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BEST AND INNOVATIVE PRACTICE ABSTRACTS

IMPROVING PHARMACY WORKFLOW THROUGH THE IMPLEMENTATION OF A UNIT DOSE DISPENSING MODEL BASED ON A DOSE STANDARDIZATION PROGRAM IN PEDIATRIC PATIENTS. Jason Topolski, Ammara Tanweer, and Marina Rabin. *Northwell Health Cohen Children's Medical Center, New Hyde Park, USA*

Introduction: Cohen Children's Medical Center (CCMC) is a 202-bed children's hospital within a large health-system in the greater New York area. Drug dosing in infants and children must be computed based on the patient's weight. Consequently, multiple volumes are drawn for every medication to provide the ordered doses. In 2016, CCMC conducted a pilot study that evaluated the safety of standard doses in pediatric patients receiving oral and rectal acetaminophen. The study demonstrated that standard doses improved patient safety outcomes compared to conventional weight-based dosing methods. Based on these results, a dose standardization policy was created for 5 medications and enhanced clinical decision support (CDS) in our computerized provider order entry (CPOE) system was implemented. In addition to patient safety, standardized doses allows for a reduction in preparation time required to compound medications as well as reduction in medication waste and cost.

Methods: In October 2016, dosing methodology was implemented for ranitidine oral liquid. Standard doses included 7.5 mg, 15 mg, 30 mg, 45 mg, 75 mg and 150 mg. Prior to February 2018, standard doses were individually drawn up from a bulk bottle of ranitidine oral liquid. As of February 6th, 2018, standard doses were repackaged as unit dose cups or syringes and distributed to automated dispensing cabinets (ADC) throughout the institution. Data was collected prior to and post implementation starting January 16th, 2018 to February 28th, 2018. This included doses wasted upon return, preparation time and missing medication requests. Patient units with no ADC support and patients less than 3 kg were excluded.

Results: During the 3-week study period prior to implementation of ranitidine oral liquid unit dose dispensing model, 120 doses were wasted and 46 missing medication requests were sent to the pharmacy. Technician preparation and pharmacist verification time took an average of 40 minutes/day or 20 hours/month. Dur-

ing the 3-week study period post-implementation, no doses were wasted and 10 missing medication requests were sent to the pharmacy. The unit dose dispensing model required 3 hours of labor and provided approximately a month's supply for all standard doses. **Conclusions:** The implementation of a unit dose dispensing model based on a dose standardization program in pediatric patients improved pharmacy workflow by decreasing drug waste, missing medication request and preparation time. Future steps will include implementing the unit dose dispensing model for other medications included in the dose standardization policy.

IMPACT OF STUDENT PHARMACIST ASTHMA INTERVENTIONS ON ASTHMA-RELATED READMISSION IN A PEDIATRIC EMERGENCY DEPARTMENT: A PILOT STUDY. Anthony Nguyen and Ean Miller. *UNT System College of Pharmacy, Fort Worth, USA and Cook Children's Medical Center, Fort Worth, USA*

Background: Asthma is a chronic disease with exacerbations occurring in 47.5% of children with asthma and reported death rates of 3.0 per million. Consultation by student pharmacists could relieve the healthcare burden in the emergency department (ED) and allow further pharmacy practice experiences. The aim of this study was to evaluate if consultation by student pharmacists would reduce return visits at 48 hours, 30 days, and 60 days following asthma-related ED visits.

Methods: Single center, prospective quality improvement initiative in a level 2 pediatric ED with 115,000 yearly visits. Patients received pharmacy student consultation if: age ≥ 4 -years-old; chief complaint of asthma, difficulty breathing, or wheezing; known diagnosis of asthma; mild to moderate severity based upon initial modified clinical respiratory score (MCRS). Consultation involved medication history, inhaler compliance assessment, an asthma control assessment (childhood asthma control test or the asthma control test), followed by asthma education, provision of an asthma action plan, and recommendations to step up therapy, if clinically appropriate. Patients were excluded from results analysis if admitted inpatient after consultation. Consulted patients were matched 1:2 with non-consulted patients during the months of Sep-Nov 2017. Matching criteria: gender, emergency triage level, MCRS severity, and age (± 12 months). The primary outcome was difference in rate of return to the ED, urgent care center,

or inpatient admission at 48 hours, 30 days, and 60 days after ED discharge between the two groups.

Results: 46 patients were consulted. All received education and home medication action plan. Compliance issues were identified in 15 patients and compliance reinforced. Inadequate control was identified for two patients; step up therapy recommendations were accepted by the ED attending physician. Collaboration with social work medication assistance was necessary for one patient. 19 patients admitted after consultation and excluded; 26 of 27 remaining patients were successfully matched 1:2 for results comparison. Demographics: 9.7 ± 3.7 years; 61.5% male; 76.9% mild MCRS. Asthma related returns between consulted and non-consulted patients were 7.7% vs 3.8% at 48 hours, 19.2% vs 13.5% at 30 days, and 19.2% vs 23.1% at 60 days. None of these results were found to have statistically significant difference ($p > 0.05$).

Conclusions: Student pharmacist consultation did not reduce return rates at 48 hours, 30 days, and 60 days. However, it allowed for a unique experience for student pharmacists by collaborating in multidisciplinary health-care and providing direct care of asthmatic patients in a pediatric ED. The brief study length of one month and a small sample size, further decreased by patient admission, are major limitations. Given the overall healthcare burden of asthma, broader implementation of pharmacist and student pharmacist led asthma care initiatives could positively impact patient outcomes and should be explored further.

AN IMPROVED POLICY AND PROCESS FOR CORTICOTROPIN GEL FOR INFANTILE SPASMS. Bernard Lee and Pamela Kravitz. *Johns Hopkins All Children's Hospital, Saint Petersburg, USA*

Purpose: Corticotropin (Acthar, ACTH) gel is one of the first line and mainstay options for the treatment and management of infantile spasms but poses some unique challenges to institutional pharmacies from both policy and budget standpoints. First, most institutions and their respective departments of pharmacy have strict policies forbidding the storage, distribution and administration of proprietary samples of medications with no exceptions. However, corticotropin's sample vial program is often overlooked or becomes an ongoing issue of controversy secondary to its unique financial impact. Corticotropin remains in the top 5 most expensive pharmaceutical agents in recent years carrying an AWP of \$46,670.40 per one 400 unit/5 mL vial. The department of pharmacy recently eliminated the corticotropin sample vial program in 2017 and assumed the full burden of cost purchasing its own supply of medication in compliance with its own formulary policies and procedures. The significant financial impact was quickly registered and other avenues of supply and equivalent infantile spasms treatment options were explored.

Methods: A comprehensive MUE was conducted at a 259 bed, free-standing children's hospital to quantify the cost burden of all patients who received corticotropin gel spanning a 5 year observation period from January 1, 2013 to December 31, 2017. Patients were eligible for inclusion if they were dispensed at least a single dose of corticotropin gel for the initiation or continuation of treatment indication of infantile spasms. Patients were ineligible for inclusion if they were dispensed or administered corticotropin for any other purpose. Simultaneously, other non-sample programs were explored with the manufacturer of corticotropin with the expressed goal of expedited delivery of home, patient specific medication supplies. In addition, discussions with the various Neurology providers were conducted to explore other, equally efficacious potential treatment options for infantile spasm.

Results: 31 patients were identified accounting for 291 dispensed doses of corticotropin within the 5 year observation period. A total of 8281 units were dispensed, which a minimum of 21 vials were estimated to have been utilized to sufficiently fill the doses dispensed. At current AWP (\$46,670.40/vial), this represented \$980,078.40 (\$196,015.68/year) over 5 years in drug cost alone. Discussions with the manufacturer revealed that an alternative patient specific supply program could be used to expeditiously deliver a supply of medication in 24–48 hours of activation. Additionally, high dose corticosteroids (prednisolone or methylprednisolone) were found to be viable alternatives for the treatment of infantile spasms by neurologists. ACTH was subsequently removed from institutional formulary.

Conclusions: Due to the significant financial impact of corticotropin acquisition and inventory, corticotropin's patient specific supply was instituted as the preferred method of corticotropin initiation and continuation of therapy for infantile spasm.

DESCRIPTION OF AN ANTIMICROBIAL STEWARDSHIP PROGRAM IN A PEDIATRIC POST-ACUTE CARE HOSPITAL. Brooke Gildon and Michael Johnson. *Southwestern Oklahoma State University College of Pharmacy, Weatherford, USA; The Children's Center Rehabilitation Hospital, Bethany, USA*

Introduction: Antimicrobial agents are widely prescribed for children, with an average of 60% of all pediatric in-patient visits resulting in at least one antibiotic order. This frequent use has impacted the rise in multidrug-resistant bacterial infections. To help optimize antibiotic use, many organizations have created antimicrobial stewardship programs (ASP). Compared to the pediatric acute care setting, an ASP in a post-acute care hospital is unique. The ASP at The Children's Center Rehabilitation Hospital (TCCRH) was started in summer 2017. TCCRH offers a wide range of services to children with complex

medical needs in long-term care, short-term rehabilitation, sub-acute care, and an outpatient clinic.

Methods/Service Description: Led by the medical director and clinical pharmacist, the CDC Core Elements of Hospital Antibiotic Stewardship Programs Checklist was used to assess practices prior to ASP initiation. Subsequently, policies on (1) restricted antimicrobials and (2) antimicrobial prospective audit and feedback were implemented. TCCRH ASP outcomes described include: antimicrobial agents/indications, patient characteristics, and interventions completed from June 14 to December 31, 2017. The study aims to (1) describe outcomes of the antimicrobial stewardship program, (2) identify pharmacist interventions as part of the ASP, and (3) create a hospital-specific antibiogram.

Results: The ASP has executed actions to address the core elements of drug expertise, actions to support optimal antibiotic use, tracking, reporting, and education. One-hundred eighty-three antimicrobial courses were started for 79 patients. This represents 0.92 new starts per day with 17% being restricted antimicrobial agents. Complex care patients encompassed 68% of all new orders. The average patient age was 9.5 years (range: 0.25–20) with an average weight of 32 kg (range: 4.4–118.8) and 53% male. The average in-patient census was approximately 105 patients during the study period. The most commonly prescribed agents were cefdinir, sulfamethoxazole/trimethoprim, amoxicillin, vancomycin, and ceftazidime at 12.6%, 10.9%, 10.4%, 8.7%, and 7.1%, respectively. Urinary tract infection was the most common indication at 23.5%. A unique, setting-specific reason for an antimicrobial start was per protocol in a febrile child with a central line or asplenia (9.3%). The ASP pharmacist completed 111 interventions. These included: restricted antimicrobial review/approval (31), initial drug choice or medication changes (17), dosing recommendations/changes (17), pharmacokinetic monitoring (14), culture review/interpretation (14), treatment duration (5), communication with outside facilities (3), and other (10). Examples of other interventions included renal dosing, medication error identification, and drug interactions. Lastly, three educational activities were completed as well as creation of the first hospital-specific antibiogram.

Conclusions: An ASP can positively impact and intervene on antimicrobial use in a pediatric post-acute care hospital. Furthermore, pharmacy can have a significant role in antimicrobial stewardship and education.

IMPACT OF A FORMAL PEDIATRIC DRUG INFORMATION SERVICE FOR THE PEDIATRIC SERVICE LINE WITHIN AN ADULT HEALTH SYSTEM. Caitlin Stehling. *St. John's University, Queens, NY, USA; Cohen Children's Medical Center, New Hyde Park, NY, USA*

Introduction: Cohen Children's Medical Center (CCMC)

is a 202-bed children's hospital within a large health system, Northwell Health, in the greater New York area. CCMC is the flagship hospital for the pediatric service line, which expands across multiple campus locations. In 2016, a dedicated pediatric drug information service was started in conjunction with St. John's University, College of Pharmacy to provide specialized drug information services to pediatric patients across the health system.

Methods: The Pediatric Medication Resource Center (PMRC) was developed to serve a drug information deficit, in addition to provide other resources such as formulary and medication safety support for pediatric patients and families, and pediatric healthcare professionals both in and out of the Northwell Health system. The PMRC was staffed by a full-time, pediatric-trained faculty member of St. John's University and the students that rotated through a pediatric drug information rotation. Requestors could submit requests in multiple ways including a direct email address and phone extension. Requests could also be submitted verbally (in-person).

Results: Over the course of a 12-month period from September 2016 to September 2017, the PMRC handled 96 formal information requests including drug information questions, formulary monograph requests, therapeutic class reviews, drug shortage questions, journal clubs, general literature searches, stability requests, and drug interaction reviews. Requestors were broken down into four categories: CCMC provider, Northwell Health system provider, SJU faculty member, or other (including patients, families, and non-Northwell Health healthcare providers). The majority of requests were asked by CCMC-specific providers including pharmacists. The next largest group of requestors were other providers within the Northwell system, who had a small pediatric population at their site. Other requests came from St. John's University faculty members, other pediatric providers outside of the Northwell Health system, and parents of pediatric patients. Request volume remained steady throughout the 12-month period with an average of 8 requests/month. Besides general drug information questions, top requests included monographs (17%) and stability requests (14%).

Conclusions: A specific pediatric-trained pharmacist and students were able to deliver accurate and efficient services to better serve pediatric patients. Pediatric specific drug information and support

EVALUATION OF ERTAPENEM UTILIZATION ONE YEAR AFTER PRACTICE CHANGE FOR APPENDICITIS AND APPENDECTOMY ANTIMICROBIAL PROPHYLAXIS. Carla-Camille Lardizabal, Boh Song, Rana Hamdy, Mikael Petrosyan, and Benjamin Hammer. *Children's National Medical Center, Washington, D.C., USA*

Introduction: Increasing antibiotic resistance of *Enterobacteriaceae* has led the Center for Disease Control and Prevention (CDC) to urge judicious use

of carbapenem antibiotics. Ceftriaxone plus metronidazole as antimicrobial treatment for appendicitis in pediatric patients is similarly efficacious and safe when compared to broader spectrum agents such as ertapenem. In December 2016, Children's National Medical Center implemented ceftriaxone plus metronidazole as the antimicrobial regimen of choice in appendicitis and appendectomy surgical prophylaxis with the goal of reducing carbapenem usage. The objective of this study was to assess the effects of this clinical pathway revision on ertapenem usage and pharmacy costs.

Methods: From October 2015 through August 2017, patients administered ertapenem at Children's National Health System (CNHS) were identified using the CNHS pharmacy dispensing database. Data collected through chart review included doses administered, medical service, and indication. Data from the post-pathway revision time period (December 2016 to August 2017) were compared to those from the pre-pathway revision period (October 2015 to October 2016). Cost savings based on cost of one day of therapy per patient were analyzed.

Results: Before pathway revision, 2,645 ertapenem doses were administered during 463 patient encounters; after pathway revision, 479 doses were administered during 106 patient encounters. Before pathway revision, the top prescribing departments were emergency medicine (287 encounters) and surgery services (144 encounters) with the most frequent indications being uncomplicated appendicitis (220 encounters) and complicated or perforated appendicitis (142 encounters). After pathway revision, the top prescribing departments were surgery services (64 encounters) and intensive care (38 encounters) with the most common indications being uncomplicated appendicitis (33 encounters) and empiric therapy for urinary tract infection, intra-abdominal abscess, or sepsis (25 encounters). Ertapenem utilization reduced from 203 doses per month before pathway revision to 53 doses per month after pathway revision. Based on an estimated reduction of 324 patients per year receiving ertapenem, the cost differential (\$154.39 for a daily dose of ertapenem vs. \$9.94 for ceftriaxone plus metronidazole, using average wholesale price) resulted in annual cost savings of \$46,801.80 for one day of therapy per patient.

Conclusions: Ertapenem usage has markedly decreased at CNHS since changing antibiotic of choice for appendicitis and appendectomy prophylaxis from ertapenem to ceftriaxone plus metronidazole. This practice change has resulted in substantial cost savings. However, further education and enforcement are needed as ertapenem continues to be used for uncomplicated appendicitis.

IMPACT OF A PEDIATRIC EMERGENCY DEPARTMENT DISCHARGE ORDER FOLDER ON PRESCRIBING ERRORS. Christine Kane, Cory Showalter, and

Lauren Buenger. *Riley Hospital for Children at Indiana University Health, Indianapolis, USA; Indiana University School of Medicine, Indianapolis, USA*

Introduction: In a pediatric emergency department (PED), a pre-populated discharge prescription order folder was integrated into the electronic medical record (EMR) with the goal to decrease prescription errors. We compared the rate of prescribing errors pre and post folder implementation to determine impact.

Methods: A retrospective chart review was conducted in the PED August 1, 2013–November 30, 2015, for patients less than 18 years of age receiving prescriptions at discharge. A random sample of 200 prescriptions of seven different medications from the folder was selected from both the pre and post implementation group for comparison. The primary end point was to evaluate the rate of error occurrence between groups. Secondary endpoints include evaluating the rate of error occurrence pre and post implementation by type of error that occurred, time of error occurrence, the training level of the prescribing physician, and the error rates based on times of pharmacist presence or not in the PED.

Results: Implementation of the discharge order folder demonstrated an absolute reduction of 10% in prescribing errors, from 23% of prescriptions during the pre-implementation period to 13% during post-implementation ($p=0.013$). Secondary endpoints provide further insight of the impact of the implementation of the folder. A numerical decrease in errors was seen in all categories of error type except selection of inappropriate product; despite statistical significance not being achieved. A statistically significant decrease was demonstrated in the error rate of prescriptions written from 0400–0759 ($p<0.001$) and 1600–1959 ($p<0.001$), with the folder facilitating a decrease in errors during hours in which a pharmacist is not present from 29% to 12% ($p=0.005$). Further evaluation into the training level of prescribing physician demonstrated learners had the greatest reduction in errors after discharge folder implementation with error rates reduced from 26% to 11% ($p=0.04$).

Conclusions: Introduction of the discharge prescription order folder in the PED has demonstrated a significant reduction in error rates and could serve as a model for EMR customization.

DRUG AND SUPPLY SHORTAGES COMPROMISE PEDIATRIC CLINICAL CARE AND HEALTHCARE RESOURCES. Christine Baumgartner and Abby Kim. *Children's Hospital Colorado, Aurora, USA*

Introduction: Recent natural disasters have further worsened the already troubling list of drug and supply shortages. The Food and Drug Administration (FDA) has developed multiple strategies to prevent or mitigate the shortages including identifying alternative manufactur-

ers, approving extended inventory dating, and temporary importation of non-United States product. After notification of a shortage, health care systems must assess the availability of drugs and supplies and identify therapeutic alternatives. The production and supply of metronidazole was greatly reduced in October 2017 and impacted patient care at our pediatric academic medical center. Due to the shortage, metronidazole was replaced with piperacillin/tazobactam, in combination with ceftriaxone, for surgical prophylaxis in patients with acute appendicitis requiring appendectomy. Use of an alternative agent resulted in additional monitoring for these patients due to the nephrotoxic properties of piperacillin/tazobactam per the Nephrotoxic Injury Negated by Just-in-time Action (NINJA) program at our institution. Upon metronidazole supply resolution, empty intravenous (IV) sterile bags became unavailable. In an effort to conserve supply, an alternative dosing regimen for metronidazole was established. Metronidazole frequency recommendations changed from q 24 hrs to q 8–12 hrs to allow dispensing within a pre-manufactured container or syringe.

Methods: A retrospective chart review was performed to identify patients who received piperacillin/tazobactam during the metronidazole shortage and restriction in November 2017. Patients that required additional monitoring for acute kidney injury (AKI) per the NINJA program were also reviewed. An additional chart review evaluated patients that did not receive appropriate post-operative metronidazole therapy during a period of the sterile IV bag shortage from December 2017 through January 2018.

Results: A total of 15 patients received piperacillin/tazobactam in place of metronidazole for appendicitis. Four of 15, 26.7%, had pharmacist documentation of risk for AKI and need for additional monitoring. Monitoring for AKI included daily renal function panel or serum creatinine at a cost of approximately \$88 and \$47 per draw, respectively. Although not easily quantifiable, additional time was required by nursing to perform daily weights and record strict fluid intake and output. A total of 23 patients were diagnosed and treated for acute appendicitis during a period of the IV empty sterile bag shortage. The alternate dosing of metronidazole to conserve supply resulted in 5 of 7 patients (71.4%) with non-perforated appendicitis to receive <24 hours of total metronidazole coverage. Sixteen patients with perforated appendicitis did not have a delay in receiving metronidazole post-operatively or miss any doses.

Conclusions: Drug and supply shortages have been, and continue to be, disruptive and potentially harmful to pediatric clinical care. The metronidazole and empty sterile bag shortage discussed is a simple, but clear example of healthcare waste and compromise of patient care.

COST EVALUATION OF CYTOMEGALOVIRUS PROPHYLAXIS VERSUS PRE-EMPTIVE THERAPY USING VALGANCICLOVIR IN PEDIATRIC KIDNEY TRANSPLANT PATIENTS STRATIFIED BY RISK. Elmer Smith, Carly Heyrend, Joseph Sherbotie, and Emily Benefield. *Primary Children's Hospital, Salt Lake City, USA; University of Utah, Salt Lake City, USA*

Introduction: Cytomegalovirus (CMV) infection is a known risk in kidney transplant recipients, which is associated with reduced graft survival and other complications. There is no consensus on prevention strategies for CMV, however, two common methods include prophylaxis with valganciclovir and watchful monitoring of CMV viral load testing followed by pre-emptive therapy with valganciclovir if testing is positive. Our institution has done a combination of the above strategies, using prophylaxis for high risk patients (donor positive, recipient negative) and pre-emptive therapy for moderate (recipient positive) and low (donor negative, recipient negative) risk patients. This evaluation assesses the cost of each strategy of the current institutional protocol, as the cost of testing and medication are significant.

Methods: This retrospective review included kidney transplant recipients at Primary Children's Hospital from January 2015-December 2017. Patients deviating from the institutional CMV protocol were excluded. The cost of prophylaxis versus pre-emptive therapy was assessed using average wholesale price for valganciclovir tablets and liquid and charge data for CMV quantitative PCR. Additionally, for patients who had CMV reactivation or seroconversion, valganciclovir cost for treatment and secondary prophylaxis was used.

Results: A total of 44 patients were transplanted during the study period with 8 patients being excluded for protocol deviations due to using valganciclovir prophylaxis for patients classified as moderate or low risk. The prophylaxis group included 13 patients, with the remaining 23 patients included in the pre-emptive therapy group (13 moderate risk, 10 low risk). Of the pre-emptive therapy group, 7 patients, all moderate risk, developed CMV viremia. The estimated average cost of valganciclovir prophylaxis was for a 3 month course was \$6118. The estimated cost of monitoring only with CMV quantitative PCR was \$4284. However, the average cost of pre-emptive therapy with valganciclovir after positive CMV PCR was \$12292 for the 7 patients. In total for moderate risk patients, the average cost was \$8596 for pre-emptive therapy.

Conclusions: Based on the high rates CMV viremia in the moderate risk patient population, the cost of prophylaxis with valganciclovir would be less than the average cost of pre-emptive therapy. For low risk patients, the most effective option is pre-emptive therapy.

IMPACT OF AN EMERGENCY MEDICINE PEDIATRIC PHARMACIST: TOOLS AND MEASURES. Gifty Edusei, Ellen Germain, Ellen Rudnick, Mark Sinnet, Hnin Khine, and Daniel Fein. *Children's Hospital at Montefiore, Bronx, USA; Montefiore Medical Center, Bronx, USA*

Introduction: In contrast to the inpatient setting, medication order review (MOR) by a pharmacist is frequently bypassed in the emergency department to provide expeditious medication administration for early goal-directed therapy and to facilitate patient flow through the pediatric emergency department (PED). However, this leads to one less check on the medication order and may put patients at increased risk for medication errors and adverse events. Presently, less than 7 percent of medications orders undergo MOR by a pharmacist in our PED and there is a poor understanding of how many medication errors are occurring. The objective for this quality improvement (QI) initiative was to increase the number of MOR to 30% by November 2016 and to determine the frequency of medication error prevented with MOR.

Methods: A multidisciplinary team including a pharmacist, PED physicians and nurses, was created for the study. Interventions for this study included: assigning a pharmacist in the PED to perform MOR, filtering high-risk medication orders that require verification by the pharmacist and medication reconciliation for PED patients. Definition of pharmacy interventions (PI) and prevented medication error include: dose adjustments, therapeutic duplication, wrong formulation, frequency clarification, rate and route clarification and unreconciled medications. Medication orders were identified by using computerized physician order entry filters and pharmacist documented any interventions made during the study period. Monthly MOR and the number of medication errors prevented were analyzed. Plan do study act cycles were utilized with adjustments made when needed.

Results: The study took place from Jan-Nov 2016. During this study period, 52,255 patients were seen in the PED. Pharmacist was present 20hr/week. Of the 64,327 medication orders, 7,771 (12%) had MOR by the pharmacist, an increase of 46% ($p < 0.05$) during post intervention. Out of the 7,771 that had MOR, pharmacy interventions occurred in 1493 cases. Of these 114 (7.6%) were clinically significant dose adjustments. The number of medication errors prevented in the PED increased 6-fold during the time period from 78/68,441 (0.11%) in 2015 to 395/64,327 (0.61%) in 2016. ($p < 0.05$) Additionally, the percentage of patients who had a pharmacy intervention quintupled over the same time period increased from 312/68,411 (0.45%) in 2015 to 1493/64,327 (2.3%) in 2016 ($p < 0.05$).

Conclusions: Availability of a pharmacist in the ED allowed increased number of MOR in real time. Applying QI methodology resulted in a significant increase in the

number of prospective medication reviews, pharmacy interventions and medication errors prevented in the PED. A 24/7 'in-situ' pediatric pharmacist in the PED would likely result in increased medication reviews and potentially decrease the likelihood of a medication error in the PED.

SUCCESSFUL IMPLEMENTATION OF A NUSINERSEN ADMINISTRATION PROCESS AT A FREE STANDING PEDIATRIC HOSPITAL. Jared Cash and Sabrina Boehme. *Intermountain Primary Children's Hospital, Salt Lake City, USA*

Introduction: Nusinersen was approved by the FDA in December of 2016 as the first labeled medication for the treatment of Spinal Muscular Atrophy (SMA) in pediatric and adult patients. Induction therapy consists of four 12 mg intrathecal doses in 60 days followed by maintenance doses every 4 months for life. This approval represents a significant advancement in SMA treatment with the potential to prevent muscle atrophy and or stop atrophy progression. Broad labeling to include all types and stages of SMA as well as the price of \$125,000 per dose sparks controversy. Local Pharmacy involvement in SMA clinics was very limited, so the challenge was to develop a process for the evaluation, approval, administration, and monitoring of nusinersen in a tertiary care free standing children's hospital.

Methods: To ensure appropriate stewardship of nusinersen a physician Neurology Board consisting of the Neurology Chair, a medical ethicist, and Chief Medical Officer was formed. The attending Neurologist refers eligible patients to this board to recommend for or against nusinersen treatment. If this medical board recommends treatment, a letter stating such is sent to the patient's insurer. The Neurology Clinic works with the insurer, and Biogen's financial assistance program for patients without insurance. After completion of these steps, pharmacy orders the first dose. Subsequent doses are ordered upon request from the Neurology clinic after the pharmacist has checked for continued insurance approval. All doses are acquired directly through the preferred distributor with a buy and bill process only. The nusinersen is given in the procedures unit of the hospital and under fluoroscopy when there is instrumentation present. The dose is prepared by the pharmacy to assure sterility. To close the loop once a dose has been given Pharmacy notifies Revenue Integrity to verify and track charging and reimbursement.

Results: March 2017 through February of 2018 a total of 19 patients received 87 doses representing a cost of 10.9 million dollars. Three SMA types have been treated including seven SMA type I patients, ten SMA type II patients, and two SMA type III. Patient demographics show ten males and nine females, and have ranged in age from 12 days of age to 14 years old at time of first dose. All doses were charged and reimbursed

through commercial or state insurance, with no patients receiving full Biogen financial assistance for a dose. The vast majority of patients 18/19 were treated in the outpatient setting.

Conclusions: Through many steps of coordination the new process for nusinersen use has been successful. Further research should be conducted focusing on the pharmacoeconomics implications to help determine more specific parameters for use once a patient has muscle atrophy.

PHARMACIST-LED INTERVENTIONS TO IMPROVE DOCUMENTATION QUALITY OF ADVERSE DRUG REACTIONS AT CHILDREN'S HOSPITAL. Jin Kim, Ryo Miyakawa, Lisa Kohn, Susan Wu, and Melinda Braskett. *Children's Hospital Los Angeles, Los Angeles, USA*

Introduction: Accurate documentation of adverse drug reactions is important in the prevention of adverse events and facilitates reassessment and decisions for future re-challenge. Patients with penicillin allergy, for example, are more frequently exposed to broad-spectrum antibiotics and experience more infections by *Clostridium difficile*, methicillin-resistant *Staphylococcus aureus*, and vancomycin-resistant enterococci.

Method: A quality-improvement project was undertaken in the inpatient setting at the quaternary care free-standing children's hospital. The project aim was to increase the number of well-documented updates of adverse drug reactions to 30 per week and proportion of well-documented entries to 70% among hospitalized patients. Well documented entries and updates were defined as ones with symptoms or severity noted. Over a 12-month period, we conducted serial Plan-Do-Study-Act (PDSA) cycles to implement various interventions. Initial interventions were calls from pharmacists to prompt clinicians to re-assess incomplete documentation. Subsequently, pharmacist-led discussion of adverse drug reactions took place during multidisciplinary rounds.

Result: During the study period with the average daily census of 296.2 patients, 100–140 adverse drug reactions were listed among inpatients at any given time. Vancomycin was the most frequently reported drug. While average weekly discharge was 325, the number of well-documented updates increased from 11 per week to 22 per week. The proportion of well-documented reactions in the inpatient setting became available during PDSA cycle 1. It was 69% initially and then plateaued at 76%. 13% of recorded reactions did not meet our criteria but was noted to contain comments useful to clinicians. Use of these comments increased during the study period across inpatient and outpatient settings.

Conclusions: Pharmacist-led interventions were successful at improving documentation quality of adverse drug reactions in the inpatient setting. Integration with

the regular workflow of pharmacists and education of other disciplines is important to sustain the impact. We plan to implement the interventions to the emergency department and outpatient clinics and simplify the documentation format in the electronic medical record.

VASOPRESSIN-RELATED ERRORS IN A PEDIATRIC HOSPITAL: STRATEGIES FOR ERROR REDUCTION. Joanie Spiro Stevens and Juan Carlos Rodriguez. *Joe DiMaggio Children's Hospital, Hollywood, USA*

Introduction: Vasopressin dosing errors may result from varying dosing units secondary to the medication's indication or patient's age. Additional risks are introduced as vasopressin is commonly titrated. Joint Commission requires inclusion of titration instructions on orders to meet standard MM 04.01.01; to comply, updates to the electronic health record (EHR) were implemented. Several vasopressin dosing errors were reported thereafter through the medication error reporting system. The objective of this project was to evaluate errors reported, ascertain their root cause, and identify opportunities to mitigate risk of future errors. Similarly, all vasopressin orders prescribed during the evaluation period were reviewed to identify and assess unreported errors.

Methods: All vasopressin incidents reported and orders administered between June 21, 2017 and October 31, 2017 were reviewed. Errors were identified and categorized as incorrect entry (order processed using the electronic order record for the incorrect indication), incomplete order (incomplete titration instructions on the order or complete titration instructions provided but dose range not specified in the dose field), and/or incorrect dose (administered dose mismatch with the ordered dose).

Results: Thirty orders were reviewed, 3 reported incidents and 27 orders identified through EHR review. Errors were identified in 17 of the 30 orders. Two orders were prescribed using the incorrect entry; the vasopressin entry for diabetes insipidus (dosed in units/kg/hr) was selected for 2 patients being treated for vasodilatory shock (dosed in units/kg/min). Four orders were classified as incomplete orders; 1 order was missing the initial rate, and 3 orders had a single ordered dose with titration instructions instead of a dose range. Five orders were administered at the incorrect dose when compared to the ordered dose; this commonly occurred on orders that were placed with a single ordered dose rather than a dose range with titration instructions. Six orders included errors in both the incomplete order and incorrect dose categories.

Conclusions: Three principal actions were taken following the project's results to reduce the risk of vasopressin dosing errors and increase awareness of error potential with vasopressin orders. First, the name of the EHR's vasopressin entries were updated

to include the indication for use, and a mandatory indication field was added as a double-check method to emphasize the relationship between indication and dosing units. Secondly, the multidisciplinary team was educated on the errors identified and the changes to the EHR. Finally, one-on-one education was provided to the pharmacists utilizing a teach-back demonstration of vasopressin ordering and dosing competency. Data collection is ongoing for the post implementation phase; however, vasopressin dosing incidents have not been reported for 3 months following enactment of the aforementioned actions.

IMPACT OF PROVIDING INFLUENZA VACCINATIONS TO CAREGIVERS OF AT-RISK NEONATAL PATIENTS.

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Introduction: Among the pediatric population, infants younger than six months of age exhibit the highest mortality rates with influenza. The American Academy of Pediatric and the Advisory Committee on Immunization Practices recommends influenza vaccination for all close contacts of high-risk infants. This population includes caregivers of infants and children with an emphasis on children 0–6 months of age who are not direct candidates for immunization. Reports have shown that only 31.2% to 45.5% of adults of child-bearing age receive the influenza vaccine with the most commonly cited reason for failing to obtain the vaccine being convenience. Having access to vaccinations within the hospital will decrease this barrier, strengthen the neonatal intensive care unit (NICU) infectious disease prevention, and maximize comprehensive care efforts. The purpose of this implementation is to increase access to influenza vaccinations for caregivers of patients in the NICU in order to reduce influenza exposure in this vulnerable population.

Methods: Upon admission to the NICU, patients' caregivers were screened by the NICU pharmacist to determine influenza vaccination status. Caregivers are defined as those with planned patient interaction greater than or equal to eight hours per day. Education was provided on the importance of influenza vaccination via discussion and written materials. If the caregivers had not received their vaccinations, they were offered to receive it in the outpatient pharmacy located in the hospital. Screening forms and insurance documentation was sent to the outpatient pharmacy in advance and appointments were set up to ensure convenient administration times. Pharmacy students were utilized to give the vaccinations as to not interrupt current outpatient pharmacy workflows. Prior to program implementation, vaccination rates were collected to compare to data from the 2015–2016 influenza season.

Results: From October, 2015, to March, 2016, 40 patients were admitted to the NICU. Data collection via retrospective phone calls to caregivers was performed and a total of 28 caregivers were contacted. Seventeen of the twenty-eight (61%) had received the influenza vaccination. From October, 2017 to March, 2018, 54 patients were admitted to the NICU. A total of 90 caregivers, including mothers, fathers, and grandparents were screened to determine influenza vaccination status. Fifteen of the ninety caregivers (17%) were provided influenza vaccinations through the outpatient pharmacy. Forty-four caregivers (49%) had already received the vaccination and 31 (34%) declined.

Conclusions: Influenza vaccination rates of caregivers of NICU patients increased when the caregivers were offered convenient access to administration of the vaccination. The increase in caregiver vaccination rates reduces exposure of the influenza virus to the vulnerable NICU population, increasing patient safety and decreasing morbidity and mortality associated with influenza. Future directions for this project include expanding caregiver screenings on all units within the hospital.

IMPLEMENTATION OF A PALIVIZUMAB ORDER PANEL TO DECREASE INAPPROPRIATE USE.

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Introduction: Palivizumab is a monoclonal antibody used to prevent infection from respiratory syncytial virus (RSV) in certain patients who are at high-risk of complications from RSV bronchiolitis. In 2015, our institution completed a medication use evaluation (MUE) that demonstrated 12% of our palivizumab use did not meet our pre-determined restriction criteria. Prior to the start of the 2016–2017 RSV season, we implemented an order panel that required prescribers to select the approval criterion for each patient receiving palivizumab. In addition, we changed our restriction policy to state that use of palivizumab outside of the pre-approved criteria would require approval from infectious diseases or the antimicrobial stewardship team. The order panel directed prescribers to contact an approval pager for patients who did not meet criteria. A second MUE was conducted during the summer of 2017 to determine if the order panel had an impact on appropriate prescribing of palivizumab.

Methods: Medication orders for patients who received palivizumab from December 2015–April 2016 and December 2016–

April 2017 were reviewed to determine the proportion of patients who did not meet the pre-approved restriction criteria. Charts were reviewed to verify the indication of palivizumab for each patient during both seasons. A chi-square was used to compare the proportion of inappropriate orders between the two seasons.

Results: From December 2015–April 2016, 80 doses of palivizumab were administered in the inpatient setting. Eleven doses (13.8%) were inappropriate; six doses were dispensed to patients who did not meet restriction criteria, and five doses were dispensed to patients who received more than one dose in a single hospitalization, which is a deviation from our policy that states patients should only receive one dose of palivizumab prior to discharge. From December 2016–April 2017, 70 doses were administered, and four doses were inappropriate; two doses in children who did not meet the pre-approved criteria, and two doses in children who received more than one dose during hospitalization. There was an overall decrease in the proportion of inappropriate doses between the two time periods. This difference was not significant ($p=0.102$). An estimated cost avoidance of \$12,807.18 was observed due to the decrease in the number of inappropriate administrations of palivizumab following implementation of the order panel and restriction policy ($n=7$).

Conclusions: Following the implementation of the order panel plus restriction policy, we observed a decrease in the proportion of inappropriate doses that were administered from the pre-implementation period to the post-implementation period, which also resulted in a cost avoidance of approximately \$13,000.

PHARMACIST DRIVEN INTRAVENOUS (IV) TO ORAL (PO) THERAPEUTIC INTERCHANGE PROTOCOL IMPLEMENTATION IN A CHILDREN'S HOSPITAL.

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Introduction: Pharmacist-driven programs that imbue pharmacists with the authority to independently initiate and carry forward IV to PO conversions is rarely described in the literature, especially in pediatrics. IV medications are more costly, associated with risk of infection and other complications, uniquely vulnerable to drug shortages, increase length of stay, and hamper transitions of care. Oral/enteral medications are the safest, most economical, and appropriate option for treatment when clinically feasible

Methods: A pharmacist driven IV to PO therapeutic interchange protocol was submitted and approved by the Pharmacy & Therapeutics (P&T) Committee in a 259 bed, free-standing children's hospital, followed by pharmacy education and workflow development and implementation. Among the 19 medications included in the protocol 11 were antimicrobials for patients greater than 2 months, 4 gastrointestinal agents, and 4 neurologic/analgesic agents. Patients were eligible for inclusion in the protocol when clinically stable and improving as defined by: tolerating enteral nutrition, taking enteral medications, or an infection was located where an oral agent would achieve adequate levels, if

applicable. Patients were ineligible for conversion from IV to PO medication if/for: antibiotic duration was <48 hours, NPO including medications, unable to tolerate PO, dysfunctional feeding tubes, active vomiting or diarrhea (>3 loose stools/day) in the previous 24 hours, gastrointestinal obstruction, malabsorption syndrome, motility disorder, active GI bleed, bacteremia/line infection, sepsis, CNS infection, endocarditis, febrile neutropenia, complicated pneumonia, or cystic fibrosis pulmonary exacerbation. Pharmacists were trained to identify eligible medications for interchange, evaluate patients for presence of inclusion and exclusion criteria, and autonomously evaluate appropriateness. When appropriate, pharmacists independently deemed when to proactively discontinue IV medications and enter equivalent PO medications orders. Results of the protocol's impact were assessed from the pre-protocol implementation assessment period (4/1/15–3/30/16) to post-protocol implementation assessment period (4/1/16–3/30/17).

Results: Pharmacist-documented IV to PO specific interventions increased by 245% (396 to 972 interventions). 16 out of 19 protocol identified agents gained increases in IV to PO interventions. Diazepam (489%), famotidine (397%) and acetaminophen (284%) had the highest percentage intervention increases. Across all agents post implementation, there were 10,401 less IV drug administrations. Total IV drug cost savings alone was estimated at \$176,569 per year as determined by wholesale acquisition cost (WAC). The greatest cost savings was \$56,534 seen with voriconazole which decreased in utilization by 16%. Finally, institution wide, global trends of IV antimicrobial days of therapy decreased while PO antimicrobial days of therapy increased which was the opposite of institutional trends from the pre-protocol assessment period; the inflection point being at the protocol implementation.

Conclusions: Establishment of a pharmacist driven IV to PO therapeutic interchange protocol resulted in significant cost savings and decreased utilization of IV medications and associated resources.

TWICE WEEKLY SULFAMETHOXAZOLE/TRIMETHOPRIM FOR PNEUMOCYSTIS JIROVECI PNEUMONITIS PROPHYLAXIS IN PEDIATRIC ONCOLOGY PATIENTS.

Michelle Bustamante and Faina Shenderov. *Joe DiMaggio Children's Hospital, Hollywood, FL, USA*

Introduction: *Pneumocystis jirovecii* pneumonitis (PJP) is an opportunistic infection that immunocompromised patients are at high risk of acquiring. The use of sulfamethoxazole/trimethoprim (SMX/TMP) as a prophylactic agent against *P. jirovecii* has been reported to be effective. At Joe DiMaggio Children's Hospital (JDCH), PJP prophylaxis is part of the standard of care for oncology patients. Literature suggests that a twice weekly SMX/TMP regimen at a dose of 5 mg TMP/kg/day, twice daily

offers comparable efficacy and a lower frequency of common side effects such as myelosuppression and hypersensitivities.

Methods: A medication use evaluation was conducted to determine the efficacy of a twice weekly SMX/TMP regimen for prevention of breakthrough PJP infection as a primary outcome. In March of 2016, JDCH adopted the twice weekly SMX/TMP regimen for PJP prophylaxis and a retrospective chart review was conducted from March 1, 2016 to September 30, 2017. Pediatric oncology patients actively receiving treatment for their malignancy and on PJP prophylaxis with SMX/TMP were included. Patients with a documented sulfa allergy, on an alternative PJP prophylactic agent, or expiring due to their malignancy, were excluded. The secondary outcomes assessed were myelosuppression and drug intolerances experienced by patients.

Results: During the evaluation time period 123 patients were identified as pediatric oncology patients. Ten patients expired due to their malignancy and were excluded from the results. Sixty-one patients were on an alternative PJP prophylactic agent or had a documented sulfa allergy and were also excluded. A total of 52 patients were on SMX/TMP twice weekly and remained on this regimen exclusively throughout the evaluation period. No breakthrough PJP infection was reported in patients receiving twice weekly SMX/TMP. Seventeen patients were transitioned from thrice weekly to the twice weekly regimen, and 35 were initiated on the twice weekly regimen. Thirty-six patients had a primary diagnosis of Leukemia/Lymphoma, and 16 had other malignancies. There were no reports of myelosuppression or drug intolerances in the 52 patients.

Conclusions: The results of this evaluation indicate that a twice weekly SMX/TMP regimen is proving to be effective for the prevention of breakthrough PJP infection. The twice-weekly SMX/TMP regimen is well tolerated and is a viable option for PJP prophylaxis in pediatric oncology patients.

ACHIEVING TARGET VANCOMYCIN TROUGH LEVELS: EFFECTIVENESS OF A NOVEL NEONATAL DOSING GUIDELINE. Robert Godin, Juan Carlos Rodriguez, and Octavio E Casanova. *Joe DiMaggio Children's Hospital, Hollywood, USA; BayCare Health System, Clearwater, USA*

Introduction: Optimal vancomycin dosing in neonates remains challenging. Current guidelines target vancomycin trough concentrations of 10–20 mg/L, with a higher goal range of 15–20 mg/L for serious infections. Literature reports successful achievement of those target levels in 25.1% and 17.5% of cases, respectively. A novel neonatal vancomycin dosing guideline was implemented at Joe DiMaggio Children's Hospital (JDCH) on 7/21/2016; it achieved target trough concentrations in 84.6% and 35.5% of collected samples for the

above ranges (Poster, 26th Annual PPAG Conference, Charlotte, NC). Data collection continued beyond the 2017 poster presentation to increase sample size and the analyses' power.

Methods: Vancomycin regimens were stratified into specific patient weight and serum creatinine range categories. The Neonatal Critical Care Committee approved the JDCH guideline, and the guidelines were incorporated into order sets in the electronic health record (EHR). All vancomycin trough levels drawn from neonatal intensive care patients dosed according to the JDCH guideline were evaluated. Primary outcome compared the percentage of vancomycin troughs in the 10–20 mg/L range to literature-reported rates. Secondary outcomes included percentage of levels in the 15–20 mg/L range, and incidence of nephrotoxicity during or within 7 days of vancomycin discontinuation using nRIFLE criteria.

Results: A total of 152 vancomycin trough levels were documented for patients dosed using the JDCH guideline. Troughs in the 10–20 mg/L range were realized in 130 of 152 (86%) of levels drawn compared to 25.1% in literature-based regimens, resulting in a 3.4 fold increase in target level achievement rate. A total of 60 of 152 trough levels (40%) were documented within the 15–20 mg/L range versus 17.5% in the literature, a 2.3 fold increase in therapeutic level attainment for this higher range. Renal risk or dysfunction meeting nRIFLE criteria was identified in 11 of 152 patients (7.2%) during or within 7 days post vancomycin course discontinuation; 9 met criteria for risk, 1 for injury, and 1 for failure. At least one confounding factor associated with nephrotoxicity was identified in 8 of 11 cases; all cases were transient.

Conclusions: The JDCH neonatal vancomycin dosing guideline was successful in achieving trough levels in the 10–20 mg/L range in 86% of samples drawn, a higher rate than in previously published protocols. In addition, when targeting levels in the 15–20 mg/L range, that goal was achieved 40% of the time. The authors' goals are to further analyze the data collected and modify the guideline to further increase the percentage of patients achieving therapeutic trough levels, particularly when targeting the higher end of the goal range. Although some patients met criteria for renal risk or dysfunction, vancomycin could not be directly implicated as the cause of nephrotoxicity.

ORAL VERSUS INTRAVENOUS MEDICATION FOR THE TREATMENT OF PATENT DUCTUS ARTERIOSUS: A COST SAVINGS INITIATIVE. Robert Godin, Juan Carlos Rodriguez, Bruce Schulman, and Doron Kahn. *Joe DiMaggio Children's Hospital, Hollywood, USA*

Introduction: Various treatment regimens are described in the literature for the management of patent ductus arteriosus (PDA). Management options include “watchful waiting” with or without fluid restriction, phar-

macotherapy, and/or surgical ligation. Intravenous (IV) ibuprofen lysine (IBU) is considered the drug of choice when pharmacologic management is chosen. More recently, acetaminophen (APAP) has been added to the arsenal of medications available to treat PDA. Recent literature supports prescribing IBU or APAP, administered via either the IV or oral (PO) route, as equally efficacious. The purpose of this quality improvement project is to quantify the cost savings realized after adopting medication use criteria promoting the use of enteral pharmacologic agents for the treatment of hemodynamically-significant PDA (hsPDA).

Methods: HsPDA was defined based on clinical and echocardiographic criteria according to unit protocols. Pharmacists and neonatologists met and developed PO IBU and PO APAP usage criteria for the treatment of hsPDA and incorporated them into the electronic health record's (EHR) order set. Oral IBU and PO APAP use was encouraged and preferentially chosen over IV IBU and IV APAP unless there were contraindications to enteral medication administration. A 6-month medication utilization report was generated from the EHR post-criteria implementation to identify neonates who were prescribed IBU or APAP to treat hsPDA. The cost savings realized from administering PO in place of IV formulations were quantified. Savings were calculated using the cost differences between IV IBU and PO IBU and between IV APAP and PO APAP.

Results: Costs for the individual dosage forms were as follows: IV IBU \$507.50/vial, PO IBU \$0.51/dose, IV APAP \$33.11/vial, and PO APAP \$0.56/dose. This resulted in cost savings of \$506.99/dose for PO IBU compared to IV IBU and \$32.55/dose for PO APAP compared to IV APAP. There were 43 courses of PO IBU and 24 courses of PO APAP ordered, resulting in 124 and 285 documented medication administrations, respectively. Overall, a total of 409 IV doses were substituted by PO doses, which realized a total cost savings of \$72,143.51 for the 6-month evaluation period.

Conclusions: In the treatment of PDA, published literature supports the use of PO IBU and PO APAP as comparable in efficacy to their more costly IV formulations. At our institution, the criteria developed to promote the use of lower cost oral treatment alternatives for the pharmacologic management of hsPDA resulted in cost-savings exceeding \$72,000 over a 6-month period. These savings should serve as a platform to accept low cost PO IBU and PO APAP as first line treatment options in the pharmacologic management of hsPDA in neonatal intensive care units.

IMPROVING MEDICATION SAFETY IN KETOGENIC PATIENTS. Robin Dills, Mary Subramanian, Greta Haggstrom, and Elizabeth Woods. *Wake Forest Baptist Health, Winston-Salem, USA*

Introduction: The ketogenic diet is a high fat, low

carbohydrate, low protein diet designed to increase the body's dependence on fatty acids for energy rather than glucose. It is used as a treatment option for children with refractory seizure disorders. Brenner Children's Hospital cares for approximately 40 chronic ketogenic diet (KD) patients who have recurring readmissions. After medication errors occurred involving these patients inadvertently receiving carbohydrate containing medications, we explored options to prevent future errors. A dextrose allergy alert was already in place in our electronic medical record (EMR). Unfortunately, the dextrose allergy failed to flag all carbohydrate containing medications.

Methods: Due to these errors, important process changes have been made in the EMR. These changes targeted improving patient safety by easily identifying KD patients at order entry and verification. Pediatric pharmacy worked with the information technology (IT) team to make these systems improvements. A KD Best Practice Advisory (BPA) was developed by the IT team. The BPA alerts prescribers, pharmacists and nurses at order entry and verification when a patient is on a KD. A shared list was developed in the EMR for KD patients. The pediatric pharmacists identify patients who are admitted to the children's hospital and on a ketogenic diet daily. These patients are posted in the pharmacy as a high alert patient. The BPA is triggered on admission for patients on this list. Work began on this project in December 2016. The IT team developed the process for the BPA to be triggered by a FYI flag in early January 2017. The project was approved by Inpatient Governance in early February 2017. The implementation date for the KD BPA was March 28, 2017.

Medications such as a clindamycin premix with hidden dextrose content were also identified. These medication ERX records were updated to include carbohydrate content to trigger the dextrose allergy alert. The time-frame for this improvement was between April to May 2017.

Results: Based on limited data there has been a clinically meaningful reduction in the number of errors related to medications in our KD patients. Prior to implementation of the programs, eight adverse patient events were identified over a two-year period in the medication error reporting system. No adverse events related to unintentional administration of carbohydrate containing medications have occurred in the 11 months since the implementation of these programs.

Conclusions: A multidisciplinary program was developed allowing all inpatient providers to easily identify KD patients when orders are processed. The addition of the hidden carbohydrates in nearly all medication records now triggers the dextrose allergy alert. The next step is to evaluate implementing similar changes in the outpatient pharmacy areas and outpatient drug dictionary to ensure safe dispensing of home medications for KD patients.

INNOVATIVE USE OF IN-ROOM TECHNOLOGY TO EXPEDITE TREATMENT OF SEIZURES IN HOPITALIZED PEDIATRIC PATIENTS. Sarah Scarpace Lucas, Arpi Bekmezian, Julie Wilson Ganz, Kendall Nash, Sarah Pollet, and Kevin Spolini. *UCSF Benioff Children's Hospital, San Francisco, USA*

Background: Status epilepticus (SE) is associated with increased morbidity and mortality; early and rapid escalation of treatment is critical to prevent neuronal injury. Treatment guidelines recommend initial anti-epileptic therapy at 5 minutes and rapid escalation to second-phase therapy if seizure persists. A prospective multicenter study and preintervention review at our institution confirmed delayed treatment in hospitalized children.

Objective: To reduce the time between seizure onset and initial benzodiazepine (BZD) administration from 7 minutes (pre-intervention) to 5 minutes or less and to reduce the time between second-phase non-BZD (phenobarbital, phenytoin, levetiracetam, valproic acid) order to administration from 28 minutes (pre-intervention) to less than 10 minutes for inpatients with persistent seizure requiring urgent therapy.

Design/Methods: A multidisciplinary team developed a key driver diagram to identify opportunities to improve efficiency. Interventions targeted team communication and medication delivery. We stocked all pyxis with intranasal/buccal BZD available on "nursing override" for easy access and administration. Non-BZDs require pharmacy compounding and the main pharmacy receives many STAT orders with competing priorities. We developed a hospital-wide seizure rescue (SR) process by using patient room staff terminals to activate pharmacy. We educated care teams about rapid treatment goals and trained nurses to press the SR button for any seizure that may require urgent therapy. The SR pharmacist arrived at the bedside with a backpack stocked with non-BZDs ready to compound. We reviewed the medical records of all patients with SR activations.

Results: Of the 102 seizures during the post-intervention period (July 2016–October 2017), 60 required urgent therapy. Median time from seizure onset to initial BZD therapy decreased from 7 minutes (pre-intervention) to 2 minutes (post-intervention). Median time from order to administration of non-BZDs decreased from 28 minutes (preintervention) to 11 minutes (post-intervention).

Conclusions: By leveraging existing patient room technology to mobilize pharmacy to the bedside we expedited non-BZD administration by 60%. Further, the rapid response SR process may have created an increased sense of urgency, helping to expedite initial BZD administration by 70%. This consequently may have prevented progression to SE, need for second phase therapy, and neuronal injury—all without requiring the additional resources of a Code team.

STEWARDSHIP EX NIHILO: EFFECTIVE ANTIMICROBIAL STEWARDSHIP IN THE PEDIATRIC INTENSIVE CARE UNIT. Weng Man Lam, Hillary Orr, and Michael L. Chang. *Children's Memorial Hermann Hospital, Houston, USA; McGovern Medical School, Houston, USA*

Introduction: Antimicrobial stewardship program (ASP) aims to improve the quality of antimicrobial use: achieving optimum clinical outcomes, ensuring cost-effectiveness of therapy, while minimizing the consequences of antimicrobial use (toxic effects and emergence of resistance). Children's Memorial Hermann Hospital (CMHH) has 278 licensed pediatric beds, including 30 pediatric intensive care unit (PICU) beds located within Memorial Hermann - Texas Medical Center, an 856 bed academic, tertiary referral and Level 1 trauma center. While Memorial Hermann had an adult ASP pharmacist, there was no dedicated pediatric program. CMHH leadership established a pediatric ASP with 0.5 FTE for a physician director, and utilized existing clinical pharmacists (without additional FTE).

Methods: To maximize limited FTEs for ASP we focused on the PICU, starting prospective audit and feedback between January 1, 2017 through September 30, 2107. We used TheraDoc clinical decision support system to identify patients on active antibiotic therapy and for documenting ASP interventions. The assigned PICU pharmacist and pediatric ASP physician met twice weekly on average for 3 hours (approximately 0.15 FTE pharmacist time) in the PICU which allowed the ASP to interact directly with prescribers to discuss recommendations. We utilized predefined stewardship interventions in TheraDoc (i.e. discontinue inappropriate antimicrobials). Each intervention was rated as accepted, accepted modified and rejected by the prescriber.

Results: In 9 months period, 783 audits were performed. The most frequent interventions were: "discontinue inappropriate antimicrobials (n=140, 17.9%)", "antimicrobial optimization (n=73, 9.3%)" and "streamline/de-escalate Gram-negative therapy (n=39, 5%)". Overall, 84.7% of recommendations were accepted and 15.3% were rejected. "Discontinue inappropriate antibiotics" had the lowest acceptance: 56.4%. Other recommendations were more frequently accepted: "Streamline/de-escalate Gram-positive antibiotics" at 88.2% and "Streamline/de-escalate Gram negative antibiotics" at 79.5% acceptance. Despite limited scope, the estimated cost savings were approximate US \$52,000. Meropenem use also decreased 35% (days of therapy / 1000 patient days) year-over-year. We identified areas for improvement (e.g. reducing duration of therapy for positive respiratory cultures), but without information technology (IT) support gathering data for prescribers to guide quality improvement was difficult. The ASP also helped Infection Prevention with activities such as outbreak investigations.

Conclusions: For a pediatric "hospital within a hospital",

a clinical pharmacist and physician with limited FTEs for ASP can effectively implement prospective audit and feedback. Our pilot program provided foundational information and justification for 1.0 FTE for pediatric ASP pharmacist for 278 beds. Face-to-face interactions were effective, but increased frequency of ASP to provider interactions along with improved data analytics and IT support could significantly improve the effectiveness of the ASP program.

INNOVATIVE/NOVEL CASE REPORTS OR SERIES

ROMIPLOSTIM IS EFFECTIVE FOR TREATING THROMBOCYTOPENIA IN PEDIATRIC HEMATOPOIETIC STEM CELL TRANSPLANT (HSCT) RECIPIENTS.

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Introduction: Thrombocytopenia is an anticipated outcome following stem cell transplant, but platelet recovery usually follows a predictable pattern. Prolonged thrombocytopenia following transplant can be the result of graft failure, disease recurrence, viral infections, medications, autoimmunity, and/or graft-versus-host disease. In allogeneic HSCT recipients, the incidence of prolonged thrombocytopenia is between 5%–37%. It is postulated that delayed platelet recovery is due to enhanced platelet consumption and/or compromised platelet production resulting in elevated thrombopoietin activity similar to patients with aplastic anemia. Romiplostim is a thrombopoietin receptor agonist that acts by stimulating thrombopoiesis. It is currently FDA-approved for chronic ITP at a dose of 1 mcg/kg subcutaneously once weekly with dose adjustments to a maximum of 10 mcg/kg targeting a platelet count between 50–200 K/mm³. There are multiple reports of using romiplostim in adults post-HSCT, however data on pediatric use is limited.

Case Report: We report on the use of romiplostim in two pediatric patients for the treatment of prolonged thrombocytopenia following allogeneic HSCT. **Patient 1** is a 13-year-old female status-post allogeneic HSCT from an HLA-matched unrelated donor for AML using a conditioning regimen of BuCyATG. She had an average platelet count of 22.24 K/mm³ from the transplant date to her first dose of romiplostim 5 mcg/kg on day +67. Due to suboptimal response, the dose was increased to 9 mcg/kg weekly on day +81. A platelet count maximum of 187 K/mm³ was achieved on day +179 and romiplostim was tapered off by day +214. After

the discontinuation of therapy, her platelet count has remained consistently above 100 K/mm³.

Patient 2 is a 4-year-old female status-post allogeneic HSCT from an HLA-matched unrelated donor for MSMD using a conditioning regimen of BuCyFlu, thiopeta, and ATG. She had an average platelet count of 22.16 K/mm³ from the transplant date to her first dose of romiplostim 5 mcg/kg on day +45. Due to suboptimal response, the dose was escalated to 8 mcg/kg weekly starting on day +91. Her platelet count increased from ~30 K/mm³ to ~70 K/mm³ and therapy was discontinued until her platelet count decreased to ~30 K/mm³ around day +154. Romiplostim was reinitiated at a dose of 5 mcg/kg for one week, followed by weekly doses of 10 mcg/kg, which she continues to receive due to persistent platelet consumption.

Conclusions: The use of romiplostim appears to be an effective treatment for prolonged thrombocytopenia secondary to BMT in pediatric patients. Doses required for this indication appear to be much higher than those for chronic ITP. Our approach is to initiate romiplostim at 5 mcg/kg subcutaneously once weekly, titrating up to a maximum of 10 mcg/kg once weekly based on platelet response. Once stabilized, the doses are then titrated down gradually at discontinuation to avoid rebound thrombocytopenia.

PHARMACOKINETICS OF INTRAVENOUS GANCICLOVIR AND ORAL VALGANCICLOVIR IN PRETERM TWINS WITH CONGENITAL CYTOMEGALOVIRUS INFECTION. Charles-Olivier Chiasson, Piché-Renaud Pierre-Philippe, Ovetchkine Philippe, Autmizguine Julie, Lachance Christian, and Martin Brigitte. *CHU Sainte-Justine, Montreal, Canada; Université de Montréal, Montreal, Canada*

Introduction: Congenital cytomegalovirus (CMV) is the most frequent viral congenital infection and the main cause of acquired sensorineural hearing loss (SNHL). Treatment with intravenous (IV) ganciclovir or oral valganciclovir has been shown to decrease the risks of CMV-related SNHL. Although extremely low birth weight (ELBW) infants are at increased risk of developing long-term CMV-related complications, data on the optimal dosing regimens is lacking in this vulnerable population.

Case Report: We present a case of twin brothers born after 27+3 weeks of gestation. The pregnancy was complicated by twin-to-twin transfusion syndrome (TTTS). Upon symptomatology concordant with congenital CMV, serum CMV polymerase chain reaction (PCR) were performed and IV ganciclovir was initiated in both infants within day of life (DOL) 5. Lumbar puncture detected a significant CMV viral load in the cerebrospinal fluid of infant 2 only. While the clinical course of infant 1 was free of any CMV-related complication, infant 2 developed necrotizing enterocolitis (NEC) at DOL 12,

for which he underwent surgical intestinal resection. While CMV viral load in blood was decreasing under treatment, PCR realized on the resected portion of intestine was positive for CMV. After approximately 4 weeks of treatment, blood PCR had become negative and treatment was completed for a total of 6 months. At the 18-months follow up, both infants displayed normal neurodevelopment and satisfactory auditory evoked potentials. Treatment with intravenous ganciclovir was initiated at 3 mg/kg every 24 hours. The dose was then adjusted according to serial therapeutic drug monitoring (TDM). This initial dose was proposed secondary to immaturity of renal function in ELBW infants, concerns on renal function in TTTS infants, and increased serum creatinine. Using ganciclovir peak and trough plasma levels, area under the curves (AUC) were estimated and served for dosing adjustments. Ganciclovir doses were adjusted for a targeted AUC_{12h} of 27 mg.hr/L (range 20–36 mg.hr/L). As renal function matured, elimination half-life decreased and reached term infant values at approximately DOL 70. Regarding toxicity, infant 2 had persistent thrombocytopenia from birth to one month of life and infant 1 developed neutropenia after switching from ganciclovir to valganciclovir. However, it is difficult to determine if those results were precipitated by adverse drug events, CMV disease, and in the case of infant 2, prematurity and NEC. Thus, dose reduction was not deemed necessary for both infants based on hematological values.

Conclusions: We describe the case of twin infants with congenital CMV in whom treatment with ganciclovir and valganciclovir was associated with favorable neuro-development long-term outcomes. The data derived from the serial AUCs bring valuable information regarding the evolution of oral absorption, drug metabolism and excretion in ELBW infants with maturing pharmacokinetic parameters, justifying the use of TDM in this population.

USE OF METHYLNALTREXONE FOR OPIOID-INDUCED CONSTIPATION IN A CRITICALLY-ILL, POST-OPERATIVE INFANT TREATED IN THE CARDIOVASCULAR INTENSIVE CARE UNIT. Christina Smith, Joanna Robbins, and Nancy Chang. *Loma Linda University Children's Hospital, Loma Linda, USA*

Introduction: Opioid-induced constipation is a common complication experienced by patients treated in the cardiovascular and pediatric intensive care units. Methylnaltrexone, a peripherally-acting selective mu-opioid receptor antagonist administered subcutaneously, presents as a potential solution in patients who are refractory to oral and rectal medications used for constipation, those who are unable to take medications via the gastric route, and in situations where gastric absorption is of concern. However, information regarding methylnaltrexone use

outside of the adult and pediatric oncology populations, specifically critically-ill infants and children, is limited.

Case Report: A 4-month-old male with multiple congenital heart defects was admitted to the cardiovascular intensive care unit for post-operative care following repair of two lesions. The patient remained intubated and mechanically ventilated for an extended period of time during which he received opioid analgesia, including continuous infusions of morphine and hydromorphone, as well as scheduled enteral methadone. Despite administration of glycerin suppositories and docusate, the patient developed constipation with obstruction and abdominal distention, and the inability to begin enteral feeds. After initiating enteral methadone and lorazepam, attempts to titrate off of continuous analgesia and extubate the patient failed in part due to desaturation events associated with agitation. With concern for malabsorption of the enterally administered pain and sedation medications, methylnaltrexone was administered to the patient as two doses given 48 hours apart. After receiving the medication, the patient's distention and ileus resolved, enteral feeds were initiated, and the patient was successfully extubated and transitioned completely to enteral medications, with no adverse effects observed.

Conclusions: This case report suggests that methylnaltrexone may be a safe and effective medication option for use in opioid-induced constipation experienced in the pediatric critical care setting.

PHARMACOKINETICS OF INHALED TOBRAMYCIN IN A POST HEMATOPOIETIC CELL TRANSPLANT PATIENT WITH BRONCHIOLITIS OBLITERANS AND END-STAGE RENAL DISEASE. Deni Trone and Elizabeth Hall. *St. Jude Children's Research Hospital, Memphis, TN, USA*

Introduction: There are no widely accepted dose alterations for inhaled tobramycin in the setting of renal dysfunction and serum concentrations are not typically monitored. Literature in the cystic fibrosis population suggests that systemic peak concentrations occur 1 to 2 hours post-administration and do not reach levels that could potentially cause toxicity.

Case Report: A 17-year-old female with a history of two hematopoietic cell transplants and kidney transplant was admitted to St. Jude Children's Research Hospital with respiratory distress secondary to an acute exacerbation of chronic bronchiolitis obliterans. A bronchoalveolar lavage was positive for *Pseudomonas aeruginosa* and *Cladosporium* species; she also had a positive Aspergillus antigen. After completing initial pneumonia treatment, the patient was transitioned to inhaled tobramycin for chronic *P. aeruginosa* management. On admission, the patient also presented with acute kidney injury that progressed into chronic kidney disease; therefore, tobramycin levels were

monitored. Initially, she received a reduced dose of tobramycin and was re-dosed when serum concentrations fell below 1 mg/L. To optimize antibiotic exposure and achieve greatest efficacy, a plan was devised to gradually increase to the typical 300-mg dose and to administer the medication approximately 1 hour prior to dialysis to correlate with the time of expected maximum serum concentrations. The patient tolerated the dose increase. A sputum concentration was obtained one hour after the dose to verify that the concentration was adequate for *P. aeruginosa* suppression. The peak sputum concentration was 2745 mg/L and a peak serum concentration at the same time was 1.7 mg/L, both of which are within the expected range. Thus, the patient's dose was determined to be safe and efficacious.

Administering the inhaled tobramycin immediately prior to dialysis did not improve the frequency of dosing. Serum concentrations were not affected by dialysis as concentrations the following day were relatively unchanged, leading to a hypothesis of delayed systemic absorption. To test this hypothesis, the tobramycin administration was changed to the evening prior to dialysis. Subsequently, tobramycin serum concentrations were less than 1 mg/L post-dialysis. The frequency of inhaled tobramycin administration was increased from twice weekly to three or four times weekly, depending on the number of dialysis sessions per week.

Conclusions: Tobramycin pharmacokinetic characteristics, including time to peak serum concentration, may vary when used inhaled drug is used outside of the cystic fibrosis population with normal renal function. Therapeutic monitoring of serum concentrations for inhaled tobramycin should be considered in patients with diminished renal function to prevent drug accumulation and associated toxicities.

USE OF N-ACETYLCYSTEINE FOR GASTRIC LACTOBEZOARS IN A 3 MONTH OLD. Dimitrios Savva, MacKenzie Crist, and Allison Lardieri. *University of Maryland School of Pharmacy, Baltimore, USA; University of Maryland Medical Center, Baltimore, USA; U.S Food and Drug Administration, Silver Spring, USA*

Introduction: Gastric lactobezoars (GLB) are a result of the inability to digest milk and mucous. While GLBs are the most common type of bezoars in infants, other types of bezoars include tricho-, phyto-, mixed food-, or medication-bezoars. Risk factors for GLBs include both formula specific or endogenous sources. Formulas that contain high casein concentrations, medium triglyceride oils, or high caloric density can increase the risk of GLBs. Other contributory factors to the formation of GLBs include dehydration, immature gastrointestinal tract, low-birth weight, and medications that cause decreased gastric secretion or delayed gastric emptying. N-acetylcysteine (NAC) is a mucolytic agent used to clear secretions and is hypothesized to be effective in

the treatment of GLBs due to the cleavage of disulfide bonds in mucoproteins. Below describes a case of the utilization of NAC in GLB at our institution.

Case Report: The patient was a 1-month-old male (4.5 kg ex 40 wk) who was transferred to the pediatrics floor for continued poor oral feeding after a one month NICU stay. His hospital stay was complicated by respiratory failure secondary to meconium aspiration syndrome (MAS) with pulmonary hypertension requiring nitric oxide support, suspected sepsis, and completion of cooling protocol for moderate hypoxic ischemic encephalopathy (HIE). An upper GI series identified a large persistent filling defect in the distal body which was most suggestive of a milk bezoar. Pharmacy was consulted to review the use of NAC for the management of the patient's milk bezoar. A dose of 45 mg (10 mg/kg) of 10% NAC diluted in 50 mL of normal saline was recommended. A total of 0.45 mL of NAC 10% was added to 50mL of normal saline. We recommended a frequency of every 6 hrs administered over 30 min via NG tube followed by clamping of the NG tube for 2 hrs. The importance of aspirating the stomach contents at 3 hr and 6 hr post NAC administration was discussed. A total of 4 doses were administered every 6 hr with total aspirate volumes of 8 mL, 5mL, 5mL, and less than 1 mL. Treatment was stopped when final aspirates were a clear mucus consistency. The patient underwent G-tube placement the next day with no further complications and the ability to advance feeds. The patient was discharged 2 days later with follow-up with pediatric surgery outpatient.

Summary: This is a patient case where 10 mg/kg/dose of 10% NAC in 50 mL NS given every 6 hr for at least 4 doses was successful in the treatment of gastric lactobezoar. Utilization of NAC can prevent severe gastrointestinal complications of GLBs and is well tolerated in infants.

USE OF VEDOLIZUMAB FOR THE TREATMENT OF REFRACTORY REJECTION IN A PEDIATRIC INTES-TINAL TRANSPLANT PATIENT. Michelle Perez and Kathy Nixon. *Holtz Children's Hospital, Jackson Health System, Miami, USA*

Introduction: Acute cellular rejection is one of the complications of intestinal transplantation which may lead to graft dysfunction or loss. Drugs available to treat rejection have unwanted systemic side effects which can lead to other complications. Vedolizumab is a humanized monoclonal antibody that specifically binds to alpha4beta7 integrin and blocks the interaction of alpha4beta7 integrin with mucosal addressin cell adhesion molecule-1 (MAdCAM-1) inhibiting the migration of memory T-lymphocytes across the endothelium into inflamed gastrointestinal parenchymal tissue. Currently, it is FDA approved for the treatment of moderate to severe ulcerative colitis and Crohn's disease in adults

who have not responded or are intolerant to other therapies. Vedolizumab use in children is currently off-label and usually reserved for patients who have exhausted other therapies. Due to its mechanism of action being localized in the intestines, it may be useful in the treatment of rejection limiting unwanted side effects from currently available immunosuppressants. We describe our experience in the treatment of refractory rejection in a pediatric intestinal transplant patient with vedolizumab.

Case Report: A 10-year-old male with history of Hirschsprung's disease leading to intestinal failure received an isolated intestinal transplant at 1 year of age. He developed severe acute cellular rejection and suspected humoral rejection leading to suspected chronic rejection leading to graft loss and relisting for transplant. He underwent a second isolated intestinal transplant and his postoperative course was unremarkable. After 2.5 years he presented with abdominal pain, nonbloody, bilious vomiting and increased ostomy output. Scope with biopsy was done and results were significant for mild acute cellular rejection. He was treated with a steroid cycle without improvement followed by three doses of thymoglobulin and another steroid cycle. He also had suspected humoral rejection and received four doses of IVIG and one dose of rituximab. Symptoms improved for about 1.5 weeks after treatment. Scope and biopsy results were again significant for mild acute cellular rejection. Due to the amount of immunosuppression received previously, the decision was made to use vedolizumab. We decided to use a dose of 177 mg/m²/dose based on an ongoing clinical trial on the use of vedolizumab in pediatric inflammatory diseases. After the first dose there was improvement clinically and in pathology. Patient received four doses of vedolizumab. Three months after the last dose, scope and biopsy results showed improvement in symptoms and pathology.

Conclusions: We report our experience using vedolizumab in a pediatric intestinal transplant patient for the treatment of refractory rejection. Vedolizumab may be useful in the treatment or prevention of rejection. Further studies are needed to evaluate dosing and safety of vedolizumab in pediatric patients for treatment of rejection.

DESENSITIZATION TO INTRAVENOUS AMIKACIN AND CONVERSION TO INHALED AMIKACIN IN A PATIENT WITH CYSTIC FIBROSIS AND MYCOBACTERIUM ABSCESSUS COMPLEX LUNG INFECTION.

Sarah Parsons, Christina Hellauer, Angela Hogan, and Cynthia Epstein. *Children's Hospital of The King's Daughters, Norfolk, USA*

Introduction: Antibiotic allergies are more frequent in cystic fibrosis (CF) patients than in the general population. Hypersensitivity reactions restrict antibiotic selection and result in suboptimal therapy leading

to lung function decline. Patients with IgE mediated reactions often require drug desensitization to provide effective management of pulmonary infections. Nontuberculous mycobacteria (NTM) are recognized as important pulmonary pathogens causing significant morbidity in CF patients. Mycobacterium abscessus is the most commonly isolated rapidly growing NTM and is the third most common cause of complex lung disease. Eradication of this bacterium is challenging due to antibiotic resistance. Mycobacterium bolletii is a subspecies of the mycobacterium complex lung disease (MABC). This case reports a patient with hypersensitivity to aminoglycosides who failed an initial desensitization. The patient was successfully desensitized to intravenous amikacin and converted to inhaled amikacin for long term management. To date there are no published reports of desensitization with IV amikacin and subsequent inhaled administration.

Case Report: An 11-year-old female with CF and MABC presented with worsening of pulmonary disease including cough, hemoptysis, fever and declining pulmonary functions. She had a history of hypersensitivity reactions to multiple medications, including tobramycin, amikacin, imipenem, esomeprazole, and lumacaftor /ivacaftor. Treatment for mycobacterium bolletii was initiated with azithromycin, linezolid, and tigecycline with the addition of inhaled amikacin post intravenous desensitization. The first intravenous desensitization protocol was a 17-step dose escalating procedure doubling the dose of medication at a fixed time interval of 20 min. Following the second dose, the patient complained of itching and a red non-urticarial rash was noted on her infusion arm. Diphenhydramine was administered, and the infusion interval was increased to 40 min. The desensitization was restarted at 0.004 mg after administering methylprednisolone, famotidine, and montelukast as pretreatment medications. After the fifth dose, the desensitization was stopped due to complaints of throat tightness and tachycardia. Nineteen days later, a second desensitization involving a 12-step doubling dose process with fixed dose advancement intervals of 20 min was successfully completed over 8 hours. Pre-medication prior to the procedure included montelukast, famotidine, diphenhydramine, and midazolam. Prior to desensitization a flexible fiberoptic laryngoscopy was performed to examine the airway and remained available throughout the process in the event of laryngeal symptoms. Intravenous amikacin was continued for 6 weeks. The transition to inhaled amikacin occurred in the outpatient allergy clinic. She was continued on a combination of inhaled and intravenous therapy for two days and prescribed an epinephrine auto injection kit. The patient and family were provided additional education on the importance of adherence to maintain desensitization and prevent anaphylaxis during treatment.

Conclusions: This is the first report of desensitization to intravenous amikacin with transition to inhaled amikacin.

RUXOLITINIB USE IN A PEDIATRIC PATIENT FOR ACUTE GRAFT VERSUS HOST DISEASE WITH CONCURRENT TRANSPLANT-ASSOCIATED THROMBOTIC MICROANGIOPATHY. Tess Dyson, Jason Cleppe, Stephen Rumelhart, Arunkumar Modi, and Elizabeth Amelon. *University of Iowa College of Pharmacy, Iowa City, IA, USA; University of Iowa Stead Family Children's Hospital, Iowa City, IA, USA*

Introduction: Ruxolitinib is traditionally used to treat myelofibrosis and polycythemia vera; however, in 2016 it was granted a breakthrough designation by the FDA for the treatment of acute graft versus host disease (aGVHD) in adults. Ruxolitinib is a Janus Associated Kinase subtypes 1 and 2 (JAK1 and JAK2) inhibitor that prevents signaling processes of cytokines and growth factors. This suppression of pro-inflammatory cytokine production leads to decreased proliferation of T cells and aids in the treatment of GVHD. There are very few accounts in the literature looking at the use and dosing of ruxolitinib in pediatric patients with aGVHD. Khandelwal et al. published the use of ruxolitinib in pediatric allogeneic hematopoietic stem cell transplant patients with steroid-refractory aGVHD. In this study, they used a dose of 5 mg twice daily for patients greater than 25 kg and 2.5 mg twice daily for those under 25 kg. More studies are needed to determine safe and effective dosing of ruxolitinib in pediatric patients.

Case Report: We report the use of ruxolitinib in a 21-month-old female for treatment of aGVHD who also had transplant-associated thrombotic microangiopathy (TA-TMA). The patient received a second bone marrow transplant from a 10/10 HLA matched unrelated donor following non-myeloablative conditioning for relapsed hemophagocytic lymphohistiocytosis (HLH), along with rATG, mycophenolate mofetil and tacrolimus for GVHD prophylaxis. On day +21 she developed stage 3, grade II aGVHD involving the skin and gut. She did not have complete response to induction methylprednisolone (1 mg/kg twice daily for 7 days), so she was subsequently started on infliximab, budesonide and triamcinolone. On day +38, ruxolitinib 2.5 mg twice daily was started for steroid-resistant aGVHD. The ruxolitinib tablet was dissolved in 20 mL of water, stirred for 10 min, drawn into a syringe, and administered via NG tube. The patient responded to ruxolitinib, and systemic steroids were successfully weaned without aGVHD relapse. On day +61, she developed hypertension, microangiopathic hemolytic anemia, refractory thrombocytopenia, and a pericardial effusion and was diagnosed with TA-TMA. Tacrolimus was successfully tapered over 7 days while sirolimus was started to maintain treatment of GVHD; however, due to uncontrollable hypertension, sirolimus was stopped on day +94. The patient had complete resolution of TA-TMA after two doses of eculizumab. Ruxolitinib was tapered and stopped on day +117 due to the small potential risk of contribut-

ing to her recurrent bleeding. Mycophenolate mofetil and methylprednisolone were continued without any evidence of relapsed aGVHD.

Conclusions: Ruxolitinib can be safely and effectively dosed and administered to pediatric patients <2 years of age for the treatment of steroid-refractory aGVHD, and can be used in place of calcineurin inhibitors in the setting of TA-TMA.

RESEARCH AND SCIENTIFIC ABSTRACTS

MORPHINE UTILIZATION FOR NEONATAL ABSTINENCE SYNDROME IN INFANTS ADMITTED TO THE NEONATAL INTENSIVE CARE SERVICE VERSUS THE GENERAL PEDIATRIC SERVICE AT A LARGE PEDIATRIC HOSPITAL. Jessica Grah, Jennifer Hale, Mary White, Theresa A. Scott, Travis W. Crook, and Alison G. Grisso. *Monroe Carell Jr. Children's Hospital at Vanderbilt, Nashville, USA*

Objective: To compare the total amount of morphine (reported as mg and mg/kg to control for weight variability) used per infant with a primary diagnosis of neonatal abstinence syndrome (NAS) and cared for in the neonatal intensive care unit (NICU) versus on the pediatric medicine acute care floor (PMAC).

Methods: In this IRB-approved, medication utilization evaluation, morphine usage data was collected for infants diagnosed with NAS from January 1, 2015 through August 31, 2017. Data were extracted from the electronic medical record and maintained within a secure, database (REDCap). Inclusion criteria included infants with an estimated gestational age of >36 weeks, a maternal history of substance exposure during pregnancy and diagnosed with NAS, located in either the NICU or PMAC unit, and received at least 1 dose of morphine for a Modified Finnegan score > 8 for at least 2 measurements. Patients with complex and potentially confounding comorbidities (e.g., seizures, sepsis, respiratory failure, etc.) as assessed by champion physician and/or receiving continuous opioid infusions were excluded.

Results: A total of 76 infants were included in the review with 37 in the NICU group and 39 in the PMAC group. While there were no significant differences between the NICU and PMAC groups for initial morphine dose (mg/kg; 0.04 ± 0.01 and 0.04 ± 0.02 respectively; $p=0.25$) and max morphine dose (mg/kg; 0.06 ± 0.02 and 0.05 ± 0.02 , respectively; $p=0.45$), the total morphine dose (mg/kg) was significantly different - $5.3 \pm .5$ and $2.4 \pm .17$, respectively ($p<0.001$). Additionally, the length of stay and duration of therapy were both significantly different with the PMAC group having smaller means for both measures. There were no significant differences between estimated gestational age, birth weight, utilization of adjunctive therapy (clonidine), polysubstance exposure in utero, and number of rescue doses between groups.

Conclusions: Infants with NAS had less morphine utilization in the PMAC group than in the NICU group. Their duration of therapy and subsequently length of stay was decreased as well. A further review of factors that may aid in this is ongoing but is hypothesized to be the effect of the different environments on the infant and the ability of their caregivers to be more involved with care.

EVALUATION OF RECOMBINANT FACTOR VIIA FOR THE TREATMENT OF ACUTE PULMONARY HEMORRHAGE IN NEONATES. Allison Jones. Norton Children's Hospital, Louisville, USA

Objectives: To assess the utility of intravenous recombinant factor VIIa (rVIIa) for the treatment of acute pulmonary hemorrhage in neonates. Secondary objectives include incidence of thrombosis, rVIIa prescribing patterns, and the use of additional treatment modalities for pulmonary hemorrhage.

Methods: Retrospective chart review of neonates born between April 2015 and November 2017 who received at least one dose of rVIIa in the neonatal intensive care unit at Norton Children's Hospital or Norton Women's and Children's Hospital. Patients were excluded if they were >30 days of age or received rVIIa for indications other than pulmonary hemorrhage.

Results: Our study included 21 patients who received at least 1 dose of rVIIa for the treatment of suspected pulmonary hemorrhage. Baseline characteristics included 47.6% males, median gestational age 30 4/7 weeks (range 24 0/7-39 2/7 weeks), and median birth weight 1610 grams (range 570–3480 grams). 18 of the 21 patients were preterm, defined as less than 37 weeks gestational age. Pulmonary hemorrhaging occurred on median day of life 2 (range 1-21), with 16 of the 21 patients already intubated at time of hemorrhage. 3 of the patients were documented as having very mild or pink tinged secretions, with 1 documented as likely mild bleeding from endotracheal tube irritation. With an overall mortality rate of 33.3% (n=7), only 4 patients died within 24 hours of rVIIa administration. 2 of these 4 patients received 2 doses of rVIIa. After excluding term neonates (n=3) and those with documented mild bleeds (n=3), the overall survival rate was 56.3%. Most patients (n=19) were prescribed a dose of 90 mcg/kg of rVIIa, with the remaining 2 patients prescribed 30 mcg/kg and 45 mcg/kg. 15 of the 21 patients received either fresh frozen plasma or packed red blood cells as concomitant therapy. 8 patients were administered endotracheal epinephrine, while 2 were administered surfactant for treatment of hemorrhage. No incidence of thrombotic events was reported.

Conclusions: Recombinant factor VIIa administration in neonates with pulmonary hemorrhage appears to be a reasonable therapy option, and was not associated with thrombosis. Prospective studies are needed to evaluate the optimal dose, frequency, and long term adverse

effects. Given the significant cost of rVIIa and limited safety data, administration should be limited to those with clinically significant, severe pulmonary hemorrhage.

PILOT STUDY COMPARING THE MODIFIED FINNEGAN VERSUS AN ADJUSTED SCORING SYSTEM FOR INFANTS WITH IATROGENIC OPIOID ABSTINENCE SYNDROME STATUS-POST CARDIO-THORACIC SURGERY. Amanda Capino, Peter Johnson, Patricia Williams, Michael Anderson, Susan Bedwell, and Jamie Miller. University of Mississippi School of Pharmacy, Jackson, USA; University of Oklahoma College of Pharmacy, Oklahoma City, USA; University of Oklahoma College of Medicine, Oklahoma City, USA; University of Oklahoma Health Sciences Center, College of Public Health, Oklahoma City, USA; OU Medical Center, Oklahoma City, USA

Objectives: The purpose of the study was to determine if using an adjusted Finnegan Scoring System (adjusted Finnegan) by excluding neonatal specific criteria from the modified Finnegan Scoring System could affect the management of drug withdrawal in infants. The primary objective of the study was to compare the mean difference between the modified Finnegan and adjusted Finnegan for infants with iatrogenic opioid abstinence syndrome (IOAS) status-post cardiothoracic surgery (CTS). The secondary objectives were to compare scoring tools and identify interventions for infants with elevated modified Finnegan scores.

Methods: This was a retrospective, observational, pilot study conducted in a tertiary care academic hospital. Infants with IOAS status-post CTS transferred between the pediatric intensive care unit and the neonatal intensive care unit (NICU) between January 1, 2014 and January 31, 2016 were included. Data collection included demographics and sedative/analgesic exposure. Additionally, modified Finnegan scores and IOAS treatment information were recorded for a 7 day period. An adjusted Finnegan score was calculated retrospectively by the study investigators. This tool excluded newborn specific factors that were identified by the neonatal research team, including a clinical nurse specialist, neonatologist, and neonatal clinical pharmacist. To assess the primary objective, the Area Under the Curve (AUC) between the mean modified Finnegan versus adjusted Finnegan were calculated and assessed for normality using the Shapiro-Wilk test. A Student's paired t-test was utilized to assess differences, with a p-value <0.05.

Results: Twenty-five patients were included in the study. The majority of patients were male (64%). The median (range) age of the patients at time of transfer to NICU was 0.8 (0.5–4.4) months. Twenty patients with at least 30 scores were included in the final analysis. Overall, the modified Finnegan scores were at least two points higher than the adjusted Finnegan. The

difference in AUC was 34.6 ($p < 0.001$). The majority of patients (92%) received an enteral agent (i.e., methadone) for the prevention/treatment of opioid withdrawal during the 7 day period. During the 7 day period, four patients (17.4%) required an increase in their methadone dose. Overall, 4 of the 9 patients (44.4%) had an elevated modified Finnegan score greater than 8 suggesting withdrawal and received a pharmacologic intervention.

Conclusions: The use of the modified Finnegan Scoring System for older infants with IOAS has the potential to overestimate drug withdrawal leading to interventions that are not necessary.

STANDARDIZING MEDICATION CONCENTRATIONS AND IMPLEMENTING MAXIMUM ADULT DOSES IN A CHILDREN'S HOSPITAL.

Anasemon Aioub, Suzannah Kokotajlo, and Christine Robinson. *Morristown Medical Center, Morristown, USA; Ernest Mario School of Pharmacy, Piscataway, USA*

Objectives: Pediatric patients are at an increased risk of medication errors that can lead to harm, with incorrect dosing accounting for the most commonly reported error. The primary objective of this study was to increase patient safety through the implementation of standardized concentrations of select medications. The secondary objective was to optimize pharmacy workflow through the use of pre-packaged antibiotic formulations.

Methods: This study did not require Institutional Review Board approval. A list of the 200 most frequently used medications in a children's hospital was generated to assess where the greatest impact could be made. Pediatric nurses and pharmacists were consulted to identify medications prepared by nursing at the bedside versus those dispensed by pharmacy as patient-specific doses. Factors such as medication stability and order urgency were considered when establishing the criteria for pharmacy-prepared medications. All oral medications, chemotherapy, continuous infusions and those medications which already had standardized concentrations were excluded. Identified medications were given standardized concentrations according to manufacturer recommendations, commercial availability, and recommended concentrations in the literature. Maximum and commonly used adult doses were identified for antibiotic doses commercially available as premixes or DUPLEX bags and those batched using addEASE Binary Connectors. Data collected included waste and the quantity of medications prepared by nursing at the bedside versus those prepared by pharmacy as patient-specific unit doses. Those prepared by nursing at the bedside were categorized as non-manipulated full doses, manipulated partial doses, and manipulated dilutions. All changes were implemented on November 15, 2017. Pre-implementation data collection occurred

from November 1, 2017 to November 14, 2017 and post-implementation data collection occurred from November 16, 2017 to November 29, 2017.

Results: Ten medications were identified to be standardized and unit-dosed. The use of commercially available formulations for maximum and commonly used adult doses of twenty antibiotics was implemented. During the pre-implementation period, 57% of medications were unit dosed by pharmacy versus 62% in the post-implementation period. Moreover, 25% of doses prepared in the pre-implementation period required manipulation by nursing before bedside administration, versus 20% in the post-implementation period. Average medication waste per medication was variable during the study period.

Conclusions: Standardizing medication concentrations and adjusting pharmacy workflow allowed for a greater quantity of doses to be dispensed as patient-specific doses. Due to variable amounts of waste for each drug, no change in medication waste can be correlated to the effects of this study.

RETROSPECTIVE COMPARISON OF TWO ENOXAPARIN DOSING AND MONITORING PROTOCOLS AT A SINGLE PEDIATRIC HOSPITAL.

Angela Wolsey, Collin Anderson, Jared Olson, Roger Wilcox, and Sabrina Boehme. *Primary Children's Hospital, Salt Lake City, USA*

Objective: Achieving therapeutic anticoagulation levels in a timely manner can be challenging in pediatric patients. Anti-Xa levels are recommended for pediatric patients who are receiving enoxaparin treatment. Despite this recommendation, ideal dosing and monitoring practices for these patients remains unclear. The purpose of this study is to examine the impact of a change in both dosing and timing of anti-Xa levels on time to first therapeutic anti-Xa level and number of dosing changes required.

Methods: A single center, retrospective review of inpatients less than 18 years old that received enoxaparin treatment with anti-Xa monitoring performed during standard and large dosing periods. The standard dosing period occurred between January 1, 2008 and January 1, 2011, with enoxaparin starting doses at 1.5 mg/kg/dose (< 3 months) and 1 mg/kg/dose (> 3 months). During the standard dosing period an anti-Xa level was measured after the first dose. The larger dosing period was from March 1, 2012 to November 30, 2016 and enoxaparin starting doses were 1.7 mg/kg/dose (< 3 months), 1.5 mg/kg/dose (3 to 12 months), 1.2 mg/kg/dose (1 year to 5 years), and 1.1 mg/kg/dose (> 5 years). During the high dosing period an anti-Xa level was measured after the second dose.

Results: A total of 219 patients were included, 87 in the standard dosing group and 132 in the large dosing group. The following results are listed as median and

interquartile range. There was a significant difference in time to first therapeutic level when comparing standard dosing 0.7 days (0.2, 1.2) and large dosing 0.7 days (0.7, 2.2). The number of dose changes between low dosing compared with high dosing was not significantly different. There was no difference in supratherapeutic levels between groups. In the age subgroup analysis the 3 to 12 months group had differing results. In this age group there were significantly fewer dose changes to reach a therapeutic concentration in large dosing 1 (1, 2) compared with standard dosing 3 (2, 4.25). The time to two therapeutic levels was significantly longer for infants in the standard dosing group compared with high dosing, 3.25 days (1.7, 7) and 1.8 days (1.7, 3.6) respectively.

Conclusions: The median time to goal anti-Xa was the same between groups, suggesting that delaying anti-Xa levels until after the second dose, not the dosing, contributed to longer time to goal anti-Xa in the high dosing group. The high dosing strategy resulted in shorter times to goal anti-Xa in infants. A higher dosing strategy in combination with monitoring an anti-Xa level after the first dose may result in shorter times to goal anti-Xa levels and fewer dose changes.

EVALUATION OF NUSINERSEN: A RETROSPECTIVE CHART REVIEW ANALYSIS AT A PEDIATRIC HOSPITAL. Brett Leja and Michael Storey. *Nationwide Children's Hospital, Columbus, USA*

Objective: The primary objective of this study is to evaluate the use and efficacy of nusinersen in all patients who received at least one dose of the medication for spinal muscular atrophy (SMA) prior to 10/01/2017.

Methods: Outcomes were evaluated by a retrospective chart review via the electronic medical record from 01/01/2017 to 12/31/2017 in patients diagnosed with SMA who received nusinersen prior to 10/01/2017. Measurements compared baseline Children's Hospital of Philadelphia Infant Test of Neuromuscular Disorders CHOP INTEND scores and Hammersmith Functional Motor Scale (HFMSE) scores to scores post -four loading doses of nusinersen.

Results: A total of 37 patients received at least one dose of nusinersen prior to 10/01/2017. For patients with SMA Type 1, six completed CHOP INTEND assessments before and after four loading doses of nusinersen. Mean increase in CHOP INTEND score was 1.8 points (range -1 to +4). For patients with SMA Type 2, ten completed HFMSE assessments before and after four loading doses of nusinersen. Baseline average HFMSE score was 20.7 (range 2–45). The average HFMSE score at approximately 5 months after initiation of nusinersen was 23.6 (range 4–51). Mean increase in HFMSE score was 2.9 points (range -1– +7). For patients with SMA Type 3, four completed HFMSE assessments before and after four loading doses of nusinersen. Baseline

average HFMSE score was 39.25 (range 20–58). Average HFMSE at approximately 5 months after initiation of nusinersen was 44.75 (range 27–63). Mean increase in HFSME was 5.5 points (range 0–10).

Conclusions: Preliminary results suggest that nusinersen may improve performance in motor functional tests. It is warranted to continue to compare functional assessments as patients progress to maintenance phase of nusinersen treatment.

HYDROCORTISONE: A PLAYER BACK IN THE BRONCHOPULMONARY DYSPLASIA (BPD) GAME. Christie Clauss, Stacey Thomas, Igor Khodak, Melissa Fazzari, Nazeeh Hanna, and Caterina Tiozzo. *NYU Winthrop Hospital, Mineola, USA*

Objectives: Bronchopulmonary dysplasia (BPD) is a complication of prematurity resulting from arrested lung development with an associated inflammation due to prolonged ventilation and oxygen exposure. Dexamethasone has been utilized as treatment due to its anti-inflammatory action but adverse effects have cautioned its use. Hydrocortisone has been proposed as alternative therapy, but currently limited data are available. No literature is present on the role of prenatal conditions such as intrauterine growth restriction (IUGR) and maternal chorioamnionitis (CAM) on the effect of hydrocortisone as treatment for BPD. Our objectives are to evaluate hydrocortisone's efficacy and safety for treatment of BPD, the impact of IUGR status and maternal CAM on the response and the best route of administration.

Methods: A retrospective chart review of infants who received hydrocortisone therapy for BPD treatment was conducted with Institutional Review Board approval. Efficacy outcomes included decrease in oxygen requirement or extubation. Safety outcomes included serum glucose, blood pressure (BP), gastric perforation, head circumference and head ultrasound (HUS) imaging. The impact of CAM and IUGR on hydrocortisone efficacy and the best route of administration were analyzed. A logistic regression model was used to examine univariate association between efficacy and several patient factors of interest.

Results: 59 charts were reviewed, 35 patients included. Decrease in oxygen requirement or extubation was detected in 46% patients (95% CI= 0.29–0.63) and in 54% patients (95% CI= 0.33–0.73) in the IV administration subset (n=26). IV route of administration was associated with a higher response (OR=1.48, p=0.05) compared to the enteral route. 20% of patients had history of IUGR and had lower response rate (OR=0.68, p=0.05). History of CAM did not affect the response to hydrocortisone (OR=0.79, p=0.37). BP and serum glucose did not show a clinically significant change. HUS results were normal except for one periventricular leukomalacia. Head circumference did not decrease and gastric perforation

was not detected.

Conclusions: Hydrocortisone treatment appears to be an effective and overall safe treatment option for BPD based on the preliminary results. IV hydrocortisone should be considered as first line treatment in BPD patients, especially in the absence of history of IUGR.

PARENTERAL NUTRITION UTILIZATION WITHIN THE PEDIATRIC INTENSIVE CARE UNIT AS INFLUENCED BY THE EARLY VERSUS LATE INITIATION DEBATE.

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Objectives: Clinical trials in both adults and pediatric patients have questioned the benefit of early parenteral nutrition. In a large multicenter, randomized controlled trial, delaying parenteral nutrition (PN) for 1 week in critically ill children resulted in shorter duration of mechanical ventilator support and hospital length of stay. We implemented a process to delay parenteral nutrition for up to 5 days in our pediatric intensive care unit (PICU) in patients greater than 30 days of age. We conducted a retrospective study to determine the success and outcomes of our intervention.

Methods: We retrospectively identified all PICU patients admitted between January 1, 2015 and December 31, 2017. Our intervention period started on July 1, 2016. We excluded patients less than 30 days of age and admitted to the PICU after the second day of hospitalization. Our primary objective was to determine the percent of PICU patients receiving PN within the first 5 days of hospitalization. Secondary objectives included calculating the percent of patients receiving 3 days or less of PN during their entire hospitalization, and the percent of patients receiving PN during their hospitalization. We used Fisher's exact test to compare the rates between the two groups.

Results: A total of 2333 patients were identified in the pre-intervention group (PIG) and a total of 2488 patients in the delayed PN initiation group (DPN). The percentage of patients receiving PN within the first 5 days of hospitalization was 5.8% in the PIG versus 3.6% in the DPN group ($p < 0.01$). The percentage of patients receiving 3 days or less of PN decreased from 2.6% of patients to 1.5% ($p = 0.01$) and the percentage of patients receiving PN during their hospitalization decreased from 7% to 4.9% ($p < 0.01$) after the intervention. Average length of stay was 6.9 days in the PIG group and 6.5 days in the DPN group.

Conclusions: Debate continues over the appropriate time to initiate PN in the critically ill child, as evidenced by the recommendations released by the American Society for Parenteral and Enteral Nutrition and the Society of Critical Care Medicine which counter with expert consensus the aforementioned randomized controlled trial. In mid-2016 after consideration of available literature, our institution moved to routinely delay

PN within the PICU for up to 5 days. The purpose of this retrospective investigation was to determine the practice impact on PN use in our institution. Decreases in PN use was seen in the pre and post intervention groups as assessed by percentage of patients initiated within 5 days of admission as well as those who received 3 days or less of PN support.

EVALUATION OF A VENOUS THROMBOEMBOLISM (VTE) RISK ASSESSMENT TOOL IN A CHILDREN'S HOSPITAL.

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Objectives: Hospital-acquired VTE is recognized nationally as a common preventable cause of hospital-related death in adults. The prevalence of VTE in pediatric patients is on the rise with a documented incidence increase of 70 percent between the years of 2001 to 2007. CHEST guidelines are available to guide the clinician in the prophylaxis and treatment of VTE, however many of the recommendations made are reported as weak recommendations or of low quality evidence. Institutions have begun developing systemic processes to identify patients at risk of VTE. The goal of our medication use evaluation (MUE) was to analyze our institution specific risk assessment tool in selecting those with diagnosis of VTE and to analyze if receipt of prophylactic anticoagulation occurred.

Methods: This single-health system, MUE included all children admitted to Palmetto Health Children's Hospital with a diagnosis of VTE between January 1, 2006 to December 31, 2016. Our MUE analyzed the Palmetto Health Children's Hospital VTE Risk Assessment Tool in addition to two retrospectively validated tools. Each patient with diagnosis of VTE was screened for exposures to risk factors identified through the assessment tools and analyzed for receipt of prophylactic and treatment therapies for VTE.

Results: Our MUE included 49 patients between the ages of 1 month to 19 years old. Incidence of VTE occurred most often in the critical care setting ($n = 30$), however VTE also occurred in the general pediatric setting. Of the risk factors assessed, mechanical ventilation ($n = 28$), central venous catheter placement ($n = 43$), receipt of total parenteral nutrition ($n = 20$), direct admission to an ICU ($n = 27$), hospitalization greater than or equal to 7 days ($n = 36$) and immobilization ($n = 35$) were the most common risk factors identified in those patients who developed VTE.

Of the 49 patients assessed, 3 patients received VTE prophylaxis. Of those 12 years and older, the children's hospital assessment tool identified 10 of 14 patients who developed VTE. Unfortunately, only 2 of the 10 high risk patients identified were prophylactically anticoagulated. Regarding treatment of VTE, 39 of 49 patients

were treated with enoxaparin, 2 patients with heparin and 8 patients received no treatment.

Conclusions: Our MUE concluded our children's hospital risk assessment tool identified patients similarly to retrospectively validated tools regarding overall patient risk. Additionally, CVC placement occurred in all but 6 patients and warrants further investigation as a potential independent risk factor. Furthermore, greater vigilance should be given to those patients transitioning from the PICU to general pediatric floors as this MUE supports VTEs occurred outside of critical care units.

DEXTROSE GEL FOR NEONATAL HYPOGLYCEMIA.

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Objectives: Neonatal hypoglycemia is common among otherwise healthy newborns, and may be associated with brain injury and developmental delay in early childhood. Hypoglycemia management involves careful feeding and monitoring. If initial intervention fails, newborns may be admitted to the neonatal intensive care unit (NICU) for intravenous (IV) dextrose therapy. A newer approach to treat hypoglycemia is dextrose gel, given to newborns within the first 48 hours after birth alongside feeds. Clinical studies suggest that use of dextrose gel at 200 mg/kg/dose improves treatment success and reduces NICU admissions. Nonetheless, studies are limited and dextrose concentrations differ among formulations. The purpose of this study was to assess the safety and effectiveness of dextrose gel at 250 mg/kg/dose to treat neonatal hypoglycemia.

Methods: We performed a multicenter, retrospective chart review of hypoglycemic newborns before (pre-implementation; n=228) and after (post-implementation; n=194) the implementation of oral dextrose gel (250 mg/kg, 50% w/v) at Atlantic Health System. Hypoglycemic newborns (defined as blood glucose levels <40 mg/dL or <45 mg/dL at 0 to 4 and 4 to 48 hours of life, respectively) with gestational age greater than or equal to 35 weeks in the first 48 hours of life were included; newborns with symptoms of hypoglycemia, metabolic syndrome, or congenital anomaly associated with hypoglycemia were excluded. Our primary outcome was the percent of treatment failure, defined as persistent hypoglycemia at 1 hour after the second intervention in newborns before and after introduction of dextrose gel. Secondary outcomes included admission to NICU for hypoglycemia, number of feeds, use of an IV dextrose bolus, hyperglycemic episodes, and duration of hypoglycemia.

Results: The occurrence of treatment failure was 24% (55 newborns) versus 5% (9 newborns) (p<0.001) in pre- and post-implementation arm, respectively. The

total number of newborns admitted to the NICU for hypoglycemia was 39 (17%) versus 20 (10%) in pre- and post-implementation arm, respectively (p=0.04). Newborns in both arms received similar number of feeds during the first 48 hours of life (17.8 ± 0.5 versus 16.5 ± 0.3 , p=0.13). IV dextrose bolus was used in 26 (11%) versus 10 (5%) newborns in pre- and post-implementation arm, respectively. There was no difference between arms for duration of hypoglycemia (3.5 ± 0.2 versus 4.6 ± 0.5 hours, p=0.08). One newborn in each arm experienced hyperglycemia.

Conclusions: Treatment failure and NICU admission rates due to hypoglycemia decreased significantly following the introduction of oral dextrose gel in newborn nursery. Administration of dextrose 250 mg/kg/dose did not cause increased adverse effects. The use of dextrose gel at 250 mg/kg/dose is safe and effective for the treatment for neonatal hypoglycemia.

JUST BREATHE: THE UTILIZATION OF LEVALBUTEROL IN A PEDIATRIC HOSPITAL SETTING.

Elizabeth Faville, Christina Martin, Julie Tremblay, and Glen Kelton. *Lee Health, Fort Myers, USA*

Objectives: Acute respiratory failure is one of the leading causes of admission to the pediatric intensive care unit. Beta adrenergic agonists are first line for rapid reversal of bronchoconstriction. Levalbuterol is theorized to result in less tachycardia than albuterol, as the pure R-isomer is thought to be responsible for bronchodilation. Current literature has shown no difference in effectiveness or adverse effects as compared to albuterol. The purpose of this retrospective review was to assess the utilization of levalbuterol over a six-month period, along with the incidence of tachycardia. The inventory of levalbuterol was also evaluated to determine waste.

Methods: Data were collected from January 1, 2017 to June 30, 2017. Tachycardia was defined as a heart rate of 20 beats per minute above the patient's baseline heart rate prior to levalbuterol treatment. Heart rate values were age-adjusted based on the pediatric advanced life support criteria. Data collected included: history of asthma or cardiac disease, heart rate at baseline and while on levalbuterol, maximum systolic and diastolic blood pressures while on levalbuterol, respiratory support, albuterol or levalbuterol use prior to admission, inpatient duration of albuterol prior to levalbuterol, and number levalbuterol administrations. The average heart rate was calculated from the first three days of treatment and excluding the first three heart rate values after the initiation of levalbuterol in order to minimize confounding factors. As a secondary outcome, the number of levalbuterol nebulas purchased, returned, and wasted were included in a cost analysis.

Results: The average baseline heart rate prior to levalbuterol was >20 beats per minute (bpm) above the maximum normal heart rate for every age group (n=31)

except for infants aged 1 month to 1 year of age (n=35). Forty eight percent experienced tachycardia while on levalbuterol with an average of 37 bpm above baseline. Over 4,000 levalbuterol nebulas were administered during the six month period, with the average patient utilizing 64 nebulas per admission. In addition to the amount of nebulas administered to the patient, a total of 188 nebulas (8%) were wasted from Pyxis machines.

Conclusions: Almost 50% of patients experienced tachycardia during the first three days of treatment with levalbuterol. Previous studies have concluded that levalbuterol causes less tachycardia than albuterol. Current literature supports the results of this review which found that patients may still experience tachycardia with levalbuterol. Therefore, there may be limited benefit of switching from albuterol to levalbuterol to minimize tachycardia. Many factors can affect heart rate and this retrospective review did not assess for specific confounding factors such as dehydration and anxiety. Based on our results, proposed recommendations include establishing levalbuterol ordering criteria and/or the removal of levalbuterol from the formulary.

EVALUATING OVERALL ANTIBIOTIC EXPOSURE IN PATIENTS ADMITTED TO THE GENERAL PEDIATRIC SERVICE.

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Objective: To evaluate the number and effect of antimicrobial exposures in patients during hospital admission.

Methods: This was a single center, retrospective, descriptive study of patients less than 18 years who received at least 1 antibiotic dose between September 2013 and March 2014. The primary outcome was to identify the number, type (ceftriaxone, vancomycin, etc.) and classes of antibiotics prescribed during admission. Secondary outcomes include length of stay, culture results, and percentage of patients discharged with antibiotics. Continuous variables were reported as median (minimum-maximum) and tested between culture groups by Kruskal-Wallis test. Categorical variables are reported as count (%) and tested between culture groups by Chi-squared test or Fisher's exact test when expected cell counts were low.

Results: Patients were divided into 4 groups: positive culture (PC), negative culture (NC), no culture drawn (NCxD), and prophylaxis (PPX). Overall, median number of antibiotics used per patient was 2 (range 1-9). Patients with positive cultures received more types of antibiotics (median 3; range 1-9) and had prolonged lengths of stay (9.5 days; range 1-184). Overall median length of stay was 3 days. Patients who received more than 4 antibiotics had significantly longer lengths of

stay (16 days, range 1-184, $p<0.001$). Cephalosporins were the most commonly prescribed antibiotic class (74% of patients). In the NCxD group, cephalosporins, penicillins and macrolides were the most common classes prescribed. Among the culture groups, aminoglycosides (13% vs 2%, $p=0.033$) and carbapenems (13% vs 0%, $p=0.006$) were more commonly administered in the PC group compared to the NC group. Clindamycin was prescribed in 32% of PC group, 19% of NC group, and 31% of the NCxD groups. Clindamycin exposure in the PPX group was significantly less (8%, $p=0.003$). Vancomycin was administered to 47% of the PC group and 33% of the NC group, but there was no statistical difference in rates of use between PC and NC groups. Only 2% of patients in the PPX group were prescribed vancomycin and no one in the NCxD group received vancomycin. Nineteen percent of patients in PPX group were discharged with antibiotics compared with 53% in PC, 52% in NC, and 54% in NCxD group. There was no differences in number of antibiotics received in patients who were discharged on antibiotics (median 1, range 1-9) and those who were not (median 2, range 1-6).

Conclusions: Patients received 1 to 9 different types of antibiotics during hospitalization. There was an association between more types of antibiotics administered and prolonged length of hospital stay. Patients with positive cultures also received more types of antibiotics and had longer hospitalizations. Future studies should focus on whether antimicrobial stewardship decreases overall antibiotic exposure and reduces hospital length of stay.

ADEQUACY OF SINGLE DOSE OF VANCOMYCIN FOR ANTIMICROBIAL PROPHYLAXIS FOR POSTERIOR SPINAL FUSION SURGERY FOR ADOLESCENT IDIOPATHIC SCOLIOSIS.

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OBJECTIVES: Surgical site infection (SSI) is one of the serious complications of spinal fusion surgery for adolescent idiopathic scoliosis (AIS). A single dose of vancomycin is used for antimicrobial prophylaxis, but prospective studies in this population are limited. Our hospital uses vancomycin for prophylaxis in posterior spinal fusion surgery due to the high prevalence of MRSA. The World Health Organization (WHO) recommends maintaining adequate serum and tissue concentrations of antibiotic throughout surgery to prevent SSI and the Infectious Diseases Society of America (IDSA) recommends maintaining vancomycin levels above 10 mg/L to prevent the development of antibiotic resistance. These goals can be challenging in posterior spinal fusion surgery due to the long du-

ration, associated blood loss and fluid administration. Currently there are no guidelines on re-dosing vancomycin during pediatric posterior spinal fusion surgery. The purpose of this study was to determine if (a) a single dose of vancomycin (15 mg/kg) administered IV within two hours prior to incision resulted in adequate serum levels of the drug for the duration of surgery in AIS and if (b) vancomycin reached the surgical site of the vertebral pedicle and how these levels compare to peripheral blood levels.

METHOD: We conducted an IRB approved, prospective observational study. Patients undergoing posterior spinal fusion for AIS and using vancomycin for antimicrobial prophylaxis were included. Patients with impaired renal function, vancomycin allergy, and presurgical antibiotic use were excluded. A single dose of vancomycin (15 mg/kg) was administered IV within two hours of incision. Vancomycin concentrations were measured in the peripheral blood at 30 minutes and 4 hours after the end of the infusion and at skin closure. Vancomycin concentration from the first and last pedicles in which screws were placed was also measured.

RESULTS: Fifteen patients were identified with AIS undergoing posterior spinal fusion and received prophylactic vancomycin. The mean age of the patients was 14.5 yrs (range, 11.5 yrs–18 yrs). Mean patient weight was 53 kg (range, 28.8 kg–82.4 kg). Thirteen (87%) patients had a vancomycin concentration <10 mg/L and three patients (20%) with concentrations <5 mg/L. Mean vancomycin concentration at four hours was 8.2 mg/L (range, 5.5–14 mg/L) and the mean concentration at skin closure was 7.4 mcg/L (range, 3.9–13.7 mg/L). Mean difference between pedicle and calculated peripheral concentration was 75% (range of 62%–100%).

CONCLUSIONS: In 87% of the study population, a single dose of vancomycin does not achieve concentrations above 10 mg/L for the duration of surgery as recommended by the WHO to prevent SSI and the IDSA to prevent resistance. Vancomycin did reach the surgical site of the vertebral pedicle and was similar to peripheral blood levels.

ALCOHOL CONTENT IN PEDIATRIC LIQUID FORMULATIONS. Jessica Biggs, Ahrang Yoo, Allison Lardieri, and Jill Morgan. *University of Maryland Medical Center, Baltimore, USA; University of Maryland School of Pharmacy, Baltimore, USA; U.S. Food and Drug Administration, Silver Spring, USA*

Objectives: Ethanol is a commonly used solvent and a preservative in liquid formulations of medications. However, since alcohol dehydrogenase activity does not reach the adult level until around 5 years of age, administering alcohol containing medications to neonates and children can be a concern. The amount of alcohol that is toxic to pediatric patients is still unclear. The American Academy of Pediatrics (AAP) suggests

not to exceed 25 mg/100 mL (0.025%) of blood ethanol concentration following a single dose of an alcohol containing medication. This study aims to examine alcohol content of commonly used medications in hospitalized pediatric patients and to analyze current practices that institutions have implemented to minimize administration of alcohol containing medications.

Methods: A list of oral liquid medications on formulary at a pediatric hospital was obtained to analyze alcohol concentrations using the package insert. From this list, the top ten medications that are most commonly used in the neonatal population were identified and ethanol volume per usual dose was calculated. In addition, the volume of each drug needed to produce a blood ethanol concentration of 25 mg/100 mL was calculated. Then an 8-item survey was sent via email to a pediatric listserv to identify institutional practices in place to minimize alcohol content in oral liquid medications.

Results: The alcohol concentration of 31 oral liquid medications ranged from >0.05% to 43%. About one-third (n=11) of medications had ≤0.5% of alcohol and about one-fourth (n=7) of medications contained >10% of alcohol. Among the ten most commonly used medications, the median alcohol concentration was 1.2% (range 0.04%–13.5%). The volume of drug that would need to be consumed to produce a blood ethanol concentration of 25 mg/100 mL was found to be higher than the usual dose given to full-term neonates. The survey was completed by 9 pharmacists. Five institutions (56%) have converted to non-alcohol containing oral medications. Medications that have been changed included phenobarbital and dexamethasone. When defined by participants, the acceptable cut-off for alcohol content in medications used for pediatric patients varied by institution and ranged from 0% to 10%.

Conclusions: The amount of alcohol included in usual doses for commonly prescribed medications for neonates is below the AAP recommended concentration. More data is needed to determine practice standards for alcohol containing medications used in pediatric and neonatal patients.

COLLABORATIVE EFFORT TO PRIORITIZE COMPOUNDED PEDIATRIC FORMULATIONS FOR UNITED STATES PHARMACOPEIA MONOGRAPH DEVELOPMENT. Waleed Khan, Jessica Biggs, Brian Serumaga, Jeanne Sun, Allison Lardieri, Omayma Kishk, and Jill Morgan. *University of Maryland School of Pharmacy, Baltimore, USA; University of Maryland Medical Center, Baltimore, USA; USP, Rockville, USA; FDA, Rockville, USA*

Objectives: The use of compounded preparations are utilized in children due to inappropriate dosage forms or concentrations, excipients, and palatability of many commercially available medications. Since there are no standardized concentrations mandated

in health-systems, there is significant variation in compounded liquid preparations, which increases the potential for errors. Groups like the Michigan Pediatric Safety Collaboration, Standardize 4 Safety and United States Pharmacopeia (USP) are working to standardize concentrations of liquid compounded medications. A new USP initiative, the Compounded Preparation Monograph Donation Program, accelerates the creation of compounded monographs which provides standardized formulations based on patient needs. The creation of USP monographs require prioritization of commonly compounded preparations. This project aims to identify gaps in the availability of formulations and stability data and determine if there are any discrepancies between recommended standard concentrations. The purpose of the project is to develop a list of priorities for USP monograph development of oral liquid formulations for pediatrics.

Methods: In June 2017, a collaboration was formed with members from USP, a school of pharmacy, and an academic medical center. Pediatric oral compounded formulations from 4 academic medical centers, USP, and the Michigan Pediatric Safety Collaboration were compared. The list of formulations and concentrations was narrowed down by 4 pediatric pharmacists to 18 clinically relevant medications. A 3-question survey was sent through pediatric pharmacy listserv groups to further prioritize and narrow this list of clinically relevant medications. Participants were asked to select the top ten medications needing a USP monograph with beyond-use dates supported by stability information. Participants were also asked to provide suggestions for alternative concentrations and/or medications that were not included in the survey. Once the Standardize 4 Safety list of medications and concentrations was available, the priority list from this project was compared to determine whether the concentrations were consistent. The finalized list of medications and associated concentrations was presented to USP as prioritized formulations for monograph development.

Results: In 2 weeks, 62 participants responded. Of the 18 medications included in the survey, participants selected an average of 8.7 medications each as needing a USP monograph, for a total of 538 selections. Selections for each medication ranged from 9.7% to 82.3%. The top ten medications for prioritization, by percentage of respondents, include (%): captopril (82.3), hydrocortisone (80.7), sodium chloride (79.0), morphine sulfate (69.4), dexamethasone (69.4), vancomycin (67.7), hydroxyurea (66.1), carvedilol (56.5), aspirin (53.23), and glycopyrrolate (46.8). The priority list contained these 10 medications along with quetiapine (40.3), which was deemed clinically necessary by the researchers. The recommended concentration for hydrocortisone on the priority list was adjusted to match the concentration published by Standardize 4 Safety.

Conclusions: Eleven medications were identified as priorities for pediatric patients for USP monograph development.

COMPARISON OF TWO MORPHINE DOSING STRATEGIES IN THE MANAGEMENT OF NEONATAL ABSTINENCE SYNDROME. J. Brock Harris and Amy P. Holmes. *Wingate University School of Pharmacy, Wingate, USA; Novant Health Hemby Children's Hospital, Charlotte, USA; Novant Health Forsyth Medical Center, Winston Salem, USA*

Objectives: The incidence of neonatal abstinence syndrome (NAS) has increased in recent years. Treatment approaches usually involve opiate replacement with morphine or methadone; however, the optimal treatment strategy has yet to be determined. We sought to compare a weight-based dosing strategy and a symptom-based dosing strategy both using morphine in the management of NAS to determine if treatment approach impacted length of stay and overall medication exposure.

Methods: A retrospective chart review was conducted from May 1, 2015 to June 30, 2017 at two neonatal intensive care units within a health system utilizing different approaches for management of NAS. A total of 89 charts were reviewed including 74 utilizing a weight-based dosing strategy and 15 using a symptom-based dosing strategy.

Results: Data from the weight-based dosing group and the symptom-based dosing group were compared using Fisher's exact tests for categorical data and t-tests for continuous data. Baseline characteristics including birth weight, weight at medication start, and post-natal age at medication initiation were the same between groups except for the post-conceptual age at morphine initiation (38 wks and 5 days vs. 39 wks and 4 days; $p=0.0407$). The weight-based dosing group had a decreased length of stay (17.1 days vs. 25.4 days; $p=0.0024$), higher initial morphine dose (0.0542 mg/kg vs. 0.0221 mg/kg; $p=0.0012$), lower total morphine dose adjustments (4.8 vs. 12.9; $p<0.0001$), fewer steps to maximum morphine dose (0.8 vs. 4.1; $p<0.0001$), fewer total doses of morphine (97.2 vs. 151; $p=0.008$), less weaning steps (4.1 vs. 8.9; $p<0.001$), and less total morphine administered per patient overall (11.7 mg vs. 21.3 mg; $p=0.0368$). There was no difference between groups in maximum dose of morphine (0.0621 mg/kg vs. 0.0574 mg/kg; $p=0.973$) or in the need to re-escalate dosing ($p=0.0803$). There was no difference between first, second, and third modified Finnegan scores ($p=0.5821$, $p=0.949$, $p=0.921$, respectively). However, neonates with symptom-based dosing had a significantly higher maximum modified Finnegan score (15.7 vs. 13.6; $p=0.0145$) indicating the symptom-based dosing group may have been less well controlled. Neonates in the symptom-based dosing group also

required the addition of adjunct therapy more often (53.33% vs. 2.7%; $p < 0.0001$).

Conclusions: Data indicate the symptom-based dosing strategy is associated with a delay in reaching adequate treatment dosing which may contribute to increased length of stay. Weight-based dosing may decrease overall total exposure to morphine as well as adjunctive therapy by controlling NAS symptoms earlier in the treatment course.

COMPARISON OF READMISSION RATES BASED ON INHALED CORTICOSTEROID DOSING RECOMMENDATIONS IN TWO ASTHMA REFERENCES DURING TRANSITION TO INPATIENT CARE. John Harris and Mindy Parman. *Wingate University School of Pharmacy, Wingate, USA; Novant Health Hemby Children's Hospital, Charlotte, USA*

Objectives: Reliable guiding principles of asthma management is crucial for optimal therapy. Recommendations regarding inhaled corticosteroid (ICS) dosing regimens vary based on reference used in practice. The primary guideline for the United States is the 2007 Guidelines for the Diagnosis and Management of Asthma, National Asthma Education and Prevention Program Expert Panel Report 3 by the National Heart, Lung, and Blood Institute (NHLBI). The NHLBI guidelines focus on one to two step-wise increases for asthma management for hospitalized patients. The Global Initiative for Asthma (GINA) also uses a step-wise approach but emphasize early rapid increase in ICS. The purpose of this study is to determine if ICS management via NHLBI versus GINA in pediatric patients with asthma reduces readmission rates at 30 and 60 days after discharge.

Methods: Included patients ($n=355$) were identified via International Classifications of Disease (ICD)-9 or ICD-10 codes for asthma hospital admissions between January 2014 and December 2016 between the ages of 5 years and 17 years. Patient ICS dose was collected during the transitions of care: prior to admission, during admission, and immediately post discharge. Inhaled corticosteroid treatment regimens were considered appropriate using NHLBI when a single step increase in ICS was ordered and when a high ICS regimen was ordered using GINA recommendations. Patients were classified as not meeting either recommendation ($n=159$), meeting only the NHLBI recommendation ($n=168$), meeting only the GINA recommendation ($n=4$), or meeting both recommendations ($n=24$). Additional baseline characteristics collected included: age, prior asthma diagnosis, reason for admission, and home ICS regimen. Poisson regression modeling was completed using SAS version 9.3 for both 30 day and 60 day readmission rates.

Results: The specific parameters assessed in the regression for both 30 and 60 day readmissions were: guideline appropriateness classification, sex, age at

admission, admission reason and year, number of home medications, and strength of ICS prior to admission, during hospitalizations, and after discharge. No parameter or guideline appropriateness group increased the risk of 30 day readmissions ($p > 0.05$). No parameter increased the risk of 60 day readmissions ($p > 0.05$). However, compliance with only the GINA recommendations increased risk of the 60 day readmissions ($p=0.0471$). The result may be affected by the low number in the group and 1 patient being readmitted twice in the first 60 days. Results may vary based on severity of baseline disease which was not collected.

Conclusions: Patients admitted due to asthma related respiratory illness do not have increased risk of readmission within 30 or 60 days if ICS doses are increased regardless of recommendations used in practice although 60 day readmissions may be increased in patients ordered high dose ICS at admission.

IMPACT OF MOLECULAR MECA TESTING IN PEDIATRIC PATIENTS WITH STAPHYLOCOCCUS AUREUS BACTEREMIA. Kristen Nichols, Emily Drwiega, Emily Israel, and Chad Knoderer. *Butler University, Indianapolis, USA; Purdue University, West Lafayette, USA; Riley Hospital for Children, Indianapolis, USA*

Objectives: Empiric, broad-spectrum antibiotic therapy for treatment of *Staphylococcus aureus* bacteremia in pediatric patients can be narrowed once identification is confirmed and susceptibilities are known. Molecular-based testing facilitates rapid detection of *mecA*, the gene that encodes for methicillin resistance in *S. aureus*. This technology ultimately decreases time to classification as methicillin-susceptible or -resistant. Rapid *mecA* testing, in combination with antimicrobial stewardship intervention, has reduced vancomycin usage, time to optimal therapy, length of stay, and hospital costs in adults with *S. aureus* bacteremia. Data in pediatrics comparing outcomes with rapid molecular testing to conventional susceptibility testing for methicillin resistance in *S. aureus* are limited. Benefits of rapid *mecA* detection have been observed only in combination with a coordinated real-time antimicrobial stewardship response. The objective of this study was to determine the impact of rapid *mecA* detection on time to optimal therapy in pediatric patients at a single tertiary care pediatric institution without formal antimicrobial stewardship intervention.

Methods: This was a retrospective cohort study of patients at a freestanding children's hospital with a blood culture positive for *S. aureus* during a 14-month period in 2014-2015 (pre-implementation) and a similar 14-month period in 2016-2017 (post-implementation). Outcomes before and after the implementation of rapid *mecA* detection via use of GeneXpert MRSA/SA BC (Cepheid, Sunnyvale, CA) were compared. Culture information, antibiotic use, and hospital stay information

were collected for each patient. The primary outcome was time to optimal therapy, which was defined as vancomycin alone for methicillin-resistant *S. aureus* (MRSA) or nafcillin, oxacillin, or cefazolin alone for methicillin-susceptible *S. aureus* (MSSA). Secondary outcomes included hours of vancomycin therapy and hospital length of stay.

Results: One hundred and one patients were included, with 61 patients in the pre-implementation period receiving conventional susceptibility testing and 40 patients in the post-implementation period receiving rapid molecular *mecA* testing and conventional susceptibility testing. The median (IQR) time (hours) to optimal therapy from culture collection was decreased from 61.5 (47.8, 68.1) to 42.5 (21.9, 56.6; $p=0.003$). However, only 20% of the patients in the post-implementation group received optimal therapy prior to final susceptibility testing, despite availability of RDT result. (Total median (IQR) hours of vancomycin receipt in patients with MSSA decreased from 48.1 (34.1, 60.2) to 25.8 (11.8, 47.8; $p=0.009$). Length of hospital stay and length of hospital stay post-positive culture were similar.

Conclusions: Despite lack of a formal protocol for response to molecular *mecA* test results, time to optimal therapy and vancomycin use were significantly decreased. Incorporation of results after availability of RDT result but prior to final susceptibility testing was lower than expected. Future larger studies should assess the impact of these alterations on outcomes including infection resolution and antibiotic adverse effects.

EVALUATION OF EXTENDED INTERVAL TOBRAMYCIN DOSING IN CYSTIC FIBROSIS PATIENTS AT AN ACADEMIC MEDICAL CENTER.

Lauren Machell, Kelly Steidl, and Jessica Ehnott. *Upstate Golisano Children's Hospital, Syracuse, USA*

Objectives: Evaluation of available literature portrays tobramycin intravenous (IV) 10 mg/kg q 24 hr as the most studied and used extended interval tobramycin regimen in the cystic fibrosis (CF) population. Contrary to this published data, our institution has historically employed tobramycin IV 7 mg/kg q 12 hr or 14 mg/kg q 24 hr as the initial dosing scheme in this patient population. The objective of this analysis is to determine the optimal empiric IV tobramycin dosing regimen for CF patients at our institution to achieve our desired pharmacokinetic endpoints.

Methods: This analysis was granted exemption by the institutional review board. Patients 1-30 years of age with CF who received IV tobramycin were identified and analyzed using retrospective review of the electronic medical record. Two-point kinetics were used to determine patient's elimination rate constant (k_e), volume of distribution (V_d), maximum serum concentration (C_{max}), area under the curve (AUC), and drug free interval. Patient specific pharmacokinetic properties

were used to model hypothetical dosing regimens including 7 mg/kg q 12 hr, 10 mg/kg q 18 hr, 10 mg/kg q 24 hr, and 14 mg/kg q 24 hr. Desired pharmacokinetic endpoints include a primary composite endpoint of a C_{max} greater than 10 times the MIC and <40 mg/L and AUC of 70-125 mg*hr/L with a secondary endpoint of a drug free interval less than 12 hrs. Results were broken down into three age groups for further assessment and evaluated using descriptive statistics.

Results: Seventeen patients aged 1–24 years were included. The primary composite endpoint was met most often using tobramycin 14 mg/kg q 24 hr (53.55%) and 10 mg/kg q 24 hr (43.33%) compared to 10 mg/kg q 18 hr (36.67%) and 7 mg/kg q 12 hr (3.33%). When evaluated by age, patients 1-7 years old most often met the primary composite endpoint with 14 mg/kg q 24 hr (85.71%), 8–18 years old with 10 mg/kg q 24 hr (56.25%), and >18 years old with both 10 mg/kg q 24 hr and 14 mg/kg q 24 hr (both 42.86%). The secondary endpoint of a drug free interval <12 hr was met most often by 7 mg/kg q 12 hr (100%) and 10 mg/kg q 18 hr (100%) followed by 14 mg/kg q 24 hr (50%) and 10 mg/kg q 24 hr (23.33%).

Conclusions: This analysis best supports the use of an every 24 hour tobramycin dosing regimen rather than an every 12 hr dosing regimen in our CF population. Using this information our institution plans to implement tobramycin IV 10 mg/kg q 24 hrs as our standard initial dosing regimen for all patients with CF being treated with IV tobramycin for a CF exacerbation.

RETROSPECTIVE STUDY TO DETERMINE THE INCIDENCE OF HYPONATREMIA IN PEDIATRIC PATIENTS RECEIVING HYPOTONIC HYPER-HYDRATION DURING CHEMOTHERAPY.

Lu Lu Htet, Si Min Josephine Teo, and Koon Mian Foo. *KK women's and children's hospital, Singapore, Singapore*

Objectives: The use of hypotonic intravenous maintenance fluids in hospitalized children has been associated with significant electrolyte abnormalities, specifically hyponatremia. Although the best choice of solution for hyper-hydration has not yet been defined for pediatric patients undergoing chemotherapy, hypotonic solutions are the standard fluid being used. The aim of this study was to evaluate the incidence of hyponatremia following administration of hypotonic hyper-hydration in pediatric patients during chemotherapy.

Methods: This was a retrospective, single-center, cross-sectional study conducted at KK Women's and Children's Hospital from Dec 2015 to May 2016. Records of pediatric hematology/oncology patients aged less than 18 years, receiving hyper-hydration with hypotonic fluids (dextrose 2.5 percent and sodium chloride 0.45 percent) during chemotherapy were evaluated. Hyponatremia is defined as serum sodium level less than 135 mmol/L and those more than 145 mmol/L as hypernatremia.

mia. Patients with hypernatremia or hyponatremia prior to chemotherapy, and long-term use of diuretics were excluded. Serum sodium level was measured before the start of chemotherapy (S0) and after completion of chemotherapy (S1).

Results: Hyponatremia was observed in 21 out of 107 admissions (19.6%) with mean sodium level at S1 of 133 plus or minus 1.14 mmol/L (ranges 131–134 mmol/L). Mean sodium drop in hyponatremia cohort was 4.3 mmol/L. Majority of hyponatremia cases were from patients with solid tumors compared to hematological related cancers (34.9%, 15/43 cases versus 9.4%, 6/64 cases $p=0.001$). Sodium bicarbonate (NaHCO_3) was added in 44 out of 107 cases as part of the chemotherapy hydration protocol, resulting in sodium concentration of 0.13 mmol/L in the hyper-hydration fluid. This significantly reduces the incidence of hyponatremia, as it was observed only in 4.5% (2/44) compared to 30.2% (19/63) in those without NaHCO_3 added. No patient experienced any clinical symptoms from sodium imbalance. No patient developed hypernatremia during the study period.

Conclusions: Our study shows that the use of hypotonic hyper-hydration during chemotherapy leads to a considerable incidence rate of hyponatremia in pediatric hematology/oncology patients. Although no complications from sodium imbalance were observed in this study, hyper-hydration using isotonic solution should still be considered for pediatric patients undergoing chemotherapy, especially for chemotherapy drugs that can cause electrolytes wasting.

BIVALIRUDIN FOR ANTICOAGULATION IN PEDIATRIC PULSATILE VENTRICULAR ASSIST DEVICES.

Maryjoy Lepak, Cassandra Hacker, and Laura D'Addese. *Nemours Children's Hospital, Orlando, USA; Ohio Northern University, Ada, USA; Cleveland Clinic Children's Hospital, Cleveland, USA*

Objectives: Data evaluating bivalirudin for anticoagulation in pediatric pulsatile ventricular assist devices (VAD) does not currently exist. Cleveland clinic transitioned from heparin to off-label bivalirudin for this select population, and this study aims to describe the safety, efficacy, and dosing of this anticoagulant. The primary objective was the number of significant bleeding and thrombotic events while receiving bivalirudin for VAD anticoagulation. Secondary objectives included the percent time in goal aPTT range and number of bivalirudin dosage adjustments to achieve initial goal aPTT. **Methods:** A retrospective single center chart review was conducted for pediatric patients less than 18 years of age who underwent VAD placement at Cleveland Clinic between January 2012 and July 2017. Patients were excluded if bivalirudin was not the primary anticoagulant during VAD implantation. Data collection included patient age and weight at VAD implantation,

sex, cardiac diagnosis, VAD implant duration, number of thrombotic and bleeding events, bivalirudin dosing and duration, aPTT goal, and aPTT levels. Descriptive statistics were utilized to report primary and secondary outcomes.

Results: Four patients met inclusion criteria, all of which were female with median age of 1.4yr (range 0.92–1.8yr) and weight 7.8kg (range 6–12.8kg) at time of VAD implantation. Dilated cardiomyopathy was the primary cardiac diagnosis ($n=3$) and ALCAPA ($n=1$). Median VAD and bivalirudin duration was 77 days (range 32–189 days) and 76 days (range 28–188 days) respectively. No thrombotic events occurred. One significant bleeding event was reported. A median bivalirudin dose of 1.3 mg/kg/hr (range 0.1–3.9mg/kg/hr) achieved goal aPTT levels 53% of the time (range 34%–66%). Approximately two dose changes were needed to achieve an initial goal aPTT level. A dose tolerance effect was observed with higher doses of bivalirudin required over time.

Conclusions: Bivalirudin appears to be a safe anticoagulation option during pediatric VAD implantation with limited bleeding events and no thrombotic events observed in this small study. Additionally, goal aPTT levels were achieved with bivalirudin. This study provides dosing information where limited data exist, and it prompts further investigation regarding potential dose tolerance over time.

STABILITY OF EXTEMPORANEOUSLY COMPOUNDED QUETIAPINE FUMARATE 10 MG/ML SUSPENSION. Melissa Gervase, Jennie Tran, Jason Evans, and Xiaowei Dong. *Cook Childrens Medical Center, Fort Worth, USA; University of North Texas System College of Pharmacy, Fort Worth, USA*

Objectives: Quetiapine fumarate is an atypical antipsychotic used off-label for the treatment of delirium in critically-ill infants and children. Quetiapine is commercially available as immediate and extended release tablets for oral administration. Although there is a published 40 mg/mL compounded suspension, this is not suitable for small doses. The purpose of this study was to evaluate the 90-day stability of a 10 mg/mL quetiapine suspension at two temperatures.

Methods: A quetiapine suspension was developed using quetiapine fumarate 400 mg tablets and Ora-Blend (SF). Samples were stored in amber plastic prescription bottles at 2 or 22 °C. A high-performance liquid chromatography method was developed and validated to analyze the quetiapine concentration. Samples were tested at 0, 7, 14, 30, 60, and 90 days. pH was also measured.

Results: The mean concentration of quetiapine fumarate remained within 5% of the initial concentration in all samples at both temperatures. No changes in pH, odor, or appearance were observed.

Conclusions: Quetiapine fumarate 10 mg/mL was stable

for 90 days in amber plastic prescriptions bottles at 2 and 22 °C.

EVALUATION OF PEDIATRIC OPIOID USE AFTER HOSPITAL DISCHARGE. Monica Bogenschutz, Jessica Bergsbaken, Hanna Christensen, Nicholas Zetes, and Jesse Weber. *UW Health - American Family Children's Hospital, Madison, USA; University of Wisconsin School of Pharmacy, Madison, USA*

Objectives: Opioid prescribing rates and deaths due to prescription opioid overdose have significantly increased over the past two decades. Reports demonstrate adult and pediatric patients are prescribed significantly larger quantities of opioids than are used for acute pain following hospital discharge. While it is a high priority to decrease the amount of opioids available in the community, it is also important to ensure patients and caregivers appropriately manage acute pain following hospital discharge. The purpose of this evaluation is to investigate opioid prescribing practices and utilization at home following discharge from an academic medical center. We also sought to assess caregivers' understanding of administration, monitoring, and proper disposal of opioid medications.

Methods: A survey of thirty caregivers of pediatric patients who filled opioid prescriptions at an outpatient pharmacy located within a pediatric hospital was conducted. Caregivers were contacted by phone five to ten days following hospital discharge to complete a survey. Survey data included patients' reason for admission, number of opioid doses administered at home, and quantity of opioid remaining. Additional survey questions assessed caregivers' understanding of opioid medication use, monitoring, and proper disposal.

Results: Twenty-five of thirty (83%) caregivers completed the survey. The most commonly prescribed opioid was oxycodone with an average of 20 doses dispensed upon discharge. Thirteen of twenty-five patients (52%) did not require any doses of opioids following hospital discharge. Of patients requiring opioids, an average of five doses (25%) were administered. The survey assessing caregivers' understanding of opioid medications and disposal revealed 72% of caregivers could recall the child's opioid dose. In addition, 24% of caregivers could recall three opioid side effects, 44% could recall two side effects, and 32% could recall one or fewer side effects. Lastly, 44% of caregivers were unable to recall signs of an opioid overdose; however, 90% of caregivers were able to identify an appropriate location to dispose of remaining opioids.

Conclusions: Results indicate opioids are often prescribed in excess of actual patient need following hospital discharge. These findings are consistent with previous internal findings, specific to pediatric tonsillectomy patients, as well as reports in the literature demonstrating the need for changes in prescribing

practices. In order to reduce the quantity of opioids prescribed at time of discharge, survey results will be shared with prescribers and inpatient pharmacists who review all discharge prescriptions. Education will be provided to prescribers and caregivers regarding pain management, use of non-opioid pain modalities, and safe opioid use and disposal. Additionally, opioid prescriptions will require indications for pain and have default dispense quantity limits. Lastly, we will implement a standard approach to follow-up with patients requiring opioids at time of discharge.

PUBLICATION RATES OF PEDIATRIC-FOCUSED RESIDENT RESEARCH PROJECTS PRESENTED AT THE PEDIATRIC PHARMACY ADVOCACY GROUP BRUCE PARKS MEMORIAL RESIDENCY SHOWCASE.

Jamie Miller, Teresa Lewis, Abriel O'Donnell, Jennifer Walling, Stephen Neely, and Peter Johnson. *University of Oklahoma College of Pharmacy, Oklahoma City, USA*

Objectives: All post-graduate year-one (PGY1) and post-graduate year-two (PGY2) pharmacy residents have to complete a quality improvement/research project, but there is a paucity of data evaluating the publication rates of pediatric-focused residency research projects. The objectives were to 1) identify the number of residency research projects presented at the PPAG Bruce Parks Memorial Residency Showcase that were published, 2) characterize the projects that were published, and 3) compare the number of publications after residency completion between residents who did and did not publish their resident research projects.

Methods: This was a descriptive study including all pediatric-focused resident projects presented at the PPAG Bruce Parks Memorial Residency Showcase from 2006-2015. Following IRB approval, literature searches for all the projects were performed by two investigators using the author names and relevant key words in MEDLINE, EMBASE, Google Scholar, and Scopus. Social media sources were used to confirm the identity of the resident in cases where a name change may have occurred (i.e., maiden versus married name). Data collection included residency program, residency type (i.e., PGY1, PGY2, or fellow), publication status, and initial position taken after residency. For those residency projects that were published, the journal citation was recorded. A second literature search was performed to identify if any publications occurred after residency completion. Descriptive and inferential statistics were performed with a $p < 0.05$.

Results: A total of 434 projects were presented. The majority were presented by females (82.5%) and PGY2 residents (57.6%). Thirty-two residents (7.4%) presented in their PGY1 and their PGY2 residency years. Seventy-four projects (17.1%) were published in a peer-reviewed journal. Forty-seven (63.5%) of these manuscripts were published in a pharmacy journal. Overall, 32 projects

(43.2%) were published in the *Journal of Pediatric Pharmacology and Therapeutics*. Of those 74 projects that were published, 55 (74.3%) were conducted by a PGY2 resident. Six-four (86.5%) of residents were listed as the first author on this publication. A greater number of residents who published their residency project had subsequent publications after residency compared to those that did not publish, 58.1% versus 33.8%, $p < 0.01$. However, the median number (interquartile range) of publications after residency were not statistically different between those that published their research project versus those that did not, 3 (1–5) versus 2 (1–4), $p = 0.126$.

Conclusions: The overall publication rate of pharmacy resident research projects was low. The majority of these projects were published in a pharmacy journal. In this cohort, residents that published their residency research projects were more likely to publish following residency completion.

IMPACT OF CEFTAZIDIME USE ON SUSCEPTIBILITY PATTERNS IN A SINGLE-CENTER NEONATAL INTENSIVE CARE UNIT.

Jamie Miller, Peter Johnson, Stephen Neely, Hala Chaaban, Bryan White, Netsanet Kassa, and Robert Welliver. *University of Oklahoma College of Pharmacy, Oklahoma City, USA; University of Oklahoma College of Medicine, Oklahoma City, USA; OU Medicine Inc., Oklahoma City, USA*

Objectives: A national shortage of cefotaxime in February 2015 resulted in increased ceftazidime use in the neonatal intensive care unit (NICU) for empiric treatment of meningitis or when relative contraindications for aminoglycosides exist. The impact of empiric ceftazidime use on antimicrobial resistance patterns in the NICU is unknown. The objectives were to 1) compare the third generation cephalosporin susceptibility rates for *Escherichia coli*, *Pseudomonas aeruginosa*, and *Stenotrophomonas maltophilia*, 2) compare the days of ceftazidime per 1,000 patient days, and 3) compare the extended spectrum beta lactamase (ESBLs) positive isolates of *Escherichia coli* pre- and post-cefotaxime shortage.

Methods: This was a retrospective, IRB-approved study in a single-center over a 5-year period. Although the shortage occurred in February 2015, cefotaxime was still available at this site until August 2016. Therefore, the pre-shortage period was defined as January 1, 2013 to July 31, 2016, and the post-shortage was defined as August 1, 2016 to December 31, 2017. The microbiology database was used to identify patients in the NICU with blood, urine, wound, cerebrospinal fluid, and tracheostomy cultures containing *Escherichia coli*, *Pseudomonas aeruginosa*, and *Stenotrophomonas maltophilia* isolates. For this study, only the first positive culture specific for the organism and site per patient were included for analysis. The cefotaxime and ceftazidime days of therapy per 1,000 patient days in the NICU were

collected via the electronic medical record system. Data were analyzed via the Chi-Square and the Wilcoxon tests with a $p < 0.05$.

Results: A total of 255 isolates were included for analysis for *Escherichia coli* ($n = 156$), *Pseudomonas aeruginosa* ($n = 72$), and *Stenotrophomonas maltophilia* ($n = 27$). There was a significant difference in the median (interquartile range) days of ceftazidime per 1,000 patient days between the pre- versus post-shortage periods, 18.6 (5.6–31.1) versus 52.9 (29.9–63.1), $p = 0.005$. There was no significant difference in the susceptibility rate for ceftriaxone for *Escherichia coli* between the pre- versus post-shortage period, 87.6% (99/113) versus 93.0% (40/43), ($p = 0.403$). In addition, there were also no significant differences in the ceftazidime susceptibility rates pre- versus post-shortage period for *Pseudomonas aeruginosa* [97.9% (47/48) versus 91.7% (22/24), $p = 0.256$] and *Stenotrophomonas maltophilia* [88.9% (16/18) versus 66.7% (6/9), $p = 0.295$]. There was no difference in the rates of *Escherichia coli* ESBLs between the pre- versus post-shortage period, 2.7% (3/113) versus 4.7% (2/43), $p = 0.625$.

Conclusions: In this single-center study, the use of ceftazidime significantly increased following the cefotaxime shortage. Based on the 1.5 year post-shortage time-frame, there was not a significant difference in the susceptibility rates for third generation cephalosporins for the first occurrence. However, the decrease in susceptibility rates for *Stenotrophomonas maltophilia* isolates could be associated with clinical significance. Different results may have been found with a longer post-shortage period or if repeat occurrences were taken into consideration.

PHARMACOKINETIC PARAMETERS AND ACUTE KIDNEY INJURY IN NEONATES WITH AND WITHOUT CONGENITAL HEART DISEASE RECEIVING AMIKACIN.

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Introduction: Aminoglycosides are commonly used in the neonatal intensive care unit (NICU) in combination with other antibiotics for treatment of early and late onset sepsis. Although gentamicin or tobramycin are often first-line, the use of amikacin has escalated in certain facilities due to observed antimicrobial resistance patterns. However, there is a paucity of data in the neonatal population, especially in neonates with congenital heart disease (CHD). The primary objective was to compare the volume of distribution (VD)

and clearance (CL) of amikacin in neonates with CHD versus controls. Secondary objectives included the comparison acute kidney injury (AKI) between groups.

Methods: This was a descriptive, retrospective study of neonates and infants who received amikacin from January 1, 2013 through August 31, 2016. Infants with CHD defects were classified as cyanotic or acyanotic. Non-CHD controls were matched in a 1:1 fashion according to postmenstrual age (PMA). AKI was defined as a reduction in urine output to <0.5 mL/kg/hr for > 8 hours, an absolute increase in serum creatinine (SCr) by 0.3 mg/dL, or an increase in SCr greater than 50% from baseline. Between-group analyses were performed using Wilcoxon-Mann-Whitney test, Student's t-test, Chi-square, or Fisher's exact analysis as appropriate with a $p < 0.05$.

Results: Fifty-four CHD patients were included and matched with 54 controls. The mean [standard deviation (SD)] gestational age (weeks) in the CHD group was 34.7 ± 5.1 versus controls at 35.5 ± 4.8 , $p = 0.44$. There was a significant difference in the median [interquartile range (IQR)] postnatal age (PNA) (days) at time of amikacin initiation between CHD and controls, 3.0 (1–15.8) versus 1.0 (1–2.8), $p = 0.02$. There was no difference in the mean (SD) calculated VD (L/kg) and CL (L/kg/hr) between the CHD and controls, 0.48 ± 0.11 versus 0.46 ± 0.13 ($p = 0.32$) and 0.052 ± 0.02 versus 0.047 ± 0.01 ($p = 0.12$), respectively. In addition, there was no difference in the percentage of AKI between the CHD group and controls, 10 (18.5%) versus 5 (9.3%), $p = 0.16$.

Conclusions: Based on the results of this small study, there were no differences in VD and CL in patients with CHD matched to a control group based on PMA. The difference in PNA between groups may have affected these results. There was a higher, although not statistically significant percentage of patients with AKI in the CHD group. Further prospective studies with a larger sample size are needed to confirm these findings.

COMPARISON OF THE SAFETY PROFILE BETWEEN NALBUPHINE AND OPIOID ANALGESICS IN PEDIATRICS. Sarah Mae Rogado, Marcus Flores, Patricia Greenberg, Yen-Hong Kuo, and Anita Siu. *Jersey Shore University Medical Center - Hackensack Meridian Health, Neptune, USA; Ernest Mario School of Pharmacy, Rutgers, The State University of New Jersey, Piscataway, USA*

Objectives: Nalbuphine is a parenteral mixed agonist-antagonist of opioid receptors that is postulated to provide similar analgesia with a more favorable adverse event profile than pure opioid agonists. However, limited evidence exists specifically comparing the incidence of adverse effects of nalbuphine with traditional opioids for pain management in the pediatric population. The primary objective of this study was to compare the overall safety profile of nalbuphine with that of pure opioid

agonists when used for pain management in pediatric patients. A secondary objective was to compare the efficacy of nalbuphine and pure opioid agonists when used for pediatric pain management.

Methods: A retrospective chart review of pediatric patients who received either nalbuphine or a pure opioid agonist from January 1, 2014 to October 1, 2017 was used to gather study data. The following patient characteristics were collected: age, weight, length of stay, nalbuphine or pure opioid agonist medication used, non-opioid pain medication use, pain scores before and after nalbuphine or pure opioid agonist medication administration, concomitant medications used to treat adverse drug reactions, frequency of bowel movements, number of episodes of nausea/vomiting, blood pressure, respiratory rate, and dermatologic side effects. In addition, the total dose per admission and average dose per day of each study medication were calculated and expressed in morphine milligram equivalents (MME). The primary outcome was the overall incidence of adverse effects. Comparative efficacy was assessed through reductions in pain scores.

Results: A total of 200 charts were reviewed and 80 patients were included in the study. Eleven patients received nalbuphine and 69 patients received a pure opioid agonist. The most common opioid agonist received was morphine in 54.9% (45/69) of cases. The average dose per day was 0.01 MME/kg for nalbuphine and 0.001 MME/kg for opioid agonists. Total reduction in pain scores (Median [IQR]: 5 [3, 5] vs 5 [3, 6.5], $p = 0.30$) and the overall incidence of adverse events (54.5% (6/11) vs 46.4% (32/69), $p = 0.75$) were similar in the nalbuphine and opioid agonist groups, respectively. The most common adverse events documented in both the nalbuphine and opioid agonist groups were gastrointestinal-related (54.5% (6/11) and 36.2% (25/69), respectively). More patients receiving nalbuphine experienced an episode of nausea/vomiting and constipation compared to the opioid agonist group, 54.5% (6/11) and 36.4% (4/11) versus 29.0% (20/69) and 23.2% (16/69), respectively.

Conclusions: Overall, the incidence of adverse effects was similar between pediatric patients who received either nalbuphine or opioid agonists. The reductions in pain scores were similar between the two study groups. The most common adverse effects among both groups were episodes of nausea/vomiting and constipation. Prospective studies comparing nalbuphine and pure opioid agonists in pediatric patients are warranted to confirm the results of this study.

BUPRENORPHINE FOR NEONATAL ABSTINENCE SYNDROME: ASSESSING USE AND BARRIERS TO USE. Shelby Warring, Jessica M. Biggs, Allison Lardieri, and Jill Morgan. *University of Maryland School of Pharmacy, Baltimore, MD, USA; University of Maryland Medical Center, Baltimore, MD, USA*

Objectives: For neonatal abstinence syndrome (NAS), there is no standard treatment protocol. Recently, a study demonstrated that buprenorphine was superior for treatment of NAS compared to morphine. The objective of this study is to determine first line treatments used for NAS within neonatal intensive care units (NICU). This study also aims to address the use of buprenorphine and the barriers for use of this agent.

Methods: A 16-item survey was created to determine an institution's NICU demographics, current protocol for NAS treatment, and the usage of and barriers for using buprenorphine. The survey was sent via email to pharmacists practicing in a NICU.

Results: A total of 121 pharmacists received the survey via email, with 24 pharmacists from distinct hospitals completing the survey for a 19.8% response rate. A majority (83%) of respondents reported using morphine as their first-line of therapy for NAS and reported using the Finnegan Neonatal Abstinence Scoring Tool for monitoring treatment (96%). Only two respondents (8%) reported using buprenorphine to treat NAS, with one implementing buprenorphine as first-line therapy in 2018. The compounded buprenorphine concentration used was 75 mcg/ml with a 30% alcohol content. Numerous barriers for buprenorphine use were cited, most notably the lack of available data (50%), alcohol content (25%), lack of experience with use (17%), and feeling confident in their current protocol (25%).

Conclusions: Morphine is still the most widely used treatment for NAS. Buprenorphine use for NAS is low due to multiple barriers. More safety and efficacy data are needed for buprenorphine as well as a neonatal-friendly, alcohol-free formulation.

POPULATION-PHARMACOKINETICS ANALYSIS OF FENTANYL AND NORFENTANYL IN CRITICALLY-ILL CHILDREN. Sin Yin Lim, Sukyung Woo, Jamie Miller, Emilie Henry, Rebecca Heltsley, Peter Johnson *The University of Oklahoma College of Pharmacy, Oklahoma City, USA; The University of Oklahoma College of Medicine, Oklahoma City, USA; Aegis Sciences Corporation, Nashville, USA*

Objective: Fentanyl pharmacokinetics (PK) in children remain largely unknown due to the heterogeneity of the population and challenges in patient recruitment. The primary objective was to characterize fentanyl PK through a population-PK approach. Secondary objectives were to 1) identify factors affecting fentanyl PK variability and 2) characterize the PK of norfentanyl, a primary metabolite, and determine its contribution to fentanyl clearance (CL).

Methods: This IRB-approved, population-PK study included children <18 years receiving fentanyl infusions from January 1-October 31, 2016 in medical and cardiovascular pediatric intensive care units (PICU). Plasma samples were collected using remnant blood

samples obtained in routine care. Plasma concentrations of fentanyl and norfentanyl were simultaneously measured via a high-performance liquid chromatography assay coupled to tandem mass spectrometry. No interventions on fentanyl dosing were made. A non-linear mixed effects model was used to perform the population-PK analysis using Phoenix NLME. Various covariates were tested including age, body weight (WT), sex, and PRISM III score.

Results: Seventeen children, with a median of 0.83 years (range, 0.1–12) and a median weight of 8.7 kg (3.4–52), were included. The majority (59%) were in the medical PICU with a mean PRISM III score of 7.8 ± 11.9 . A two-compartment model best described concentration-time profiles of fentanyl and norfentanyl. Fentanyl total CL was highly variable among the children. Of the tested covariates, only WT showed a significant correlation with CL, reducing the inter-individual variability (IIV) of CL from 122% to 46%. The population fentanyl CL, defined as $CL = 53 \cdot (WT - 3.3) / [8.5 + (WT - 3.3)]$, was 20.5 L/hr (2.3 L/hr/kg) for a 8.7 kg child. The CL nonlinearly increased with WT and plateaued into 53 L/hr, approaching the adult levels, at higher WT >50 kg. No covariates were significant in other PK parameters. The central volume of distribution was 12.8 L (IIV CV% 9%). Fentanyl distribution was extensive and highly variable, with the peripheral volume of 128 L (126%) and distributional CL of 17.9 L/hr (167%). Norfentanyl formation CL was 1.53 L/hr (44%) and contributed in average of 21%, ranging from 1.3%–68%, to total fentanyl CL.

Conclusions: This study characterized population-PK of fentanyl and its primary metabolite in critically-ill children. We found that the fentanyl CL variability was largely explained by WT, but remained relatively high. The fentanyl CL nonlinearly increased with WT. These findings suggest that current weight-based dosing strategy (mcg/kg/hr) that assumes linear relationship between CL and WT may further contribute to the dosing variability. In addition, the highly variable fentanyl distribution properties added the uncertainty to the time to achieve target steady-state concentrations. Titration of infusions based on pharmacodynamic targets is needed, and further study of dosing strategies is warranted.

SCHOLARSHIP OF TEACHING ABSTRACTS

DEVELOPMENT, IMPLEMENTATION AND EVALUATION OF A RESTRUCTURED COMMUNITY BASED PEDIATRIC ELECTIVE. Allison Chung and Lea Eiland. *Auburn University, Harrison School of Pharmacy, MOBILE, USA; Auburn University, Harrison School of Pharmacy, Auburn, USA*

Introduction: A pediatric pharmacotherapy elective for third-year pharmacy students was taught for 8 years with minor changes in structure and teaching methods throughout the years. Due to increased student

feedback regarding the time demand, structure of the course, and a new school-wide curriculum being developed, the pediatric elective was not offered in 2016. A systematic major revision of the pediatric course was initiated. The objective was to develop and implement an introductory pediatric elective that provided community pharmacy education and integrated seamlessly into the new curriculum.

Methods: Descriptions of pediatric electives offered at other school of pharmacies were solicited through professional organizational listserves, emails and internet searches. This information was systematically assessed to determine common characteristics and unique assignments of the different courses. The previous therapeutic focused elective was changed to provide an introduction to basic pediatric concepts and accommodate second-year students. The backwards design method was used to develop outcomes and innovative learning techniques. Outcome measures included the student course evaluations and two surveys developed by the course coordinators. These surveys were administered at midpoint and at end of the course, to evaluate the students' perceptions of the newly designed course.

Results: A new two credit hour pediatric elective entitled 'Introduction to Pediatrics' was implemented focusing on basic pediatric concepts and therapeutic topics commonly encountered in the community setting. Active learning activities included the use of debates, games and patient case scenarios. Students completed a longitudinal service project in which they were involved in a child-based organization for at least 16 hours during the semester. Each group presented on their impact and reflection of the longitudinal experience. Student course evaluation for the Introduction to Pediatrics course improved compared to prior pediatric electives. In 2015, ratings ranged from 2.6–2.95 out of 4 whereas ratings of the redesigned course ranged from 3–5.3 out of 6. The response rate was low for the new course, 23% compared to 96% previously. The response rate for the student surveys were 71% (midpoint) and 76% (final). Overall, results were positive. A majority of students expressed positive interest in the topics discussed (means 3.15–4.46 out of 5) and reported adequate amount of time spent on the topics (scores 1.5–2.29 out of 3). Teaching activities had positive scores, ranging from 2.58–4.27 out of 5. A majority of students thought the longitudinal project was feasible and should be continued.

Conclusions: A pediatric elective was re-designed in a systematic fashion to focus on basic pediatric concepts and the community setting. Based on course evaluations and student surveys, the re-designed course had improved student ratings and feedback compared to the prior offering. Future course evaluations and an external peer-review of the course will occur for continued improvement of the course.

CURRENT DESIGNS OF PEDIATRIC ELECTIVE COURSES IN SCHOOLS OF PHARMACY. Allison Chung and Lea Eiland. *Auburn University, Harrison School of Pharmacy, MOBILE, USA; Auburn University, Harrison School of Pharmacy, Auburn, USA*

Introduction: In 2013, a joint American College of Clinical Pharmacy and Pediatric Pharmacy Advocacy Group issued an opinion paper calling for increased quality and quantity of pediatric education in pharmacy schools. They specifically recommended integrating more pediatric concepts into the standard curriculum and the accessibility of a pediatric elective to all pharmacy students. Since this paper, a 2014 survey assessed that 61% of pharmacy schools did offer a pediatric elective course to their pharmacy students. Common topics and methodologies were assessed but specific activities, assignments and assessments were not described. Prior to restructuring a pediatric elective, this study was commenced to systematically evaluate the innovative teaching strategies, activities and disease states that various pediatric elective courses utilized at other schools of pharmacy.

Methods: Pediatric course syllabi, topics, and teaching methods were solicited through organizational listservs and emails in May 2016. An internet search was performed in 2016 and 2018. The following pertinent data was gathered: course descriptions, number and types of instructors, evaluation processes, credit hours, hours per week, length of course, estimated out-of-class work/time, prerequisites, student composition, required texts, outcomes/objectives, teaching style/format of course, grade composition, assignment types, unique projects of the courses, and presence of satellite campus. All data was entered into a secured Google Sheets document.

Results: Twenty-seven pediatric course elective syllabi, email descriptions, research reports, and topic overviews representing 19 schools across 12 states from 2011 to 2018 were evaluated. Five schools offered more than two different pediatric elective classes. Faculty composition of the courses varied from one coordinator/instructor (15%) to multiple coordinators/instructors (33.3%) of various combinations. Instructors included pharmacists, physicians, pharmacy residents, and other healthcare disciplines. Course credit hours were typically either two credits (56%) or three credits (19%). Major topics of discussion included pharmacokinetics (69%), common pediatric diseases (76%) and drug information/literature evaluation (56%). A wide variety of specific disease states existed. Topics not covered as frequently included ethics and legislation (31%), pediatric psychiatry (31%), and neonatal intensive care unit concepts (19%). Unique teaching activities included use of movies, games, social media, mock patient rounds, creation of children's books or patient education material, clinical debates, simulations, elementary school outreach, service projects and on-site experiences.

Conclusions: Each school had widely varied methods of delivering their pediatric elective courses. Through the data collection, commonalities in major topics covered were elucidated and unique teaching activities highlighted. Future work includes surveying pediatric course coordinators to gain a better portrayal across all pharmacy schools. The data obtained through this characterization will allow schools of pharmacy to evaluate or initiate their own pediatric elective, to identify common disease states covered and to gain ideas for incorporation of interesting activities.

EXAMINING THE IMPACT OF AN EDUCATIONAL PROGRAM FOR INTERPROFESSIONAL STUDENTS TO ACHIEVE RESPECT AND COLLABORATION IN TEAMS. Jill Morgan, Victoria Marchese, Elsie Stines, Margaret Martin, Everett Smith, and Jay Perman. *University of Maryland School of Pharmacy, Baltimore, USA; University of Maryland School of Medicine, Baltimore, USA; University of Maryland, Baltimore, USA; University of Maryland Medical Center, Baltimore, USA; University of Maryland School of Social Work, Baltimore, USA*

Introduction: When working in a comprehensive clinic students and clinicians are expected to work together to provide quality care to patients. The purpose of our study was to examine an educational program [Interprofessional Students to Achieve Respect and Collaboration in Teams (I-SPARCT)] focusing on students respect, knowledge, and attitudes of interprofessional practice with the long-term goal of fostering the growth of collaborative teams.

Methods: Ninety-five students from six schools (Law, Medicine, Pharmacy, Nursing, Physical Therapy, Social Work, and Dentistry) attended three lunch and learn sessions and clinic experiences in a pediatric gastroenterology clinic. A pre and post survey was completed by the students to assess their respect, knowledge and attitudes about IPE using the validated attitudes towards healthcare team scale.

Results: Forty students were able to be matched for pre- to - post comparisons. There was a significant difference in overall mean scores for attitudes towards healthcare teams in ambulatory care (69 pre vs 78.3 post, $p < 0.001$). The overall mean scores for assessing the understanding of other healthcare professions were significantly increased after the interprofessional experience for educational requirements, scope of practice, and level of respect ($p < 0.0001$, $p < 0.0001$, and $p = 0.0064$ respectively). In addition, the overall mean score for perceived level of respect for you from each profession was significantly increased from 78.6 to 87.2 after the interprofessional experience ($p = 0.0038$).

Conclusions: A multi-session comprehensive learning experience (I-SPARCT) was beneficial in improving positive attitudes, knowledge, and respect amongst a diverse group of health care students.

IMPACT OF A SKILL-FOCUSED REDESIGN OF AN ELECTIVE PEDIATRIC PHARMACOTHERAPY COURSE. Kristen Nichols, Christine Kane, and Chad Knoderer. *Butler University, Indianapolis, USA; Riley Hospital for Children, Indianapolis, USA*

Objectives: An elective pediatric pharmacotherapy course has been offered to students in the 3rd professional year at our college for over 10 years. Changes to the course were made in response to instructor observations and student feedback, with the goal of maintaining a high level of student preparation for pediatric-related entrustable professional activities. Course content, activities, and student assessments focused on calculating and measuring doses, medication safety, developmental pharmacokinetics, finding and applying drug/medical information, verbal and written communication, and patient assessment. The objective of this study was to determine the impact of a redesigned elective course on student performance on a verbal assessment of pediatric pharmacy skills and knowledge.

Methods: This was a pre- and post-course verbal assessment which was administered outside of class time. The voluntary assessments were completed during the first and last weeks of the semester. Students were assessed in-person by 1 of 2 course instructors who used a standard questionnaire to ask 7 different clinical questions. Each clinical question was mapped to at least one of the course areas of focus listed above. Points assigned to successful completion of each component were determined prior to study initiation for a total of 28 possible points. Performance was documented by one of the two course instructors. A brief, written, open-ended survey was administered to students after each assessment to determine confidence and obtain student feedback.

Results: Ten students participated in both assessments. Total clinical performance score (mean $\pm$ SD) significantly improved from 13.3 ± 2.7 pre-course to 20.8 ± 2.9 post-course ($p < 0.005$). When viewed as a percentage of total possible points, however, the mean $\pm$ SD pre- and post-course scores were both below 75% ($48.2 \pm 9.3\%$ vs. $74.2 \pm 10.4\%$; $p < 0.005$). Students were awarded 50% of points or less for each question but two during the pre-course assessment. For the overall group, there was a positive change noted for each clinical question following course completion, with statistically significant increases ($p < 0.05$) observed in 5 of the 7 questions. Students earned a mean (IQR) score of 83.3% (66.7–100) and 91.7% (83.3–100) on a question focused on an ibuprofen recommendation in the pre- and post-course assessments ($p = 0.334$). The other question with no significant increase focused on the use of a drug without an FDA approved pediatric indication. Full points were awarded for this question in 8/10 student in the pre-course assessment and all of the students in the post-course assessment.

Conclusions: Students improved overall and with respect to specific pediatric skills following completion of the pediatric pharmacotherapy elective course. Additional course improvements may be necessary to further improve performance on the post-course assessment.

GRADUATES OF A PEDIATRIC DEGREE OPTION PROGRAM IN A DOCTOR OF PHARMACY CURRICULUM: PROGRAM PERCEPTIONS AND CONFIDENCE IN PEDIATRIC KNOWLEDGE AND SKILLS.

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Introduction: A curricular track (Pediatric Degree Option program) was created at the University of Oklahoma College of Pharmacy to improve competence in pediatrics with the first graduate in 2011. Students have to complete 6-8 hours of didactic coursework and 2-3 advanced pharmacy practice experience (APPE) rotations. The objectives of this study were to 1) identify confidence with pediatric pharmacotherapy knowledge statements, 2) perceptions of the program, 3) compare confidence in pediatric pharmacotherapy knowledge statements among residency trained versus non-residency trained graduates, and 4) categorize initial employment position following graduation.

Methods: A survey was conducted in the 30 program graduates from 2011-2016. A 29-item questionnaire was developed to assess confidence pertaining to pediatric pharmacotherapy knowledge statements and post-graduation employment characteristics. An analysis of variance (ANOVA) was utilized to compare responses between residency and non-residency trained graduates.

Results: Nineteen (63.3%) graduates responded. All graduates expressed "very high" or "high" confidence with dose calculations, selection for the first-line treatment for otitis media, and counseling caregivers on drug therapy. Whereas, <75% of graduates expressed "very high" or "high" confidence with identification of pharmacokinetic differences in pediatrics and with counseling children. Ten (52.6%) graduates completed a post-graduate residency with five (50%) of these completing a post-graduate year-one residency in a children's hospital. Seven (36.8%) graduates completed a post-graduate year-two (PGY2) residency with three (42.1%) of these completing a pediatric PGY2 and/or fellowship. A comparison was made between responses to the pharmacotherapy statements

between graduates with and without post-graduate training. The only statement with a difference was identification of pediatric drug information sources with those completing post-graduate training reporting higher confidence ($p=0.08$). Fourteen (73.7%) graduates believed that the Pediatric Degree Option influenced the type of pharmacist position that they took after graduation and gave them an advantage over other candidates for their first position following graduation.

Conclusions: Graduates noted high confidence in pediatric pharmacotherapy knowledge statements. Many graduates completed post-graduate training. However, there were limited differences in knowledge confidence statements between graduates who did and did not complete residency training. The Pediatric Degree Option program was well received and provides an opportunity for additional knowledge and skill development in pediatrics.

STUDENT ABSTRACTS

COLLABORATION OF AN INTERPROFESSIONAL TEAM ON A MEDICAL MISSION TRIP: OPPORTUNITIES FOR AN ENHANCED PHARMACIST ROLE.

Brianna Cobern and Annesha White. *University of North Texas System College of Pharmacy, Fort Worth, USA*

Introduction: There is a multitude of literature discussing the benefits of having pharmacy services incorporated into the medical mission team, however very few articles discuss in detail how pharmacists provide those services especially in pediatric populations. The UNTHSC Christian Medical Association organizes an annual trip to various countries in Central America and has recently started incorporating pharmacists. The objective of this research was to review the literature within the last decade on the contribution of a pharmacist on the medical mission team. A secondary aim was to identify specific areas for consideration, such as pediatric dosing, medication acquisition, and formulary development.

Methods: A review of the literature was conducted identifying articles by searching PubMed, Scopus and Academic Search Complete, using the keywords 'pharmacy', 'mission trips', 'medical missions', 'formulary', and 'religious missions.' Articles that were published between 2007 and 2017 were included in the analysis. A summary was provided based on eight subtopics: pediatrics, acquiring medications; formulary development; work flow; transportation; packaging, labeling and medication setup; medication data collection; and counseling. A template was developed reflecting medical mission trip workflow.

Results: The search yielded a total of 10 articles for review. There were no randomized controlled trials identified in the literature. However, all of the studies retrieved reflected a positive impact of the pharmacist

on the mission team. Findings revealed that medication acquisition and formulary development are key pre-trip roles for pharmacists. If medication is being brought outside the country where the trip is taking place, pharmacists should research the foreign country's policies beforehand to ensure there are no issues with customs during travel. Counseling and work flow were the most common roles in terms of impact. Packaging and labeling improved efficiency for patients when customized to their language preference. Few studies thoroughly examined pediatric dosing, and none of the studies highlighted the pharmacist's role in pediatric dosing. Nevertheless, pharmacists should be aware of the many considerations for pediatric populations during medical mission trips.

Conclusions: Previous literature has shown that pharmacy services are beneficial, but developing more standardized methods of how to utilize pharmacy services will help increase pharmacist contributions on mission trips. More research using randomized control trials or specific outcome measures would benefit the existing body of literature. An opportunity exists for pharmacists to effectively contribute on an interprofessional team. Pharmacists are trained to provide clinical pharmacy services within areas of expertise. Pediatric populations being served during a medical mission trip can benefit during pharmacy involvement in dosing, storage, compounding and administration of medications for children.

ASSESSMENT OF MEDICAL STUDENTS' KNOWLEDGE OF PEDIATRIC MEDICATION TASTE AND PALATABILITY. Caitlin Phoebus, Omayma Kishk, Jessica Biggs, Regina Macatangay, Rebecca Carter, and Allison Lardieri. *University of Maryland, School of Pharmacy, Baltimore, USA; University of Maryland Medical Center, Baltimore, USA; University of Maryland, School of Medicine, Baltimore, USA; Food and Drug Administration, Silver Spring, USA*

Objectives: The purpose of this study is to assess medical students' knowledge and beliefs about pediatric medication administration and taste before and after an education session.

Methods: The participants of this study included third year medical students as part of their pediatric clerkship block. The medical students completed a survey before and after an education session regarding pediatric pharmacology and palatability. The surveys asked them questions about their knowledge and beliefs regarding medications and associated taste. The education session was focused on pediatric pharmacology and medication palatability. During the education session, the participants had the option to partake in a taste test of five common pediatric medications. Afterwards, they participated in a five-minute game responding with their opinions of the medication taste test. The Kahoot! survey assessed the medical students' thoughts about

the five medications given during the taste test. The five medications were oral suspensions of amoxicillin, cefdinir, clindamycin, prednisolone and ranitidine. The students were asked to choose a response for each medication with one of four choices: (1) It tasted the best; (2) It tasted the worst; (3) It was good, but wasn't the best; and (4) It was bad, but wasn't the worst. This study has been IRB approved; students filled out waivers for the taste test and were asked about any medication allergies.

Results: Thus far, there are 77 medical students total that completed the Kahoot! survey. However, only 73/77 (94.8%) students answered the questions regarding amoxicillin, cefdinir, and prednisolone; while 77/77 (100%) students answered the questions on clindamycin and ranitidine. Amoxicillin was voted among 41/73 (56.2%) students to be the best tasting medicine out of the five. Prednisolone was voted the worst tasting medicine by 64/73 (87.7%) of the participants that responded. The results from pre- and post-surveys are still under review.

Conclusions: Participants found amoxicillin to be the best tasting medication, and prednisolone was voted the worst tasting medication. This taste test was an important demonstration to the medical students that palatability may affect medication adherence, especially in pediatric patients. A further analysis will be completed regarding participants' thoughts about medication administration and palatability before and after this education session.

THE ALPHABET SOUP OF PHARMACY CERTIFICATIONS. Mary Casino, Christina Thomas, Jade Jochem, Laura Tonner, Kristen Nichols, and Chad Knoderer. *Butler University, Indianapolis, USA*

Abstract: Background: Pharmacy certifications can be confusing and intimidating for student pharmacists, especially those students who may not have learned about them through a course or reading, but they are becoming more common. At our college of pharmacy, information about certifications is not directly incorporated into the pharmacy curriculum. The objective of this study was to determine pharmacy students' knowledge of and interest in pharmacy certifications before and after an educational presentation.

Methods: A 30-minute education session focusing on pharmacy certifications was offered to all pharmacy students at our college. Students who attended the session were given the opportunity to participate in pre-session and post-session surveys administered online via Qualtrics. The survey included multiple choice and free response questions to determine respondent demographics, current knowledge, interest in pharmacy certifications, and barriers to pursuing certifications. The study was approved by the university's institutional review board.

Results: A total of 100 participants completed the post-survey with a class-year distribution of 2.0% pre-pharmacy, 17.2% first-year, 29.3% second-year, 38.4% third-year, and 13.1% fourth-year. Ninety-one participants (91.1%) reported previous pharmacy experience, with community experience being the most common (53.5%) followed by community and hospital experience (24.2%). Prior to the education, (9.5%) of participants self-reported their pharmacy certification knowledge as moderate to expert compared to 86.6% of participants following education ($p < 0.005$). More respondents correctly identified that BCPPS signifies a board certification in pediatric pharmacy following the education session (47.6% vs. 81%; $p = 0.092$).

Interest in obtaining certifications in the future increased from 28.6% to 90.5% following the education ($p < 0.005$). Of the respondents reporting interest in obtaining a BPS board certification (65%), the most common certifications of interest were pharmacotherapy (42.6%), followed by ambulatory care (38.9%), critical care (27.8%), oncology (25.9%), pediatrics (20.4%), nutrition support (20.4%), psychiatry (18.5%), geriatrics (18.5%), and nuclear (7.4%). Overall, 74.1% of respondents rated the importance of including pharmacy certifications in the pharmacy program's curriculum as an 8 or higher on 10-point scale.

Conclusions: In this study, there was a significant increase in pharmacy students' knowledge of pharmacy certifications after the educational presentation. Respondents self-reported a strong interest in pursuing pharmacy certifications post-graduation. In a profession of increasing specialization, the results of this study support the need to improve awareness and potential benefits of raising that awareness.

IMPLEMENTING A PROTOCOL FOR WEANING PARENTERAL NUTRITION WITH THE INITIATION OF ENTERAL NUTRITION IN CRITICALLY ILL NEONATES. Christopher Michael Dorian, Shivali Patel, Komal Nadeem, and Danielle Marie Alm PharmD BCPS. *Philadelphia College of Pharmacy at the University of the Sciences, Philadelphia, USA*

Introduction: Premature neonates often require total parenteral nutrition (TPN) as their primary source of nutrition. The gastrointestinal tract of premature neonates is not fully developed and is often unable to handle large volumes of enteral feeds. However, small volumes of enteral feeds are recommended to prime the gut and therefore aid in maturation and tolerance. The primary objective of this study was to determine the process of weaning parenteral nutrition with the initiation of enteral nutrition and evaluate the benefit of decreasing total parenteral nutrition as enteral feeds are increased.

Methods: This study was approved by the Institutional Review Board at Cooper University Health Care and University of the Sciences. A retrospective data analysis

was conducted of 20 neonates who received total parenteral nutrition while being admitted to the neonatal intensive care unit at The Children's Regional Hospital at Cooper University Health Care. This study included patients who were admitted from January 2014 to December 2015. Data was collected utilizing the information from individual patient charts on the electronic health record and documented on a secure Microsoft Excel Sheet. Data obtained from the electronic health record included patient demographics (i.e., height, weight, race, and sex), indication for TPN, length of stay, individual components of TPN and their respective doses, laboratory values for serum electrolytes, bilirubin, and serum creatinine, total fluid volume, and volume of enteral nutrition administered. The primary endpoint was the percentage of weaning with enteral nutrition greater than 50 mL/kg/day with the current weaning strategy. The secondary endpoints assessed the safety of the current weaning strategy instituted, total calories and fluid volume per day. Data was analyzed using descriptive statistics.

Results: This study determined that currently there is no standardized protocol instituted for the weaning of parenteral nutrition when enteral nutrition is initiated at The Children's Regional Hospital at Cooper University Health Care. Only 40 percent ($n = 8$) of patients in this study were weaned off of their parenteral nutrition with enteral nutrition (EN) greater than 50 mL/kg/day however 92% abruptly stopped TPN. Additionally, the absence of a protocol for weaning parenteral nutrition brought about various safety concerns. There was an incidence of cholestasis in 25 percent ($n = 5$) of patients and metabolic complications from overfeeding were noted in 20 percent ($n = 4$) of patients. Average total fluid volume (TPN + lipids + EN) was 215 mL/kg/day [range 166–264 mL/kg/day].

Conclusions: Protocols exist throughout various pediatric institutions for weaning neonates off parenteral nutrition with the initiation of enteral nutrition. However, there are currently no national guidelines that provide specific recommendations. Additionally, the Children's Regional Hospital at Cooper University Health Care has not yet instituted a weaning protocol. Inappropriate weaning of parenteral nutrition with the initiation of enteral nutrition places neonates at risk for improper nutritional support, increased total fluid volumes and cholestasis. Data from this study will be used to implement a total parenteral nutrition weaning protocol at the Children's Regional Hospital at Cooper University Health Care.

EVALUATION OF NON-ADHERENT PALIVIZUMAB IN AN INPATIENT SETTING. Enas Salah, Christine Robinson, and Danielle McDonald. *Rutgers University, New Brunswick, USA; Morristown Medical Center, Morristown, USA*

Introduction: Palivizumab is a humanized mono-

clonal antibody indicated for prevention of respiratory tract infections caused by respiratory syncytial virus in high risk patients. American Academy of Pediatrics narrowed the eligibility criteria in 2014 to infants who are born before 29 weeks' gestation, have chronic lung disease of prematurity, and are immunocompromised. The purpose of this study is to evaluate appropriate adherence to the updated palivizumab guidelines at Goryeb Children's Hospital.

Methods: A retrospective chart review was performed to identify patients who received palivizumab from August 2014 to July 2017 as an inpatient at Goryeb Children's Hospital. Use was considered adherent if the patient met the suggested criteria in the American Academy of Pediatric guidelines, received the dose within the respiratory syncytial virus season (November 1 to March 31), did not experience a breakthrough respiratory syncytial virus hospitalization prior to dose, and was discharged to home. Additionally, opportunities to dose round to vial size (within 10%) and share vials (based on doses administered within forty-eight hours with combined absolute doses less than 100 mg) were assessed. The primary outcome is the percentage of palivizumab doses administered to pediatric inpatients during the 2014 to 2017 respiratory syncytial virus seasons that were adherent. Secondary outcomes include reasons for non-adherence and opportunities for dose rounding and vial sharing. This study was reviewed by the institutional review board.

Results: Eighty-eight patients receiving a total of 94 inpatient doses of palivizumab were evaluated in this study. Sixty-nine doses (73%) were adherent to predefined criteria. Only 77 doses (82%) were received between November 1 and March 31. Eight doses (9%) were administered before November 1 and 9 doses (10%) were administered after March 31. Eighty-nine doses (95%) met the American Academy of Pediatrics criteria. The majority of the doses (96%) were administered in the Neonatal Intensive Care Unit. Fifty-one doses (54%) were prepared from shared vials, while 13 doses (14%) had the opportunity to round doses or share vials. Thirty doses (32%) did not have an opportunity for rounding or sharing.

Conclusions: The majority of inpatient use of palivizumab was adherent. When non-adherent, date of dose was the main reason, however, the rationale for use appears appropriate. Doses were administered in mid-October to provide respiratory syncytial virus coverage while outpatient approval was being obtained, which can be a lengthy process. April doses were allowed as long as active respiratory syncytial virus infections were detected in the hospital. Therefore, palivizumab inpatient doses will be allowed beginning in mid-October and possibly April based on respiratory syncytial virus activity. Opportunities for dose rounding and vial sharing will be optimized through weekly evaluation of eligible patients.

MILLENNIALS CALL THE SHOTS: VACCINE HESITANCY AMONG TENNESSEE MILLENNIALS. Jenna Summerlin, Danya Horchi, Mary Kate Anderson, Sara Cox, and Zachery Halford. *Union University College of Pharmacy, Jackson, USA*

Background: Disease prevention by vaccination is one of the greatest public health achievements of the last century. However, a groundswell of concerns over vaccine safety, efficacy, and necessity by certain groups has led to increasing rates of vaccine hesitancy despite the availability of appropriate vaccine services. The Periodic Survey of Fellows conducted by the American Academy of Pediatrics in 2013 found that 87% of pediatricians encountered parents who refused a vaccine. This survey, directed towards Tennessee millennials (ages 19–37), aimed to (1) evaluate the frequency of vaccine hesitancy, (2) identify attitudes toward vaccination, (3) identify common sources of vaccine information, and (4) evaluate millennial perception of pharmacists screening, recommending, prescribing and administering vaccines.

Methods: A 21 question survey targeting Tennessee millennials was distributed through social media sites (Facebook and Twitter) from January 1 through January 31, 2018. The survey included questions regarding respondent demographics, attitudes on vaccines, sources of vaccine information, and perceptions of pharmacist participation in the vaccine process. Descriptive statistics were used to analyze all responses.

Results: A total of 632 electronic surveys were received, with 476 respondents meeting inclusion criteria. Most of the participants had received some level of college education, with 95% reporting some college attendance and 76% completing at least an Associate's Degree. Compared to national trends, respondents did not display an abnormal propensity towards vaccine hesitancy. One in five parents (20%) reported intentionally delaying or refusing a vaccine for a reason other than illness or allergy. In addition, 87% of parents and 91% of all respondents believed that it was important for everyone to get the recommended vaccines for themselves and their children. The majority of respondents agreed that vaccines are still needed even when the disease is no longer prevalent (85%) and that vaccine benefits outweigh their risks (90%). Of the six possible sources of vaccine information listed, respondents identified physicians and pharmacists as their top two utilized and trusted sources. Additionally, 80% of respondents conveyed comfort and trust in pharmacists screening, recommending, prescribing, and administering vaccines to themselves and/or their children. Finally, nearly 20% of millennials surveyed were not satisfied with the overall quantity of vaccine information they receive.

Conclusions: This study suggests vaccine hesitancy among Tennessee millennials to be similar to other

studied population cohorts. In addition, this study affirmed that Tennessee millennials trusts pharmacists to provide vaccine services. Pharmacists have the knowledge to provide vaccine information and the clinical skills to appropriately screen, assess, recommend and administer vaccines. As pharmacists continue to expand their clinical responsibilities, addressing vaccine hesitancy through patient education and vaccine advocacy should continue to be an important pillar of pharmacy involvement within the community.

DOSE MATTERS: A LITERATURE REVIEW OF PROPHYLACTIC PROBIOTIC DOSE FOR THE PREVENTION OF SEVERE NECROTIZING ENTEROCOLITIS IN VERY LOW BIRTH WEIGHT NEONATES.

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Introduction/Background: Necrotizing enterocolitis (NEC) is one of the most common diseases in very low birth weight (VLBW) (<1500 g) neonates and significantly impacts morbidity and mortality. Previous meta-analyses found that prophylactic probiotic use may reduce the risk of NEC in VLBW neonates, but did not address the optimally effective probiotic dose. We conducted a literature review to compare the efficacy and safety of prophylactic probiotic dosing for the prevention of severe NEC in VLBW neonates.

Methods: A literature search was conducted to identify randomized control trials from 1986–2016 randomizing VLBW neonates to prophylactic probiotics versus placebo for the prevention of NEC. Studies were divided into those comparing high dose (greater than or equal to one billion colony forming units per day) or low dose prophylactic probiotics (< one billion colony forming units per day) versus placebo for comparison. Relative risks (RR) and 95% confidence intervals (CI) were calculated for comparisons of interest.

Results: 22 studies met inclusion criteria. Among VLBW neonates, high dose prophylactic probiotics showed a risk reduction in severe NEC of 65 percent versus placebo (RR 0.35, 95 percent CI: 0.26–0.47, $p < 0.0001$); low dose prophylactic probiotics did not statistically significantly reduce NEC risk. No studies reported any adverse events due to probiotic administration.

Conclusions: In this literature review we found that only high dose prophylactic probiotics reduced the risk of severe NEC in VLBW neonates versus placebo. Given poor health outcomes due to NEC, and the relative ease of adding prophylactic probiotics, institutions should consider routine use of high dose probiotics in VLBW neonates.

TREATMENT ALTERNATIVES TO CEFOTAXIME IN NEONATAL AND INFANT SEPSIS. Lisa Wang, Sarah Smith, and Yuman Lee. *St. John's University, Queens, USA*

Introduction: The ongoing cefotaxime medication shortage significantly affects neonatal patients. Cefotaxime is a third generation intravenous cephalosporin used when gram negative coverage for enteric bacteria is desired. Cefotaxime was first recommended by the American Academy of Pediatrics and American College of Obstetrics and Gynecology for treatment of neonatal sepsis in and meningitis in 1996. Over the subsequent years, cefotaxime has proven to be a safe and effective antibiotic due to excellent penetration into the CSF and low toxicity associated with high doses. In February of 2015, manufacturers of cefotaxime discontinued the production leaving one manufacturer to fill the demand. Currently, issues related to raw materials limit the availability of cefotaxime. Now left with fewer treatment options, we want to find out what other medications are being used to mitigate this situation and their rationale.

Methods: A survey was conducted using the survey tool google forms. An email with a link to the survey was sent to every PGY2 pediatric residency director and pediatric pharmacist listed in PPAG's member directory.

Results: In neonates <28 days of life, 50% of the hospitals surveyed are using ceftazidime in place of cefotaxime and 40% are using gentamicin in place of cefotaxime. 10% are using 1 dose ceftriaxone. 40% are using two different antibiotics in place of cefotaxime. 20% are still using cefotaxime. 10% are using meropenem. 20% are using cefepime. The medications not selected in our survey include: vancomycin, cefazolin, cefuroxime, ceftiofur, nafcillin, penicillins.

In neonates >28 days of life 80% are using ceftriaxone. 30% are using ceftazidime. 30% are using gentamicin. 10% are using cefepime. 20% are using 2 antibiotics. 10% are using 3 antibiotics. The rationale for antibiotic choice consists of: formulary constraints, reserves of cefotaxime, following AAP recommendations, data from local antibiogram considered.

Conclusions: In the neonates less than 28 days old, majority of hospitals surveyed treated infant sepsis with ceftazidime. In patients 28 days and older, ceftriaxone was the main drug used in hospitals. This follows the recommendations by the AAP. However, with hospitals resorting to the usage of other cephalosporin and other classes of antibiotics, this creates an opportunity to become more familiar with how they work in neonates so that treatment outcomes with them in the future can be more predictable.

PROPHYLACTIC PROBIOTICS AND GASTROINTESTINAL MORBIDITIES IN PREMATURE INFANTS: A SEVEN YEAR INSTITUTIONAL EXPERIENCE.

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Introduction/Background: Preterm infants often have gastrointestinal (GI) complications which can range from temporary feeding intolerance to intestinal stasis, necrotizing enterocolitis (NEC), and death. Oral probiotics, either prophylactically or in response to symptoms, may have an impact on these GI complications. In 2012 our institution's medium-sized Neonatal Intensive Care Unit established a nutrition protocol that included prophylactic probiotics in infants born weighing <1250 g. Treatment with probiotics for these patients was initiated on day of life 2 and continued until 34 weeks corrected gestational age. In early 2017 this policy was modified, removing prophylactic probiotics and reserving the use of probiotics for treatment of infants with GI symptoms only. The intent of this investigation was to compare gastrointestinal morbidities and growth in patients born less than 1250 grams and cared for at our institution over a 7-year period: before, during, and after discontinuation of prophylactic probiotics as standard of care.

Methods: Conducted a retrospective review of electronic medical records for infants born less than 1250 grams from June 2010 to January 2018. Cases of genetic abnormalities, surgery (other than for necrotizing enterocolitis), and neonatal abstinence syndrome were excluded. Days of parenteral nutrition, days until full feeds, feeding intolerance events, NEC (Bell's Staging), and average daily weight gain were evaluated. Trends in these occurrences before, during, and after use of standardized prophylactic probiotics guideline were compared.

Results: Medical records of 686 sequential qualifying infants were investigated from 3 groups: period 1 from June 2010 to July 2012 before probiotics prophylaxis (n=143), period 2 from August 2012 to March 2017 during probiotics prophylaxis (n=479), and period 3 from April 2017 to January 2018 after institutional probiotics prophylaxis ceased (n=64). Birth characteristics and demographics were not different among groups. Infants in Period 2 had fewer days to full feeds and fewer feeding intolerance events versus Periods 1 or 3 ($p<0.05$). Average daily weight gain (20.75 grams vs 17.75 grams) was improved in Period 2 versus Period 3 ($p<0.05$). Hospital length of stay was not significantly different in Periods 2 and 3 ($p=0.9789$). NEC incidence was not statistically different between Periods 1 and 2, but stopping routine use prophylactic probiotics in Period 3 was associated with increased NEC incidence ($p<0.05$).

Conclusions: Prophylactic probiotics in infants less than 1250 grams can be a valuable addition to a feeding/nutrition standard of care bundle. Our experience suggests that probiotics prophylaxis significantly reduced

the time to full feeds, decreased intolerance events, increased daily weight gain, and may mitigate risks of severe gastrointestinal complications in this high-risk patient population.

THERAPEUTIC INNOVATIONS IN CHILDHOOD LEUKEMIA: AN OVERVIEW OF CURRENT CLINICAL TRIALS. Meagan Freil, Noreen Hussain, Jaymie Padero, and Nelly Adel. *Touro College of Pharmacy, New York, USA*

Introduction: One of the most common types of childhood leukemia is acute lymphocytic leukemia (ALL). Pediatric leukemia is the leading cause of mortality in patients 18 years or younger. As a result of standard curative therapy, ALL is associated with a 5-year survival rate of over 90 percent. However, acute myeloid leukemia (AML) and chronic myeloid leukemia (CML) are currently associated with 5-year survival rates less than 90 percent. There are currently several hundred clinical trials aiming to improve survival rates of childhood leukemias. The objective here is to summarize current studies and foresee the future direction in treating childhood leukemia.

Methods: A search was conducted utilizing www.clinicaltrials.gov for clinical trials pertaining to leukemia. In order to isolate trials focused on childhood leukemia, a series of inclusion and exclusion criteria were applied. The most prominent inclusion criteria were studies utilizing novel treatments, immunological interventions, or any changes in current standard of care. The most distinct exclusion criteria were trials that did not focus on pediatric patients. The clinical trials were categorized based on the subtype of leukemia and the treatment regimens. Trials were further classified into changes in standard therapy, the use of new novel therapies, or investigating immunologic therapies.

Results: An initial search yielded 5266 clinical trials. After applying the inclusion and exclusion criteria, 103 trials were included. Each trial was further analyzed to identify the various subtypes of childhood leukemias and the several treatment regimens. Some trials included several forms of leukemia and thus the quantification of disease states exceeded 103. The included studies referenced ALL 92 times and AML 65 times. CML and CLL, however, were quite understudied due to the limited cases of these diseases in pediatric patients. In regards to the treatment regimen, 94 trials examined a change in standard of care. This change was mainly identified as variations in standard medications for leukemia. There were 12 novel treatment options; varying between new biologic drugs (i.e., blinatumomab) and new formulations of drug therapies (i.e., DaunoXome). It is important to note that 26 trials were studying immunologic therapies; these therapies included new stem cell transplant methods and current dosing of rituximab, a biological monoclonal antibody

targeting CD20.

Conclusions: Currently childhood leukemia remains the prime area of research in pediatric patients. Our search suggests that the majority of trials are focusing on modifying current chemotherapy regimens to minimize toxicity and to improve treatment outcome. It is also apparent in our search that the pediatric trials are still in the preliminary stages for novel agents, biologicals, and immunotherapy when compared to the adult population. Despite this we are still optimistic that the future holds great improvement in the mortality and the possibility of curing childhood leukemia.

RETROSPECTIVE EVALUATION OF CURRENT CHEMOTHERAPY INDUCED NAUSEA AND VOMITING PREVENTION ANTIEMETIC REGIMENS IN PEDIATRIC CANCER PATIENTS RECEIVING INPATIENT HIGH-RISK CHEMOTHERAPY. Meghan McElligott, Eric LeCato, Denise Howrie, and Scott Maurer. *University of Pittsburgh School of Pharmacy, Pittsburgh, USA; Children's Hospital of Pittsburgh of UPMC, Pittsburgh, USA*

Introduction/Background: The purpose of this project is to evaluate the efficacy of CHP-UPMC's current inpatient antiemetic regimens in high emetic risk chemotherapy protocols in pediatric cancer patients. Results will inform planned institutional guideline revisions, incorporating new ASCO 2017 antiemetic guidelines.

Methods: The CHP-UPMC pharmacy dispensing database was queried to identify pediatric patients aged 0-21 years old who were ordered two selected high emesis risk chemotherapy: 1) cisplatin regimens or 2) pediatric Ewing sarcoma regimen incorporating alternating cycles of ifosfomide/etoposide (IE) with vincristine/doxorubicin/cyclophosphamide (VAC). Retrospective data collection from the electronic health record was conducted, with approval by the UPMC Quality Improvement Committee. Information included patient demographics (age, gender, weight, BSA, diagnosis) and specifics of chemotherapy (drug(s), doses, frequency, route) and prescribed scheduled and "as needed" (PRN) antiemetics. Descriptive data analysis includes frequency and volume of emesis, notation of nausea or retching and number of PRN antiemetic doses required for each patient course of treatment.

Results: HER review occurred for 33 patients: 26 received cisplatin and 7 received VAC/IE. Cisplatin-treated patients received preventative medication including corticosteroids (76.9% patients), fosaprepitant (92.3% patients), ondansetron (96.2% patients) and olanzapine (34.6% patients). PRN antiemetics were used by 50% patients, usually lorazepam IV or promethazine IV. 7.7% of patients receiving cisplatin therapy had an episode of breakthrough emesis and 23.1% of cisplatin patients reported nausea at least once. I/E-treated patients received preventative medication usually including corticosteroids (100% patients) and ondansetron or

granisetron (100% patients). PRN antiemetics were used by 28.6% patients, usually lorazepam IV or promethazine IV. 14.3% of patients receiving I/E therapy had an episode of breakthrough emesis and no I/E-treated patients reported nausea. VAC-treated patients received preventative medication, usually corticosteroids (100% patients), ondansetron (71.4% patients) and fosaprepitant (85.7% patients) while PRN antiemetics were required by 42.9% patients, usually lorazepam IV or promethazine IV. No patients receiving VAD therapy had an episode of breakthrough emesis and 14.3% of VAD-treated patients reported nausea. For all regimens, PRN medications were used for either emesis or nausea. While breakthrough emesis was low, nausea was higher incidence. Further subgroup analysis is planned including incidence of breakthrough emesis and PRN breakthrough medications in first cycle of treatment and patient-specific sequential responses to antiemetics across multiple identical chemotherapy regimens.

Conclusions: Efficacy of current CINV prevention strategies will be informed for several high emetic regimens during this quality improvement project. Modifications of antiemetic regimens will be designed, incorporating actions based in this work and the updated 2017 ASCO guidelines for emesis control.

RETROSPECTIVE STUDY OF CALFACTANT VERSUS PORACTANT ALFA FOR RESPIRATORY DISTRESS SYNDROME IN PREMATURE INFANTS. Pamela Nicoski, Tomas Munoz, and Marc Weiss. *Loyola University Medical Center, Maywood, USA; Memorial Hospital of Carbondale, Carbondale, USA*

Objective: To determine if there is a difference in mortality, oxygen requirement at 28 days of life, oxygen requirement at 36 weeks adjusted gestational age, and other health outcome measures in premature infants who received poractant alfa versus calfactant for respiratory distress syndrome.

Study Design: This is a retrospective study conducted at the Loyola University Medical Center in Maywood, Illinois involving 599 premature infants born between September 1, 2008 and August 31, 2015 with a diagnosis of respiratory distress syndrome (RDS) and who received at least one dose of surfactant. Poractant alfa was used exclusively from September 2008 to February 2012 and calfactant exclusively from March 2012 to August 2015. Exclusion criteria included patients with major congenital abnormalities, out born infants, and those with incomplete charts. Mortality, bronchopulmonary dysplasia, major morbidities, and length of stay were compared between surfactant groups. Comparisons were made using 2-tailed unpaired t-tests (continuous variables) and chi-square (categorical variables). Significance was defined as p less than 0.05.

Results: Seven hundred and fifty seven patients were evaluated, of which 28 patients did not meet inclusion

criteria, 35 had major congenital anomalies and 95 had incomplete charts. Of the 599 eligible patients, 284 received poractant alfa and 315 received calfactant for RDS. The groups did not differ in birth weight, gender, ethnicity, or antenatal steroid use but gestational age was slightly lower in the poractant group. No differences were found in mortality or oxygen requirement at 28 days of life and 36 weeks adjusted gestational age. The calfactant group had significantly less pulmonary hemorrhage, use of mechanical ventilation, ventilator days, and days on oxygen; however, the need for any supplemental oxygen as well as days on high-flow nasal cannula did not differ. With respect to other health outcomes, significantly less patients in the calfactant group were diagnosed with sepsis, necrotizing enterocolitis, spontaneous intestinal perforation, patent ductus arteriosus requiring treatment, and grade 3 to 4 intraventricular hemorrhage or periventricular leukomalacia. Less surfactant doses were given in the poractant group but the length of stay was longer.

Conclusions: This evaluation found no difference between calfactant and poractant alfa in mortality or bronchopulmonary dysplasia, but patients in the calfactant group showed significantly less morbidity rates and length of stay. Because this study compared two different time periods in which practice changes may have occurred in an unrecognized fashion, we cannot confidently ascribe all of the improvements seen in the calfactant group to the use of that surfactant though the difference in pulmonary hemorrhage is consistent with one previous study. A prospective, randomized controlled trial comparing poractant alfa and calfactant would better establish differences that exist between these two products.

COMPARISON OF CLINICAL OUTCOMES AND MEDICATION EXPOSURE OF OBESE VERSUS NON-OBESE CHILDREN ADMITTED TO THE PEDIATRIC INTENSIVE CARE UNIT. Katy Stephens, Erica Bergeron, Philip Barker, Jamie Miller, Tracy Hagemann, Teresa Lewis, and Peter Johnson. *University of Oklahoma College of Pharmacy, Oklahoma City, USA; University of Tennessee College of Pharmacy, Nashville, USA*

Objectives: Few studies have compared clinical outcomes and medication exposure between non-obese and obese children admitted to the pediatric intensive care unit (PICU). The objectives were to 1) compare clinical outcomes, 2) median number of medications, and 3) median number of continuous infusions (CI) between non-obese versus obese children admitted to the PICU.

Methods: This was a retrospective, IRB-approved study of children ages 2-17 years admitted to the PICU on or after January 1, 2011 and discharged before December 31, 2011. Obesity was defined using the Centers for Disease Control and Prevention criterion as a body mass index (BMI) >95th percentile for age and gender.

Normal-weight patients were defined as children with a BMI <95th percentile for age and gender. Data collection included baseline demographics, hospital and PICU length of stay (LOS), mortality, mechanical ventilation (MV) requirement, and all medications received while in the PICU. Clinical outcomes of interest for the primary objective included PICU LOS, MV requirement, and mortality. Descriptive and inferential statistics were employed for data analysis, with a *priori* level of significance of 0.05.

Results: A total of 836 admissions were included with 22.0% (184/836) admissions involving obese patients. In addition, there was no difference in the median age [interquartile range (IQR)] in obese versus non-obese admissions, 7 years (5–11) versus 8 (4–13), $p=0.274$. There was a significant difference in the MV requirement between obese versus non-obese admissions, 16.8% ($n=31$) versus 1.5% ($n=10$), $p=0.0001$. There was no significant difference in the median (IQR) ICU LOS between obese versus non-obese admissions, 1 (1–2) versus 1 (1–2), $p>0.05$. In addition, there was no significant difference in mortality in obese versus non-obese admissions, 2.2% ($n=4$) versus 2.8% ($n=18$), $p=0.656$. There was no significant difference in the median (IQR) number of medications in the PICU between obese versus non-obese patients, 12 (7–18) versus 12 (8–21), $p>0.05$. However, there was a significant difference in the number of CI required between the obese versus non-obese admissions, 24.5% ($n=45$) versus 38.3% ($n=249$), $p=0.0005$; despite this, there was no significant difference in the median (IQR) number of CI per admission between obese versus non-obese admissions, 2 (1–6) versus 2 (1–5), $p>0.05$.

Conclusions: Approximately one-fifth of all admissions included obese children. There was a significantly greater need for MV in obese children, but there were no differences in PICU LOS or mortality. In addition, there was no significant difference in the median number of medications between groups, but non-obese children required significantly more CI than obese children.

RELIABILITY OF PARENT ALLERGY REPORTING AND DOCUMENTATION IN PEDIATRIC HOSPITALIZED PATIENTS. Rachel Jackson, Cristal Lozano, Sarah Glade, Jordan Burdine, and Sherry Luedtke. *Texas Tech University Health Sciences Center, Amarillo, TX, USA*

Background: Patients often have difficulty discerning drug allergies from adverse drug reactions (ADRs), with studies in adults estimating that only about 15-20 percent of ADRs are allergic reactions. However, when patients experience ADRs, they are often deemed “allergic” to the medication without further clarification, and these medications are then flagged in the patient’s record to influence future prescribing. A detailed history of the patient’s adverse reaction can help determine whether or not the self-reported history is compatible

with a true drug allergy, allowing medication administration in patients who are unlikely to be allergic.

Objectives: To determine the accuracy of reliability of parent allergy reporting and drug allergy documentation in pediatric medical records. Secondly, to compare factors associated with inaccurately reported allergies.

Methods: A prospective evaluation of caregiver reported drug allergies was performed for all patients admitted to an inpatient pediatric service from February 2017 to March 2018. Caregivers completed a standardized drug allergy questionnaire which clarified symptoms, timing of the reaction, resolution of the reaction, as well as re-challenges of the respective drug. Demographic data including patient age at the time of the reaction, patient age at the time of the survey, and concomitant allergies or diagnosed immunological conditions were gathered. Allergies were classified as true allergy, probable allergy, unlikely allergy, or not an allergy based upon responses. Data collected was then compared to the documentation in the electronic medical records.

Results: Preliminary results. A total of 76 drug allergies were reported in 54 patients. Of the reported allergies, 43.4% were classified as true allergies, 28.9% probable allergies, 5.3% unlikely allergies, 2.6% unknown classification, and 19.7% were not allergies. The most common allergy reported was penicillin and the most common reaction rash. The majority of allergies (38.1%) reportedly occurred in patients less than 2 years of age. Seventy two percent of allergies were incorrectly documented in the electronic medical records, and 6% of allergy reports occurred in patients never exposed to the medication. Thirty-seven percent of patients reported being instructed to avoid the medication without having a true allergy; and, in 22.4% of the reports, the patient was using concurrent medications that commonly cause allergic reactions. Final results to be presented.

Conclusions: It is crucial that allergies be clarified and appropriately documented to ensure patient safety and optimize drug therapy selection. These findings will aid in identifying the degree of inconsistent reporting and documentation to assist in developing quality improvement initiatives.

INTERN PHARMACIST EXPANDED ROLE IN PEDIATRIC CRITICAL CARE. Shannon Ramsden, Sharon Gordon, and Jennifer Hamner. *Children's Hospital Colorado, Aurora, USA*

Introduction/Background: At Children's Hospital Colorado (CHCO) we have recently developed distinct clinical roles for our pharmacy interns in the pediatric critical care setting. We identified three well defined roles for our interns to practice at the top of their scope: Stress ulcer prophylaxis screening in the pediatric ICU (PICU), palivizumab (Synagis) counseling in the neonatal ICU

(NICU), and reviewing titration parameters for continuous infusion range orders to ensure compliance with Joint Commission requirements in all critical care units. These activities allow the intern pharmacist to not only extend clinical services, but also benefit from learning how to appropriately screen patients and make medication recommendations, comprehend progress notes and lab results, and understand regulatory compliance.

Methods: Once the intern completed the required training and competencies, they were allowed to perform the new roles. For stress ulcer prophylaxis screening in the PICU, the interns were trained to identify patients eligible for stress ulcer prophylaxis, therapeutic duplications, and if therapy could be switched from intravenous to oral administration. The interns utilized the electronic medical record (Epic) to identify indications requiring stress ulcer prophylaxis per the CHCO Stress Ulcer Prophylaxis Guidelines for PICU Patients. The interns documented an intervention in the patient's electronic medical record if there was an inconsistency in prophylaxis indication and current therapy, a therapeutic duplication was identified, or if a switch to an oral therapy was indicated. Similar to stress ulcer prophylaxis recommendations, interns documented an intervention if a continuous infusion range order did not contain the proper requirements per the Joint Commission including initial infusion rate and titration parameters. For palivizumab counseling, patients were identified by our NICU pharmacists, then our intern pharmacists completed counseling with the patient caregivers, and documented the teaching through an intervention.

Results: Since the expansion of the intern pharmacist role at CHCO in January 2018, our interns have expanded clinical coverage through frequent recommendations regarding stress ulcer prophylaxis in the PICU and documentation of titration parameter compliance for continuous infusion range orders in the critical care units. Currently, there have not been any counseling opportunities for palivizumab counseling for our interns.

Conclusions: We have expanded clinical services through the utilization of intern pharmacists at the top of their scope. To date, our intern pharmacists have demonstrated that they are capable of screening patients for stress ulcer prophylaxis appropriateness and proper documentation of continuous infusion range orders. Our preliminary results have demonstrated the mutual benefit of utilizing our intern pharmacists as clinical extenders, and providing our interns with invaluable clinical experience and knowledge in pediatric pharmacy.

EVALUATING THE ROLE OF CHIMERIC ANTIGEN RECEPTOR T-CELL THERAPY FOR ACUTE LYMPHOBLASTIC LEUKEMIA IN PEDIATRIC POPULATION: A LITERATURE REVIEW. Tinnie Liao-Ng Yan, Diana Duong, Virleny Garcia, Christine Le, Sana Shafi, and

Nelly Adel, PharmD, BCOP, BCPS. *Touro College of Pharmacy, New York, USA*

Background: There are two approved chimeric antigen receptor (CAR) T-cell treatments for both advanced acute lymphoblastic leukemia (ALL) and advanced large B-cell lymphoma. Tisagenlecleucel (Kymriah) was approved in August 2017 for the treatment of relapsed or refractory (R/R) B-cell precursor ALL for patients up to 25 years old. ALL is the most common childhood cancer; defined as when cancer cells replaced greater than 25% of the bone marrow. Current survival rate for children and adolescents with ALL is 94% and 74%, respectively. In CAR treatment, the patient's T-cells are collected and genetically modified to bind specifically to patient's cancer cells. Preliminary data showed complete remission (CR) within three months after infusion. A significant side effect is Cytokine Release Syndrome (CRS) characterized by high fevers and very low blood pressure. Other serious side effects included neurotoxicity, difficulty breathing, a weakened immune system, and etc. The standard therapy for ALL is combination chemotherapy or tyrosine kinase inhibitors for those with a Philadelphia chromosome. This study's objective is to review the literature regarding the safety and efficacy of CAR T-cell therapy in the pediatric patients with ALL.

Methods: A literature search was conducted of "CAR T-cells" using MEDLINE for articles published between February 2013 and February 2018. Eligibility criteria

for this study included abstracts, clinical trials, and review articles published within the last 5 years and included pediatric patients. Exclusion criteria included incomplete studies, adult patients and articles that did not focus on ALL.

Results: 36 articles were obtained, of which 19 were excluded due to adult patients only (3), news article (3), not clinically related (4), non-human trial (2), not related to ALL (5), and not in English (2). The remaining 17 articles were assessed for safety and efficacy of CAR T-cells in pediatric patients with ALL. The main outcomes of the studies include CR, minimal residual disease (MRD)-negative remission, and relapse rate. Patients between ages 11 months to 17 years old with refractory B-ALL were administered CAR T-cell therapy and showed 83% remission but relapsed within 2-7 months. In these studies, CRS was treated with an interleukin-6-receptor (IL-6R) or tocilizumab (7). Patients also experienced neurologic events (seizures) up to 23-40%, hematological events, fever, and graft versus host disease (1).

Conclusions: Overall, pediatric patients with relapsing ALL experienced good response to CAR T-cell therapy. Complete remission rates were high and the relapse rates was delayed. The majority of these trials had a small patient size and more research and head-to-head trials will give us a better insight on how to use this approach. One issue to consider is the current price tag for CAR T-cell therapy and how to justify its use for a short response rate.