



SUSPECTED PEDIATRIC BONE AND JOINT INFECTIONS UNIVERSITY OF MICHIGAN CLINICAL PRACTICE GUIDELINE

I. OVERVIEW: Bone and joint infections are relatively common invasive bacterial infections in children and adolescents. These infections can develop via hematogenous spread, via direct spread from adjacent soft tissue infection, or as a result of trauma or surgery. In the pediatric population, these infections typically present with symptoms of fever, refusal to walk or move an extremity, or localized tenderness and inflammatory changes over a bone or joint. The most common causative organisms in pediatric patients include *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Streptococcus pneumoniae*. In patients <5 years, *Kingella kingae* is also common. Appropriate surgical management and antibiotic therapy for these infections is important due to the relative difficulty of antibiotic penetration into bone and joint tissue. Although treatable, improperly treated bone and joint infections can result in significant morbidity and even death.

II. PURPOSE: The purpose of this document is to provide guidance to all medical providers in the emergency department or on an inpatient service who are caring for a pediatric patient with a suspected bone or joint infection. Consultants may also benefit from this document. Current practices are variable based on provider, and it is the hope that this guideline will also help to standardize the care of these patients.

III. SCOPE: This guideline includes management of non-neonatal pediatric patients (from 90 days to 17 years of age) who are evaluated in the emergency department or admitted to the hospital for an acute presentation of a suspected hematogenous (not associated with trauma or surgery) bone or joint infection. The guideline includes recommendations for diagnostic work-up, antibiotic therapy, and other aspects of management in the emergency department, on the inpatient floor, and at the time of patient discharge. This guideline also does not pertain to patients with chronic bone or joint infections, or infections complicated by the presence of hardware. In those instances, it is best to discuss management directly with the on-call Pediatric Infectious Diseases team.

IV. DEFINITIONS:

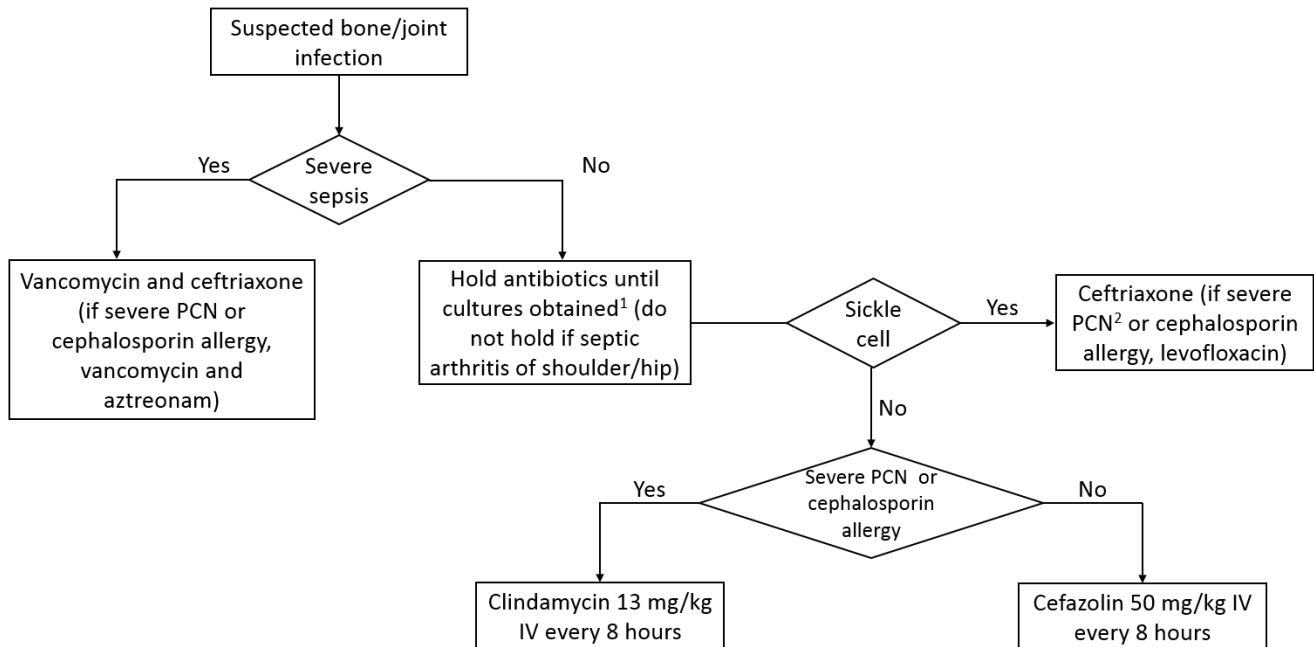
- **Osteomyelitis:** Osteomyelitis is inflammation of the bone. In this setting, it is presumed to be due to an infectious cause. Acute osteomyelitis is diagnosed within 2-4 weeks of symptom onset in a previously uninfected bone.
- **Septic arthritis:** Septic arthritis is an infection within the joint space.

V. GUIDELINE:

Emergency Department evaluation

- **Initial evaluation:**
 - o Lab work: CBC with differential, ESR, CRP, blood culture, *Kingella* PCR (if <5 years old).
 - *Kingella* PCR: Sendout to Nationwide Children's (order as miscellaneous sendout, test code is KNGBLD, requires 3 mL blood in an EDTA tube).
 - o Imaging (preferably obtained before orthopedic surgery consult):
 - X-rays: Obtain to evaluate/rule out fracture or other pathology. These may be normal in early osteomyelitis and cannot be used to rule out infection.
 - Ultrasound: Obtain to evaluate for joint effusion, and/or other pathology.
 - o Additional studies should be obtained on an individual basis, as indicated based on the history of present illness.
- **Surgical management:**
 - o Orthopedic surgery should be consulted to evaluate for the need for further imaging (such as MRI) and/or acute surgical intervention.
 - Osteomyelitis: Bone, fluid, and/or soft tissue specimens should be sent for Gram stain, aerobic and anaerobic culture.

- Septic arthritis: Joint fluid should be obtained in the OR and sent for cell count and differential, Gram stain and culture, Kingella PCR (if <5 years of age).
 - Kingella PCR: Sendout to Nationwide Children's (test code KNGJF, requires 1 mL (0.4 mL minimum) joint fluid).
 - In the case of suspected osteomyelitis where orthopedic surgery has decided against acute surgical intervention, pediatric Interventional Radiology (IR) should be contacted to arrange an IR-guided bone biopsy to be sent for Gram stain and culture.
 - IR-guided aspirate is not necessary if the patient's blood culture has turned positive for a causative organism in the interim.
- **Admission:**
 - Pediatric orthopedic surgery will determine whether the patient will be better served on the orthopedic service or a general pediatric service with an orthopedic surgery consult.
- **Empiric antibiotics:**



¹If uncomfortable holding antibiotics, please call Pediatric Infectious Diseases to discuss prior to starting.

²Severe penicillin (PCN) allergy is defined by urticaria, angioedema, or anaphylaxis.

Inpatient management

- **Consults:**
 - If not already done, consult Pediatric Infectious Diseases.
 - Orthopedic surgery will continue to follow the patient on the floor, even if there is no initial need for surgical intervention.
- **Targeted antibiotics:**
 - After culture results are available, antibiotics should be adjusted to target the appropriate organism (see Table I).
 - For patients with additional antibiotic allergies, resistant organisms, and/or other difficulties selecting appropriate antibiotics, please discuss with Pediatric Infectious Diseases.

- **Repeat laboratory studies:**
 - While hospitalized, inflammatory markers should be obtained every 24-48 hours until clear improvement noted.
 - If blood culture is positive, it should be repeated daily until negative for 48 hours.

- **Repeat imaging:**
 - If blood cultures are persistently positive, and/or patient is still febrile, and/or exam is not significantly improving after >48 hours of appropriate therapy, consider repeat imaging.

Discharge planning

- **Criteria for oral step-down therapy and discharge:**
 - Oral therapy and discharge can be considered when following criteria are met:
 - Afebrile
 - Negative blood cultures ≥ 48 hours
 - Tolerating PO
 - Substantial clinical improvement with near return to normal function
 - Improving inflammatory markers
 - See Table I for specific recommendations for oral step-down therapy.

- **Outpatient follow-up:**
 - In most cases, patients will receive a minimum 3 week course of antibiotics for septic arthritis and a minimum 4 week course of antibiotics for acute osteomyelitis.
 - Follow-up should be arranged near the end of the minimum course, which may require the patient to be seen by a new Pediatric Infectious Diseases provider.
 - In general, antibiotic prescriptions should be written with sufficient supply to last at least through the first Pediatric Infectious Diseases follow-up appointment.
 - Treatment courses will be extended as needed at the discretion of the Infectious Diseases physicians during follow-up clinic appointments.
 - Pediatric Infectious Diseases will arrange for repeat laboratory testing (CBCPD, ESR, and CRP), preferably obtained just prior to Pediatric Infectious Diseases clinic visit.

Table I. Targeted antibiotics for treatment of bone and joint infections

Organism	IV therapy	Oral step-down therapy	Dosing Recommendations
<i>Staphylococcus aureus</i> (MSSA) or culture negative	<p>First line¹: Cefazolin²</p> <p>Severe PCN or cephalosporin allergy³, without bacteremia: Clindamycin</p> <p>Severe PCN or cephalosporin allergy³, with bacteremia: Vancomycin²</p>	<p>First line¹: Cephalexin²</p> <p>Severe PCN or cephalosporin allergy³: Clindamycin</p> <p>Severe PCN or cephalosporin allergy³: TMP-SMX^{2,4}</p>	<p>Amoxicillin: 33 mg/kg/dose PO q8h (max: 1000 mg/dose)</p> <p>Amoxicillin-clavulanate: 33 mg amoxicillin/kg/dose PO q8h of the 600-42.9 mg/5 mL concentration (max: 1000 mg/dose)</p> <p>Ampicillin: 50 mg/kg/dose IV q6h (max: 2000 mg/dose)</p>
<i>Staphylococcus aureus</i> (MRSA)	<p>First line¹, without bacteremia: Clindamycin</p> <p>With bacteremia: Vancomycin²</p>	<p>First line¹: Clindamycin</p> <p>Clindamycin resistance: TMP-SMX^{2,4}</p>	<p>Cefazolin: 50 mg/kg/dose IV q8h (max: 2000 mg/dose)</p> <p>Cefuroxime: 50 mg/kg/dose IV q8h (max: 1500 mg/dose)</p>
<i>Streptococcus pneumoniae</i> , group A or B <i>Streptococcus</i>	<p>First line¹: Ampicillin²</p> <p>Severe PCN or cephalosporin allergy³: Clindamycin</p>	<p>First line¹: Amoxicillin²</p> <p>Severe PCN or cephalosporin allergy³: Clindamycin</p>	<p>Cephalexin: 37.5 mg/kg/dose PO 4 times daily (max: 1000 mg/dose)</p>
<i>Kingella kingae</i>	<p>First line¹: Ampicillin²</p> <p>PCN allergy: Cefuroxime</p> <p>Severe PCN or cephalosporin allergy³: TMP-SMX^{2,4}</p>	<p>Beta-lactamase negative or unknown: Amoxicillin²</p> <p>Beta-lactamase positive: Amoxicillin-clavulanate²</p> <p>Severe PCN or cephalosporin allergy³: TMP-SMX^{2,4}</p>	<p>Clindamycin: 13 mg/kg/dose IV/PO q8h (max: 900 mg/dose IV, 600 mg/dose PO)</p> <p>TMP-SMX⁴: 6 mg TMP/kg/dose IV/PO q12h (max: 320 mg TMP/dose)</p>
Other	Discuss with Pediatric Infectious Diseases		<p>Vancomycin: Pediatric vancomycin dosing guidelines</p>

¹Recommendations assume organism is susceptible to listed agent. If organism is resistant, move to the next recommended agent or discuss with Pediatric Infectious Diseases.

²Renal adjustment may be necessary. See [Antimicrobial dosing recommendations for pediatric patients](#).

³Severe penicillin (PCN) allergy is defined by urticaria, angioedema, or anaphylaxis.

⁴TMP-SMX = Trimethoprim-sulfamethoxazole.

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- **Key References:**

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- Peltola H, et al. Short- versus long-term antimicrobial treatment for acute hematogenous osteomyelitis of childhood: prospective, randomized trial on 131 culture-positive cases. [Pediatr Infect Dis J 2010;29:1123-8.](#)

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The recommendations in this guide are meant to serve as treatment guidelines for use at Michigan Medicine facilities. If you are an individual experiencing a medical emergency, call 911 immediately. These guidelines should not replace a provider's professional medical advice based on clinical judgment, or be used in lieu of an Infectious Diseases consultation when necessary. As a result of ongoing research, practice guidelines may from time to time change. The authors of these guidelines have made all attempts to ensure the accuracy based on current information, however, due to ongoing research, users of these guidelines are strongly encouraged to confirm the information contained within them through an independent source.

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