

# Musculoskeletal Infections v1.0: ED Evaluation

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## PHASE I (E.D.)

### Inclusion Criteria

- Suspected septic arthritis and/or osteomyelitis in children > 3 months old

### Exclusion Criteria

- Permanent implanted orthopedic hardware
- Symptoms at site contiguous with pressure ulcer/chronic wound
- Suspected necrotizing soft tissue infection
- Suspected axial skeletal involvement (i.e. skull, spine, ribs, sternum)
- Chronic recurrent multifocal osteomyelitis
- Immunocompromised patient (e.g. BMT, oncology, transplant)

### Abbreviations:

Septic Arthritis (SA)  
Osteomyelitis (OM)  
Musculoskeletal (MSK)

### Kocher Criteria

#### Predictors for SA of the hip:

- Non-weight-bearing
- Temp > 38.5C
- ESR ≥ 40 mm/hr
- WBC > 12,000 cells/mm<sup>3</sup>

[Caird et al.](#) introduced a fifth predictor for SA of the hip:

- CRP > 2.0 mg/dL

!

For patients who are hemodynamically unstable or with sepsis physiology, also refer to [Septic Shock Pathway](#)

### ED Team Assessment

Evaluate for [signs/symptoms](#) suggestive of a primary MSK Infection

!

Delayed diagnosis of hip SA can lead to avascular necrosis of the femoral head

### Initial Workup

**Labs:** Order CBC with diff, CRP, ESR

**Microbiology:** Consider aerobic + anaerobic blood cultures

**Imaging:** Order x-ray of the involved bone/joint

### Low Clinical Suspicion for SA and/or OM:

- Consider hip US if hip SA remains on the differential
- Consider alternative diagnoses (e.g. transient synovitis)
- If patient is clinically stable for discharge, consider PCP follow-up in 1-3 days

### Moderate/High Clinical Suspicion for SA and/or OM:

- Consult Orthopedics
- Order hip US if hip SA is suspected
- Consider MRI of the suspected involved extremity w/Ortho input (see [MRI Logistics](#))
- Coordinate procedural sedation/analgesia if joint aspiration appropriate in the ED

### Alternative Unifying Diagnosis

Off Pathway

### Initial Antibiotics

- Draw aerobic + anaerobic blood cultures prior to initiating antibiotics
- [Empiric IV Antibiotics](#)
- Discuss timing of first antibiotic dose with Orthopedics -- may hold if patient is clinically stable, diagnosis is not yet confirmed, and/or patient is awaiting further diagnostics/surgical intervention

# Septic Arthritis/Osteomyelitis - Signs and Symptoms

There is considerable overlap in the clinical presentation of septic arthritis (SA) and osteomyelitis (OM). The rate of concurrent infection in children with both septic arthritis and osteomyelitis may be ~15-40%.

Systemic symptoms may include:

- Fever
- Infants: irritability, vomiting, poor feeding

Local symptoms may include:

- Limp, refusal to bear weight, pseudoparalysis
- SA: hot swollen immobile peripheral joint, pain on passive range of motion
- OM: focal tenderness

Pain/tenderness and joint involvement may be easier to localize in older children compared with infants and young children.

*[LOE: Guideline (Saavedra-Lozano, 2017)]*

# Kocher Criteria

## Original Derivation Study, 1999:

*Retrospective chart review of 282 patients evaluated between 1979 and 1996 at a major tertiary-care children's hospital presenting with an acutely irritable hip.*

*Final diagnoses included confirmed septic arthritis, presumed septic arthritis, and transient synovitis, on the basis of joint fluid aspirate results, cultures from joint fluid and blood, and the patients' clinical course.*

*Four independent multivariate clinical predictors were identified to differentiate between septic arthritis and transient synovitis: fever ( $T > 38.5C$ ), non-weight bearing status, elevated ESR ( $\geq 40$  mm/hr), and elevated WBC ( $> 12,000$  cells/mm<sup>3</sup>).*

*Probability for septic arthritis of the hip based on number of predictors present:*

- 0 predictors: <0.2% risk*
- 1 predictor: 3.0% risk*
- 2 predictors: 40.0% risk*
- 3 predictors: 93.1% risk*
- 4 predictors: 99.6% risk*

*[LOE: Expert Opinion (Kocher, 1999)]*

## Prospective Validation Study, 2004:

*Kocher Criteria were prospectively applied to 213 consecutive patients between 1997 and 2002 at a major tertiary-care children's hospital presenting with an acutely irritable hip.*

*51 children were diagnosed with septic arthritis; 103 children were diagnosed with transient synovitis.*

*Probability for septic arthritis of the hip based on number of predictors present:*

- 0 predictors: 2.0% risk*
- 1 predictor: 9.5% risk*
- 2 predictors: 35.0% risk*
- 3 predictors: 72.8% risk*
- 4 predictors: 93.0% risk*

*[LOE: Expert Opinion (Kocher, 2004)]*

## Kocher Criteria (continued)

### **Caird et al, 2006:**

*Prospective cohort study of 48 patients evaluated between 2000 and 2003 at a major tertiary-care children's hospital presenting with an acutely irritable hip who underwent hip aspiration.*

*34 children were diagnosed with septic arthritis; 14 children were diagnosed with transient synovitis.*

*Researchers performed a multivariate analysis comparing these two groups on the basis of the four Kocher Criteria plus CRP. They found that only ESR and CRP were independently associated with septic arthritis, with CRP being the strongest predictor:*

*CRP > 2.0 mg/dL → OR = 14.5 (95% CI: 3.2-64.9)*

*ESR ≥ 40 mm/hr → OR = 7.0 (95% CI: 1.5-51.8)*

*Probability for septic arthritis of the hip based on number of predictors present:*

*0 predictors: 16.9% risk*

*1 predictor: 36.7% risk*

*2 predictors: 62.4% risk*

*3 predictors: 82.6% risk*

*4 predictors: 93.1% risk*

*5 predictor: 97.5% risk*

*[LOE: Expert Opinion (Caird, 2006)]*

# MRI Logistics

## Option #1: MRI w/ and w/o contrast

- After placing order, coordinate timing with Radiology
- For children requiring sedation, coordinate with Anesthesia

### Contact Info:

MRI: x7-4458

Anesthesia Board Runner: x7-2433

## Option #2: FAST OSTEOMRI

- Seattle Children's FAST OSTEOMRI protocol is currently being evaluated by Radiology for efficacy and cost-efficiency
- Only available to:
  - Patients with **high** suspicion for OM
  - Patients  $\geq$  24 months of age
  - Patients who have received formal consultation and approval for this imaging protocol by Orthopedics
- Orthopedics Team will place order, with name of supervising Orthopedics Attending specified in "Special Instructions"
- If between 0700-2300: contact Radiology to expedite non-sedated limited MRI for osteomyelitis evaluation
- If between 2300-0700: contact Radiology to coordinate for first study in the morning\*

*\*First study in the morning only available at 0700, Mon-Fri. Patient should be waiting NPO in MRI holding with MRI screening sheet completed by nursing*

## Empiric IV Antibiotics

Empiric First Dose Antibiotics Table - Septic Arthritis / Osteomyelitis	
Clinical Scenario	Recommended Therapy
Non-toxic; low risk for MRSA	IV Cefazolin 50mg/kg x1 Max dose: 2000mg
Non-toxic; cefazolin allergy* or MRSA risk	IV Clindamycin 13.3mg/kg x1 Max dose: 600mg
Systemically/critically ill and MRSA not yet ruled out by culture	IV Vancomycin 15mg/kg x1 Max dose: 2000mg
*Cefazolin does not share a side-chain with other cephalosporins. Patients with a documented allergy to other cephalosporins are at low-risk for reacting to cefazolin administration and should preferentially receive this therapy as opposed to clindamycin, unless there are other clinical concerns for MRSA infection.	
For patients at risk for other special non-staph/strep pathogens (e.g. sickle cell disease -- <i>Salmonella</i> ), consider ID Consult to assist with antibiotic selection	

[LOE: Guideline (Saavedra-Lozano, 2017)]

**MRSA Risk Factors:** known MRSA carrier, recurrent skin abscesses in patient or family member, recently or frequently hospitalized

# Musculoskeletal Infections Approval & Citation

Approved by the CSW MSK Infections team for October 1, 2019 go-live

## CSW MSK Infections Team:

ED & Co-Owner	Alex Stephan, Fellow-MD
ED & Co-Owner	Derya Caglar, MD
ED Clinical Nurse Specialist	Sara Fenstermacher, MSN, RN, CPN
Orthopedics	Todd Blumberg, MD
Pharmacy	Adam Brothers, PharmD
Infectious Disease	Matthew Kronman, MD, MSCE
Radiology	Sarah Menashe, MD
Lab	Xuan Qin, PhD
Hospitalist	Jason Rubin, MD

## Clinical Effectiveness Team:

Consultant:	Lisa Abrams, ARNP
Project Manager:	Asa Herrman
CE Analyst:	James Johnson
Librarian:	Jackie Morton, MLS
Program Coordinator:	Kristyn Simmons

## Clinical Effectiveness Leadership:

Medical Director:	Darren Migita, MD
Operations Director:	Karen Rancich Demmert, BS, MA

Retrieval Website: <http://www.seattlechildrens.org/pdf/MSK-Infections-pathway.pdf>

## Please cite as:

Seattle Children's Hospital, Stephan, A, Caglar, D, Abrams, L, Blumberg T, Brothers, A, Fenstermacher, S, Herrman, A, Kronman, M, Menashe, S, Rubin, J, Qin, X, Migita, D, 2019 September. MSK Infections Pathway. Available from: <http://www.seattlechildrens.org/pdf/MSK-Infections-pathway.pdf>

# Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children's. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94, Hultcrantz M et al. J Clin Epidemiol. 2017;87:4-13.):

Quality ratings are *downgraded* if studies:

- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings are *upgraded* if it is felt that:

- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

## Certainty of Evidence:

★★★★ High: The authors have a lot of confidence that the true effect is similar to the estimated effect

★★★○ Moderate: The authors believe that the true effect is probably close to the estimated effect

★★○○ Low: The true effect might be markedly different from the estimated effect

★○○○ Very low: The true effect is probably markedly different from the estimated effect

Guideline: Recommendation is from a published guideline that used methodology deemed acceptable by the team

Expert Opinion: Based on available evidence that does not meet GRADE criteria (for example, case-control studies).

The empiric antibiotic recommendations in this pathway are based on an internal work group's development of consensus-based guidelines of care for children with bone or joint infections, updated 12/2018.

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# Summary of Version Changes

- **Version 1.0 (10/1/2019):** Go live

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## Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

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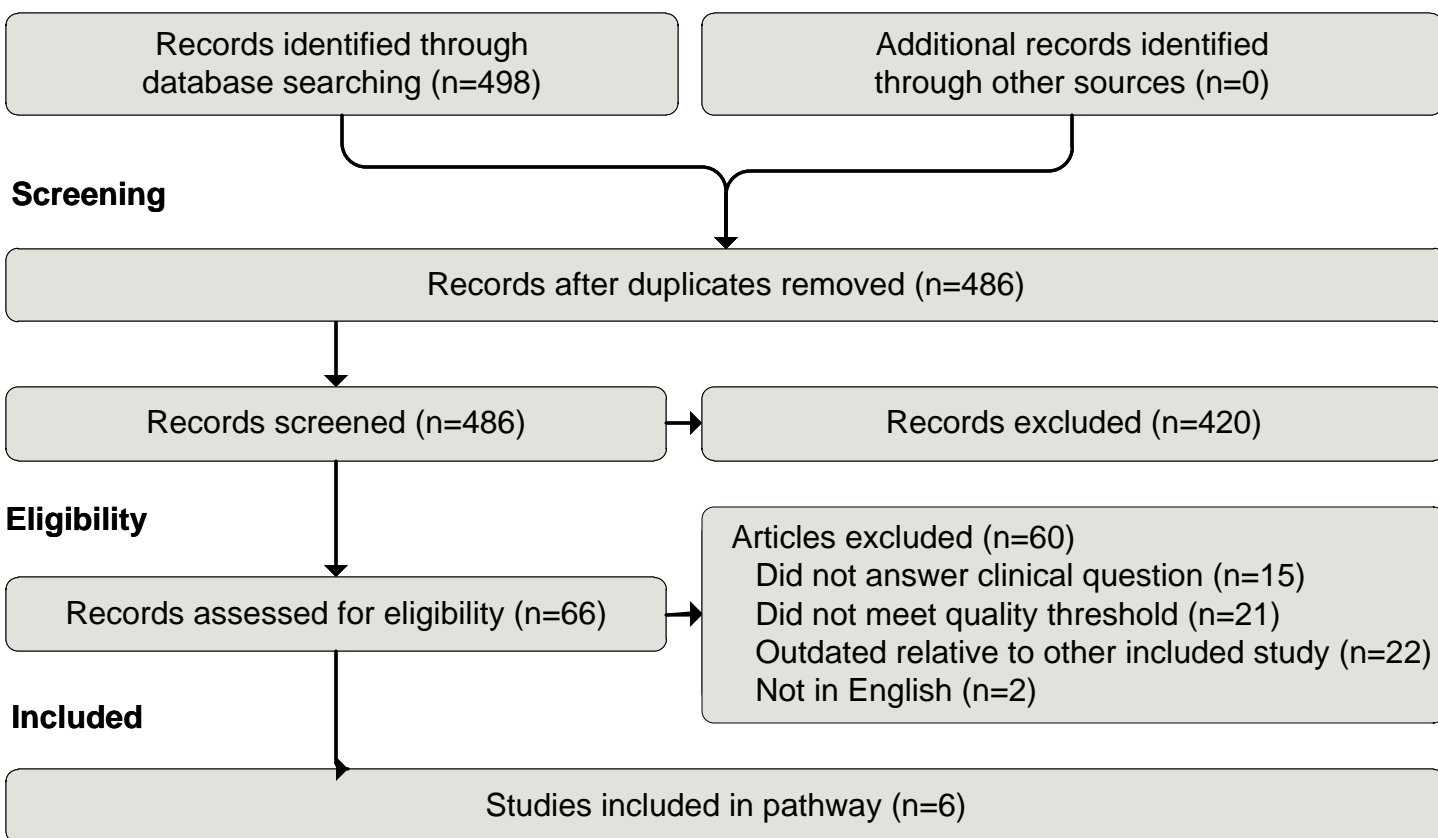
# Bibliography

## Methods

The literature search was conducted in February of 2019. The search targeted synthesized literature on osteomyelitis, septic arthritis and infectious arthritis and was limited to English and humans and 2009-current. The search was executed in Ovid Medline, Embase, Cochrane Database of Systematic Review (CDSR), and Turning Research into Practice database (TRIP).

Two reviewers independently screened abstracts, included guidelines and systematic reviews that addressed optimal diagnosis, treatment, and prognosis of patients who meet pathway inclusion/exclusion criteria. One reviewer extracted data and a second reviewer quality checked the results. Differences were resolved by consensus. Additional references from internal Seattle Children's Hospital guidelines were added as supplemental resources.

## Identification



Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535

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