Suspicion of MSK Infection

HIGH SUSPICION: Fever PLUS at least one of
- Refusal to bear weight
- Focal pain
- Limited use of extremity
- Immobility of extremity

**If patient not at UNCH, request transfer**
Initial Diagnostic Management
- If sepsis suspected, proceed to Code Sepsis
- Make patient NPO
- Imaging: Focused radiographs of affected region(s).
- Labs: BMP, CBC/diff, CRP, ESR, Blood culture

Assess RISK of MSK Infection
Does the patient have ANY of:
- Radiographic evidence of infection
- Temperature ≥ 38.5°C
- WBC > 12,000
- CRP > 20 mg/L
- ESR > 40 mm/hr
- Unable to bear weight

HIGH risk for MSK infection
Obtain Orthopedic Surgery Consult

LOW risk for MSK infection
Trial NSAIDs

Discharge Criteria
Does patient meet BOTH of following:
1. Clinical improvement (afebrile, ambulating without pain)
2. AND reliable follow-up is available?

Discharge home with PCP follow-up within 48 hours
- ADMIT to Pediatric Hospitalist Service
- Consult Ortho
- Scheduled ketorolac
- Observation
- NPO overnight

Improve after 12-24 hours?
- YES
- Repeat CBC and CRP
- NO
- Consider managing as HIGH RISK

Improve after 24 hours?
- YES
- NO
- Rising CRP or WBC?
- YES
- NO
- Consider managing as HIGH RISK

Box 1: Inclusion Criteria
- Age: 6 months to 21 years
- Suspicion of acute MSK infection
  - Osteomyelitis, septic arthritis, or pyomyositis
  - Symptoms <2 weeks

Box 2: Exclusion Criteria
- Infants under age 6 months
- Symptoms >2 weeks
- Suspected postoperative infection
- History of penetrating injury (Ex: bite wound, trauma patient)
- Patient with surgical hardware
- Myelomeningocele
- Immunocompromised status
- History of chronic recurrent multifocal osteomyelitis (CRMO)

Box 3: Suspicion of MSK Infection
History
- Pain, fever, inability to bear weight, gait disturbance/limp, limited use or immobility of extremity or spine

Exam
- Localized swelling, tenderness, warmth, erythema; fever; limited joint range of motion; gait (if patient able)

Box 4: Synovial Fluid Specimen Collection
Order in EPIC
1. Joint fluid culture
   - Specimen type: Fluid, joint
   - Specimen Source: Joint, [left knee]
2. Body fluid cell count
   - Specimen type: Fluid, joint
   - Specimen Source: Joint, [left knee]

Obtain
- Syringe with at least 4-5 mL
- If limited volume, culture is #1 priority

Send
- Needleless syringe in bag with order stickers for both CULTURE and CELL COUNT
 UNC Children's Clinical Practice Guideline
Pediatric Musculoskeletal Infection
Page 2: Antibiotic Selection

**Tailoring Antibiotic Therapy to Results**
Ensure Pediatric Infectious Diseases is consulted.

**Gram-positive cocci in blood culture**: Add vancomycin. Consult ID. Consider oxacillin.

**Gram-negative rods in Gram stain or culture of tissue or fluid**: Include ceftriaxone. Do not narrow coverage based on Gram stain. Consult ID.

**Gram-negative rods in blood culture**: Include ceftriaxone in regimen. Consult ID.

**Code Sepsis, negative blood cultures**: After 36-48 hours, consider de-escalation if patient is improving. Consult ID.

**Clinical Sepsis**
Children meeting criteria for Code Sepsis should be managed according to Code Sepsis protocols. In most cases, the most appropriate antibiotics are vancomycin plus ceftriaxone.

**Cephalosporin Intolerance**
Most Penicillin-allergic patients can safely take cephalosporins. If cephalosporins truly contraindicated, consult ID for recommendations.

**Patient age and risk of Kingella**
Children under age 4 are at higher risk for Kingella kingae infection. Kingella is susceptible to cephalosporins, but not clindamycin or vancomycin.

**Assess vaccination status**
Consider ceftriaxone for children who are not completely vaccinated against pneumococcus and Haemophilus influenzae type b. Haemophilus influenzae is not susceptible to cefazolin, clindamycin, or vancomycin.

**Antibiotic Dosing**
Note: Individual patient situations may require dose adjustments

**Intravenous**
Cefazolin: 50 mg/kg IV Q8, max 2000 mg/dose
Clindamycin: 10-13 mg/kg IV Q8, max 600 mg/dose
Oxacillin: 50 mg/kg IV Q6, max 3000 mg/dose
Ceftriaxone: 50 mg/kg IV Q24, max 2000 mg/dose
Vancomycin: Consult vancomycin dosing guide. Goal trough 15-20 for sepsis/bacteremia and severe infections

**Oral**
Cephalexin: 75-100 mg/kg/DAY div Q6-Q8, max 4000 mg/day
Clindamycin: 10-13 mg/kg/dose PO Q8, max 600 mg/dose
Cefdinir: 7 mg/kg/dose PO Q12, max 600 mg/DAY
 UNC Children’s Clinical Practice Guideline  
Pediatric Musculoskeletal Infection  
Page 3: Inpatient Management Phase

High Risk for MSK Infection (per Page 1)

Order MRI with and without contrast.

Can MRI be completed immediately?

No

Proceed with MRI prior to surgical intervention

Proceed with alternative evaluation and management.

MSK Infection Confirmed?

Yes

Consult Ped's ID

Consult VIR or MSK Radiology for biopsy procedure. See Page 4: Procedural Guidance

No

Drainable abscess or septic joint?

Yes

Septic Arthritis suspected or confirmed?

No

Consult Ped's ID

Consult VIR or MSK Radiology for biopsy procedure. See Page 4: Procedural Guidance

Yes

Pediatric Hospitalist attending discusses with Ortho attending

Send

Box 1: Specimen Collection

Biopsy Specimen Orders
Order:
• Aerobic/anaerobic culture
• AFB culture
• Fungal culture
• If SOLID tissue: surgical pathology exam

Body Fluid (i.e., synovial fluid)
See Box 4 on page 1 (“Synovial Fluid Specimen Collection”)

Send:
• Liquid pus or body fluid: needleless syringe in bag, as much as possible (up to 5 mL)
• Solid tissue: place in sterile specimen cup. Do NOT place in formalin

Box 2: Treatment Failure

The following findings may indicate treatment failure:
• Fever > 72 hours after admission or surgery
• Rising CRP > 48 hours after admission (or after surgery)
• Worsening pain or failure to progress
• Persistent bacteremia for at least 3 calendar days

Differential Diagnosis of Treatment Failure
• Inadequate source control (consider multifocal infection)
• Antibiotic-resistant pathogen
• Inadequate antibiotic dosing/levels
• Endovascular infection: endocarditis or septic thrombophlebitis

Steps to consider, based on findings
• Repeat imaging, source control
• Antibiotic optimization
• Echocardiogram
• Venous Doppler studies

Box 3: Discharge Criteria

Must meet ALL of the following
• No fever for >24 hours
• Pain manageable (usually without opiates)
• CRP decreased to at least 50% of peak
• Succeeding in PT: able to ambulate 650 feet, go up and down stairs
• Blood cultures negative (minimum 36h)
• If positive cultures, antibiotic susceptibility results available to guide therapy
• Must tolerate at least one dose of home antibiotic regimen (most will be PO)
• Follow-up appointments arranged:
  • Pediatric ID: usually 2-3 weeks
  • Orthopedic Surgery: Individualized
• Prescriptions filled (preferably at UNC)

Assess Treatment Failure Criteria daily (Box 2)

Assess discharge criteria daily

Positive

• Repeat blood culture
• Cancel biopsy procedure (Note: if true abscess present, proceed with drainage)

Negative

• Ensure patient NPO
• Proceed with biopsy as soon as possible
• Send samples (Box 1)

Meet discharge criteria? NO

Assess Treatment Failure Criteria daily (Box 2)

Meet discharge criteria? YES

Discharge home

Continue medical management
• Antibiotics
• Aggressive hydration, monitor renal function especially if receiving NSAIDs and/or vancomycin
• Pain control: acetaminophen, ketorolac, oxycodone. IV opiates only if necessary

Continue medical management
• Consult PT
• Pain management, transitioning to PO only
• Adjust antibiotics as needed in consultation with Ped's ID.
• Repeat CRP Q48H or PRN (do not send on POD #1)
• Additional labs (CBC, renal function) PRN
• If positive blood cultures, repeat Q24-48H until NG x36 hours

Discharge home
Suspected MSK Infection

**Box 1: Indications for Joint Aspiration**
- Suspicion of septic arthritis of any extremity joint: hip, knee, ankle, shoulder, elbow, wrist
- In septic arthritis, joint aspiration should occur as *soon as safely possible*

**Box 2: Importance of Joint Aspiration**
- Delayed management of septic arthritis can result in permanent joint dysfunction
- Cell counts can quickly confirm or refute the diagnosis of septic arthritis
- Culture can establish the microbial cause of septic arthritis, allowing targeted therapy
- Decompression of the joint is therapeutic, pending definitive surgical management

**Box 3: Synovial Fluid Specimen Collection**

*Order in EPIC*
1. Joint fluid culture
   - Specimen type: Fluid, joint
   - Specimen Source: Joint, [left knee]
2. Body fluid cell count
   - Specimen type: Fluid, joint
   - Specimen Source: Joint, [left knee]

*Obtain*
- Syringe with at least 4-5 mL
- If limited volume, culture is #1 priority

*Send*
- Needleless syringe in bag with order stickers for both CULTURE and CELL COUNT

**Box 4: Which service should perform the biopsy or abscess drainage procedure?**

<table>
<thead>
<tr>
<th>Anatomic Location</th>
<th>Who does the procedure?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Joint Aspiration</td>
<td>Pediatric Radiology</td>
</tr>
<tr>
<td>Aspiration of other joint (knee, ankle, shoulder, elbow, wrist)</td>
<td>Orthopedic Surgery</td>
</tr>
<tr>
<td><em>Note: Consider MSK Radiology for shoulder aspiration, vs early operative management.</em></td>
<td></td>
</tr>
<tr>
<td>Aspirate lesion of appendageal skeleton or musculature</td>
<td>Musculoskeletal (MSK) Radiology</td>
</tr>
<tr>
<td>Aspirate lesion of axial skeleton (ex. vertebral involvement, SI joint, etc.) or associated muscles (ex. psoas abscess)</td>
<td>Vascular and Interventional Radiology (VIR)</td>
</tr>
<tr>
<td>Complex or multifocal lesion (e.g., osteomyelitis with associated pyomyositis)</td>
<td>Orthopedic Surgery in OR</td>
</tr>
<tr>
<td>Definitive debridement of septic arthritis</td>
<td>Orthopedic Surgery in OR</td>
</tr>
</tbody>
</table>

**Box 5: Sedation Providers**

<table>
<thead>
<tr>
<th>Plan</th>
<th>Who does Sedation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Room (OR)</td>
<td>Pediatric Anesthesia</td>
</tr>
<tr>
<td>Bedside Aspiration in ED or PICU</td>
<td>ED or PICU Attending</td>
</tr>
<tr>
<td>Bedside Aspiration on floor</td>
<td>Pediatric Sedation Team</td>
</tr>
<tr>
<td>MSK Aspiration</td>
<td>Pediatric Sedation Team</td>
</tr>
<tr>
<td>VIR Aspiration</td>
<td>Pediatric Anesthesia</td>
</tr>
</tbody>
</table>