Suspicion of MSK Infection

High Suspicion for MSK Infection
Fever AND refusal to bear weight, focal pain, limited use and/or immobility of extremity

Low Suspicion for MSK Infection
Afebrile, history of trauma

Initial Diagnostic Management
- Make patient NPO
- Imaging: Radiograph of affected region
- Labs: CBC with diff, CRP, ESR, blood culture *
- Consider BMP given potential for nephrotoxic drugs
  *Obtain maximum allowable blood culture volume, See Policy 4.26

Refusal to bear weight and fever present. Is radiograph consistent with infectious process OR does patient have at least one of the following predictors?
- WBC > 12,000
- CRP > 2mg/dl
- ESR > 40

High Risk for MSK infection
Consult Ortho on all patients

Low Risk for MSK infection
Trial NSAIDs

Does patient meet the following criteria?
- Clinical improvement (Afebrile, able to ambulate) AND
- Patient has reliable follow-up

Aspiration Results

WBC > 50,000: Proceed to OR
25,000-50,000 WBC: Consider OR, close observation
<25,000 WBC: Close observation and consider auto-immune and/or post-infectious diagnoses

Specimen Collection

Lab Order Prioritization of Joint Fluid Depends on Volume Obtained (4-5 mL)
1. Culture Fluid (Code:CUFLD)
2. Cell Count (Code:FLCT)
3. For patients ≤ 48 months order Kingella PCR from synovial fluid, tissue or bone (Code:KINPCR)
4. Lyme testing if clinically indicated. Order Lyme serology from blood (Code:BBPEPA) and Lyme PCR from synovial fluid Only (Code: LYMPCR).

How to submit specimens: For all tests listed above except Lyme serology, use a needleless capped syringe or sterile container. For Lyme serology, use a serum separator (red top).

See the "PED IP MSK Infection Specimen Collection" order set for specific order information.

Inclusion Criteria
- 6 months to 21 years
- Suspicion of acute musculoskeletal infection (Symptoms less than 2 weeks): osteomyelitis, septic arthritis, pyomyositis

Exclusion Criteria
- Infants less than 6 months
- Chronic and subacute musculoskeletal infection (Symptoms greater than 2 weeks)
- Postoperative infection
- Penetrating trauma
- Patient with hardware
- Myelomeningocele
- Chronic recurrent multifocal osteomyelitis (CRMO)
- Immunocompromised

Suspicion of MSK Infection

Obtain the following:
- History
  - Pain, fever, inability to bear weight, gait disturbance/limp, limited use or immobility of extremity or spine, travel to endemic Lyme areas
- Physical Exam
  - Limited range of motion, swelling, tenderness, warmth at site, fever, erythema, psoas sign

Aspiration
- Hip
- Other Joints

Consider US Especially for shoulder or if radiographically equivocal

Discharge home with PCP follow-up within 48 hours
Consult Ortho Admit to Hospitalist Scheduled NSAIDs
Proceed to Inpatient Guideline (Continue to page 2)

Admit to Hospitalist
Start antibiotics (See table, page 3)
NPO
If at SR, ask Sedation MD to assess Sedation vs. Anesthesia for MRI

Proceed to Inpatient Guideline (Continue to page 2)

Lab Order Prioritization of Joint Fluid
- Culture Fluid
- Cell Count
- Kingella PCR
- Lyme
- Lyme serology

How to submit specimens: For all tests listed above except Lyme serology, use a needleless capped syringe or sterile container. For Lyme serology, use a serum separator (red top).

See the "PED IP MSK Infection Specimen Collection" order set for specific order information.
Musculoskeletal (MSK) Infection Clinical Practice Guideline
Inpatient Management

If patient is direct admit from Urgent Care, consult Orthopedics upon arrival to the inpatient unit

High Risk for MSK Infection
- Continue Antibiotics
- MRI Imaging
  - Inpatient team or Ortho to place MRI order for Fast/Rapid Osteomyelitis MRI as appropriate. (see criteria and decision tree on page 4)
  - If patient does not meet criteria for rapid non-contrast MRI, place order for MRI with and without contrast
  - Contact Radiology MD AND Sedation MD (contact Radiology attending to discuss coordinating MRI sedation with aspiration) if same day MRI needed

Low Risk for MSK Infection
- Scheduled Toradol
- Observation
- NPO overnight

Msk Infection?
- Consult ID
- Drainable abscess or septic joint?
  - Yes
    - Go to OR or IR
    - Send specimen
  - No
    - Stop antibiotics
    - Continue alternative mgmt

Blood culture results after 24H?
- Positive
  - Consult IR for bone biopsy
  - Make patient NPO before desired procedure
  - Clear: 2 hours
  - Breastmilk: 4 hours
  - Formula: 6 hours
  - Solids: 8 hours
- Negative
  - Consult ID

Meet criteria to transition to PO Antibiotics?
- Yes
  - Continue antibiotics (See table, page 3)
  - Provide medical management ¹
  - Consult PT
- No
  - Meet discharge criteria? ²

Meet discharge criteria?
- Yes
- No

Criteria for Continued Medical Management
- Fever >72H
- Persistent bacteremia (≥ 3 cultures)
- CRP not improving

Criteria for Transition to PO Antibiotics
- Must meet ALL of the following criteria:
  - No fever >24H
  - Minimal pain
  - CRP decreased by >50% of initial value
  - Blood cultures negative for 36H
  - No signs of endocarditis, pneumonia, or DVT

Discharge Criteria
- Pain controlled by PO meds
- Tolerating PO antibiotics

Specimen Collection
Lab Order Prioritization of Joint Fluid Depends on Volume Obtained (4-5 mL)
1. Culture Fluid (Code:CUTFLD)
2. Cell Count (Code:FLCT)
3. For patients ≤ 48 months order Kingella PCR from synovial fluid, tissue, or bone (Code:KINPCR)
4. Lyme testing if clinically indicated. Order Lyme serology from blood (Code:BBPEPA) and Lyme PCR from synovial fluid only (Code:LMYPCR).

How to submit specimens: For all tests listed above except Lyme serology, use a needleless capped syringe or sterile container. For Lyme serology, use a serum separator (red top).

If tissue and/or bone is collected in the OR, submit in a sterile container and place orders for tissue culture or sterile container.

For all tests listed above except Lyme serology, use a needleless capped syringe or sterile container. For Lyme serology, use a serum separator (red top).

Additional labs every 48H PRN and on planned discharge day
- CBC and CRP
- CBC and CRP 36-48H
- PICC lines not routinely recommended
- Mechanical VTE prophylaxis may be considered at the discretion of the treating physician for patients with any of the following risk factors:
  - Age > 8 years
  - Infection where offending agent is MRSA
  - Surgical treatment for osteomyelitis
  - Elevated CRP >6 mg/dl
  - Consider imaging with Doppler Ultrasound if prolonged swelling or pain out of proportion to infection or exam.

¹ Medical Management
- Aggressive hydration (given risk of bacteremia/potentially nephrotoxic drugs)
- CBC and CRP 36-48H from surgical procedure or admission labs
- Additional labs every 48H PRN and on planned discharge day
- PICC lines not routinely recommended
- Mechanical VTE prophylaxis may be considered at the discretion of the treating physician for patients with any of the following risk factors:
  - Age > 8 years
  - Infection where offending agent is MRSA
  - Surgical treatment for osteomyelitis
  - Elevated CRP >6 mg/dl
  - Consider imaging with Doppler Ultrasound if prolonged swelling or pain out of proportion to infection or exam.

² Criteria to Transition to PO Antibiotics
- Must meet ALL of the following criteria:
  - No fever >24H
  - Minimal pain
  - CRP decreased by >50% of initial value
  - Blood cultures negative for 36H
  - No signs of endocarditis, pneumonia, or DVT

³ Criteria for Continued Medical Management
- Fever >72H
- Persistent bacteremia (≥ 3 cultures)
- CRP not improving

4 Discharge Criteria
- Pain controlled by PO meds
- Tolerating PO antibiotics

Specimen Collection
Lab Order Prioritization of Joint Fluid Depends on Volume Obtained (4-5 mL)
1. Culture Fluid (Code:CUTFLD)
2. Cell Count (Code:FLCT)
3. For patients ≤ 48 months order Kingella PCR from synovial fluid, tissue, or bone (Code:KINPCR)
4. Lyme testing if clinically indicated. Order Lyme serology from blood (Code:BBPEPA) and Lyme PCR from synovial fluid only (Code:LMYPCR).

How to submit specimens: For all tests listed above except Lyme serology, use a needleless capped syringe or sterile container. For Lyme serology, use a serum separator (red top).

If tissue and/or bone is collected in the OR, submit in a sterile container and place orders for tissue culture (Code:BBPEPA) and bone culture (Code:CUBONE).

See the "PED IP MSK Infection Specimen Collection" order set for specific order information.
### IV Antibiotic Table

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Bacterial Targets</th>
<th>Drug</th>
<th>Dose</th>
<th>Max Single Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months - ≤ 4 years and medically stable</td>
<td><em>S. aureus</em>, <em>S. pyogenes</em> (GAS), <em>K. kingae</em></td>
<td>Clindamycin AND</td>
<td>13mg/kg IV q8h</td>
<td>900mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cefazolin</td>
<td>40mg/kg IV q8h</td>
<td>2000mg</td>
</tr>
<tr>
<td>6 months - ≤ 4 years and not fully immunized against</td>
<td><em>S. aureus</em>, <em>S. pyogenes</em> (GAS), <em>K. kingae</em>,</td>
<td>Clindamycin AND</td>
<td>13mg/kg IV q8h</td>
<td>900mg</td>
</tr>
<tr>
<td></td>
<td><em>H. influenzae</em>, <em>S. pneumoniae</em></td>
<td>Ceftriaxone</td>
<td>75mg/kg IV q24h</td>
<td>2000mg</td>
</tr>
<tr>
<td>&gt; 6 months and ill appearing</td>
<td><em>S. aureus</em>, <em>S. pyogenes</em> (GAS), <em>K. kingae</em>,</td>
<td>Vancomycin ¹ AND</td>
<td>15mg/kg IV q6h</td>
<td>1000 mg</td>
</tr>
<tr>
<td></td>
<td><em>H. influenzae</em>, <em>S. pneumoniae</em></td>
<td>Ceftriaxone</td>
<td>75mg/kg IV q24h</td>
<td>2000mg</td>
</tr>
<tr>
<td></td>
<td><strong>Consider</strong> Ceftriaxone ³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Consider</strong> Ceftriaxone ³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 4 years old and medically stable</td>
<td><em>S. aureus</em>, <em>S. pyogenes</em> (GAS)</td>
<td>Clindamycin</td>
<td>13mg/kg IV q8h</td>
<td>900mg</td>
</tr>
<tr>
<td></td>
<td><strong>Consider</strong> Ceftriaxone ³</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Recommended vancomycin starting dose. Goal trough 10-15μg/mL. Pharmacokinetic service will monitor trough levels and adjust accordingly.

² Consider adding clindamycin empirically in critically ill patients while waiting for confirmation of therapeutic vancomycin level.

³ If not fully immunized against *H. influenzae* or *S. pneumoniae* OR concern for Lyme disease or Gonorrhea, add ceftriaxone.

### Suggested Antibiotics for PO Transition

<table>
<thead>
<tr>
<th>Bacterial Targets</th>
<th>Drug</th>
<th>Dose</th>
<th>Max Single Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSSA or <em>K. kingae</em></td>
<td>Cephalexin</td>
<td>40mg/kg/dose q8h</td>
<td>1000mg</td>
</tr>
<tr>
<td>MRSA</td>
<td>Clindamycin</td>
<td>13mg/kg/dose q8h</td>
<td>600mg</td>
</tr>
<tr>
<td><em>S. pyogenes</em> (GAS)</td>
<td>Amoxicillin</td>
<td>30mg/kg/dose q8h</td>
<td>1000mg</td>
</tr>
</tbody>
</table>
Fast/Rapid Osteomyelitis MRI

Patient presents with suspected **acute osteomyelitis**

Consult Orthopedic Surgery

Patient meets criteria \(^1\text{,}^2\)

Once all requirements met, clinical team to place order for Non Contrast MRI\(^3\)

**Patient taken to MRI per time set by lead MRI technologist**

Potential complications include: Failed Study and/or Additional Sequences Needed. See Workflow Below

---

**Failed Study:**
If patient fails study because of need for sedation (or non-diagnostic images) or found not to meet criteria while in MRI, patient will be rescheduled by MRI technologist for standard osteomyelitis protocol as soon as possible.

- Timetable determined by lead MR technologist.
- Whether patient stays in MRI or returns to room in the interim determined by lead MR technologist.
- Order changed in Epic by MR technologists.
- Sedation team notified.
- All failed studies documented on spreadsheet for age of patient, reasons for fail, ordering attending, attending name if not on orthopedic service, time of day, location, and lead MRI tech.

**Additional Sequences Needed:**
If for treatment decisions, patient requires post contrast sequences after initial study, additional sequences will be performed as soon as possible.

- Timetable determined by lead MR technologist.
- Whether patient stays in MRI or returns to room in the interim determined by lead MR technologist.
- Second MRI order to be placed by Orthopedic Physician or clinical team after consultation with Orthopedics.
- If additional sequences needed, initial non-contrast MRI will be dictated and completed separately.
- All studies requiring additional sequences will be documented on spreadsheet for age of patient, reasons for fail, ordering attending, attending name if not on orthopedic service, time of day, location, and lead MRI tech.

---

**2\(^1\) INCLUSION CRITERIA**
- Healthy inpatient age \(\geq 2\) years with high clinical suspicion for acute osteomyelitis in the upper or lower extremity who can easily perform a 15 minute non-sedated MRI.

**2\(^2\) EXCLUSION CRITERIA**
- Patient age <2 years
- Outpatients
- Chronic symptoms (>2 weeks)
- Exclusion sites: spine, chest, pelvis (hips are okay)
- History of sickle cell disease
- History of immunodeficiency
- History of JIA or other rheumatologic condition
- History of prior osteomyelitis in same location
- History of prior surgery in same location
- Personal history of cancer, cancer predisposition syndromes, chemotherapy, radiation, bone marrow, or any other prior transplant
- History of vascular anomaly in area of concern
- Aggressive bone lesion/changes by plain film (incidental lesion like NOF is okay)

**2\(^3\) NON CONTRAST MRI REQUIREMENTS TO ORDER**
- Past medical history (PMH) available in Epic to confirm patient’s PMH would not preclude modified protocol
- Plain film of site has been performed within 24 hours & available on PACS
- CBC within past 24 hours
- Specific site must be included in order (Ex: tibia – not lower extremity)

**2\(^4\) EPIC ORDER**
- Site (femur, tibia, foot/ankle)
- Plain films available