 days
- Amoxicillin 1000mg PO daily OR 500mg PO BID x 10 days
- Penicillin G Benzathine (>27kg) 1.2 million units IM x 1 dose

SECOND LINE ADULT:

- For patients with penicillin allergy (NOT including anaphylaxis): Cephalexin 500mg PO BID x 10 days
- Anaphylaxis to penicillin or severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Azithromycin 500mg PO on day one, 250mg PO daily on days 2-5; Azithromycin 500mg PO daily x 3 days, or Clindamycin 300mg PO TID x 10 days

Symptomatic Relief for all Patients (viral or bacterial infections):

- Rest
- Adequate fluid intake
- Antipyretics (no ASA (i.e. aspirin) under age 2)
- Magic mouthwash
- > 6yrs of age: gargle with warm salt water
- > 3yrs of age: sucking on hard candy

NOTE: *Medicated throat lozenges/sprays (not recommended in children/adolescents)*

CONSIDERATIONS

- Individual will be contagious for 24 hours after starting antibiotic tx.
- Treatment for non-symptomatic GAS carriers is NOT routinely recommended.
- Testing or empiric tx of asymptomatic household contacts is NOT routinely recommended.
- There is no evidence of benefit for glucocorticoids in children or adolescents. Short term dosing may be beneficial in adults.
- Treatment for Group C & G are the same recommendations.

Best Practices for Communicating with Patients:

- Identify and validate patient's and parent's concerns.
- Provide clear recommendations including specific symptom treatment and contingency plan for if symptoms worsen.

- Confirm agreement and answer questions.
- Provide education about antibiotic use and associated risks, including bacterial resistance and *C. difficile.*

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(adopted from Washington State Department of Health DOH 420-198 Aug 2017)

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SYMPTOMS AND/OR RISK FACTORS

Presenting Symptoms:

- Cough > 5 days in a patient WITHOUT COPD
- Purulent sputum occurs in 50% of cases and does NOT necessarily indicate bacterial infection
- Low-grade fever is common early in illness (<100.5 F or <38C)
- Diffuse wheezes or rhonchi on exam, but NOT rales or signs of consolidation
- Mild dyspnea
  - Chest wall pain due to coughing

Comorbidities to consider:

- COPD
- Asthma
- Elderly (> 75 years)
- Immunocompromised
- Heart failure
- Underlying bronchiectasis

Testing:

- Vital signs including SpO2
- Obtain CXR if: hemoptysis, ill-appearing, focal abnormality on auscultation, age >70, RR >24 bpm, temperature > 100.4F or >38C for longer than 4 days OR recurrent after having resolved for longer than 24 hours, HR > 100 bpm, resting O2 sat < 90% cough not improving after > 6-8 weeks
- A low procalcitonin (if available) may help confirm decision to withhold antibiotics

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

Bronchitis is a self-limited inflammation of the bronchi due to respiratory infection by viruses (>90% of cases)

- Influenza A or B
- Parainfluenza

- Human metapneumovirus
- Rhinovirus
- RSV
- Pertussis
- Consider influenza PCR during flu season if high risk or <48 hours of symptoms
- Consider pertussis PCR if paroxysms, post-tussive emesis, inspiratory whoop or known exposure to pertussis case. Report suspect, probable or confirmed pertussis to local public health.
- Respiratory pathogen testing is discouraged in uncomplicated acute bronchitis

NOTE: *the most common causes of acute uncomplicated bronchitis DO NOT require antibiotics*

RECOMMENDED TREATMENT AND DURATION

NOTE: *Antibiotic therapy may be indicated for bronchitis in patients with comorbidities such as immunosuppression, COPD/chronic bronchitis, cystic fibrosis, or other underlying lung disease other than asthma. Recommendations for these patients is beyond the scope of this guideline.*

Symptoms without comorbidities present < 14-21 days:

- Guaifenesin Q4H prn cough
- Dextromethorphan Q4H prn cough

NOTE: *Narcotic medications should not be used for cough suppression in acute bronchitis.*

- Albuterol inhaler prn difficulty breathing or wheezing present on exam in patients with asthma or underlying pulmonary disease

Symptoms and comorbidities present:

- Evaluate for pneumonia or COPD exacerbation or alternative causes
- If positive evaluation, treat accordingly
- If negative evaluation, follow guideline for symptoms without comorbidities above
- Adjunctive medications Ibuprofen 400mg PO Q6-8H prn pain or inflammation
- Naproxen 500mg PO Q12H prn pain or inflammation
- Acetaminophen 325mg-650mg PO Q6h prn pain

CONSIDERATIONS

- Expected duration of cough is 2-3 weeks (average 18 days).
- Persistent cough, especially cough lasting > 6-8 weeks, may be a sign of another disease process ranging from minor to serious, such as post- nasal drip syndrome, medication use (e.g., lisinopril), irritant exposure, asthma, gastroesophageal reflux disease (GERD), smoking or second-hand smoke exposure, chronic bronchitis, bronchiectasis, or malignancy.
- Antihistamines are NOT effective for bronchitis
- Provide patient education on rationale for NOT prescribing antibiotics, expected duration of symptoms, importance of smoking cessation and smoke-free environment, avoidance of irritants, adequate hydration, rest, humidified air, and to follow- up for worsening symptoms. Describe the diagnosis as "viral illness" or "chest cold"

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SYMPTOMS AND/OR RISK FACTORS

Initial Testing/Imaging

- Vital Signs: Temp, BP and Pulse Oximetry

  NOTE: *No routine labs or CXR are indicated for children well enough to be managed outpatient*

- Labs:
  - Blood work: CBC with differential, CRP, blood cultures if not fully immunized OR fails to improve after initiation of antibiotics
  - Viral Testing: SARS-CoV-2 testing at all times during pandemics. Influenza PCR during influenza season
  - If atypical pathogen suspected: PCR Respiratory Panel if available
  - Sputum gram stain and culture: if intubating, collect at time of initial ET tube placement; consider testing in older children who can produce sputum sample
  - Urinary antigen detection testing is not recommended in children; false-positive tests are common.
- Radiography:
  - AP and lateral CXR if failure to improve on initial antibiotic therapy
  - AP and lateral CXR 4-6 weeks after diagnosis if recurrent pneumonia involving the same lobe

Criteria for Outpatient Management

- Mild CAP: no signs of respiratory distress and SpO2 >=90% on room air
- Able to tolerate PO
- No concerns for pathogen with increased virulence (ex. CA-MRSA)
- Family able to carefully observe child at home, comply with therapy plan, and attend follow up appointments

Inpatient Admission Criteria

PEDIATRIC FLOOR

- Respiratory distress (tachypnea, dyspnea, apnea, retractions, grunting, nasal flaring)
- SpO2 <90% on room air
- Unable to tolerate PO
- Suspected or documented CAP caused by pathogen with increased virulence (ex. CA-MRSA)

- Concerns about observation at home, inability to comply with therapy, inability to be followed up

PICU

- Respiratory support: Intubated or requiring non-invasive positive pressure ventilation
- Concern for respiratory failure
- Concern for sepsis
- FiO2 needs HFNC >50% to keep saturation ≥92%
- Altered mental status

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

- The most common suspected pathogens are viral. For bacterial pneumonia common pathogens include: *Streptococcus pneumonia* and *Mycoplasma pneumoniae*.
- Atypical pneumonia is highly unlikely in children <5 years old. For children > 5 years of age, empirically add a macrolide if atypical pneumonia cannot be ruled out.
- For suspected viral pneumonia, the most common pathogens include: Respiratory Syncytial Virus (RSV), Human Rhinovirus, Human Metapneumovirus, and Adenovirus

RECOMMENDED TREATMENT AND DURATION

UNCOMPLICATED PNEUMONIA

Previously healthy and fully immunized children:

Inpatient Treatment:

FIRST LINE:

Ampicillin 50mg/kg IV q6h (max 2000mg/dose)

SECOND LINE:

- Ceftriaxone 100mg/kg IV once, then 50mg/kg IV q24h (max 2000mg/dose)
  For patients with penicillin allergies (including anaphylaxis): Ceftriaxone is safe
- Severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Levofloxacin: 6 month-5 years old: 8-10mg/kg PO BID (max 375mg/dose) or ≥5 to 16 years of age: 8-10mg/kg PO q24h (max 750 mg/dose)

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

Outpatient Treatment:

FIRST LINE:

Amoxicillin 45mg/kg PO BID (max 2000mg/dose)

SECOND LINE:

- For patients with penicillin allergy (including anaphylaxis): Cefuroxime or cefprozil in children > 6 months of age needing a liquid formulation
- For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Levofloxacin

COMPLICATED PNEUMONIA

Not fully immunized with PCV13 & Hib or suspicion for *H. influenzae* or severe disease and/or complicated pneumonia:

Inpatient Treatment:

FIRST LINE:

Ceftriaxone 100mg/kg IV once, then 50mg/kg IV BID (max 2000mg/dose)
For patients with penicillin allergies (including anaphylaxis): Ceftriaxone is safe

SECOND LINE:

For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Levofloxacin: 6 month-5 years old: 8-10mg/kg PO BID (max 375mg/dose) or ≥5 to 16 years of age: 8-10mg/kg PO q24h (max 750 mg/dose)

For suspicion of Methicillin resistant *Staphylococcus aureus*:

- ADD: Clindamycin 13mg/kg PO TID (max 600mg/dose)
- For PICU or Severe Infection, ADD Vancomycin

Outpatient Treatment:

FIRST LINE:

Amoxicillin/clavulanate 45mg amoxicillin component/kg PO BID (max 2000mg/dose of amoxicillin component)

SECOND LINE:

Penicillin Allergy (including anaphylaxis): cefuroxime 15mg/kg PO BID (max 500mg/dose) or cefprozil 15mg/kg PO BID (max 500mg/dose) in children > 6 months of age needing a liquid formulation

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Levofloxacin.

For pneumonia in children > 5 years of age and atypical pneumonia cannot be ruled out:

FIRST LINE:

ADD azithromycin 10mg/kg IV/PO daily for 1-2 days then transition to oral step down if possible (max 500mg/dose).
A 3-day total azithromycin course is sufficient for atypical coverage.

SECOND LINE:

(For children > 7 years only) ADD Doxycycline 1-2 mg/kg PO BID (max dose 200mg/day) for 7-10 days.

DURATION:

- Uncomplicated pneumonia: 7-10 days. Although a 10-day duration is recommended in the most recent IDSA guidelines, shorter courses (3-5 days outpatient or 5-7 days inpatient) may be considered for mild disease in children aged ≥6 months.
- Complicated pneumonia: duration is dependent on clinical response, in general 2-4 week course.

CONSIDERATIONS

- Viral pneumonia is most common in children < 5 years of age. Antibiotics are not typically necessary. If influenza positive, treat with oseltamivir.
- Children should show clinical signs of improvement within 48- 72 hours allowing de-escalation of therapy based on available culture results and consideration of transition to oral step-down therapy.
- If no improvement or worsening, pursue further diagnostic work up as indicated. Consider broadening antibiotics and formal infectious disease consultation.

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SYMPTOMS AND/OR RISK FACTORS

Symptoms: productive cough, chest pain, dyspnea, diminished breath sounds, crackles not cleared with coughing, abdominal pain, with or without fever.

Assess: Chest X-ray; pulse oximetry

Adult **CURB-65** Score (Triage patients in the outpatient setting): 1 point each for the criteria below

Confusion

Blood **U**rea nitrogen > 20 mg/dL

Respiratory rate > 30 breaths/min
Blood pressure SBP < 90 or DBP < 60 mmHg

Age > **65** years

Manage inpatient for score ≥2, Manage outpatient for score (0-1)

Severe CAP (2007 IDSA/ATS Criteria) (Consider use in patients already hospitalized with CAP): Either 3 minor criteria OR 1 major criterion: consider ICU level care.

Minor Criteria:

- Respiratory rate ≥ 30 breaths/min
- $Pa_{02}/Fi_{02} \leq 250$
- Multilobar infiltrates
- Confusion/disorientation
- Uremia (BUN ≥ 20 mg/dl)
- WBC < 4000 cells/µl (leukopenia due to infection alone, not chemotherapy induced)
- Platelet < 100,000/µl
- Temp < 36°C
- Hypotension requiring aggressive fluid resuscitation

Major Criteria:

Septic shock with need for vasopressors

Respiratory failure requiring mechanical ventilation

UPDATE: *Healthcare associated pneumonia (HCAP) is no longer a designated category of pneumonia. This is because HCAP risk factors are poor at predicting prevalence of multidrug resistant organisms and lead to unnecessary use of broad-spectrum antibiotics without improved outcomes.*

Patients should be treated according to specific risk factors (detailed below) and their severity of illness.

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

Send sputum for gram stain & culture, CXR, urinary pneumococcal antigen, urinary legionella antigen, and blood cultures for hospitalized patients.

Send nasal swab for rapid influenza testing.

Respiratory PCR and/or procalcitonin (PCT) may be helpful if unclear diagnosis of pneumonia or acute exacerbation of COPD.

Most Common Etiologies:

Bacterial: *S. pneumonia*, Mycoplasma, *H. influenza, Chlamydophila pneumoniae*

Respiratory viruses: Influenza A & B, adenovirus, respiratory syncytial virus, parainfluenza

Structural lung disease such as bronchiectasis or exacerbations of COPD with multiple courses of antibiotics and/or chronic steroid use may warrant coverage for *Pseudomonas aeruginosa*

RECOMMENDED TREATMENT AND DURATION

Community-acquired pneumonia (outpatient)

FIRST LINE
Patients with no co-morbidities:

- Amoxicillin 1g PO TID
- Doxycycline 100mg PO BID

Patients with comorbidities (chronic heart, lung, liver, or renal disease; diabetes mellitus; alcoholism; malignancy; asplenia):

- **Amoxicillin/Clavulanate 875/125mg BID PLUS Azithromycin
- Levofloxacin 750 mg PO Daily

**Cefuroxime 500mg PO BID or Cefpodoxime 200mg PO BID may be used in place of amoxicillin/clavulanate. Dose for Azithromycin is 500mg on day 1 then 250 mg daily thereafter or Azithromycin 500mg q24h x 3 days. Doxycycline 100mg PO BID is an alternative option to azithromycin.

DURATION: Typically 5 days

Continued ›

UPDATE: *Azithromycin is provided for atypical coverage and should not be relied upon as monotherapy for ambulatory or inpatient management of pneumonia due to increasing Streptococcus pneumoniae resistance.*

Community-acquired pneumonia (inpatient)

FIRST LINE

Ceftriaxone 1 to 2g IV daily PLUS Azithromycin 500mg PO/IV q24hr x 3 days unless confirmed Legionella pneumonia.

For patients with penicillin allergies (including anaphylaxis): Ceftriaxone is safe.

SECOND LINE:

Levofloxacin 750mg PO/IV q24hr

Indications for Broadening Antimicrobial Coverage:

- Add Vancomycin IF prior respiratory isolation of MRSA or if there are imaging or clinical findings concerning for MRSA pneumonia
- Add Cefepime 2g IV q8h IF prior respiratory isolation of *P. aeruginosa*
- Add Cefepime AND Vancomycin IF severe pneumonia AND received IV antibiotics in preceding 90 days

Alternative antibiotics with anti-MRSA coverage include linezolid and ceftaroline. Alternative antibiotics with anti-Pseudomonal coverage include ceftazidime, piperacillin/tazobactam

DURATION: Typically 5 days - 3 days may be considered in patients with rapid clinical improvement.

Consider stopping antibiotics IF:

Afebrile x48 hours

AND Less than 2 of the following:
SBP< 90, HR >100, RR >24, Pa_{02}< 60 on room air

AND/OR PCT < 0.25

Hospital Associated Pneumonia (HAP) and Ventilator Associated Pneumonia (VAP)

- Defined as pneumonia occurring > 48h after admission (HAP) or >48h after endotracheal intubation (VAP).

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

- Empiric coverage should include *P. aeruginosa* and MRSA and final treatment targeted to cultures and sensitivities. MRSA coverage is not necessary if there is recent documented absence of MRSA colonization of the nares or upper airway.
- Typical duration for HAP/VAP is 7 days

UPDATE: *The 2019 CAP guidelines recommend against adding anaerobic coverage for aspiration pneumonia except in cases of suspected lung abscess or empyema*

CONSIDERATIONS

- During flu seasons, send Flu testing and then give empiric oseltamivir 75mg PO q12h while awaiting results. Higher doses of oseltamivir (ie. 150mg BID) in critically ill or obese patients have not been associated with improved outcomes.
- Yeast in sputum rarely represents true infection.
- If MRSA nares swab or sputum is negative for MRSA, discontinue vancomycin.
- Anaerobic coverage such as piperacillin-tazobactam is not usually necessary for CAP, HAP or VAP.
- Consider narrowing therapy at 48 hours if cultures remain negative.
- Consider MRSA coverage if post-influenza pneumonia (days to weeks) and necrotizing/ life-threatening presentation. Ensure regimen targets *S. pneumoniae* and *H. influenzae* as well.
- CF or Lung Transplant patients likely require infectious diseases consultation.

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13. *Dinh A, Ropers J, Duran C, et al; Pneumonia Short Treatment (PTC) Study Group. Discontinuing β-lactam treatment after 3 days for patients with community-acquired pneumonia in non-critical care wards (PTC): a double-blind, randomised, placebo-controlled, non-inferiority trial. Lancet. 2021 Mar 27;397(10280):1195-1203.*

ORGAN SYSTEM:	SYNDROME:
Intra-abdominal	Intra-abdominal Infections in Adults Inpatient

SYMPTOMS AND/OR RISK FACTORS

High Risk/Severe Criteria

Albumin <2.5

Age >70 years Immunocompromised state
Severe sepsis/septic shock

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

Intra-abdominal infections are usually of a polymicrobial process and may include the following pathogens:

Enterobacterales
Enterococcus sp.
Anaerobes (including Bacteroides sp.)

Anaerobes are less significant for biliary sources UNLESS bile duct to bowel anastomosis or fistula is present. Anaerobes are a concern with liver abscesses due to the delivery of anaerobic bowel contents to the liver via the portal venous system.

Routine blood cultures are NOT recommended for community-acquired infections among immunocompetent patients without physiologic derangements. However, cultures SHOULD be obtained in patients with nosocomial infection or who require operation for prior treatment failure.

RECOMMENDED TREATMENT AND DURATION

EXTRA-BILIARY SOURCE:

appendicitis, diverticulitis, bowel perforation with peritonitis, hepatic abscess

Extra-biliary Source MILD-MODERATE Risk

FIRST LINE

Ceftriaxone 2gm IV q24hr PLUS Metronidazole 500mg IV q8hr

For patients with penicillin allergies (including anaphylaxis): Ceftriaxone is safe

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

SECOND LINE

For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Levofloxacin 750mg IV q24h PLUS Metronidazole 500mg IV q8hr

NOTE: *Because many of the patients who are managed without a primary source control procedure may be treated in the outpatient setting, the oral regimens recommended can also be used as either primary therapy OR step-down therapy following initial intravenous antimicrobial therapy.*

Oral options: levofloxacin plus metronidazole, an oral cephalosporin with metronidazole; culture data may allow for the use of amoxicillin-clavulanate or moxifloxacin, but these agents should NOT be used empirically due to high rates of B. fragilis resistance.

Extra-biliary Source HIGH RISK/SEVERE

FIRST LINE

Piperacillin-tazobactam 4.5gm IV q6hr (or extended infusion)

For patients with penicillin allergies (including anaphylaxis): Cefepime 2gm IV q8hr PLUS Metronidazole 500mg IV q8hr

SECOND LINE

For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Levofloxacin 750mg IV q24h PLUS Metronidazole 500mg IV q8hr

Consider the addition of Aztreonam 2gm IV q8hr

NOTE: *IF previous colonization or concerns for highly resistant GNRs, may consider meropenem 1gm IV q8hr as a substitute for piperacillin-tazobactam or additional GNR coverage to levofloxacin. Or may use ertapenem IV q24 (if pseudomonas is not a concern)*

Duration of therapy

Without source control/surgery: 4 to 7 days total

With source control/surgery: 4 days post-operative therapy if adequate surgical source control

5 days for uncomplicated diverticulitis

If retained focus of infection, duration should be guided by clinical response (at least 7 to 14 days).

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

BILIARY SOURCE: cholecystitis, cholangitis

Biliary source MILD-MODERATE Risk

FIRST LINE

Ceftriaxone 2gm IV q24hr

For patients with penicillin allergies (including anaphylaxis): Ceftriaxone is safe

SECOND LINE

For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Levofloxacin 750mg IV q24h

NOTE: *Anaerobic therapy is NOT indicated unless a biliary-enteric anastomosis is present*

Biliary Source HIGH RISK/SEVERE

FIRST LINE:

Piperacillin-tazobactam 4.5gm IV q6hr (or extended infusion)

For patients with penicillin allergies (including anaphylaxis): Cefepime 2gm IV q8hr PLUS Metronidazole 500mg IV q8hr

SECOND LINE For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies:

Levofloxacin 750mg IV q24h

PLUS

Metronidazole 500mg IV q8hr

Consider the addition of Aztreonam 2gm IV q8hr

NOTE: *IF previous colonization or concerns for highly resistant GNRs, consider meropenem 1gm IV q8hr as a substitute for piperacillin-tazobactam or additional GNR coverage to levofloxacin.*

Duration of therapy

Uncomplicated with operative or endoscopic management : ≤ 24 hours

Uncomplicated, without operative or endoscopic management: 5 days

Complicated by inadequate source control: Duration should be determined on a case-by-case basis, depending on timing of source control and other clinical factors.

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

NOTE: *In the event of uncomplicated IAIs, the infection involves a single organ and does not extend to the peritoneum. When the source of infection is treated effectively by surgical excision, post-operative antimicrobial therapy is not necessary, as demonstrated in managing uncomplicated acute appendicitis or cholecystitis.*

CONSIDERATIONS

- Due to E.coli resistance >10%, empiric quinolone use alone is cautioned in high-risk/severe cases . Double-coverage with the addition of aztreonam or an aminoglycoside should be considered in these high-risk/severe circumstances when using a quinolone as the backbone of therapy.
- Empiric ampicillin-sulbactam is NOT recommended for use because of high rates of resistance among community-acquired E. coli and B. fragilis.
- The IDSA definition of source control is a "single procedure or series of procedures that eliminate infectious foci, control factors that promote ongoing infection, and correct or control anastomotic derangements to restore normal physiologic function" Review of operative reports is often necessary to determine whether source control has been achieved.
- Empiric coverage of Enterococcus or Candida is NOT recommended for mild-moderate community-acquired intra-abdominal infections
- Empiric Enterococcal treatment is recommended for healthcare associated infections with previous cephalosporin therapy, immunocompromised patients, and those with valvular heart disease or prosthetic intravascular materials.
- Bowel injuries from penetrating, blunt, or iatrogenic trauma repaired within 12hr of initial insult should be treated with antibiotics for < 24 hrs. Likewise, antibiotics should be used for < 24hrs when there is intraoperative contamination of the peritoneum by enteric contents.
- Use of ursodeoxycholic acid and/or antibiotics for the prevention of biliary stent occlusion or infection is NOT routinely recommended.
- Need for antibiotics in mild, outpatient diverticulitis disease remains controversial
- Aminoglycosides are NOT recommended for routine use in adults with community acquired intra-abdominal infection because of the availability of less toxic agents demonstrated to be at least equally effective. However, aminoglycosides may be necessary in high risk/severity patients in combination with a quinolone and metronidazole in patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies.

REFERENCES

1. *Joint Surgical Infection Society and Infectious Diseases Society of America Guidelines (CID 2010:50)*
2. *Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery (ASHP 2013;70(3))*
3. *Management of intra-abdominal infections: recommendations by WSES 2016 consensus conference (World J Emerg Surg 2016;12:22)*
4. *Trial of short-course antimicrobial therapy for intraabdominal infection (NEJM 2015;372:1996-2005)*

ORGAN SYSTEM:	SYNDROME:
Urinary Tract	**Asymptomatic Bacteriuria**

SYMPTOMS AND/OR RISK FACTORS

Isolation of a specific quantity of bacteria in an appropriately collected urine specimen (≥105 cfu/mL from an individual WITHOUT signs or symptoms of infection.

CULTURE & SUSCEPTIBILITY (C&S) INVESTIGATION

Routine C&S is NOT indicated in asymptomatic patients unless screening in pregnancy or prior to urologic procedure with compromise of the urothelial mucosa.

RECOMMENDED TREATMENT AND DURATION

Pregnant women: (select one option)

- Nitrofurantoin 100mg PO BID x 5d
  NOTE: *contraindicated at > 38 weeks gestation or when the onset of labor is imminent.*
- Cephalexin 500mg PO BID x 5d

Urologic procedure:

Direct treatment based on pre-procedure screening C&S.

CONSIDERATIONS

- **DO NOT screen for asymptomatic bacteriuria outside of pregnancy or upcoming urologic procedures**.
- Scope of this guideline is limited to immunocompetent adults >18 y/o without history of renal transplant. Please see references for UTI in solid organ transplant recipients: Guidelines from the American Society of Transplantation Infectious Diseases Community of Practice
- Bacteriuria identified on preoperative urine screening for non-urologic procedures (cardiac, ortho, vascular) is NOT an indication for antibiotics and does not decrease surgical site infections or prevent UTIs
- Consider a short course of antibiotics (1 or 2 doses) rather than a prolonged course for patients with asymptomatic bacteriuria undergoing urologic procedures.
- Antibiotics should be given within 30-60 minutes prior to the start of the procedure

REFERENCES

1. *Clinical Practice Guideline for the Management of Asymptomatic Bacteriuria: 2019 Update by the Infectious Diseases Society of America. (IDSA 2019; 68(10): e83-e110.*
2. *Urinary tract infections in solid organ transplant recipients: Guidelines from the American Society of Transplantation Infectious Diseases Community of Practice. (Clin Tranplant 2019;33(9):e13507*

ORGAN SYSTEM:	SYNDROME:
Urinary Tract	Adult Lower Tract UTI (Cystitis)

SYMPTOMS AND/OR RISK FACTORS

General symptoms: Acute onset dysuria, frequency or urgency with no systemic or upper signs of infection

NOTE: *Consider deviation from the below recommendations (or consult ID) if any of the following risk factors for multidrug resistant organisms are present: antibiotic exposure within 90 days, presence of urinary invasive device(s), history of UTI with multi-drug resistant organism.*

CULTURE & SUSCEPTIBILITY (C&S) INVESTIGATION

If patient requires inpatient admission for acute cystitis, urine C&S are critical in order to optimize therapy.

Urine cultures should be collected from a midstream void prior to antibiotics or a freshly placed urinary catheter.

RECOMMENDED TREATMENT AND DURATION

FIRST LINE: (SELECT ONE OPTION)

- Nitrofurantoin (Macrobid) 100mg PO BID x 5d
- TMP-SMX DS 1 tablet PO BID x3d

SECOND LINE:

- Ciprofloxacin 250mg PO BID x 3d
- Beta-lactams (see note):
- Cephalexin 500mg PO BID x 7d

  Cephalexin is safe for patients with penicillin allergy except those with anaphylaxis or severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS)
- Amoxicillin-clavulanate 875/125mg BID x 7d

NOTE: *on male UTI: Can be considered uncomplicated. Nitrofurantoin can be considered if not concern for prostate involvement. Treatment courses 7 days of antibiotics has been shown to be as effective as >7 days.*

NOTE: *Beta-lactams have been shown to be inferior to alternative treatment options due to decreased dwell time in the urine*

NOTE: *Due to adverse effect profile and beneficial use in more systemic/deep-seated infections, fluoroquinolone use should only use when no other alternatives exist.*

CONSIDERATIONS

- Avoid nitrofurantoin in last trimester of pregnancy or during labor due to concern of causing hemolytic anemia in the newborn.
- Avoid TMP-SMX near term due to potential increase in kernicterus.
- If at risk for STIs w/ symptoms of urethritis, consider screening for gonorrhea and chlamydia.
- For ESBL (Extended Spectrum Beta-lactamase) producing organisms, treat according to reported susceptibility with nitrofurantoin, TMP/SMX or ciprofloxacin. If resistant to all tested antibiotics or multiple allergies, consider Fosfomycin 3gm PO once if available or consult Infectious Diseases for potential alternatives. Prolonged treatment beyond recommended duration is NOT required.
- Nitrofurantoin is contraindicated for CrCl < 30mL/min
- Patients with recurrent UTIs should have empiric therapy selected based upon prior C&S results.
- Chronic antibiotic prophylaxis for most patients with risk factors for recurrent, complicated UTI is NOT typically recommended. Risk of resistance outweighs the slight reduction in infection rate.

NOTE: *One randomized trial confirmed that pre-menopausal women with recurrent UTIs who drank more water (1.5L total fluid daily) got fewer UTIs. Consider vaginal estrogen in post-menopausal women with recurrent UTI*

REFERENCES

1. *Executive Summary: International Clinical Practice Guidelines for the Treatment of Acute Uncomplicated Cystitis and Pyelonephritis in Women: CID 2011;52(5):561–564.*
2. *2015 Updated Beers Criteria.*
3. *Hooton TM et al. JAMA Intern Med 2018;178(11):1509-1515.*
4. *Ingalsbe M et al. Ther Adv Urol. 2015; 7(4): 186-193.*
5. *Germanos G et al. OFID. 2019l 6(6): ofz216.*
6. *Raz and Stam. N Engl J Med. 1993 Sep 9;329(11):753-6.*

ORGAN SYSTEM:	SYNDROME:
Urinary Tract	Adult Upper Tract UTI (including Pyelonephritis)

SYMPTOMS AND/OR RISK FACTORS

Upper UTI is frequently associated with general symptoms of UTI plus one or more of the following: fever, chills, back/flank pain, or pelvic or perineal pain in men (which may suggest prostatitis).

NOTE: *Consider deviation from the below recommendations (or consult ID) if any of the following risk factors for multidrug resistant organisms are present: antibiotic exposure within 90 days, presence of urinary invasive device(s), history of UTI with multi-drug resistant organism.*

CULTURE & SUSCEPTIBILITY (C&S) INVESTIGATION

If patient requires inpatient admission for acute pyelonephritis, urine C&S are critical to optimize therapy.

Urine cultures should be collected from a midstream void prior to antibiotics or a freshly placed urinary catheter.

RECOMMENDED TREATMENT AND DURATION

Inpatient:

FIRST LINE

- Ceftriaxone 1g IV Q24H
  For patients with penicillin allergies (including anaphylaxis): Ceftriaxone is safe

SECOND LINE

For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies

- Ciprofloxacin 400mg IV Q12H
- Levofloxacin 750mg IV Q24H

Outpatient:

FIRST LINE

- Ceftriaxone 1g IM/IV x 1 dose (ok for patients with penicillin allergies, including anaphylaxis)

For patients with severe penicillin allergies with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies: Gentamicin 5mg/kg IM/IV x 1 dose

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

After IM/IV dose of Ceftriaxone or Gentamicin, provide one of the following:

FIRST LINE

- Cephalexin 1g PO TID x 10-14d

  Cephalexin is safe for patients with penicillin allergy (NOT including anaphylaxis)

SECOND LINE:

If anaphylaxis to penicillin or severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergies

- Ciprofloxacin 500mg PO BID x 7d

NOTE: *Above recommendations are for empiric antimicrobial therapy, tailor maintenance therapy to C&S report.*

Duration:

- Total duration may vary based upon antibiotic selection
- GNR bacteremia from a urinary source can safely be treated for a total of 7 days, in patients who are hemodynamically stable, and without fever for at least 48 hours by day 7.

CONSIDERATIONS

If at risk for STIs w/ symptoms of urethritis, consider screening for gonorrhea and chlamydia.

Scope of this guideline is limited to immunocompetent adults >18 y/o without history of renal transplant.

If E. coli susceptibility to TMP/SMX is <80% avoid as empiric therapy, but may be considered if confirmed by C&S for pyelonephritis (2 week duration).

Patients with recurrent UTIs should have empiric therapy selected based upon prior C&S results.

For ESBL (Extended Spectrum Beta-lactamase) producing organisms, treat according to reported susceptibility with TMP/SMX or ciprofloxacin. If resistant to all tested antibiotics or multiple allergies, consult Infectious Diseases for potential alternatives. ESBL pyelonephritis may require inpatient admission for IV carbapenem antibiotic.

Chronic antibiotic prophylaxis for most patients with risk factors for recurrent, complicated UTI is NOT typically recommended. Risk of resistance outweighs the slight reduction in infection rate.

Persistent fever for 72 hours is not unexpected and does not warrant a change in therapy or imaging in the absence of hemodynamic instability.

Consider imaging to evaluate for a perinephric abscess if there is persistent fever for > 72 hours after the initiation of appropriate antibiotics

REFERENCES

1. *Executive Summary: International Clinical Practice Guidelines for the Treatment of Acute Uncomplicated Cystitis and Pyelonephritis in Women: CID 2011;52(5):561–564.*
2. *Yahav et al. 7 vs. 14 days of antibiotic therapy for uncomplicated gram-negative bacteremia: A non-inferiority randomized controlled trial. CID 2018.*
3. *Kutob LF et al. Effectiveness of oral antibiotics for definitive GNR infections. Intern J Antimicrob Agents 2016;48:498-503."*

ORGAN SYSTEM:	SYNDROME:
Urinary Tract	Catheter- Associated UTI (CAUTI)

SYMPTOMS AND/OR RISK FACTORS

Consider deviation from the below recommendations (or consult ID) if risk factors for multidrug resistant organisms are present.

For long-term care or nursing home residents with altered mental status changes, foul smelling urine, or change in urine color, seek alternative causes (ie. dehydration, medications, environmental changes, metabolic problems, bleeding, stroke). Provide increased fluids (if not contraindicated) and increase monitoring of I/Os and vitals.

CULTURE & SUSCEPTIBILITY (C&S) INVESTIGATION

If patient requires inpatient admission for complicated UTI, urine C&S are critical in order to optimize therapy.

Urine cultures should be collected from a midstream void prior to antibiotics or a freshly placed urinary catheter.

Prevalence of bacteria in urine among individuals with a chronic catheter is 100%. Correlate treatment with symptoms.

RECOMMENDED TREATMENT AND DURATION

Inpatient:

FIRST LINE:

- Ceftriaxone 1g IV Q24H

For patients with penicillin allergies (including anaphylaxis): Ceftriaxone is safe

SECOND LINE:

- Ciprofloxacin 400mg IV Q12H, OR
- Levofloxacin 750mg IV Q24H

Above recommendations are for empiric antimicrobial therapy, tailor maintenance therapy to C&S report.

Outpatient:

Base empiric treatment on prior culture data. If stable vitals & afebrile, provide definitive therapy when new C&S result.

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

Duration:

- 7 days, if symptoms promptly resolve.
- 3-day regimen may be considered for CAUTI with catheter removal.
- Some experts advocate treating CAUTI as cystitis with 3-5 days of antibiotics in patients without signs of upper tract disease.
- If response to therapy is delayed, consider alternative diagnoses. Longer durations, 10-14 days, may be required in cases of complex or altered anatomy.

CONSIDERATIONS

Chronic antibiotic prophylaxis for most patients with risk factors for recurrent, complicated UTI is NOT typically recommended. Risk of resistance outweighs the slight reduction in infection rate.

If *E. coli* susceptibility to TMP/SMX is <80% avoid as empiric therapy, but may be considered if confirmed by C&S for complicated UTI.

REFERENCES

1. *Diagnosis, Prevention, and Treatment of Catheter-Associated Urinary Tract Infection in Adults: CID 2010; 50:625–663.*
2. *Behr MA, Drummond R, Libman MD, Delaney JS, Dylewski JS. Fever duration in hospitalized acute pyelonephritis patients. Am J Med. 1996;101(3):277-280. doi:10.1016/S0002-9343(96)00173-8*

ORGAN SYSTEM:	SYNDROME:
Urinary Tract	**Pediatric FEBRILE Urinary Tract Infection** (Ages 2-24 months)

SYMPTOMS AND/OR RISK FACTORS

Symptoms

Fever

Poor feeding Vomiting

Irritability Strong-smelling urine

Diagnostic Criteria for Acute Pyelonephritis

Urinalysis results that suggest infection

- Positive nitrite OR
- Leukocyte esterase OR
- Pyuria AND
- >50,000 CFUs per mL of a uropathogen cultured from a urine specimen obtained through catheterization or SPA

Risk Factors in the absence of another source of infection

Girls: Age <12 months, Temp >39 C, Fever >2 days

Boys: Temp >39 C, Fever >24 hours, Uncircumcised

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

Obtain urine culture PRIOR to starting antibiotics

Adjust therapy based on C&S results

RECOMMENDED TREATMENT AND DURATION

Ambulatory Empiric Treatment

FIRST LINE

Cephalexin 50mg/kg/day PO divided TID or QID (max 4gm/day)

SECOND LINE (B-LACTAM ALLERGY)

Sulfamethoxazole/trimethoprim 4-5mg/kg PO BID (trimethoprim component for dosing; max 160mg trimethoprim/dose)

Inpatient Empiric Treatment

FIRST LINE

Ceftriaxone 50mg/kg IV Q24H (max 2gm/day)

SECOND LINE (B-LACTAM ALLERGY)

Gentamicin 5mg/kg/day IV

Duration of therapy for either ambulatory or inpatient: 7-10 days

CONSIDERATIONS

- Obtain renal/bladder ultrasound for 1st febrile UTI
- VCUG for 2nd febrile UTI or if abnormalities seen on renal/ bladder ultrasound
- If child has received TMP/SMX previously, consider alternative if second line therapy is considered.
- "For children > 24 months consider verbal reports of frequency, dysuria, hesitancy, urgency, abdominal/flank pain. Review prior C&S for guidance on empiric treatment if prior history of UTI. It is reasonable to follow same treatment and duration recommendations outlined here."

REFERENCES

(Adopted from the 2018 Alaska Antimicrobial Stewardship Collaborative guide)

1. *Roberts KB. Urinary tract infection: clinical practice guideline for the diagnosis and management of the initial UTI in febrile infants and children 2 to 24 months. Pediatrics. 2011;128(3):595-610.*
2. *Shaw K, et al. Pathway for the Evaluation and Treatment of Children with Febrile UTI. Children's Hospital of Philadelphia. https://www.chop.edu/clinical-pathway/urinary-tract-infection-uti-febrile-clinical-pathway. Accessed Oct 2018.*

SYMPTOMS AND/OR RISK FACTORS

Complicating Risk Factors:

NOTE: *Guideline recommendations are for uncomplicated cellulitis in adults and excludes those with complicating risk factors; if complicating risk factors, treatment may vary and formal ID consultation should be considered.*

- Infected diabetic or vascular ulcer
- Critical illness
- Concern for necrotizing fasciitis
- Deep tissue infection
- Surgical site infection
- Injection drug use
- Human or animal bite
- Bacteremia
- Periorbital or orbital cellulitis
- Perineal/vulvar/perianal infection
- Pregnancy

Diagnostic Studies:

- Wound culture of purulent drainage
- Blood cultures are not routinely needed unless systemically ill, diabetic or other immunosuppression
- Plain film only if concern for foreign body or necrotizing fasciitis
- The following are NOT routinely indicated for initial management of uncomplicated disease: ESR, CRP, Procalcitonin, blood cultures, fungal or AFB cultures, plain films, CT or MRI

  NOTE: *necrotizing fasciitis is a clinical diagnosis. Surgical consultation should be obtained if there is any concern, regardless of imaging findings*

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

- Non-purulent cellulitis is most commonly attributed to beta- hemolytic streptococci
- Purulent cellulitis or cutaneous abscess is most commonly attributed to beta-hemolytic Streptococci or *Staphylococcus aureus* and warrants empiric coverage for MRSA.
- Recurrent MRSA infections need not be cultured at every presentation.

- Gram-negative or anaerobic coverage is usually unnecessary for purulent or non-purulent uncomplicated cellulitis, unless there is direct anatomic communication between the GI or GU tract.

RECOMMENDED TREATMENT AND DURATION

Non-purulent cellulitis:

FIRST LINE INPATIENT

Cefazolin 1 gm IV q8hr

SECOND LINE INPATIENT

Penicillin allergy (including anaphylaxis): cefazolin is safe

For patients with severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Clindamycin 600 mg IV q8hr

FIRST LINE OUTPATIENT or oral step-down

Amoxicillin 500mg PO TID or Cephalexin 500mg PO QID

SECOND LINE OUTPATIENT

Penicillin allergy (including anaphylaxis), severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Clindamycin 300 PO TID

Purulent cellulitis or cutaneous abscess:

FIRST LINE ADULT INPATIENT

NOTE: *I&D is of utmost importance*

Vancomycin

FIRST LINE ADULT OUTPATIENT or oral step-down based upon C&S

NOTE: *I&D is of utmost importance*

Antibiotics may not be necessary for drained abscess without surrounding induration or erythema

TMP/SMX DS 1 tab PO BID or Doxycycline 100mg PO BID or Clindamycin 300mg PO TID

Duration of antibiotics for uncomplicated cellulitis in adults is usually 5 days for uncomplicated cases including a well-drained abscess without surrounding cellulitis but may be extended for severe or poorly responsive disease

NOTE: *Consider adding analgesia, such as ibuprofen or acetaminophen, to all situations of cellulitis if no contraindications exist.*

CONSIDERATIONS

Antibiotics with broad-spectrum gram-negative activity are NOT recommended except necrotizing fasciitis.

Vancomycin levels may not be needed for uncomplicated infections.

May consider oral de-escalation options if clinically improving in 2-3 days. Utilize suggested empiric oral options when culture negative or not available.

Treat tinea pedis if present.

Elevate affected area(s)

Consider MRSA decolonization with intranasal mupiricon and chlorhexidine rinses or bleach baths for patients with recurrent S. aureus infections.

REFERENCES

1. *Ko LN et al. Imaging & blood cultures in cellulitis. JAMA Intern Med 2018; [e-pub].*
2. *Stevens DL, et al. Practice Guidelines for the Diagnosis and Management of SSTI: 2014 Update by IDSA. CID. 2014; 59(2):e10-e52.*

ORGAN SYSTEM:	SYNDROME:
Skin and Soft Tissue	Adult Diabetic Foot Infection

SYMPTOMS AND/OR RISK FACTORS

Assessment

- Physical examination to assess for evidence of infection and depth
- Ankle brachial index (ABI) and/or transcutaneous oxygen tension measurement
- Plain film to assess for foreign bodies, deformity, boney destruction, soft tissue gas, and/or foreign bodies.

NOTE: *metal probe has a negative predictive value of 98% for osteomyelitis; plain film has a specificity 67%, sensitivity 60%*

- When more specific imaging is needed to evaluate for either soft tissue abscess or osteomyelitis an MRI is preferred

Osteomyelitis Evaluation:

- Consider osteomyelitis in any infected, deep, or large foot ulcer, particularly those that are chronic and over bony prominences
- Plain films along with the probe to bone test are reasonable first steps in evaluating for osteomyelitis
- Patients where the diagnosis remains unclear should undergo MRI
- Patients with findings suggestive of osteomyelitis should undergo debridement with bone culture before antibiotics are started if possible
- Consult orthopedics or vascular surgery for potential surgical intervention
- If debridement is not an option an IR guided bone biopsy should be obtained to determine the microbial etiology
- Consult infectious diseases for evaluation and management of long-term antibiotics

Risk

- Infection related to ulceration to the bone, ulcers that have been present for longer than 30 days, recurrent trauma and peripheral arterial disease

Diagnostic Criteria

Obvious purulent drainage AND/OR 2 of the following: Erythema, Pain, Tenderness, Warmth, Induration

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

Infected ulcers initially harbor staphylococcus and streptococcus.

With increasing time, depth and size, wounds are colonized and/ or infected with multiple organisms, including Gram negatives and anaerobes

- Do not culture a clinically uninfected lesion
- Do obtain an appropriate specimen for culture from INFECTED wounds and before antibiotics are started, if possible
- Cleanse and debride before collection of tissue
- Tissue collection using sterile scalpel or curettage or biopsy from the base
- Aspirate any purulent secretions using sterile needle & syringe
- Do not obtain a specimen by swabbing the wound or wound drainage

Clinical Manifestation of Infection	PEDIS grade	IDSA Infection Severity
No symptoms of signs of infection	1	uninfected
Infection present as defined by 2 of the following: •Local swelling or induration •Erythema •Local tendernes or pain •Local warmth •Purulent discharge		
Local infection involving only skin and subcutaneous tissue. If erythema, must be >0.5 cm to ≤2 cm around the ulcer	2	mild
Local infection with erythema >2 cm or involving deeper than skin and subcutaneous tissues, and no systemic inflammatory response signs	3	moderate
Local infection with signs of SIRS, as manifested by fever, tachycardia, tachypnea, leukocytosis	4	Severe

RECOMMENDED TREATMENT AND DURATION

MILD: Local infection with erythema <2cm.

FIRST LINE

Cephalexin 500mg PO QID OR Amoxicillin-clavulanate 875/125 mg PO BID

If MRSA concern add: Doxycycline 100 mg PO BID or TMP/SMX DS 1 tab PO BID

SECOND LINE

Penicillin allergy (including anaphylaxis), severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Clindamycin 300 mg PO TID

Duration for mild infections of soft tissue only is 1-2 weeks.

Continued ❯

RECOMMENDED TREATMENT AND DURATION *Continued*

MODERATE: Local infection with or involvement of deeper structures (abscess, osteomyelitis, septic arthritis) or more extensive erythema (>2 cm spread or associated lymphangitis) without systemic signs of inflammation

NOTE: *May use oral or parenteral agents depending on care location and severity of infection. Treat for pathogens as above plus aerobic gram-negatives. Consider addition of MRSA active agent if history of MRSA infection/colonization.*

Oral Options:

FIRST LINE

Amoxicillin-clavulanate 875/125 mg PO BID

If MRSA concern add: Doxycycline 100 mg PO BID or TMP/SMX DS 1 tab PO BID

SECOND LINE

Penicillin allergy (including anaphylaxis) or severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS): Levofloxacin 750 mg PO daily PLUS Doxycycline 100 mg PO BID

IV Options:

FIRST LINE

Ceftriaxone 2 gm IV daily PLUS Metronidazole 500 mg IV/PO q8h OR Ampicillin/sulbactam 3 gm IV q6h OR

Ertapenem 1 gm IV daily

If MRSA concern add: Vancomycin 15 mg/kg IV Q12h

SECOND LINE

Penicillin allergy (including anaphylaxis): ceftriaxone and ertapenem are safe

Severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Levofloxacin 750 mg IV daily PLUS Clindamycin 900 mg IV q8h

Moderate soft tissue only infections may require 1-3 weeks.

SEVERE: As above with systemic signs of infection (fever, tachycardia, leukocytosis, hypotension, sepsis syndrome, necrotizing infection, etc.) Generally, life- or limb-threatening.

NOTE: *Increased frequency of polymicrobial infection. Treat gram-positive cocci including MRSA, aerobic gram-negative rods, and anaerobes. Do not*

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

include Pseudomonas coverage unless risk factors (water exposure, previous isolation of Pseudomonas). Consult a surgery team in all severe infections.

FIRST LINE

Vancomycin 15 mg/kg IV q12h PLUS Ceftriaxone 2 gm IV daily PLUS Metronidazole 500mg IV q8h (PREFERRED) OR

Vancomycin 15 mg/kg IV q12h PLUS Ertapenem 1 gm daily OR

Vancomycin 15 mg/kg IV q12h PLUS Piperacillin/tazobactam 4.5 gm IV q8h (or Extended Infusion)

NOTE: *If water exposure: Treat for Pseduomonas replacing ceftriaxone with cefepime 2gm IV q8hr until cultures return.*

SECOND LINE

Penicillin allergy (including anaphylaxis): ceftriaxone and cefepime are safe

Severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Vancomycin 15 mg/kg IV q12h PLUS Aztreonam 2g IV q8h PLUS Metronidazole 500mg IV q8h

Severe soft tissue infections with initial improvement on IV antibiotics can be switched early to highly bioavailable oral agents (FQ, TMP/SMX, linezolid, metronidazole, etc.) for a combined treatment duration of 2-4 weeks.

Antibiotics can be stopped 2-5 days post resection for bone or joint involvement if complete resection of infected tissue is confirmed post amputation.

If residual soft tissue infection exists after complete bone resection IV and oral antibiotics combined typically lasts 1-3 weeks. If residual infected bone an additional 1-3 weeks is recommended. Recommend infectious diseases consult for management of residual bone infection.

Extended durations are likely if no surgery or residual dead bone exists.

REFERENCES

1. *Adopted from the Nebraska Medicine Diabetic Foot Infections Institutional Treatment Guidance. [Accessed March 2019]*
2. *Kwon KT et al. Microbiology and Antimicrobial Therapy for Diabetic Foot Infections. Infection & Chemotherapy 2018;50(1):11-20.*
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SYMPTOMS AND/OR RISK FACTORS

NOTE: *Guideline recommendations are for uncomplicated cellulitis in children > 44 weeks and excludes those with complicating risk factors; if complicating risk factors, treatment may vary and formal specialty consultation may be warranted.*

Guideline exclusion criteria:

- Hospital-acquired, surgical site & device-associated infections • Presumed necrotizing fasciitis
- Orbital/periorbital cellulitis
- Immunodeficiency
- Pressure ulcers
- Solitary dental abscess

Risk factors for MRSA:

- MRSA in the patient
- MRSA in the family
- Recurrent boils, pustules, "spider bites", that required antibiotics, in patient or family

Specialty Consultation Considerations:

- Orthopedics if deep extremity infection (e.g., tenosynovitis, septic arthritis, osteomyelitis)· Deep puncture wound of hand/ fingers/feet
- General surgery if peri-anal abscess (within 1cm of anal verge)· Breast abscess· Perineal abscess· Pilonidal cyst· Large or complex abscess
- ENT if neck abscess
- Dental if facial cellulitis of dental origin

Low Risk Criteria:

Simple abscess · Adequate I&D· Age ≥1 year· No fever· Well- appearing· No significant comorbidities· Follow up assured

Inpatient Admit Criteria (any one of the following):

Systemic illness, not tolerating PO, treatment failure on > 48 hrs of appropriate antibiotics, rapidly progressive lesion, pain control/wound care needed, inadequate follow-up, all < 2 months of age; consider if < 6 months

Diagnostic Studies:

- The following are NOT routinely indicated for initial management of uncomplicated disease: ESR, CRP, Procalcitonin, blood cultures, wound swab/ superficial cultures, fungal or AFB cultures, plain films, CT or MRI
- Perform bedside ultrasound unless clearly fluctuant or draining

- If fluctuant or abscess > 1cm on ultrasound, provide sedation/ pain control, I&D and wound culture of purulent drainage
- Obtain a CBC, CRP, and blood cultures in children with signs of systemic toxicity, including ill-appearance, rapidly spreading lesions, persistent fevers, and age < 1 year
- Plain film only if concern for foreign body or necrotizing fasciitis

CULTURE AND SUSCEPTIBILITY (C&S) INVESTIGATION

- Non-purulent cellulitis is most commonly attributed to beta- hemolytic streptococci
- Purulent cellulitis or cutaneous abscess is most commonly attributed to beta-hemolytic Streptococci or Staphylococcus aureus and warrants empiric coverage for MRSA.
- Recurrent MRSA infections need not be cultured at every presentation.
- Gram-negative or anaerobic coverage is usually unnecessary for purulent or non-purulent uncomplicated cellulitis.

RECOMMENDED TREATMENT AND DURATION

Non-purulent cellulitis:

INPATIENT

FIRST LINE INPATIENT

Cefazolin 50 mg/kg IV per day q8hr

SECOND LINE INPATIENT (β-Lactam Allergy)

Clindamycin 25-40 mg/kg per day q6-8hr or Vancomycin if systemic toxicity

OUTPATIENT

FIRST LINE OUTPATIENT OR ORAL STEP-DOWN

Cephalexin 25-50 mg/kg per day divided TID or QID

SECOND LINE OUTPATIENT (β-Lactam Allergy)

Clindamycin 25-30 mg/kg per day TID

Purulent cellulitis or cutaneous abscess:

INPATIENT

FIRST LINE INPATIENT:

Clindamycin 10 mg/kg/dose IV q6-8hr (max does range 600- 900mg/dose IV)

SECOND LINE INPATIENT:

Vancomycin 15mg/kg/dose IV q6-8hr (initial max 1gm/dose) if systemically ill, failed outpatient clindamycin, or abscess in an area difficult to drain completely

Continued ›

RECOMMENDED TREATMENT AND DURATION *Continued*

OUTPATIENT

NOTE: *No systemic antibiotics are needed if adequate I&D and low risk*

FIRST LINE OUTPATIENT or oral step-down:

Clindamycin 10 mg/kg /dose PO TID (max single dose range 450-600mg/dose)

SECOND LINE OUTPATIENT:

TMP/SMX 4-6 mg/kg/dose trimethoprim PO BID (max 160mg TMP/dose) or doxycycline if > 8 years 2mg/kg/dose PO BID (max 100mg/dose)

Duration of antibiotics for uncomplicated cellulitis in children is usually 7-10 days. May consider shorter durations (5-7 days) for non-severe infections with quick response to therapy or extended to 14 days for severe disease.

CONSIDERATIONS

- Antibiotics with broad-spectrum gram-negative activity are NOT recommended except necrotizing fasciitis, and in most cases should be avoided.
- Tailor antibiotics if culture results are available; utilize suggested empiric oral options when culture negative or not available.
- May consider oral de-escalation options if clinically improving in 2-3 days.
- If no improvement on adequate antibiotics after 48 hours or significant or rapid progression (ie. more than just 1-2 cm beyond margins) at any time, image (U/S preferred) to rule out abscess formation and consider modification to antibiotic therapy.
- NOTE: *The development of a new abscess within an area of previous infection while on antibiotics does not in and of itself constitute treatment failure. Likewise, it is not uncommon for erythema to spread after initiation of antibiotics due to release of toxin from killed organisms. Reasonable discharge criteria include: Lesion(s) show signs of improvement, tolerating PO, pain controlled, afebrile > 24 hours, F/U assured within 48 hours*
- Discuss with ID with there has been fresh or saltwater contact
- If worried about palatability or concerns about administration exist, a single oral antibiotic dose may be given prior to discharge.

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(adopted from Seattle Children's Guide: Simple cellulitis / abscess and UCSF Pediatric Guideline: Skin & Soft Tissue Infections)

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11. *Squire et al. ABSCESS. Acad Emerg Med 2005;12(7):601-6*
12. *Tayal, VS et al. The effect of soft-tissue ultrasound on the management of cellulitis in the ED. Acad Emerg Med 2006;13(4):384-8.*

ORGAN SYSTEM:	SYNDROME:
Miscellaneous	Simplified Approach to Antibiotic Selection in Adults with sepsis-related organ dysfunction

ANTIMICROBIAL STEWARDSHIP KEY POINTS

1. Patients presenting with severe sepsis/septic shock are often infected with the same common bacteria that cause less severe presentations.
2. The key decision is whether to use an antibiotic (or antibiotic combination) that is based on the specific syndrome (pneumonia, UTI, etc.) or to treat sepsis (severe or shock) as an undifferentiated disease state.
3. The most likely pathogens should be covered with the most effective and potent antibiotics. For example, *S. pneumoniae* is killed very effectively with ceftriaxone.
4. The risk for specific organisms or for drug-resistant infections can be determined by reviewing available data, focusing on the presenting syndrome, and recent healthcare and antibiotic exposures.
5. Obtain cultures, especially blood cultures, as early as possible and preferably before administering antimicrobials. If there are barriers to getting cultures, antimicrobial administration should not be delayed.
6. Although supporting evidence is not as strong, other interventions for sepsis, including checking a lactate level (and repeating if elevated) and volume resuscitation, are important considerations.

SYMPTOMS AND/OR RISK FACTORS

How much room do you have to be wrong? Is the patient in acute care or critical care? Does the patient have evidence of end organ dysfunction? The more serious the patient's condition, the more important time to treatment matters.

What is the most likely source of infection, and which pathogens are the most common culprits for these infections?

Is the patient at risk for an infection with MRSA based upon prior infections or, surveillance cultures?

Should anaerobes be covered based upon extra-biliary colonic source, cavitary aspiration pneumonia?

Is the patient at risk for pseudomonas or another MDRO (prior *P. aeruginosa* or MDR infections, skilled nursing facility or long-term acute care hospital resident)?

RECOMMENDED TREATMENT AND DURATION

If shock, rapid initiation of early broad-spectrum antibiotics as an undifferentiated disease state are warranted. If a syndrome-based approach to sepsis or severe sepsis, consider the following key agents for adequate empiric coverage based upon risk of MRSA, anaerobes or pseudomonas.

FIRST LINE ADULT, COMMUNITY ACQUIRED

Ceftriaxone 2g IV daily

FIRST LINE ADULT, AT RISK FOR PSEUDOMONAS (e.g. hospital acquired)

Cefepime 2gm q8hr

FIRST LINE ADULT, HISTORY OF ESBL

Meropenem 1gm q8hr

SECOND LINE INPATIENT

Penicillin allergy (including anaphylaxis): ceftriaxone/cefepime/meropenem are safe

For patients with severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Aztreonam 2g IV q6 hours + Vancomycin loading dose IV x1 (2g if ≥ 70 kg, 1.5g if <70 kg).

In addition to the above agents, additional antibiotics are recommended in the following scenarios:

<u>If Risk of MRSA</u>

FIRST LINE ADULT

Include Vancomycin IV loading dose X 1 (2gm if > 70kg, 1.5gm if < 70kg) STAT, then 15mg/kg IV q12hrs

<u>If Risk of anaerobes</u>

FIRST LINE ADULT

Include Metronidazole 500mg IV q8hr

<u>If Risk for highly resistant gram-negative pathogens including Acinetobacter</u>

FIRST LINE ADULT

Include Ciprofloxacin 400mg IV q8hr

Continued ›

SECOND LINE ADULT

Include Tobramycin 7mg/kg IV q24hr

NOTE *Antibiotic recommendation assumes that these drugs or spectrum of activity are not already included in the syndrome-based approach to sepsis.*

CNS CONSIDERATIONS

If adult patient presents with concerns for meningitis, ensure adequate coverage for *S. pneumoniae, N. meningitidis* and *H. influenzae*; consider Listeria and HSV in patients age > 50, immunocompromised or has alcohol dependence.

Obtain blood cultures immediately. Start antibiotics as soon as blood cultures have been obtained.

LP for opening pressure, gram stain, culture, HSV PCR, cell count, glucose and protein.

Do not wait for results of LP to initiate antimicrobials.

Non-surgical community-acquired meningitis:

FIRST LINE

Consider dexamethasone 0.15mg/kg IV q6hr for 2-4 days, give 15 minutes prior to antibiotics if possible

Ceftriaxone 2gm IV q12hr PLUS Vancomycin IV loading dose X 1 (2gm if > 70kg, 1.5gm if < 70kg) STAT, then 15mg/kg IV q8hrs (vancomycin is included for 3rd generation cephalosporin-resistant *S. pneumoniae*)

ADD: Ampicillin 2gm IV q4hr for Listeria coverage
ADD: Acyclovir 10mg/kg IV q8hr for HSV coverage

SECOND LINE

Penicillin allergy (including anaphylaxis): ceftriaxone is safe. If ampicillin is required for *Listeria*, alternatives are meropenem 2gm every 8 hours or ceftriaxone and trimethoprim-sulfamethoxazole 5 mg/kg IV every 8 hours

For patients with severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Hold ceftriaxone, continue vancomycin and add levofloxacin 750 mg IV daily. For patients who have risk factors for *Listeria* infection, substitute trimethoprim-sulfamethoxazole 5 mg/kg IV every 8 hours in place of ampicillin.

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RECOMMENDED TREATMENT AND DURATION *Continued*

Post-surgical meningitis:

S. epidermidis, S. aureus, P. acnes, gram-negative rods (including P. aeruginosa) should be covered empirically.

FIRST LINE

Cefepime 2gm IV q8hr PLUS Metronidazole 500mg IV q8hr PLUS Vancomycin IV loading dose X 1 (2gm if > 70kg, 1.5gm if < 70kg) STAT, then 15mg/kg IV q8hrs

SECOND LINE

Penicillin allergy (including anaphylaxis): cefepime is safe

For patients with severe penicillin allergy with delayed severe cutaneous reactions (DRESS, SJS) or any cephalosporin allergy: Hold cefepime, continue vancomycin and add levofloxacin 750 mg IV daily.

NOTES