

Osteomyelitis and Septic Joints; Practical Considerations

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Goals/objectives

- To improve understanding of the diagnosis, treatment, and follow-up of pediatric bone and joint infections
 - Describe common presentations of bone and joint infection in children
 - List most common etiologies
 - Identify appropriate diagnostic studies
 - Prescribe empiric antibiotics
 - Understand limitations of empiric antibiotics
 - Describe important aspects of follow-up

Osteomyelitis- types

- Hematogenous
 - Bacteremia- metaphysis-local infection
 - The younger the patient, the more likely infection will extend to joint space
- Direct extension
 - Local infection eventually extending into bone
- Traumatic / surgical
 - Nail in the foot, trauma, direct manipulation

Presentation- hematogenous osteomyelitis

Neonate

- Fever
- ↓ movement
- Redness, swelling
- Pustule
- irritability

Young Child

- c/o pain
- Limp
- Stops walking
- Fever

Older child

- c/o pain
- Fever

Organisms- hematogenous osteomyelitis

Neonate

- *S. aureus*
- Group B strep
- Gram neg enterics

Young child

- *S. aureus*
- *K. kingae*
- Group A strep
- *S. pneumonia*
- (*H. influenzae b*)

Older child

- *S. aureus*
- Group A strep

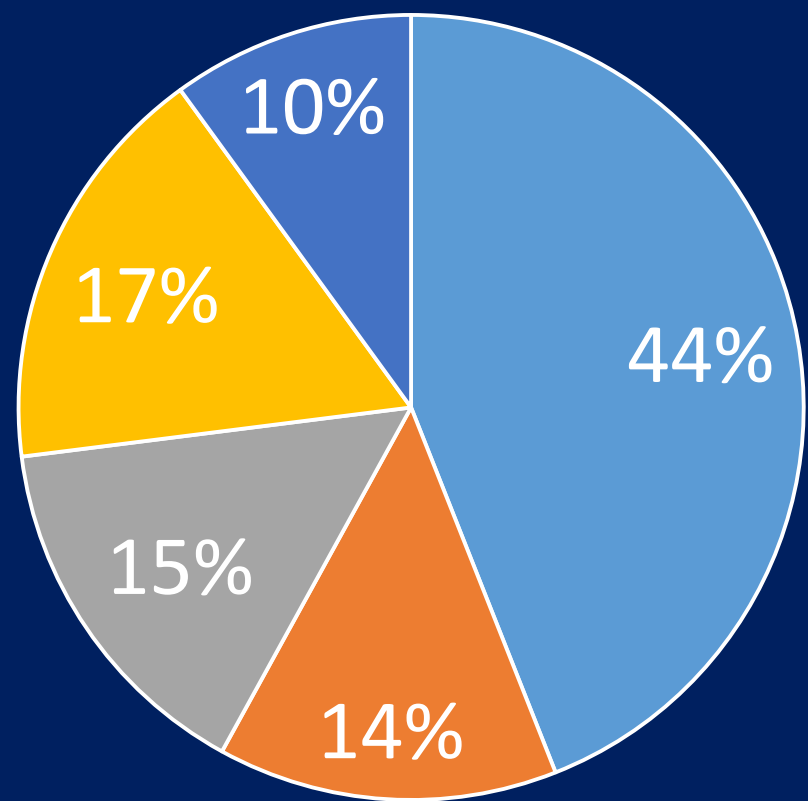
Special circumstances

Just had chicken pox?

Child with sickle cell disease?

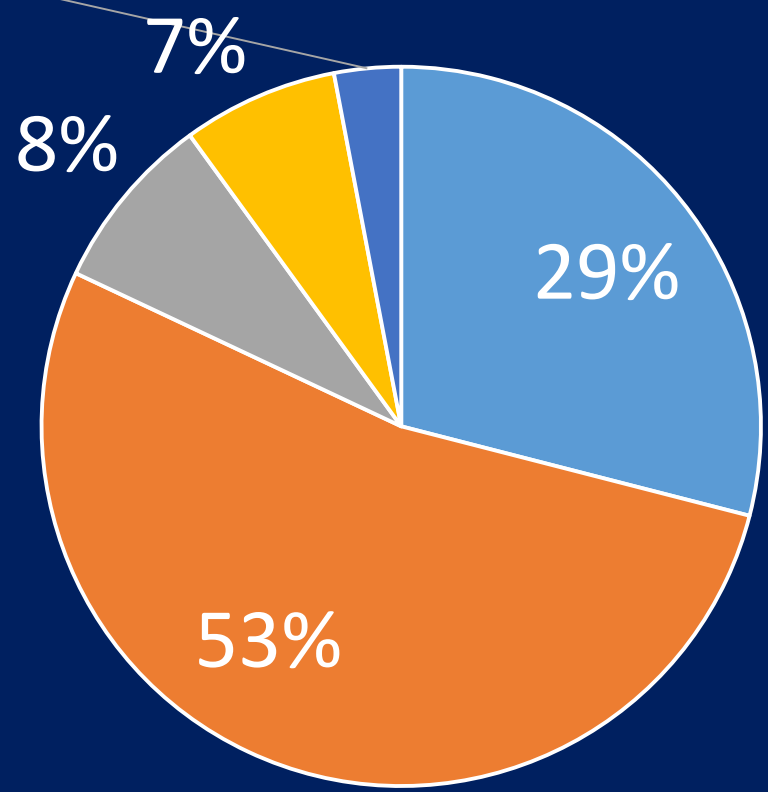
Culture vs Molecular Testing for Osteo

Culture results for Osteomyelitis



■ S. aureus ■ K. kingea ■ Group A Strep ■ other ■ S. pneumonia

Molecular results for Osteomyelitis

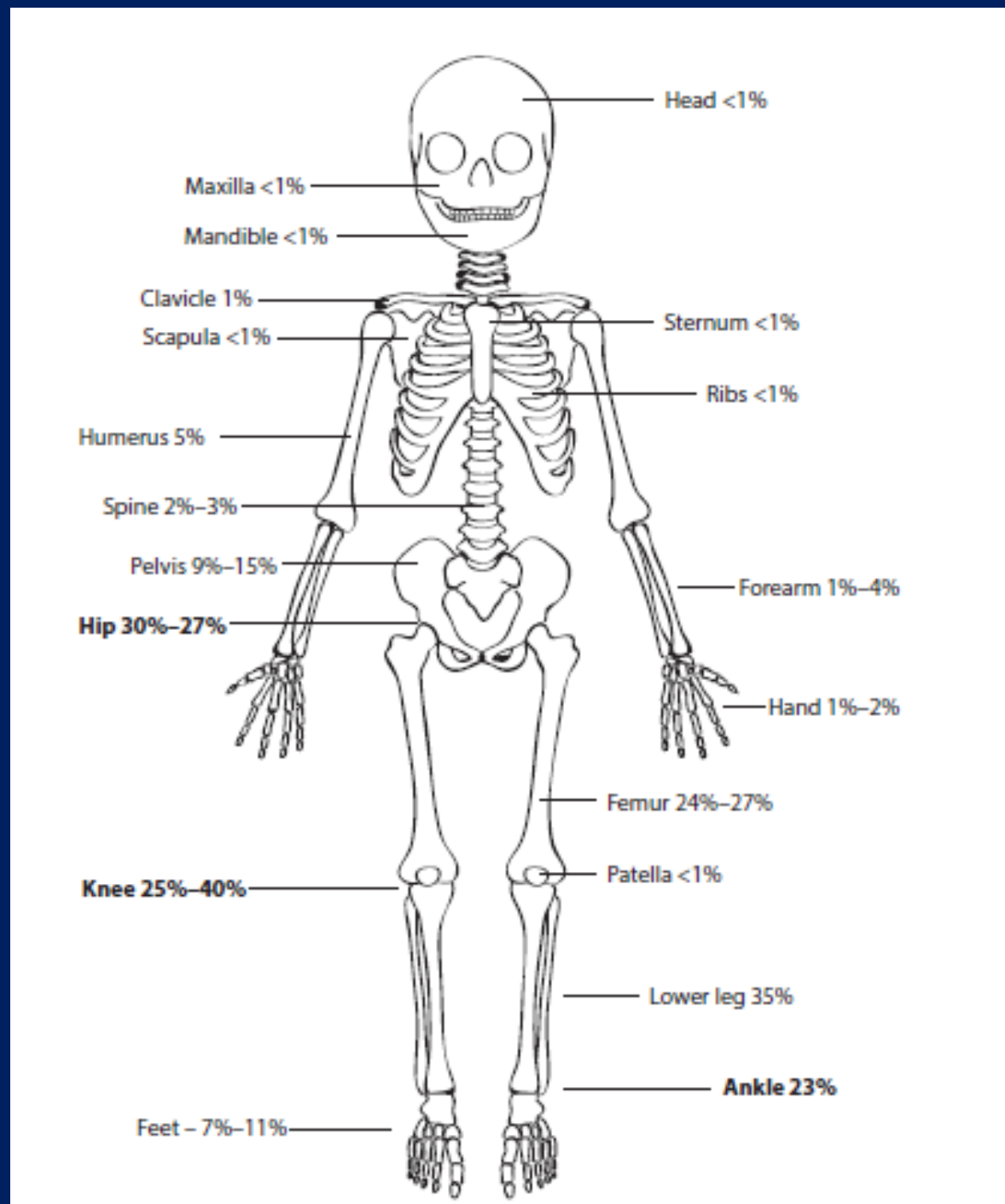


Less Common Causes of Osteo/ septic joint

Table 1
Important aspects of the patient history and associated pathogens or syndromes

Historical Finding	Associated Diagnosis
Travel	
International	Tuberculosis
Western United States	Coccidioidomycosis
Midwest United States	Histoplasmosis
Eastern United States	Lyme arthritis
Hunting/forest	Blastomycosis
Animal exposures	
Cat/kitten scratch	<i>Bartonella henselae</i>
Cat bite	<i>Pasteurella multocida</i>
Cat or livestock birth	<i>Coxiella burnetti</i> (Q-fever)
Reptiles/amphibians	<i>Salmonella</i> spp
Ingestions	
Unpasteurized dairy	Brucellosis Tuberculosis (<i>Mycobacteria tuberculosis</i>)
Not fully immunized	<i>Haemophilus influenza</i> <i>Streptococcus pneumoniae</i>
Sickle cell disease	<i>Salmonella</i> spp
Recent pharyngitis	<i>Streptococcus pyogenes</i> (invasive infection or postinfectious arthritis) <i>Fusobacterium necrophorum</i> (Lemierre disease)
Recent diarrheal illness	Postgastrointestinal infection arthritis (reactive arthritis) <i>Salmonella</i> spp

Distribution of Infected Bones/ Joints



Hematogenous osteomyelitis; evaluation

- History
- Physical Examination
 - Vital signs
 - Evidence of sepsis?
 - Area(s) of tenderness
 - Redness/swelling
- Laboratory
 - CBC
 - ESR
 - CRP
 - Blood culture
 - Bone aspirate/culture
- Imaging
 - X-ray
 - MRI
 - CT
 - Ultrasound

Treatment considerations

- What drug?
- What route?
- How long to treat?

Neonate

- Anti-staph
- Cephalosporin

Young child

- Anti-staph
- Anti-*K. kingae*
- (*change if un-immunized*)

Older child

- Anti-staph

In the old days.....

- MSSA, S. pneumonia, group A strep
 - IV Cefazolin... to oral Keflex or
 - IV Nafcillin ... to oral Dicloxacillin
- Good data that 4 weeks was plenty
- PICC lines weren't available so home IV not easy

Now.....

- Up to 50% of S aureus is MRSA
 - Vanco covers 100% of Staph but doesn't cover Kingella
 - Clinda misses 15-20% of Staph
 - Bactrim covers staph but no data on outcomes
- Does MRSA require longer treatment?
- Doctors have gotten attached to PICC lines. Is IV better than oral?

We are left with 4 major questions

- What empiric antibiotics to use initially?
- What empiric antibiotics to use for switch to outpatient?
- IV or Oral?
- How long to treat?

Antibiotics

- Anti- staph
 - Nafcillin/oxacillin
 - Vancomycin
 - Clindamycin
 - TMP/SMZ
 - Linezolid
 - Minocycline/doxycycline
 - Daptomycin
- 1st, 2nd, or 3rd generation cephalosporin

Prolonged Intravenous Therapy Versus Early Transition to Oral Antimicrobial Therapy for Acute Osteomyelitis in Children

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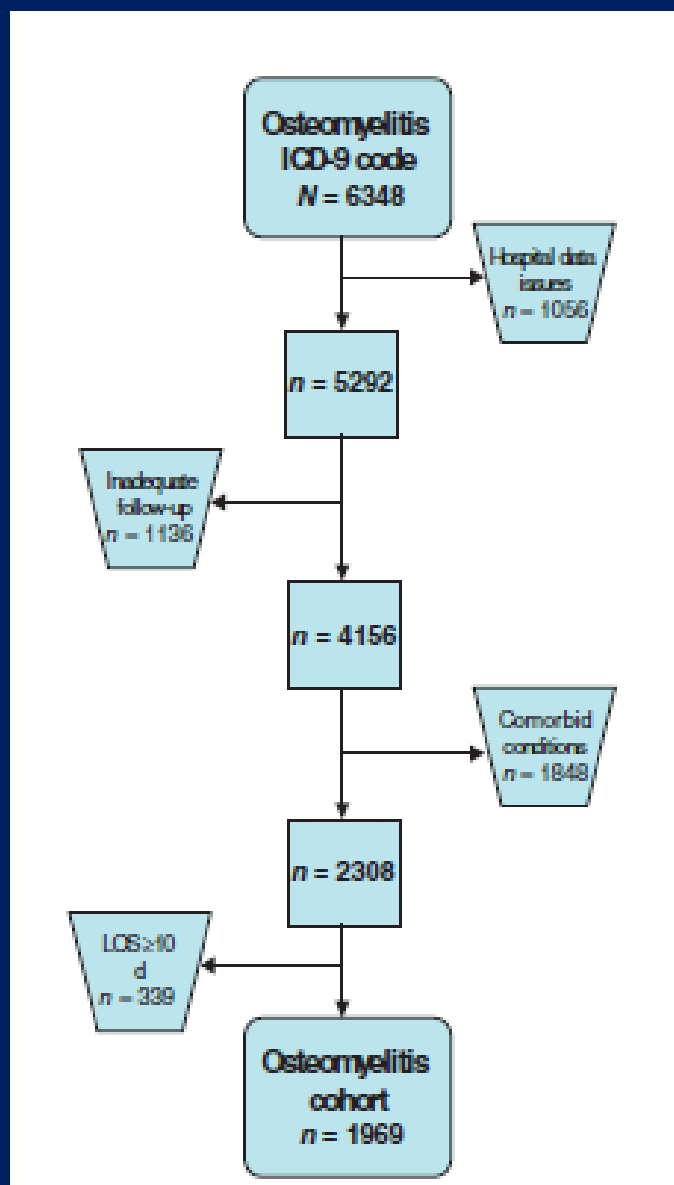


TABLE 1 Demographic and Clinical Characteristics

Characteristics	Intravenous Therapy (N = 1021)	Oral Therapy (N = 948)
Age, n (%)		
0–1 y	86 (8)	77 (8)
1–5 y	343 (34)	322 (34)
>5 y	592 (58)	549 (58)
Length of hospital stay, median (interquartile range), d	5 (3–6)	4 (3–6)
Gender, n (%)		
Male	629 (62)	583 (62)
Race, n (%)		
White	725 (71)	676 (71)
Black	186 (18)	150 (16)
Other	66 (6)	80 (8)
Missing	44 (4)	42 (4)
Site, n (%)		
Shoulder	23 (2)	25 (3)
Upper arm	48 (5)	39 (4)
Forearm	31 (3)	34 (4)
Hand	38 (4)	38 (4)
Pelvic/thigh	315 (31)	287 (30)
Lower leg	247 (24)	245 (26)
Ankle/foot	182 (18)	178 (19)
Multiple sites	25 (2)	25 (3)
Unspecified	112 (11)	77 (8)
Organism, n (%) ^a		
Group A streptococcus	35 (3)	34 (4)
Streptococci, other	11 (1)	15 (2)
<i>S aureus</i>	351 (34)	291 (31)
Staphylococcus, other	51 (5)	33 (3)
Methicillin-resistant <i>S aureus</i>	83 (8)	62 (7)
<i>Escherichia coli</i>	2 (<1)	2 (<1)
Pneumococcus	12 (1)	9 (1)
Other Gram-negative organisms	9 (1)	5 (1)
>1 organism	89 (9)	73 (8)
Surgical procedure	377 (37)	314 (33)
Parental antibiotics received, n (%)		
Cefazolin	603 (59)	508 (54)
Oxacillin/nafcillin	345 (34)	243 (26)
Vancomycin	188 (18)	83 (9)
Clindamycin	309 (30)	321 (34)
Trimethoprim-sulfamethoxazole	5 (<1)	6 (1)
Linezolid	2 (<1)	2 (<1)
Other ^b	355 (35)	216 (23)
Case mix Index, median (interquartile range) ^c	1.67 (1.67–1.67)	1.67 (1.67–1.67)

Transition to oral therapy by institution and treatment outcomes

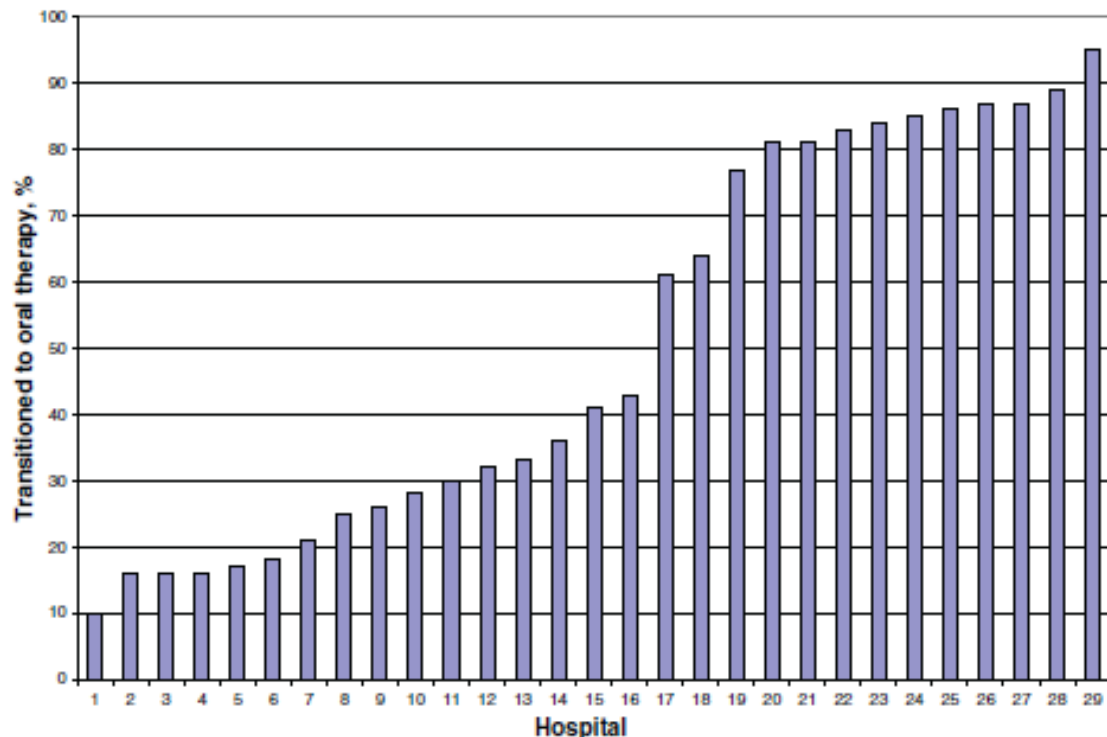


TABLE 2 Treatment Outcomes of Acute Osteomyelitis

Outcome	Intravenous Therapy (<i>N</i> = 1021), <i>n</i> (%)	Oral Therapy (<i>N</i> = 948), <i>n</i> (%)	Propensity Score-Adjusted OR (95% CI) for Those Children Treated With Early Transition to Oral Therapy
Primary outcome			
Treatment failure within 6 mo of diagnosis	54 (5)	38 (4)	0.77 (0.49–1.22)
Chronic osteomyelitis	13 (1.3)	8 (0.8)	0.84 (0.33–2.13)
Musculoskeletal surgery	18 (1.8)	15 (1.6)	0.80 (0.38–1.70)
Complication of osteomyelitis ^a	11 (1.1)	6 (0.6)	0.75 (0.27–2.07)
Acute osteomyelitis as sole readmission diagnosis	12 (1.2)	9 (0.9)	0.72 (0.25–2.08)
Secondary outcomes			
Any rehospitalization within 6 mo of diagnosis	102 (10)	56 (5.9)	0.6 (0.38–0.96)
Catheter-associated complication	35 (3)	0 (0)	—
Adverse effect of antimicrobial agents ^b	15 (1.5)	4 (0.4)	0.39 (0.14–1.1)

Analysis used the complete cohort. — indicates no data.

^a Data include synovitis, pyogenic arthritis, sacroiliitis, disorders of bone and cartilage not otherwise specified, and disc disorder.

^b Data include adverse drug reactions associated with antibiotics, *C. difficile* infection, or agranulocytosis.

Oral therapy

- Use high doses
- Emphasize adherence
- Careful follow-up
- Significant data that change to oral can occur early (3 days) when there is significant evidence of clinical improvement
- Total duration of therapy of 4 weeks is adequate

We are left with 4 major questions

- What empiric antibiotics to use initially?
 - Depends on age and how ill the child is
- What empiric antibiotics to use for switch to outpatient?
 - Probably clindamycin
- IV or Oral?
 - Oral
- How long to treat?
 - 4 weeks unless slow response to therapy or very extensive disease or MRSA, then would consider 6 weeks.

A coordinated,
protocol-driven
approach
probably works
best

- After review of past experience, investigators initiated standard diagnosis and treatment protocol for all suspected bone and joint infections.
- Included: labs, blood culture, rapid schedule MRI, with bone aspiration while still sedated.
- Team rounding
- Standard follow up

TABLE III Demographic, Imaging, Antibiotic, Surgery, and Hospitalization Differences Between Cohorts

Differences	Group I (N = 210)	Group II (N = 61)	P Value*
Demographic			
Age at the time of hospitalization†‡ (yr)			0.76
Birth to three years	70 (33.3%)	23 (37.7%)	
Four to twelve years	110 (52.4%)	29 (47.5%)	
Thirteen to eighteen years	30 (14.3%)	9 (14.8%)	
Sex†			0.37
Male	129 (61.4%)	33 (54.1%)	
Female	81 (38.6%)	28 (45.9%)	

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J of Bone and Joint
Surgery 2013

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TABLE III Demographic, Imaging, Antibiotic, Surgery, and Hospitalization Differences Between Cohorts

Differences	Group I (N = 210)	Group II (N = 61)	P Value*
Imaging			
No. of MRIs per child	1.01	1.33	0.04
MRI delay after admission§	2.47	1.04	0.0002
Antibiotic			
Empiric antibiotic frequency†			
Clindamycin	27 (12.9%)	52 (85.2%)	0.0001
Cefazolin	89 (42.4%)	0 (0.0%)	0.001
Vancomycin	25 (11.9%)	6 (9.8%)	0.58
Other	69 (32.9%)	3 (4.9%)	0.02
Antibiotic changes per child			
Mean duration of intravenous antibiotic use§	19.3	13.5	0.11
Mean duration of oral antibiotic use§	27.7	43.7	0.0004
Total duration of antibiotic use§	41.9	54.9	0.04
Surgical			
No. of surgeries per child	1	1.1	0.54
Hospital			
Length of initial stay§	10.75	9.25	0.22
Readmission frequency†	24 (11.4%)	4 (6.6%)	0.34
Total length of stay§ (including readmission)	12.8	9.7	0.054

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Septic joint

- Almost everything said about osteo applies to joints but:
- *H. influenza* was an important pathogen so think of it if unimmunized; in teenagers, consider *N. gonorrhoeae*
- *Kingella kingae* hard to culture from joint fluid. Should inoculate blood culture bottles or perform PCR
- Septic hip is surgical emergency; ask surgeon to drain immediately
- Antibiotics concentrate in joint fluid- no reason to instill antibiotics into joint
- Generally can treat for total (IV+ PO) 3 weeks

Special cases

- Step on nail “osteo”
- Pelvic osteo
- TB osteo- if exposure history or poor response to therapy, culture for TB
- Premies and neonates

My suggestions

- PIDS and IDSA Guidelines slated to come out in 2018- suggest review
- In the meantime
 - If possibly septic- Vancomycin AND 3rd generation cephalosporin and look very hard for one or more focus to drain. Drainage of primary focus critical.
 - If not toxic, would start with clindamycin IV. If response is good, you know your oral switch drug.
 - Always get blood culture prior to antibiotics.
 - Always push ortho to aspirate bone or joint to try to get a bug.
 - I almost always go to oral and I switch as soon as “clearly getting better”; this is obviously easier if I am sure of my oral switch drug.
 - If using beta-lactam, monitor CBC weekly for neutropenia.
 - If using oral beta-lactam, use high dose (100-150 mg/kg/day).
 - Careful follow up.