

# Musculoskeletal Infection Pathway Executive Summary

Physician Owners: Dr. Esposito & Dr. Simonsen

## PRIMARY OBJECTIVE

Develop a pathway for treating musculoskeletal infection in the Emergency Department, inpatient area, and effectively transition to an outpatient setting.

## CLINICAL CARE GUIDELINES

### Intended for patients:

- 6 months to 18 years
- With suspicion of acute (less than 2 weeks) deep musculoskeletal infection; osteomyelitis, septic arthritis, pyomyositis

### Not Intended for patients with:

- Postoperative infection or foreign bodies
- Infections from penetrating trauma
- Chronic infection (symptoms greater than 2 weeks)
- Infants (less than 6months), as they may have: 1) other pathogens, 2) multifocal disease, and 3) poor oral antibiotic absorption
- Medically complex children

## CLINICAL MANAGEMENT

### Clinical Assessment:

- Vital signs on admission
- Observation and/or history for:
  - o Limited used or immobility of extremity or spine
  - o Gait disturbance/Limp
  - o Inability to bear weight
  - o Pain
  - o Fever greater than 38.5°C
  - o Non-infectious causes
- Physical examination for the presence of:
  - o Limited range of motion
  - o Tenderness
  - o Swelling
  - o Warmth at site
  - o Erythema
  - o Psoas sign
  - o Fever

### Laboratory Studies:

- **Source evaluation:** Send pus (not a swab) for Gram stain and bacterial culture, and if possible tissue/synovium for pathology. If joint fluid, send for bacterial culture, Gram stain, cell count, differential and fluid to hold. If unusual case or exposures, consult ID for further testing/culturing recommendations.
- **Emergency Department**
  - o CBC
  - o CRP
  - o ESR
  - o Blood culture
- **Emergency Department/Operating Room**
  - o Biopsy/aspiration to establish microbial etiology, for therapeutics (to prevent rupture into contiguous joint, for example) and abscess discovery
  - o Best method of obtaining a source culture to be discussed by primary team with orthopedics
  - o Send source culture (NO SWABS), Gram stain and pathology on all cases, unless blood culture positive for a likely pathogen. For joints, send cell count, glucose, protein, synovial pathology and fluid to save from suspected source  
For patients 6 months to 4 years of age, add *K. kingae* culture via blood culture bottle
- **Surgical drainage and/or irrigation indicated if:**
  - o Infection of a joint suspected
  - o Abscess found on clinical exam on imaging
  - o Patient does not improve on medical therapy after 48 hours
- **Initial Imaging Studies**
  - o Plain radiographs can be insensitive for the evaluation of acute soft tissue and osseous infection, but if diagnostic may avoid further imaging; soft tissue swelling, though nonspecific, may be an early finding of MSK infection
  - o Additional imaging as directed following discussion with Orthopedics to assure the correct exam is ordered in the appropriate time frame
- **Consults to Consider**
  - o Orthopedics
    - Discuss on all confirmed and probable MSK infections prior to advanced imaging
  - o Infectious Disease
    - Consult on all confirmed and probable MSK infections within 24 hours of admission

### INITIAL THERAPIES: ED AND INPATIENT

1. Pain control administered per Emergency Department/primary team
2. NPO and place PIV
3. Source culture should be obtained prior to starting antibiotics, unless blood culture positive, unless patient's clinical status too unwell
4. All patients are to be treated with IV antibiotics initially
5. If blood culture positive, cover according to suspected organism (see Table 1)
6. **If patient condition allows** and not contraindicated by bacterial differential based on exposures or history, cover narrowly with IV agent with oral alternative and follow cultures and assess clinical response
  - a) Greater than or equal to 4 years = clindamycin and/or cefazolin
  - b) 6 months to 4 years = cefazolin (cover *K. kingae*)

- c) Consider both clindamycin and cefazolin for increased *S. aureus* coverage, in more severely ill patient, particularly if bacteremic
- d) Consider adding vancomycin if: hip joint involved (potential increased morbidity) for expanded MRSA coverage, severe illness, GPC bloodstream infection, multifocal infection

7. Narrow based on culture and susceptibility results

8. **If critically ill**, patient should be managed off the MSK Infection Pathway

### ADMISSION CRITERIA

1. Admit all patients with suspected and confirmed MSK infections on pathway unless indicated otherwise by Orthopedics or ID.

### CHANGE TO ORAL ANTIBIOTICS AND DISCHARGE CRITERIA

1. If improves, treat intravenously and inpatient until:
  - a) Clinically substantially improved (weight bearing if allowed, improved motion of infected joint, well appearing)
  - b) Tolerating orals
  - c) Afebrile x 24 hours
  - d) Known susceptibilities indicating there is an appropriate oral alternative to intravenous therapy
  - e) Falling CRP
2. If blood cultures positive, repeat daily post initiation of antibiotics until negative x 48 hours; if ongoing bacteremia, consider evaluation for intravascular infection and/or other foci, and longer course of intravenous antibiotics
3. Also consider longer course of intravenous treatment if: adequate drainage not achieved, unusual organism(s), hip joint involvement, multifocal disease, unusually severe disease, doubt about oral absorption or compliance

### Discharge Planning and Follow-up:

1. Arrange home IV therapy if indicated, and educate family on the importance of antibiotic adherence, assure family is able to purchase medication, and understands possible side effects of antibiotics (see Table 1).
2. Outpatient follow up with ID for :
  - a) Continued clinical improvement
  - b) Antibiotic tolerance/compliance
  - c) Improving ESR/CRP
  - d) Laboratory indications of antibiotic side effects
3. Treat until:
  - a) Patient has reached expected clinical improvement for condition
  - b) ESR/CRP normal
  - c) Minimum total time on antibiotics
    - i. Septic joint: 3 to 6 weeks
    - ii. Osteomyelitis: 4 to 6 weeks
    - iii. Range depends on severity, and some severe infections will require longer therapy
  - d) Obtain baseline plain radiograph at the end of therapy, note children with MRSA osteomyelitis are high risk for pathologic fracture

4. For patients with septic hip obtain a baseline end of antibiotic therapy plain radiograph of the hip for comparison over time and insure patient follows up with Orthopedics 1-2 weeks post-op and again over the next 3-6 months from surgical intervention; remaining follow up after these visits will be determined based on outcome/imaging and discretion of Orthopedist.

## RATIONALE (SAFETY, QUALITY, COST, DELIVERY, ENGAGEMENT, & SATISFACTION)

- **Safety:** Will be maintained by close communication between ED providers, Hospitalists, ID, and Orthopedics
- **Quality & Delivery:** Will be improved by reducing unnecessary variation related to diagnostic testing, antimicrobial utilization, and specialist involvement
- **Cost:** Will be reduced by reducing variation in treatment which leads to potential delays, adverse events, and readmissions
- **Engagement:** Is created and supported by involvement of providers across the continuum of care that evaluate and treat musculoskeletal patients
- **Patient/Family Satisfaction:** Shall be improved by providing the highest quality care based on established guidelines and the latest evidence available in the literature

## IMPLEMENTATION ITEMS/ SUPPORTING DOCUMENTS

- Ortho Septic Arthritis/Osteomyelitis Admit Order Set
- Musculoskeletal Initial Evaluation Algorithm
- MSK Inpatient Algorithm
- Antibiotics and Monitoring for Patients with Musculoskeletal Infections
- Laboratory Protocol for OR Specimens obtained by Ortho

## METRICS PLAN

- MSK order set used
- ED triage time/admit time to OR start time decreased
- Antibiotics ordered from pathway orderset
- Monitor % of patient discharged with PICC
- Monitor length of stay (compare discharges with PICC verses without)
- Readmissions within 30 days
- ID consult within 24 hours of admission

## TEAM MEMBERS

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# Musculoskeletal Infection Pathway

## Executive Summary

**TABLE 1. Antibiotics and Monitoring for Patients with Musculoskeletal Infections**  
**(Other antibiotics may be indicated based on culture results)**

Developed by Antimicrobial Stewardship at Children's Hospital Colorado, Sarah Parker & Jason Child 2014

	Cefazolin (IV)	Cephalexin (PO)	Cefotaxime (IV)	Ceftriaxone (IV)	Vancomycin (IV)	Clindamycin (IV or PO)	Ampicillin (IV)	Amoxicillin (PO)
Daily amount (in mg/kg/day)	100-150 mg/kg/day divided Q6-8H	100-150 mg/kg/day divided QID	150-200 mg/kg/day divided Q6-8H	100 mg/kg/day divided Q12-24H	60-80 mg/kg/day divided Q6H	40 mg/kg/day IV, divided Q6-8H PO, divided TID	200mg/kg/day IV, divided Q6H	90mg/kg/day PO, divided TID
Single daily amount maximum for MSK infection	8000 mg divided Q6H	4000 mg divided QID	8000 mg divided Q6H	2000 mg divided Q12-24H	6000 mg divided Q8H (adjust dose with levels, can use continuous, consult ID)	2700 mg IV (IV, divided Q8H) 1800 mg PO (PO, divided TID)	8000mg IV divided Q6H	2000-4000 mg PO divided TID
<b>Organism</b>								
MSSA <sup>2</sup>	+	+	2	2	+	+		
MRSA					+	+ <sup>3</sup>		
<i>S. pyogenes</i> (Group A strep)	+	+	+	+	+	+	+	+
<i>S. pneumoniae</i>	+	+	+	+	+	+	+	+
<i>Kingella kingae</i> <sup>5</sup>	+	+	+	+			+	+
<b>Side Effects</b>								
Diarrhea, including <i>C. difficile</i> colitis	+	+	+	+	+	+	+	+
Bone marrow suppression	+	+	+	+	+	+	+	+
Rash	+	+	+	+	+	+	+	+
Stevens Johnson Syndrome	+	+	+	+	+	+	+	+
Drug fever	+	+	+	+	+	+	+	+
Nephrotoxicity, Interstitial nephritis	+	+	+	+			+	+
Nephrotoxicity, other					+			
Elevated transaminases				+		+		
Labs to monitor for infection resolution and side effects	<sup>1</sup> CBC, CRP or ESR, BUN, Cr	<sup>1</sup> CBC, CRP or ESR, BUN, Cr	<sup>1</sup> CBC, CRP or ESR, BUN, Cr	<sup>1</sup> CBC, CRP or ESR, BUN, Cr, LFTs	<sup>1</sup> CBC, CRP or ESR, BUN, Cr, vanc trough	<sup>1</sup> CBC, CRP or ESR, BUN, Cr, LFTs	<sup>1</sup> CBC, CRP or ESR, BUN, Cr	<sup>1</sup> CBC, CRP or ESR, BUN, Cr



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## Executive Summary

- 1 All patients on antibiotics for MSK infection should be followed with a weekly CBC, ESR or CRP. There are additional labs specific to the antibiotic, for example: urinalysis and BUN/creatinine screen for renal function and interstitial nephritis, CBC for neutropenia. Clinically patients should be followed for signs of allergy including rash, for diarrhea (any antibiotic can cause Clostridium difficile colitis), for fevers (for severe allergy and line infection, recurrent infection), for compliance and other complaints. All antibiotics can cause anaphylaxis. Side effects listed are most common, but do not represent all side effects.
- 2 Although cefotaxime and ceftriaxone are often listed as having activity against MSSA, in general, antistaphylococcal penicillins (such as nafcillin) or first generation cephalosporins (such as cefazolin) are the preferred therapy.
- 3 The use of clindamycin for MRSA depends on local susceptibility patterns and, if available, susceptibility testing.
- 4 Nafcillin, vancomycin and penicillin can be given by continuous infusion; discuss with ID/pharmacy.
- 5 *Kingella kingae* is a predominant cause of bone and joint infection in the 6 month to less than 4 year age group, but is difficult to culture. Unless microbial cause is known, it should be empirically covered. 92% of *K. kingae* disease is in children aged 6 to 29 months. It predominantly causes septic arthritis, but can also cause isolated osteomyelitis and tenosynovitis; it generally has a milder presentation than *S. aureus*.

TABLE 2.

### BRIEF DIFFERENTIAL FOR THE ACUTE LIMPING CHILD

Infectious etiologies	Septic arthritis Osteomyelitis Discitis Pyomyositis Psoas abscess Cellulitis
Other Orthopedic Conditions	SCFE Perthes Fracture, acute or stress Foreign body
Inflammatory Conditions	Transient synovitis JRA Reactive arthritis (Strep, etc) Rheumatic fever
Other Systemic Conditions	Leukemia Spine or other solid tumors Sickle cell disease



### APPENDIX A.

#### Stat Joint/Synovial Aspirates (Orthopedic Surgery)

1. Nurse will obtain joint aspirate kit  
(will be kept in OR – in the core, in cabinet by ice machine, ED and lab)
2. Notify Pathology (X5519) that a “STAT JOINT/SYNOVIAL ASPIRATE” will be obtained in OR or ED. (These exact words are critical for communication).
3. Surgeon will perform joint aspiration - using the kit to obtain the specimen.
  - a) > 1.0 cc obtained
    - 1) 1.0 cc or more in EDTA (purple top tube)  
[for cell count & differential]
    - 2) 0.5 cc or more in sterile syringe with cap  
[for culture (includes gram stain)]
  - b) < 1.0 cc obtained
    - 1) culture (syringe) ONLY  
[will not be enough for cell count & differential]
4. **GREEN JOINT SPECIMEN STAT RUN PAPER** completed
  - a) patient sticker with identification
  - b) specimen source
  - c) surgeon
  - d) results call to phone number
  - e) tests to be performed (check box)
    - 1) cell count & differential
    - 2) gram stain & culture
5. Specimen sent to Pathology (tube station # 410)
  - a) Tube the biohazard specimen bag **which should contain the following:**
    - Labeled Specimen(s) – include phone # for lab to call and report results.
    - **GREEN JOINT SPECIMEN STAT RUN PAPER – this paper has to be sent with the specimen to alert lab of STAT RUN.**
  - b) Call Pathology AGAIN to notify them that specimen has been sent (X5519) – confirm that lab understands it is a “STAT JOINT/SYNOVIAL ASPIRATE” that will need to be immediately delivered to Hematology and Microbiology.
  - c) Document the specimen and “mark as sent” – you do not need to create orders or print anything.
6. Pathology technician **IMMEDIATELY** delivers specimens to Hematology & Microbiology
7. Pathology technician enters orders into EPIC (to be signed by MD).
8. Hematology performs cell count & differential
  - a) Call results once cell count completed
  - b) Call results once differential completed
9. Microbiology performs gram stain & sets up culture
  - a) Call gram stain result

10. OR or ED nurse ensures that a replacement kit is obtained from lab and restocked

#### JOINT ASPIRATE KIT (AVAILABLE IN OR, ED & LAB)

- Two 10 cc syringes
- 18 gauge spinal needle
- 18 gauge delivery needle
- EDTA (purple) tube
- Laboratory **GREEN SURGERY SPECIMEN RUN STAT** paper
- Instructions/procedure