to children with asthma, we tested the hypothesis that mammalian pets could harbor respiratory pathogens of relevance to disease exacerbation among inner-city children with asthma.

Methods. We tested nasal and pharyngeal biospecimens from subset of 5–17 years old primarily African-American children with asthma enrolled in an ongoing cohort (ECATCh, NCT02251379) prior to trial randomization. At a home visit within three weeks prior to the clinic visit at which children were swabbed, mammalian pets whose owners consented to participate were sampled at nares, mouth, and perineum, depending on animal access and temperament. Aliquots (400 µL) of medium from Copan e-swabs from children and mammalian pets were cultured for multiple respiratory pathogens at the clinical microbiology laboratory at Johns Hopkins Hospital.

Results. We evaluated 95 children with asthma and 60 mammalian pets at the baseline clinic and home visits, respectively. In children, carriage of respiratory pathogens was: *Staphylococcus aureus*, 36.8%; *Moraxella catarrhalis*, 8.4%; Group A Strep, 7.4%; *Streptococcus pneumoniae*, 1%. In mammalian pets, carriage of respiratory pathogens was: *Moraxella catarrhalis*, 11.7% (1 dog, 6 cats where 5 of the cats were in the same household); *Streptococcus pneumoniae*, 1.7% (1 dog). In the home where the dog carried *Moraxella catarrhalis* (perineum site), the child also carried *Moraxella catarrhalis* (nares site). Children with dogs had 8-fold higher odds of detection of *Moraxella catarrhalis* (95% Confidence Interval: 1.4, 46.9, $P = 0.02$), controlling for other pet ownership and demographic variables. Dogs had higher contact with child participants than cats (contact score higher by 0.7 points on average, $P < 0.05$).

Conclusion. Mammalian pets may harbor respiratory pathogens, including *Moraxella catarrhalis*. Future studies are needed to determine the direction of transmission and whether mammalian pets can serve as a vehicle or reservoir of pathogens of relevance to respiratory disease in children.

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2332. Higher Pediatric Vancomycin Dosing Trends Toward Improved Therapeutic Troughs

August Boeglin, MD[1]; Len Yonemura, PharmD[2]; Marian Melish, MD[3] and Natascha Ching, MD[3]; [1]Hawaii Pediatric Residency Program, Honolulu, Hawaii, [2]Kapiolani Medical Center for Women and Children, Honolulu, Hawaii, [3]University of Hawaii John A. Burns School of Medicine, Honolulu, Hawaii

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Background. Vancomycin is challenging to dose due to a narrow therapeutic index. Inadequate dosing undertreats dangerous infections, while high doses can cause Acute Kidney Injury (AKI). Standard pediatric vancomycin dosing (40–60 mg/kg/day) often produces inadequate troughs. Our institution began permitting a higher initial vancomycin dose: 80 mg/kg/day for children 1 month to 12 years old, and 60 mg/kg/day for children ≥ 13 years old. This study aims to determine whether higher dosing has increased the rate of therapeutic troughs or the rate of AKI.

Methods. A retrospective review was conducted of patients < 18 years of age who were admitted to our institution and received vancomycin. 842 unique courses of vancomycin were identified and age, sex, race, vancomycin dosing, trough results, and creatinine data were abstracted. 450 records were excluded based on criteria of age < 1 month, pre-existing renal failure, or no measured troughs. 392 unique vancomycin courses for 340 unique patients were analyzed. Therapeutic troughs were defined as 10–20 µg/mL. Statistical analysis was performed using Chi-square test, Fisher's exact test, and unpaired t-test.

Results.

	Pre-Intervention	Post-Intervention	Change	*P*-value
Ages 1 month to 12 years				
Mean initial dose (mg/kg/day)	62.6	73.2	10.6	<0.001
Initial trough therapeutic	32.7%	41.1%	8.4%	0.31
Initial trough subtherapeutic	63.0%	55.5%	−7.5%	
Initial trough supratherapeutic	4.3%	3.4%	−0.9%	
AKI rate	20.9%	8.1%	−12.8%	0.013
Ages ≥ 13 years				
Mean initial dose (mg/kg/day)	56.3	54.9	−1.4	0.51
Initial trough therapeutic	40.9%	32.5%	−8.4%	0.50
Initial trough subtherapeutic	59.1%	67.5%	8.4%	
Initial trough supratherapeutic	0.0%	0.0%	0.0%	
AKI rate	22.6%	12.0%	−10.6%	0.30

Younger patients with higher vancomycin dosing attained an initial therapeutic trough in 41.1% vs. 32.7%.

Conclusion. A higher initial vancomycin dose trended toward an improved rate of therapeutic troughs in children 1 month to 12 years old. There was no evidence of increase in the rate of AKI or supratherapeutic troughs. While vancomycin dosing remains challenging, a policy permitting higher initial dosing may more adequately treat dangerous infections without risking adverse effects. Further study of higher vancomycin dosing is warranted.

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2333. Practice of Endotracheal Tube Suction Catheter Flushes With Polymyxin in Extremely Low Birthweight Neonates

Michael Edzards, MD[1]; Sudeepta Basu, MD[2]; Marni Jacobs, PhD[3] and Rana Hamdy, MD, MPH, MSCE[4]; [1]Infectious Diseases, Children's National Medical Center, Washington, DC, [2]Neonatology, Children's National Medical Center, Washington, DC, [3]Biostatistics and Study Epidemiology, Children's National Medical Center, Washington, DC, [4]Infectious Diseases, Children's National Medical Center, Washington DC

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Background. Aerosolized or powdered forms of polymyxin have been used as prophylaxis for ventilator associated infections in adults. In 2015, Children's National Medical Center neonatal intensive care unit (NICU) protocol recommended that neonates <1,000 g receive polymyxin endotracheal tube suction catheter flushes with the goal to reduce acquired respiratory infection. The objective of this study was to describe the clinical characteristics and outcomes of patients who received polymyxin endotracheal tube flushes compared with those who received saline.

Methods. A retrospective cohort study of infants weighing <1,000 g ventilated for >48 hours in the NICU, January 1, 2015–June 30, 2016 was performed. Data were collected from an internal NICU database, medication billing data, and through chart review of the electronic health record. Demographics, antibiotic treatment days, ventilator days, length of stay, mortality, and microbiologic culture data were compared between patients receiving polymyxin and saline using chi-squared for binary and t-test for continuous variables.

Results. Of the 71 patients included, 38 received polymyxin and 33 received saline. Mean gestational age at birth was 24.1 weeks (23.9 polymyxin vs. 24.2 saline, $P = 0.06$); median age on admission 4 days (3 vs 12, $P = 0.019$); median admission weight 700 g (640 vs. 800, $P = 0.002$); 52% were male (58% vs. 45% group). Median antibiotic days was 52 (77 vs. 41, $P = 0.056$), median ventilator days 39 (43.5 vs. 33, $P = 0.06$). Pathogenic bacteria was cultured in 38% of patients in whom at least one lower respiratory tract (LRT) culture was obtained (62.5% vs. 38.1% $P = 0.24$). Pathogenic bacteria resistant to at least one antibiotic class to which is normally susceptible was found in 10% (13% vs. 6%, $P = 0.32$). No differences were seen in mortality (16% vs. 15%, $P = 0.94$) or median length of stay (101 vs. 92, $P = 0.41$).

Conclusion. An NICU protocol recommending prophylactic polymyxin use for ELBW infants was implemented more frequently in younger and more premature neonates. Mortality and length of stay did not differ among babies who received polymyxin. Patients who received polymyxin did not grow a statistically significant higher proportion of pathogenic or resistant bacteria from LRT cultures compared with those receiving saline.

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2334. Risk Factors of Multidrug-Resistant Gram-Negative Bacterial Bloodstream Infections in Children's Hospitals in Japan

Yuta Aizawa, MD, PhD[1]; Takayo Shoji, MD[2]; Kenta Ito, MD[3]; Masashi Kasai, MD[4]; Hiroki Sakurai, MD[5]; Etsushi Toyofuku, MD[6]; Kisei Minami, MD[7]; Tadashi Hoshino, MD, PhD[8] and Yuho Horikoshi, MD[1]; [1]Infectious Diseases, Tokyo Metropolitan Children's Medical Center, Tokyo, Japan, [2]Infectious Diseases, Shizuoka Children's Hospital, Shizuoka, Japan, [3]General Pediatrics, Aichi Children's Health and Medical Center, Nagoya, Japan, [4]Department of Infectious Disease Medicine, Hyogo Prefectural Kobe Children's Hospital, Hyogo, Japan, [5]Department of Rheumatics and Infectious Disease, Miyagi Children's Hospital, Miyagi, Japan, [6]Department of Infectious Disease and Immunology, Kanagawa Children's Medical Center, Kanagawa, Japan, [7]Department of General Pediatrics, Nagano Children's Hospital, Nagano, Japan, [8]Division of Infectious Diseases, Chiba Children's Hospital, Chiba, Japan

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Background. Although multidrug-resistant (MDR) Gram-negative bacilli (GNB) are a serious and growing concern worldwide, the epidemiological data on children are still limited. Our aim was to evaluate the risk factors for MDR GNB bloodstream infections (BSI) in children.

Methods. Patients with GNB BSI were enrolled between April 2010 and March 2017 at eight children's hospitals in Japan. Clinical and microbiological data were collected retrospectively. The 2012 criteria of the Centers for Disease Control and Prevention were used to define MDR. MDR and non-MDR GNB BSI were then compared in terms of risk factors.

Results. In total, 629 GNB BSI cases were identified. The median age and proportion of males was 2 years (IQR 0.3–8.7) and 50.7%, respectively. Underlying diseases were found in 94% of the patients. The proportion of GNB BSI cases developing after >48 hours from admission was 76.2%. The most common GNB was *Escherichia coli* (29.3%, 184/629), followed by *Klebsiella pneumoniae* (19.7%, 124/629) and *Pseudomonas aeruginosa* (16.4%, 103/629). MDR comprised 24.5% (154/629) of cases. The MDR rate for *E. coli*, *K. pneumoniae*, and *P. aeruginosa* was 44.0% (81/184), 23.4% (29/124), and 16.5% (17/103), respectively. The coverage rate of the initial empiric therapy for the MDR and non-MDR GNB BSI cases was 60.4% and 83.4%, respectively ($P < 0.001$). The all-cause mortality rate at 28 days of GNB BSI was 10.7% (67/629), 13.6% (21/154), and 9.7% (46/475) for MDR- and non-MDR GNB BSI, respectively ($P = 0.167$). The all-cause mortality rate at 28 days was 10.4% (14/135) and 7.7% (27/351) for MDR and non-MDR *Enterobacteriaceae* BSI ($P = 0.341$) and 41.2% (7/17) and 18.6% (16/86) for MDR- and non-MDR *P. aeruginosa* BSI, respectively ($P = 0.056$). Multivariate logistic regression analysis showed that MDR GNB BSI was

independently associated with anticarcinogenic drug use within 30 days (OR: 43.90; 95% CI: 4.69–411.08), older age (OR: 1.05; 95% CI: 1.02–1.09), and admission to the neonatology ward (OR 0.019; 95% CI: 0.005–0.076).

Conclusion. One-fourth of GNB BSI cases were MDR. Anticarcinogenic drug use and older age were risk factors for MDR GNB BSI in children's hospitals. MDR *P. aeruginosa* infections were associated with higher all-cause mortality.

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2335. *Acinetobacter baumannii* Infection—Clinical Profile, Drug Resistance, and Presence of Virulence Factor *AdeRS*: Experience From a Pediatric Tertiary Care Centre in North India

Prerna Khurana, MD[1]; Karnika Saigal, MD[1]; Arnab Ghosh, MD[1]; Dhulika Dhingra, MD[2]; Mamta Jajoo, MD[2] and Anup Mohta, MS Mch[3]; [1]Microbiology, Chacha Nehru Bal Chikitsalaya, Delhi, India, [2]Pediatrics, Chacha Nehru Bal Chikitsalaya, Delhi, India, [3]Pediatric Surgery, Chacha Nehru Bal Chikitsalaya, Delhi, India

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Background. *Acinetobacter baumannii* has emerged as an important opportunistic pathogen. Its ability to develop resistance to multiple antibiotics leaves few treatment options. *AdeRS*, a two-component regulatory system, which controls expression of the adeABC efflux pump is involved in multidrug resistance. There is lack of data regarding presence of virulence factors leading to antimicrobial resistance and their correlation with the outcome of the patients. The study was done to evaluate the prevalence of virulence factors *AdeRS* gene responsible for the accentuation of drug resistance, and correlation with the clinical outcome of the patient.

Methods. Clinical details of 80 patients with labeled *A. baumannii* infection were collected and analyzed with the resistance patterns of the isolates and molecular detection of the *AdeRS* virulence gene.

Results. 80 patients with labeled *A. baumannii* infection were included in the study. Most common presentation among patients with *A. baumannii* was pneumonia (46.25%) followed by sepsis. 63.75% of patients were admitted in the ICU. Neonates were mostly affected. Of the total 37 neonates with *A. baumannii* infections, 26 were hospital acquired. Mean weight of neonates with infection was 2.1 kg. 45.9% neonates with *A. baumannii* infections had undergone surgery for congenital anomalies. Sepsis was the most common presentation among neonates. Overall, mortality was 41.25%. The maximum mortality was among neonates (57.6%). Children presenting with sepsis had a higher mortality. Mortality in ICU patients was 78.8% compared with 21% in the wards. Average length of stay in the hospital after acquisition of *A. baumannii* infection was 20.2 days. Of the total 80 isolates, 2.5% were MDR and 86.25% were XDR strains. *AdeRS* was present in 90% of the isolates. All the isolates with XDR pattern of drug resistance had *AdeRS* gene. 27.5% of the isolates were tigecycline resistant and *AdeRS* gene was present in all them. Thirty-three patients who died all possessed *AdesRS* gene and were XDR strains.

Conclusion. *A. baumannii* is responsible for a substantial percentage of nosocomial infections. Presence of *AdeRS* gene reduces the susceptibility to large number of drugs and thus selects out XDR *A. baumannii* with high mortality rates in the hospital settings, leaving efflux pump inhibitors as the therapy of choice.

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2336. Resistance Mechanisms and Factors Associated With CTX-M-9 Group Extended-Spectrum β-Lactamase (ESBL)-Producing *Enterobacteriaceae* Infections in Children

Rachel L. Medernach, MD[1]; T. Nicholas Domitrovic, MS[2]; Jared R. Rispens, MD[3]; Andrea M. Hujer, BS[4]; Nadia K. Qureshi, MD[5]; Steven H. Marshall, MS[6]; David C. Nguyen, MD[7]; Susan D. Rudin, BS[8]; Xiaotian Zheng, MD, PhD[9]; Robert A. Weinstein, MD, FIDSA, FSHEA[10]; Robert A. Bonomo, MD[11,12] and Latania K. Logan, MD, MSc[2,13,14,15]; [1]Rush University Medical Center, Chicago, Illinois, [2]Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland, Ohio, [3]Internal Medicine and Pediatrics, Rush University Medical Center, Chicago, Illinois, [4]Louis Stokes Cleveland VA Medical Center, Cleveland, Ohio, [5]Pediatrics, Loyola University Medical Center, Maywood, Illinois, [6]Research Service, Louis Stokes Cleveland Department of Veterans Affairs Medical Center, Cleveland, Ohio, [7]Departments of Internal Medicine and Pediatrics, Rush University Medical Center, Chicago, Illinois, [8]Research Service, VA Cleveland Medical Center, Cleveland, Ohio, [9]Children's Memorial Hospital, Chicago, Illinois, [10]Division of Infectious Diseases, Rush University Medical Center, Chicago, Illinois, [11]Research, Louis Stokes Cleveland Veteran's Affairs Medical Center, Cleveland, Ohio, [12]Case Western Reserve University, Cleveland, Ohio, [13]Pediatrics, Rush University Medical Center, Chicago, Illinois, [14]Rush Medical College, Chicago, Illinois, [15]John Stroger Hospital of Cook County, Chicago, Illinois

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Background. There is an increasing incidence of extended-spectrum β-lactamase (ESBL) producing *Enterobacteriaceae* infections in children. However, most studies focus only on CTX-M-1 group (CTX-M-15). We sought to define the epidemiology of the CTX-M-9 group (CTX-M-9) producing *Enterobacteriaceae* infections in children to devise more effective treatment and prevention strategies.

Methods. A case–control study of children (0–21 y), cared for by 3 Chicago area hospitals during 2011–16, was performed. Cases were 44 children diagnosed with third-generation cephalosporin (3GC) resistant and/or carbapenem-resistant (CR) *Enterobacteriaceae* infections who had CTX-M-9 genes accounting for β-lactam resistance. PCR amplification, DNA sequencing, and DNA microarray analysis (Check-Points®) assessed for *bla* genes. MLST, rep-PCR and phylogenetic analysis were also performed. Controls were 135 children with 3GC and carbapenem susceptible *Enterobacteriaceae* infections matched by age range and hospital. Demographics; comorbidities; device, antibiotic, and healthcare exposures; and the impact of location of patient residence were evaluated. Race categories were white, black, Hispanic, and other. Stratified analysis and multivariable logistic regression were used to explore associations between predictors and CTX-M-9 infection. Data were analyzed in SAS 9.4.

Results. The median age of cases was 4.1 years. The predominant organism (39/44, 89%) was *E. coli* of virulent phylogroups B2 (41%) and D (59%). MLST analysis revealed that this collection of strains was polyclonal.

On multivariable analysis, children with CTX-M-9 *Enterobacteriaceae* infections were more likely to be diagnosed in an outpatient clinic (OR 4.5), have *E. coli* infection (OR 7.0), and be of race "other" (OR 7.6) vs. controls. Residents of South Chicago were 6.7 times more likely to have a CTX-M-9 *Enterobacteriaceae* infection than controls; while residence in Northwest Chicago was associated with a 81% decreased risk. Significant differences in other demographics, comorbidities, invasive devices, antibiotic use, or recent healthcare were not found.

Conclusion. We observed striking regional differences in occurrence of CTX-M-9 producing *Enterobacteriaceae*, suggesting that environmental influences and plasmid transfer may contribute to acquisition. It is worrisome that a large number of ESBL *Enterobacteriaceae* strains bearing CTX-M ESBLs circulate in the community among children.

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2337. Clinical Characteristics of Children Infected With Macrolide-Resistant Mycoplasma Pneumonia in Central Ohio—Preliminary Data

Mariana Lanata Piazzon, MD[1]; Huanyu Wang, PhD[2]; Kathy Everhart, MS[3]; Octavio Ramilo, MD, FPIDS[4] and Amy Leber, PhD[3]; [1]Pediatrics, Section of Infectious Diseases, Nationwide Children's Hospital, Columbus, Ohio, [2]Nationwide Children's Hospital, Columbus, Ohio, [3]Department of Laboratory Medicine, Nationwide Children's Hospital, Columbus, Ohio, [4]Pediatrics, Nationwide Children's Hospital, Columbus, Ohio

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Background. Macrolide-resistant *Mycoplasma pneumoniae* (MRMp) has emerged in the last 2 decades, with rates as high as 93% in Asia. Rates in the United Stated vary from 3.5 to 13.2%. By sequencing we identified our local resistance rate of 1.8% (9/477) in isolates collected from October 2015 to December 2017. Previous reports described increased morbidity in patients with MRMp. We evaluated the clinical characteristics of children infected with MRMp in Central Ohio.

Methods. Of the 9 MRMp isolates identified, clinical data were available in 7 cases. We performed a case–control (1:3) analysis, where Mp patients were matched by month and year of presentation. Retrospective analysis of electronic health records (HER) was performed to identify clinical and treatment characteristics. Continuous variables are shown as medians and inter-quartile ranges (IQR), and categorical variables as percentages. For comparisons T, Mann–Whitney U, and Fisher's exact tests were used as appropriate.

Results. Both groups had similar demographics with no differences in age and gender. Median age (IQR) was 8.5 years (6–17) for the MRMp and 8 (IQR 3.5–11.5) for the Macrolide-susceptible Mp (MSMp). Duration of symptoms at presentation was similar, median (IQR) of 11 (4–14) days for MRMp, and 8 (6.25–13.25) days for MSMp ($P = 0.7$). All patients with MRMp had fever compared with 17 (81%) of the MSMp ($P = 0.07$). Tmax was similar in both groups ($P = 0.11$). All patients (100%) had cough. There were no differences in the frequency of oxygen requirement, fatigue, shortness of breath, sore throat, nasal congestion, rash, headache and chest radiographic findings. There were similar rates of hospitalization with 4 (57%) in the MRMp and 8 (38%) in the MSMp ($P = 0.42$). Among hospitalized children, there were no differences in duration hospitalization, median (IQR) 6 (1.25–21.25) days for MRMp and 2 (1–2.75) for MSMp ($P = 0.31$). None required invasive ventilation. One MRMp patient had encephalitis; this was the only patient requiring intensive care compared with none MSMp ($P = 0.25$). All patients were initially treated with azithromycin, but 2 (12%) of the MRMp were switched to levofloxacin ($P = 0.06$).

Conclusion. We did not identify significant differences in clinical characteristics between patients with MRMp and MSMp. This could be related to our low local rate of MRMp.

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2338. Change in Genetic Structure of *Streptococcus pneumoniae* Isolates From Invasive Diseases After National Immunization Program of Extended-Valency Pneumococcal Conjugate Vaccines in Korea

Kyuyol Rhie, MD PhD[1,2]; Hyeon Seung Lee, MD[3]; Chan Jae Lee, MD[4]; Eun Hwa Choi, MD, PhD[5] and Hoan Jong Lee, MD, PhD[5]; [1]Pediatrics, Department of Pediatrics, Seoul National University Children's Hospital, Seoul, Korea, Republic of (South), [2]Pediatrics, Department of Pediatrics, Mediplex Sejong Hospital, Incheon, Korea,