Results. Seven patients were identified; all had sickle cell disease and five had moderate to severe asthma requiring controller medications. They presented to the emergency department with mild respiratory illness with fevers, but had hemodynamic stability. Peripheral blood cultures were obtained and intravenous ceftriaxone was administered as the empiric antibiotic therapy. Six patients were discharged home after evaluation, and one patient was admitted for treatment for acute chest syndrome with venoocclusive crisis (see figure). When the blood cultures grew *B. holmesii*, previously discharged patients were called back for follow-up; three were admitted, and only one patient had a subsequent blood culture growing *B. holmesii*. Hospitalization days ranged from 3 to 5 days, and two patients went home with oral ciprofloxacin at the time of discharge. Total antibiotic days ranged from 1 to 15 days among the seven patients. No one required an intensive level care, and all were asymptomatic without recurrence of *B. holmesii* infections at the post-discharge follow-up.

Conclusion. In our pediatric patients with *B. holmesii* bacteremia, clinical recovery was favorable with no severe illness, despite widely different treatment regimens and length of therapy. The questions still remain regarding pathogenicity of *B. holmesii* infection and efficacy of antibiotic use.

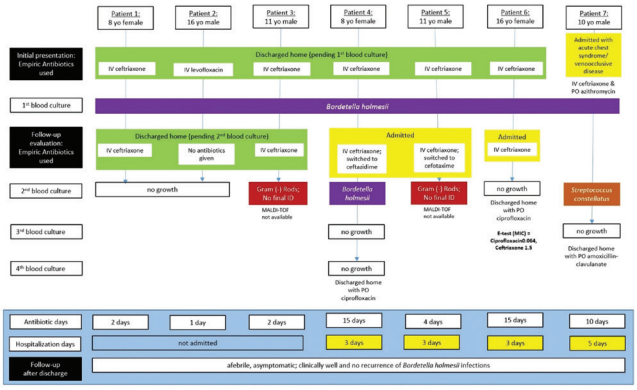

Figure. Summary of treatment course and follow-up for the patients with *Bordetella holmesii*

Disclosures. **All authors:** No reported disclosures.

2313. Risk of Relapsed or Persistent Infection Caused by Enterobacter Species in Children

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Background. *Enterobacter* species are a major cause of infections in hospitalized children. Treatment is complicated by the presence of a chromosomal AmpC β-lactamase, capable of inactivating certain antibiotics, including third-generation cephalosporins (3GC). Previous studies in adults have reported a 3–19% risk of relapsed bacteremia with 3GC therapy. Data in children regarding risk factors predicting relapse or persistence of infection are lacking. We sought to determine the frequency of and risk factors for relapse or persistence of *Enterobacter* infection in children.

Methods. Retrospective study of patients <21 years old admitted to Texas Children's Hospital during 2012, 2015 and 2016 with bacteremia due to *Enterobacter* species. Risk factors for relapse or persistence of bacteremia 72 hours and up to 30 days after initial positive blood culture were evaluated; relapsed infection at secondary sites also was evaluated.

Results. 58 individual patients with bacteremia due to *Enterobacter* species were identified; most (58%) were immunosuppressed and 19 (32.8%) were critically ill. The majority (75.9%) had primary bacteremia; 82.8% had a central line. An intra-abdominal source was identified in 6 (10.3%) patients. Seventeen (29.3%) patients had initial *Enterobacter* isolates resistant to 3GCs. Of the 41 patients with 3GC-susceptible isolates, 5 (12.2%) had relapse or persistence of infection; 2 of these developed relapse with an isolate resistant to 3GCs. Among the relapsed cases, those who developed resistant isolates had uncontrolled intra-abdominal or biliary sources of infection. Treatment with a 3GC was not associated with increased risk of relapse or persistence of infection (OR 2.1; 95% CI, 0.3–14.2, $P = 0.45$). Source control was inadequate in all cases of relapsed bacteremia. Relapsed cases with primary bacteremia cleared their bacteremia with central line removal. One patient with relapsed infection died.

Conclusion. The incidence of relapsed or persistent *Enterobacter* infection after initial bacteremia is comparable to previous adult studies. However, treatment of 3GC-susceptible isolates with 3GCs did not result in higher rates of treatment failure. Source control is important in preventing relapse or persistence of infection.

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2314. Invasive *Haemophilus influenzae* Infections in Children: A 10-Year Study

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Background. The rate of *Haemophilus influenzae* type b (HIB) infections has decreased dramatically since the use of HIB vaccines in infants and children. The current prevalence of invasive HIB infections and those due to non-type b *H. influenzae* is not fully known. The objective was to describe the cases of all invasive *H. influenzae* infections and describe the spectrum and severity of clinical disease.

Methods. Retrospective study of all hospitalized patients with culture-proven invasive *Haemophilus influenzae* infections at Nationwide Children's Hospital, Columbus, Ohio, from 2009 to 2018. The electronic health records were reviewed for pertinent demographic, clinical, laboratory data, and outcomes.

Results. There were a total of 59 culture-proven *H. influenzae* infections of which 12 were excluded due to insufficient patient data. The remaining 47 patients (32 [68%] male; 30 [64%] white, 8 [17%] African-American) and their culture results are provided in Table:

Haemophilus influenzae Infections in 47 Patients: Culture Results

	Type a $N = 1$ (%)	Type b $N = 3$(%)	Encapsulated non-b $N = 11$(%)	Not typeable $N = 30$(%)	Not typed $N = 2$(%)	Total $N = 47$(%)
<6 months	0	0	0	7(23)	1(50)	8(17)
≥6–12 months	1(100)	2(67)	7(64)	7(23)	0	17(36)
>1–5 years	0	1(33)	4(36)	6(20)	1(50)	12(25)
>5–8 years	0	0	0	8(26)	0	8(17)
>8–17 years	0	0	0	0	0	0
≥18 years	0	0	0	2(6)	0	2(4)
Blood only	1(100)	1(33)	4(36)	27(90)	2(100)	35(75)
CSF only	0	1(33)	0	0	0	1(2)
Both Blood and CSF	0	1(33)	5(45)	0	0	6(13)
Both CSF and Peritoneal Fluid	0	0	0	1(3)	0	1(2)
Both Blood and Synovial Fluid	0	0	2(18)	0	0	2(4)
Both Blood and Eye Discharge	0	0	0	2(6)	0	2(4)
Virus Coinfection	1(100)	3(100)	3(27)	14(46)	1(50)	22(47)
Bacteria Coinfection	0	1(33)	0	5(16)	2(100)	8(17)
Death	0	0	0	1(3)	0	1(2)

There were 14 (30%) patients with pneumonia and bacteremia, 6 (13%) with meningitis and bacteremia, 2 (4%) with only meningitis, 1 (2%) with bacteremia/meningitis and septic hip, 2 (4%) septic arthritis with bacteremia, 1 (2%) with periorbital cellulitis and bacteremia, and 21 (45%) with only bacteremia. Of the 3 cases of *H. influenzae* type b, 2 had not been vaccinated while 1 received only 1 dose of HIB vaccine.

Conclusion. Invasive *H. influenzae* infections were associated with substantial morbidity and a 2% case-fatality rate.

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2315. *Neisseria meningitidis* Oro-Pharyngeal Carriage, Serogroups and Clonal Complex in Children and Adolescents in Argentina

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Background. *Neisseria meningitidis* (Nm) pharyngeal carriage is a necessary condition for invasive meningococcal disease. In 2017, Argentina introduced a tetravalent meningococcal conjugated vaccine (MenACYW) to the National Immunization Program for children. We present the first carriage study in children in the prevaccine era. Aims: 1) to assess the rate of Nm carriage in healthy children and adolescents attending a public hospital in Buenos Aires city; 2) to determine serogroup and clonal complex distribution; 3)to determine carriage risk factors by age.

Methods. Cross-sectional study including children 1–17 years, stratified in two age groups (1–9 years and 10–17 years) assisted at Ricardo Gutiérrez Children Hospital between March-December 2017. Oro-pharyngeal swabs were plated and meningococci identified by conventional microbiology methods. Serogroup was determined by PCR. Clonal complex was determined by MLST.

Results. A total of 1751 children were included. Group aged 1–9 years: 38 Nm were isolated from 943 samples collected: overall carriage 4.0%. Serogroups distribution: B 26.3%, Y 2.6%, W 5.3%, Z 5.3%, non-groupable 7.9% and non-capsulated 52.6%. Clonal complex was determined for 25 isolates. Attendance at social venues was the only independent predictor of Nm carriage (adjusted OR: 2.02, CI 95% = 1.01–4.03; $P = 0.04$). Group aged 10–17 years: 76 Nm were isolated from 808 samples: overall carriage 9.4%. Serogroups distribution: B 19.7%, C 5.3%, W 7.9%, Y 9.2%, Z 5.3%,

non-groupable 7.9% and non-capsulated 44.7%. Clonal complex was determined for 58 isolates. Independent predictor of Nm carriage: attendance at night clubs (adjusted OR: 3.38, CI95% = 1.28–8.93; $P = 0.013$); passive smoking at home (adjusted OR: 0.55, CI 95% = 0.32–0.93; $P = 0.025$). Preliminary data show a total of 10 different clonal complexes present among all serogroups in the 1–9 years group aged and 13 in 10–17 years.

Conclusion. Overall carriage was higher in the 10–17 years population. The non-encapsulated Nm was prevalent in both groups and serogroup B was the most frequent among the encapsulated. The results demonstrated a high diversity of *N. meningitis* in pharyngeal carriage.

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2316. The Frequency of Multifocal Disease and Pyogenic Hip Arthritis in Neonates With Osteomyelitis

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Background. Osteomyelitis and septic arthritis are important infections in neonates in intensive care units. The literature on neonatal osteoarticular infections during the past twenty years, a period during which there was an emergence of community-associated methicillin-resistant *Staphylococcus aureus* (MRSA), is limited. The purpose of this study was to describe a case series of neonatal osteoarticular infections during recent decades. In particular, we sought to describe the current microbiology, prevalence of multi-bone and contiguous joint involvement, and proportion of cases with pyogenic arthritis of the hip.

Methods. Multi-center retrospective chart review. Cases were identified through NICU registries at 2 tertiary/quaternary children hospitals between 1993 and 2017. The diagnosis required suggestive clinical findings plus radiological findings or positive blood, joint fluid, or bone culture.

Results. Thirty cases were identified. The median gestational age was 28 weeks, with 24 (80%) cases occurring in premature babies. The median age at time of diagnosis was 33.5 days (range, 11–175) days.

The most common localized clinical findings were erythema (66%) and swelling (60%); the most common systemic finding was apnea (53%). Seventy percent had osteomyelitis, 27% had both bone and joint involvement, and one had septic arthritis only. Eight babies (27%) had an infection in more than one noncontiguous site. The most commonly identified bone was the femur (41%) and joint was the knee (20%) followed by hip (17%). Of the 5 babies with hip infection, two were recognized more than 48 hours after initial presentation. An ultrasound of the hip was performed on 12 babies (40%), including 4 out of the 5 who had surgical drainage of the hip.

Cultures of blood, joint fluid, and bone were positive in 23, 6, and 2 babies, respectively. Methicillin-susceptible *S. aureus* (71%) was the most common pathogen followed by MRSA (21%).

Conclusion. Neonates in a NICU with osteoarticular infection frequently have multiple sites of involvement. The hip joint is infected in a sizeable minority of babies with osteoarticular infection. In view of the importance of early diagnosis and surgical drainage of pyogenic hip arthritis, ultrasound of the hips should be considered in neonates in a NICU with osteoarticular infection at any body site.

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2317. Multicenter Retrospective Cohort Study of Pediatric Osteomyelitis

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Background. There is controversy about the appropriate management of acute osteomyelitis in children.

Methods. Retrospective cohort study of presentation, management and outcomes of all patients admitted with acute osteomyelitis (<2 weeks duration) during 2010–2016 at 4 US and Canadian tertiary care hospitals (hosp). Long-term complications (LTC) were defined as amputation, limp, chronic or secondary infection, or readmission. Overall complications included LTC, admission to ICU and delayed surgery (>72 hours).

Results. 712 patients were admitted, with a median age of 8.0 years. There were significant differences in rates of initial use of MRI for diagnosis, MRSA, PICC insertion, hosp stay and IV antibiotic duration (Table 1). Clindamycin (45.7%), cefazolin (24.1%) and vancomycin (13.7%) were the most common IV antibiotics used while clindamycin (47.1%) and cephalexin (38.6%) predominated for oral. The median age of patients with MRSA was similar to those without MRSA (8.2 vs. 7.8 years, $P = 0.18$), but MSSA patients were older (9.6 vs. 6.9 years, $P < 0.0001$). Contiguous septic arthritis was more common in younger children (6.8 vs. 8.5 years, $P < 0.001$). MRSA patients had higher overall complication rates (25.2% vs. 10.0%, $P < 0.0001$), but long-term complications were unrelated to duration of IV or total antibiotics.

Table 1: Summary Results of Multi-center Study of Pediatric Osteomyelitis

	Children's Hosp. of Omaha	Children's Mercy, Kansas City	Norton Children's	Children's Hosp. of Eastern Ontario	*P*-value
No. of patients enrolled	137	398	127	46	–
M: F ratio (%)	58.7:41.2	64.8:35.1	51.5:48.4	69.5:30.4	0.02
Median age (years)	7.6	7.6	8.2	8.6	0.32
% of all initial imaging MRI	38.1%	89.8%	45.9%	20.4%	<0.0001
% Abnormal, all initial imaging	75.8	87.4	80.0	68.8	<0.001
MSSA rates (%)	40.3	46.0	45.0	50.0	<0.19
MRSA rates (%)	10.7	17.1	23.0	0	<0.0001
Median hospital stay (days)	4.0	4.0	4.0	6.0	<0.0001
Median days of IV antibiotics	18.0	4.0	3.0	9.5	<0.0001
Median days of total antibiotics	42.0	34.0	33.0	41.5	<0.0001
Frequency of PICC insertion	67.7%	8.5%	8.7%	45.8%	<0.0001
Long-term complications	6.1%	4.3%	7.1%	10.5%	0.18

Conclusion. Despite significant variation in management, long-term complication rates were similar across US and Canadian sites with different MRSA rates. These data support equivalence of shorter (≤ 4 days) duration of IV antibiotics and reduced need for PICC insertion for pediatric osteomyelitis.

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2318. Comparison of Musculoskeletal Infections Due to Non-Typhoidal Salmonella Species and *Staphylococcus aureus* in Immunocompetent Children

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Background. Non-typhoidal Salmonella species (NTS) rarely cause musculoskeletal (MSK) infections in healthy children. Data on clinical presentation and outcomes of NTS MSK infections is limited to case reports and case series. No previous studies have directly compared children with NTS MSK infections to children with MSK infections due to *Staphylococcus aureus* (SA), the most common cause of MSK infections in children.

Methods. In a retrospective case–control study children aged 1 month to 18 years seen at Texas Children's Hospital from 2010 to 2017 with NTS MSK infections were compared with patients with SA MSK infections. Date of infection matched controls were selected 3:1. Patients with known hemoglobinopathies, immunodeficiencies or infections due to penetrating trauma or related to prosthetic devices were excluded. Logistic regression was used to evaluate associations between historical, clinical and laboratory variables and NTS or SA MSK infection.

Results. From 2010 to 2017, 27 cases of NST MSK infections were identified, 12 of which occurred in healthy children. The control group had 37 patients. The case and control groups had similar baseline demographics. Predictors of NTS MSK infection included exposure to reptiles (odds ratio [OR], 6.86; 95% confidence interval [CI], 1.03–45.60) and a history of preceding diarrhea (OR, 7.25; 95% CI, 1.12–47). No presenting signs or laboratory markers were identified as predictors of NTS MSK infection. Blood cultures were positive in 8 (66.7%) of the NTS MSK cases. Length of hospital stay, duration of fever or complications did not differ significantly between the two groups and children with NTS MSK infections had a low rate of complications (16.7%). Six (50%) patients with NTS infections had unremarkable evaluations for hemoglobinopathies and immunodeficiencies.

Conclusion. Healthy children with NTS MSK infections often report a history of reptile exposure and preceding diarrhea compared with children with MSK infections due to SA. If such history is obtained, addition of a third-generation cephalosporin to empirically cover for NST should be considered pending blood and tissue cultures. In contrast to previous case reports and case series, children with NTS MSK infections had a lower rate of complications.

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