Ochsner Children's Hospital

MSK INFECTION PATHWAY

Inclusion Criteria
- Age: ≥ 3 months and < 19 years
- Suspicion of acute MSK infection
- Symptom duration < 4 weeks

Exclusion Criteria
- Age: < 3 months
- Suspected postoperative infection
- Patient with surgical hardware
- Penetrating trauma
- History of chronic recurrent multifocal osteomyelitis (CRMO)
- Immunocompromised

SUSPICION OF MSK INFECTION?

* **Fever** *PLUS* at least **one** of the following:
- Refusal to bear weight or limping child
- Focal pain or localized erythema/tenderness
- Limited use of or immobile extremity

No → Continue usual ED management

Yes

PLEASE SEE PAGES 2 & 3 FOR ANTIMICROBIAL DOSING AND ADDITIONAL CONSIDERATIONS

INITIAL DIAGNOSTIC EVALUATION:
- Make patient NPO
- Labs: Blood culture, CBC with diff, BMP, CRP/ESR
- Plain film of affected area(s)
  - ** For hip XR, obtain bilateral hip views + pelvis*

? INCREASED RISK OF MSK INFECTION ?

Does the patient have ANY of the following:
- Radiologic suspicion for MSK infection
- Fever ≥ 38.5°C
- Peripheral WBC ≥ 12,000/µL
- CRP ≥ 20 mg/L *or* > 2 mg/dL
- ESR ≥ 40 mm/hr
- Unable to bear weight

Yes → **CONSULT ORTHOPEDIC SURGERY**
** TRANSFER if Orthopedic services unavailable**

No → **LOW RISK for MSK Infection**
Trial NSAIDs, reassess

Concern for Joint Effusion?

Yes → **OBTAIN US of AFFECTED JOINT(S)**
** For hip US, obtain bilateral views*

Joint Effusion?

Yes:
- Obtain synovial fluid aspirate from affected joint(s) and send for cell count and culture
  ** This may be done at bedside, with IR, or in the OR per Orthopedic recommendation.*
- Obtain MRI of affected limb if not yet done (if it will NOT delay any operative intervention)
- NPO, start mIVF, PRN analgesia

Aspirate Concerning for Infection?

Yes → **Is the patient ill-appearing?**
Meets Phoenix Sepsis Score criteria
OR requires PICU-level care

Yes:
- Start empiric antibiotics prior to invasive procedures (see page 2)
- Consider CODE SEPSIS

No:
- Perform invasive procedures
- Start empiric antibiotics after invasive procedures, no longer than 48-72 hr delay (see page 2)

No → **OBTAIN MRI of AFFECTED LIMB(S)**
*** Discuss fast MRI/protocol with Radiology ***

MRI consistent with osteomyelitis?

No → **Consider alternative diagnosis**

Yes → **Is the patient ill-appearing?** (see above)

No → **OBTAIN MRI of AFFECTED LIMB(S)** (see above)

Clinical Improvement?
Afebrile, ambulating without pain AND reliable follow up?

Yes → **DISCHARGE HOME**
PCP follow in ≤ 48 hrs

No → **Consider the following:**
- Consulting Orthopedics
- Admission to monitor and trend labs (*eg*, CBC, CRP)

*** Invasive Procedures:**
- Bone aspirate and/or biopsy
- Purulent fluid aspiration
- Synovial fluid aspiration

For **hip** aspiration, discuss with Radiology, Orthopedics, and possibly Sedation Team

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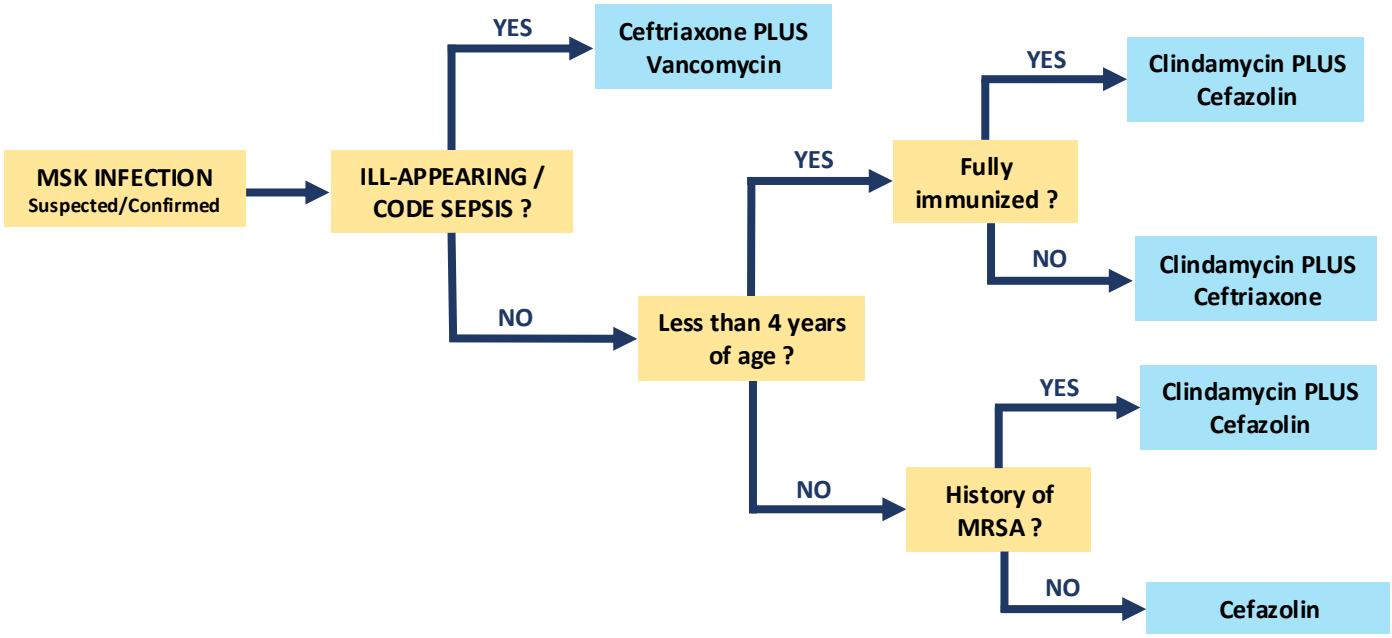
EMPIRIC THERAPY



Patient Characteristics	Pathogen Targets	Medication[a]	Dose[a]	Max Dose
MEDICALLY STABLE: **3 months - ≤ 4 years of age**	S. aureus, S. pyogenes (GAS), K. kingae	Clindamycin IV AND Cefazolin IV	13 mg/kg/dose q8h 50 mg/kg/dose q8h	900 mg 2,000 mg
MEDICALLY STABLE: **3 months - ≤ 4 years of age** **Not fully immunized against H. influenzae or S. Pneumoniae**	Above PLUS H. influenzae, S. pneumoniae	Clindamycin IV AND Ceftriaxone IV	13 mg/kg/dose q8h 75 mg/kg/dose q24h	900 mg 2,000 mg
MEDICALLY STABLE: **> 4 years of age**	S. aureus, S. pyogenes (GAS)	Cefazolin IV	50 mg/kg/dose q8h	2,000 mg
MEDICALLY STABLE: **> 4 years of age** **History of MRSA**	Above PLUS MRSA	Clindamycin IV AND Cefazolin IV	13 mg/kg/dose q8h 50 mg/kg/dose q8h	900 mg 2,000 mg
ILL-APPEARING or CODE SEPSIS	S. aureus, S. pyogenes (GAS), K. kingae, H. influenzae, S. pneumoniae	Vancomycin IV AND Ceftriaxone IV	Pharmacy to dose 75 mg/kg/dose q8h	Pharmacy to dose 2,000 mg
History of Sickle Cell Disease	Above PLUS Salmonella	Start empiric antibiotics for sickle cell disease with fever, consult ID and Hematology		

[a] Doses should be adjusted for renal function, as appropriate.

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DEFINITIVE THERAPY

Select a susceptible agent against the pathogen, with the narrowest spectrum, lowest adverse effect profile and most favorable patient tolerance.

Pathogens	Preferred agents[a]	Alternative agents[a]	Oral agents[a]	Duration of Therapy & Considerations
S. aureus (MSSA)	Cefazolin IV 50 mg/kg/dose q8h (Max dose: 2,000 mg)	Oxacillin IV 50 mg/kg/dose q6h (Max dose: 2,000 mg)	Cephalexin PO 25 mg/kg/dose q6-8h (Max dose: 1,000 mg	ID should be consulted to help with determining duration of therapy ABA: - 10-14 days (if rapid clinical improvement & consistent, progressive decrease in CRP by the end of the first month) AHO: - Uncomplicated: 3-4 weeks
S. aureus (MRSA)	Clindamycin IV (if susceptible) 13 mg/kg/dose q8h (Max dose: 900 mg) OR Vancomycin IV (Dosing per pharmacy)	Consult ID	Clindamycin PO (if susceptible) 13 mg/kg/dose q8h (Max dose: 600 mg) OR Trimethoprim-Sulfamethoxazole 5 mg trimethoprim/kg/dose q8h (Max dose: 160 mg of trimethoprim)	
Group A strep	Ampicillin IV 50 mg/kg/dose q6h (Max dose: 2,000 mg)	Cefazolin IV 50 mg/kg/dose q8h (Max dose: 2,000 mg)	Amoxicillin PO 30 mg/kg/dose q8h (Max dose 1,000 mg)	ABA: 10-14 days
K. kingae	Ampicillin IV 50 mg/kg/dose q6h (Max dose: 2,000 mg)	Cefazolin IV 50 mg/kg/dose q8h (Max dose: 2,000 mg)	Amoxicillin PO 30 mg/kg/dose q8h (Max dose 1,000 mg)	ABA: 10-14 days AHO: 3-4 weeks
S. pneumoniae **Susceptible strains with MIC values to penicillin <2 mcg/mL**	Ampicillin IV 50 mg/kg/dose q6h (Max dose: 2,000 mg)	Penicillin G IV 75,000 units/kg/dose q6h (Max dose 4 million units)	Amoxicillin PO 30 mg/kg/dose q8h (Max dose 1,000 mg)	ABA: 10-14 days
S. pneumoniae **Relatively resistant to penicillin with MIC values ≥ 2 mcg/mL**	Ceftriaxone IV 50 mg/kg q24h (Max dose: 2,000 mg)	Clindamycin IV (if susceptible) 13 mg/kg/dose q8h (Max dose: 600 mg) OR LevoFLOXacin IV 6 months - < 5 years: 10 mg/kg/dose q12h ≥ 5 years: 10 mg/dose q24h (Max dose: 750 mg)	Clindamycin PO (if susceptible) 13 mg/kg/dose q8h (Max dose: 600 mg) OR LevoFLOXacin PO 6 months - < 5 years: 10 mg/kg/dose q12h ≥ 5 years: 10 mg/dose q24h (Max dose: 750 mg)	ABA: 14-21 days

[a] Doses should be adjusted for renal function, as appropriate.

MSK INFECTION PATHWAY

ADDITIONAL INFORMATION AND CONSIDERATIONS:

DEFINITIONS:

- **Acute Hematogenous Osteomyelitis (AHO)**: Occurs when bacteria enter and proliferate within the cellular and extracellular matrix of the bone
- **Acute Bacterial Arthritis (ABA)**: A serious joint infection caused by bacteria; symptoms include pain, swelling, warmth, and limited motion

DIAGNOSTIC LABORATORY TESTING:

- Blood Culture prior to the administration of antimicrobial therapy
- C-Reactive Protein (CRP), if infection is confirmed this can serve as a baseline
- Erythrocyte Sedimentation Rate (ESR), if infection is confirmed this can serve as a baseline
- Procalcitonin (PCT), guidelines suggest **against** measuring

KOCHER CRITERIA:

- (1) Non-weightbearing, (2) Fever > 38.5°F, (3) ESR > 40 mm/hr, and (4) WBC > 12, 000 cells/mm^3
- Modified Kocher adds CRP > 2 mg/dL or 20 mg/L and plus refusal to bear weight has 74% probability of ABA
- *Note*: Kocher criteria has only been validated for the hip and may not apply to other joints

Kocher Criteria	Probability of Septic Arthritis
0/4	< 0.2%
1/4	3%
2/4	40%
3/4	93%
4/4	99%

WHEN TO START EMPIRIC MICROBIALS:

- Ill appearing (sepsis or PICU): Obtain blood cultures and start immediately, before invasive procedures
- Not clinically ill: May wait until after invasive procedures, however, no more than 48-72 hours

IMAGING CONSIDERATIONS:

- **Acute Hematogenous Osteomyelitis**:
  - Plain radiography of the potentially infected bone(s)
  - Magnetic resonance imaging (MRI)
- **Acute Bacterial Arthritis**:
  - Plain radiography of the affected joint and adjacent bones
  - Ultrasonography of the affected joint may be required to detect the presence of a joint effusion (particularly of the hip or shoulder); if joint effusion absent this suggests that ABA is not present
  - MRI if needing to assess the extent of inflammation and infection
- **For HIP imaging:** Please obtain bilateral views for both radiographs and ultrasonography

INVASIVE PROCEDURES:

- For AHO, aspirates and/or biopsy of bone and/or associated purulent fluid collection(s): Routine microbiological studies are recommended
- For ABA, synovial fluid from the affected joint by arthrocentesis: Cell count/differential and routine microbiological culture are recommended
  - WBC greater > 50,000/µL highly suggestive
  - WBC 25,000-50,000/µL still may consider infection

Ochsner Children's Clinical Pathways Committee
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