19th Annual Meeting Abstracts

CHARACTERISTICS OF ADVERSE DRUG REACTIONS AT CHILDREN

Adnan Bajraktarevic, Slobodan Trninic, Jasmina Ceman Saric, Alma Abdagic Maslar, Nermina Korac, Sanda Majstorovic, Indira Tahmiscija, Branka Djukic.
Public Health Institution of Health Center Sarajevo – Pediatrics Department, Sarajevo, Bosnia and Herzegovina, Clinical Medical Centar, Sarajevo, Bosnia and Herzegovina, Pharmaceutical faculty, Sarajevo, Bosnia and Herzegovina, Pediatrics Clinic, Sarajevo, Bosnia and Herzegovina, First Medical Aid Pediatrics Department, Sarajevo, Bosnia and Herzegovina. bajrakm@bih.net.ba

INTRODUCTION Children are at exceptionally high risk for adverse drug events. The large number of drugs that require study, coupled with limited resources, dictates the need to prioritize the drugs for study in children populations. Critical changes in drug labeling for pediatric patients illustrate that unique pediatric dosing often is necessary, reflecting growth and maturational stages of pediatric patients. **AIMS** We sought to describe characteristics of adverse reactions in children, to determine whether drugs are given primarily to severe sick children, and to examine potential safety issues. **METHODS** Survey of pediatric medical, drug safety reports of National Health Net in two periods for give years from 1998 to end 2009 year. Methods including: searching, inclusion criteria, quality assessment and meta-analysis were assessed.Spontaneous reporting of adverse drug reactions (ADRs) in pediatrics hospitals and pediatrics offices is scarce and several obstacles to such reporting have been identified previously. **RESULTS** We analysed 1291 ADR reports corresponding to 5 441 ADRs. Consumers reported 8% of the ADRs. The median number of reported ADRs in children per year increased from 124 (range 103-169 in the first period 1998-2003 year to 199 (range 158-266) in the second period 2004-2009. Adverse drug reactions (ADRs) were reported for 1.07% of children patients and 3.12% in infants patients. **DISCUSSION** These findings fail to confirm that the recommended use of combined descriptors for medicine side effects is unequivocally superior to absolute frequency alone. **CONCLUSIONS** Safety monitoring during the early postmarketing period is crucial to detect rare, serious, or pediatric-specific adverse events. Pediatric cases are often especially tragic with severe adverse drug reactions. Drug studies in the children population are performed frequently after the pathophysiologic abnormalities revert to normal and may not be generalizable to sick children.

TREATMENT OF ATYPICAL HEMOLYTIC-UREMIC SYNDROME WITH ECULIZUMAB IN A 10 MONTH OLD CHILD

Sarabeth Baxter, Kelly Steidl, Luke Probst, James Listman.
Upstate University Hospital, Syracuse, NY, United States. sbb_uconn@hotmail.com

INTRODUCTION Hemolytic-uremic syndrome (HUS) occurs in 6.1 per 100,000 children under age 5 and carries a 25% mortality rate. It is characterized by hemolytic anemia, thrombocytopenia and renal impairment caused by microvascular thrombosis in the kidney. Atypical HUS is attributed to genetic, acquired or idiopathic causes leading to abnormalities in complement function and subsequent uncontrolled complement activation. Eculizumab, a novel monoclonal antibody, is indicated for treatment of paroxysmal nocturnal hemoglobinuria but has been used in some adults and a 4 year old for treatment of atypical hemolytic-uremic syndrome (aHUS). We report our experience with eculizumab for treatment of aHUS in a 10 month old child. **METHODS** An 8 month old female presented with edema, 2-3 days of loose stool; initial bloodwork included blood urea nitrogen of 30 mg/dL, creatinine of 0.7 mg/dL, and hemoglobin of 7.8 g/dL. She was diagnosed with aHUS upon further workup, including suggestion of a complement regulatory protein deficiency (given low C3 levels). The patient was readmitted twice in two months due to ongoing symptoms. Management included daily plasma transfu-

sions while admitted and 2-3 weekly infusions as an outpatient and aggressive management with several antihypertensives and furosemide. During the third admission, her serum creatinine reached 1.9 mg/dL and the patient required twice daily plasma transfusions; during this admission plasma exchange therapy and hemodialysis were begun. At this point, the decision was made to use eculizumab. A dose of 300mg IV weekly for 2 weeks then every 3 weeks thereafter was chosen based on limited pediatric data and product configuration. Meningococcal prophylaxis with penicillin was initiated. **RESULTS** After starting eculizumab, dialysis continued for 11 days as urine output returned to baseline, C3 levels normalized and plasma exchange therapy was stopped. The patient continued to require aggressive antihypertensive management and was eventually discharged on amlodipine, lisinopril, chlorothiazide and furosemide. The third dose of eculizumab was given 1 week early, just before the patient's discharge and continued every 3 weeks thereafter. Serum creatinine has remained stable at 0.3 mg/dL and hemoglobin at 9.7-10.1 mg/dL. Furosemide was discontinued after the fifth dose of eculizumab and the patient continues triple antihypertensive therapy. No further plasma or red blood cell transfusions have been needed and no further readmissions have occurred. The patient has not experienced any adverse effects from eculizumab infusions.

ELECTRONIC REFRACTIVE INDEX DETECTION OF COMPOUNDED INTRAVENOUS MEDICATION PREPARATION ERRORS IN A PEDIATRIC HOSPITAL

Charisa Flaherty, Mark MacKay, Jared Cash. *Primary Children's (Intermountain Healthcare), Salt Lake City, Utah, United States, University of Utah College of Pharmacy, Salt Lake City, Utah, United States.* jared.cash@imail.org

INTRODUCTION According to the Institute of Medicine's report "To Err is Human," medication errors are the leading cause of preventable adverse events in the hospital. Further analysis of medication errors have shown intravenous (IV) medications and pediatric patients have a greater likelihood of harm when errors do occur. Unfortunately, sterile product compounding errors are very difficult to detect once the medication leaves the pharmacy therefore end product testing has been suggested. Refractive index (RI) is one such suggested testing method. The purpose of this study is to determine if RI can identify IV room compounding errors. **METHODS** Twenty commonly compounded sterile medications were chosen. A baseline RI value was measured on an electronic refractometer (J157, Rudolph Research Analytical), which is accurate to the fifth decimal place. Five samples of each medication were randomized to be appropriately or inappropriately made. Inappropriate preparations were based on realistic potential IV room errors. A blinded investigator measured each unknown sample and compared it to the baseline in an attempt to identify any errors. The unknown samples were compared to three different percentages of the baseline RI: ± 5%, ± 10%, ± 15%. Sensitivity (ability to identify error when present) and specificity (ability to not falsely identify errors) were then calculated for each different percentage. The twenty medications tested are: acyclovir 5 mg/mL, calcium chloride 8 mg/mL, clindamycin 10 mg/mL, cyclosporine 2.5 mg/mL, dexmedetomidine 4 mcg/mL, epinephrine 50 mcg/mL, fentanyl 10 mcg/mL, fosphenytoin 25 mg/mL, gentamicin 5 mg/mL, hydrocortisone 10 mg/mL, hydromorphone 100 mcg/mL, insulin 1 unit/mL, levetiracetam 100 mg/mL, methylprednisolone 10 mg/mL, midazolam 0.4 mg/mL, morphine 1 mg/mL, nitroprusside 400 mcg/mL, norepinephrine 50 mcg/mL, potassium chloride 1 meq/mL, tobramycin 5 mg/mL. About half of the medications were compounded in NS and the rest were compounded in D5W. **RESULTS** Cyclosporine, fentanyl, hydromorphone, levetiracetam, potassium chloride, morphine, and nitroprusside were all correctly identified as appropriately made or inappropriately made regardless of RI percentage cut off. Acylovir, clindamycin, gentamicin, and tobramycin were all corrently identified with the ±5% cut off. Medications that were the most difficult to correctly identify were calcium chloride, methylprednisolone, and midazolam. Medications that were compounded in D5W were correctly identified more often than those compounded in NS. The sensitivities were 80% for the ± 5% group, 88% for the ± 10% group, and 100% for the ± 15% group. The specificities were 80% for the ± 5% group, 54% for the ± 10% group, and 40% for the ± 15% group.

CONCLUSIONS Electronic RI with 5 decimal place accuracy shows potential benefit in detecting IV room errors. When all medications tested are considered, the ± 5% RI has the best specificity and sensitivity at 80% each. It appears that RI may be even more accurate with specific medications than others and more detailed testing of each medication is warranted.

STABILITY OF FUROSEMIDE AND CHLOROTHIAZIDE MIXED IN A SYRINGE

Jeffrey Cies, Wayne Moore, Robert Mason.
St. Christopher's Hospital for Children, Philadelphia, PA. Alfred I. duPont Hospital for Children, Wilmington, DE, United States. jeffrey.cies@gmail.com

INTRODUCTION Furosemide is a loop diuretic and chlorothiazide is a thiazide diuretic which are commonly used in pediatric patients for varying reasons. Furosemide and chlorothiazide can be used concomitantly to maximize diuresis. It has been a practice at some institutions to combine furosemide and chlorothiazide in the same syringe even though stability data is currently lacking for this combination. The purpose of this study was to determine whether the furosemide and chlorothiazide combination is stable when mixed in a syringe. **METHODS** Chlorothiazide and furosemide were dissolved in dextrose USP to a final concentration of 10 mg/mL of chlorothiazide and 1 mg/mL of Furosemide and combined in a 30-ml syringe. Controls of chlorothiazide in dextrose, furosemide in dextrose and dextrose alone were also prepared for control purposes. Samples were loaded into individual vials in an Alliance HPLC auto-sampler maintained at 25°C. At timed intervals over 48 hours, a 10-uL sample was taken from each vial for separation on a Novapak C18 (3.9 X 300 mm), eluting with a gradient from 0.1% trifluoroacetic acid to 100% acetonitrile and monitoring elutes at 254 nm. **RESULTS** Peaks of chlorothiazide and furosemide were well-separated by the HPLC method. In the mixture and chlorothiazide alone samples, an additional peak absorbing at 254 nm slowly appeared over time. The source and identity of this UV absorbing material is unknown. The area of the peaks corresponding to chlorothiazide and furosemide did not change significantly over a 48 hour period. **CONCLUSIONS** Chlorothiazide (10 mg/mL) and furosemide (1 mg/mL) are stable for up to 48 hours at room temperature in dextrose, either alone or in combination. An unknown UV absorbing compound increased during storage of the chlorothiazide in dextrose, with or without furosemide, and did not affect the stability of either agent. Infusion of chlorothiazide (10 mg/mL) and furosemide (1 mg/mL) mixed with dextrose in a syringe can be utilized for infusion for a period up to 48 hours. Information regarding Y-site compatibility with other medications and the chlorothiazide/furosemide combination is still unknown.

PIPERACILLIN/TAZOBACTAM PHARMACOKINETICS IN A CRITICALLY ILL CHILD

Jeffrey Cies.
St. Christopher's Hospital for Children, Philadelphia, PA, United States. jeffrey.cies@gmail.com

INTRODUCTION Treatment of sepsis and septic shock remains a significant challenge in an intensive care unit setting and the need for improvements in current treatment strategies is paramount. Current evidence suggests that early and appropriate antibiotic therapy remains the most important intervention that a clinician can implement for such patients. Given the increasing incidence of sepsis, further research toward optimizing antibiotic therapy is a priority. Alterations in the volume of distribution (Vd) and clearance of antibiotics in patients with sepsis and septic shock have been documented in the literature. Data from Joukhadar has shown significantly reduced concentrations of piperacillin in peripheral tissues in critically ill adult patients with septic shock. Impaired antibiotic distribution into tissue, the target site where most infections occur, is a major concern for clinicians and may explain the high morbidity and mortality in this patient population. Piperacillin and piperacillin/tazobactam (PTZ) have a wide dosage range in pediatric patients. The current recommended dosing of P is 200-300 mg/kg/day divided every 4-6 hours and for PZT is 200-400 mg/kg/day of piperacillin divided every 6-8 hours. The actual dose and interval selected depends on the indication in addition to minimum inhibitory concentration of the most common pathogens(s) for that indication. Children between the ages of 6 months-6 years typically have larger Vds and faster clearance of drugs

which can impact the dose and interval selection. **METHODS** Retrospective chart review of a 3 year old, 15 kg patient admitted with Escherichia coli septic shock. **RESULTS** This was a 3 year old, 15 kg patient admitted with septic shock as a result of Escherichia coli bacteremia. The patient had been receiving 50 mg/kg/dose of the piperacillin component IV every 6 hours and his condition worsened and was transferred to the intensive care unit (ICU) requiring fluids, vasopressors and inotropic support. Upon admission to the ICU, the patient was started on PTZ at a dose of 100 mg/kg/dose of the piperacillin component IV every 6 hours. After a standard 30 minute infusion, random piperacillin concentrations were obtained at 1 and 3 hours from the end of the first infusion. Piperacillin serum concentrations were plotted against time, and individual pharmacokinetic parameters were determined by a non-compartmental analysis. The initial concentration (Co) was determined to be 60 mcg/mL as compared to an initial Co of 360 mcg/mL reported in the literature. The Vd was determined to be 1.7 L/kg as compared to a Vd of 0.24 L/kg reported in the PTZ package insert. **CONCLUSIONS** Appropriate piperacillin serum concentrations may not be achieved in pediatric ICU patients with sepsis and septic shock based on current dosing recommendations. Dosing and subsequent serum concentrations of antimicrobial agents in pediatric patients with sepsis and septic shock need to be further evaluated to determine if current recommended doses achieve appropriate serum concentrations.

EVALUATION OF THE NEED FOR AN ANTIMICROBIAL STEWARDSHIP PROGRAM IN A PEDIATRIC HOSPITAL SYSTEM

Alyson Davis.
Children's Healthcare of Atlanta, Atlanta, GA, United States. alyson.a.davis@gmail.com

INTRODUCTION Antimicrobials are among the most frequently used medications in hospitalized patients and account for up to 30% of a hospital pharmacy's budget. In order to promote their judicious use, the Infectious Diseases Society of America developed guidelines for establishing antimicrobial stewardship programs (ASP) within acute care hospitals. The purpose of this study was to evaluate the current use of antimicrobials at this institution and to assess the need for an ASP. **METHODS** This study consisted of three areas of review of current antibiotics practices at Children's Healthcare of Atlanta, including a meropenem Medication Use Evaluation (MUE), a review of the de-escalation practices within the Neonatal Intensive Care Unit (NICU), and a review of IV to oral conversion practices within the Pediatric Intensive Care Unit (PICU). Each area was evaluated through a retrospective chart review. For the meropenem MUE, 149 patient charts were reviewed. The primary objective was to determine the current usage patterns of meropenem by indication and location. The secondary outcome was to evaluate de-escalation practices based on culture and sensitivity reports. The review of broad-spectrum antibiotic de-escalation practices in the NICU consisted of 121 retrospective chart reviews. To be included, patients must have been started on vancomycin, meropenem, or piperacillin-tazobactam within 7 days of admission. The primary objective of this portion of the study was to evaluate the current de-escalation practices based on culture and sensitivity reports. The secondary objective was to determine the most common indications for broad-spectrum antibiotic use in the NICU. In the IV to oral conversion portion of the study, 33 antibiotic courses were reviewed. Patients were started on IV medications with a bioequivalent oral form. The primary objective was to evaluate current IV to oral conversion practices. **RESULTS** The most common indications for the use of meropenem included respiratory tract infections, necrotizing enterocolitis, and fever and neutropenia in immunocompromised patients. Of the seventy patients who could have appropriately received de-escalated therapy, 62.8% received de-escalated antibiotic regimens, 97.8% of those to an appropriate regimen. The most common indications for broad-spectrum antibiotics in the NICU were necrotizing enterocolitis, clinical deterioration, and gastroschisis. Fifty-seven patients had culture and sensitivity results that supported de-escalation of therapy. Of these, 59.6% received de-escalated antibiotic regimens, and 40.4% continued on broad spectrum antibiotics despite culture and sensitivity results.For IV to oral conversion, of the 33 antibiotic courses, 10 were eligible for IV to PO conversion, and eight were converted to appropriately.

CONCLUSIONS An antimicrobial stewardship program would be of benefit at this institution. The infectious diseases team would be more involved with the use of broad-spectrum antibiotics, which would lead to improved de-escalation practices based on cultures and sensitivities, decreased or prevented resistance, and decreased cost.

EVALUATION OF VANCOMYCIN DOSING FOR COMPLICATED INFECTIONS IN PEDIATRIC PATIENTS

Spencer Durham, Marroyln Simmons.
Sacred Heart Children's Hospital, Pensacola, Florida, United States. durhash@gmail.com

INTRODUCTION Since the publication of new guidelines for the monitoring of vancomycin in January 2009, higher doses of vancomycin have been necessary to achieve the newly recommended trough of 15 to 20 mg/mL for complicated infections, including pneumonia, endocarditis, sepsis, osteomyelitis/septic arthritis, and central nervous system (CNS) infections. This study was undertaken to evaluate current vancomycin dosing regimens and to determine the dose necessary to achieve a therapeutic vancomycin trough in pediatric patients with complicated infections. **METHODS** A retrospective chart review of patients admitted to a teaching children's hospital from July 1, 2009 through April 30, 2010 was conducted. Patients treated with vancomycin therapy for a complicated infection were included in the study population. Patients with renal dysfunction and patients receiving vancomycin prior to admission were excluded. Each patient was evaluated for initial and final vancomycin dose and corresponding trough levels. In addition, measures of renal function and number of dose changes were reviewed. **RESULTS** A total of 73 patients were started on vancomycin for complicated infections. Two patients were excluded due to renal dysfunction and one patient was excluded due to home use of vancomycin. Patients less than 50 kg were started on a vancomycin dose of 15 mg/kg IV every 6 hours or immediately changed to this dose by the Pediatric Pharmacy Pharmacokinetic Consultation Service. Patients greater than 50 kg were started on a standard dose of 1 gram IV every 8 hours. Trough levels were obtained with the fifth dose. A total of 43 patients had trough levels drawn with the initial vancomycin dosing regimen: six patients receiving 1 gram every 8 hours, one patient receiving 1 gram every 6 hours, and 36 patients receiving 15 mg/kg every 6 hours. Three of these patients obtained an initial vancomycin trough level between 15 and 20 mg/L. Two patients had supratherapeutic levels: one patient receiving 1 gram every 8 hours and another patient receiving 15 mg/kg every 6 hours. All other patients had a trough level below 15 mg/L. Eighteen patients had repeat vancomycin trough levels drawn, with only five patients obtaining a therapeutic trough. The average dose to obtain this trough was 21.15 mg/kg every 6 hours (range 18.75 to 23 mg/kg/dose every 6 hours). All other patients were discontinued from vancomycin therapy. **CONCLUSION** The results of the study indicate that currently recommended vancomycin dosing schemes are inadequate to obtain a therapeutic vancomycin trough for most patients with complicated infections. Further research is needed to determine an optimal initial dose for these patients. Decreasing the number of dose changes needed to obtain therapeutic levels in these patients will improve patient care and decrease healthcare costs.

EVALUATION OF VANCOMYCIN DOSING AND SUBSEQUENT LEVELS IN PEDIATRIC PATIENTS

Lea Eiland.
Auburn University, Huntsville, AL, United States. eilanls@auburn.edu

INTRODUCTION Due to concerns of increasing resistance to vancomycin, newer adult guidelines recommend higher trough concentrations based upon the type of infection. Although these recommendations are not specific to pediatrics, the principle issue can be extrapolated to children. Desired higher trough levels will theoretically require higher dosing of vancomycin in children. The purpose of the project was to evaluate current dosing regimens and subsequent therapeutic troughs of vancomycin being used in a community hospital and compare to reference recommended doses and guidelines. **METHODS** Vancomycin is an automatic pharmacy pharmacokinetic consult per the hospital

Pharmacy and Therapeutics committee. Pharmacokinetic parameters of pediatric patients prescribed vancomycin from January 2005-May 2010 were evaluated in this retrospective chart review. Only those patients with trough levels obtained appropriately were included in the analysis. Patients in the nursery and neonatal intensive care unit were excluded. Vancomycin dosing (dose and interval) that provided goal trough levels was obtained and calculated. Goal trough levels were also evaluated and compared to vancomycin prescribing guidelines respective of the year. Secondary outcomes included identifying patient demographic factors that impacted vancomycin dosing, indications, the incidence of troughs, peaks, and culture and sensitivity obtained, and comparing physician versus pharmacist dosing of vancomycin. **RESULTS** There were 440 troughs obtained over the 6 year period for 266 patients (age 12 days to 18 years). Vancomycin dosed at 80 mg/kg/day or higher produced more therapeutic troughs (10-20 mg/L) than lower doses, $p<0.001$. Specifically, vancomycin dosing at 80 mg/kg/day and higher divided every 6 or 8 hours produced a trough 10 mg/L or higher 70% and 63% of the time, respectively. Troughs did not differ based on dosing intervals, $p=0.463$. Forty-six percent of the patient's troughs were at goal (5-15 mg/L) during 2005-2008 where as only 30% of patient's troughs reached extrapolated adult recommendations of (10-20 mg/L) after 2009. Dosing vancomycin in an every six hour schedule has been utilized more frequently than an every 8 hours since 2009, $p<0.001$. Pharmacists dosing was more likely to result in goal trough levels than physician dosing, $p=0.009$. **CONCLUSIONS** The vancomycin dosing regimens currently recommended in pediatric references (40-60 mg/kg/day) does not provide optimal trough levels in children today the majority of the time. Higher daily doses of vancomycin are needed to reach desired therapeutic troughs of 10-20 mg/L.

EVALUATION OF A VANCOMYCIN DOSING PROTOCOL IN POST-OPERATIVE PEDIATRIC CARDIOTHORACIC SURGERY PATIENTS

Emily Gish, Peter Johnson, Kevin Farmer, Christine Allen, Michael Burton, Ryan Webb, Susana Chavez-Bueno, Tracy Hagemann.
University of Oklahoma Health Science Center College of Pharmacy, Oklahoma City, United States, University of Oklahoma Health Science Center College of Medicine, Oklahoma City, United States.
emilygish@gmail.com

OBJECTIVES With concerns of increasing vancomycin minimum inhibitory concentrations (MIC) for methicillin resistant Staphylococcus aureus isolates, a vancomycin dosing protocol of 20 mg/kg/dose IV every 8 hours was implemented for all pediatric patients. This study was designed to assess the appropriateness of this protocol in pediatric cardiothoracic surgery (CTS) patients versus an otherwise healthy control. **METHODS** A retrospective chart review of patients <18 years-of-age, receiving vancomycin following CTS was performed for one year following implementation of the dosing protocol. Patients were excluded if the vancomycin protocol dose was not utilized or if a trough concentration was not obtained within 1 hour of the true trough. An age, sex-matched control group was identified to assess dosing appropriateness. Data collected include baseline demographic information, vancomycin dosing regimen with serum concentrations, serum creatinine (SCr), albumin, urine output, surgical information, and potentially nephrotoxic concomitant medications. The primary outcome was defined as the difference in trough concentrations between groups. Secondary outcomes included assessment of nephrotoxicity, defined as an increase of SCr > 50% from baseline, and identification of factors that may result in differing trough concentrations. Unequal variance t-tests were utilized for non-normally distributed continuous variables and chi-squared analyses were performed for categorical variables. A multivariable linear regression model was used to identify factors associated with differences in log-transformed vancomycin trough concentrations between groups. **RESULTS** Forty-four patients received vancomycin following CTS. Four patients were excluded due to inappropriately obtained trough concentrations, while 13 were excluded due to non-protocol dosing regimens leaving 27 patients for evaluation of the primary outcome. Males represented 55.6% of patients with a mean age of 1.12 years (range 2 days-6 years). Mean trough concentrations were significantly differ-

ent between groups (CTS: 18.4 mg/L, control: 8.8 mg/L; p<0.001). Fourteen patients (51.9%) in the CTS and 10 (37%) in the control groups had trough concentrations within the recommended range of 10-20 mg/L. Mean baseline SCr was similar between groups (CTS: 0.34 mg/dL, control: 0.32 mg/dL); however, the number of patients reaching the defined limit of nephrotoxicity was much greater in the CTS group (CTS: 20, control: 3; p<0.001). Baseline albumin was the only factor identified that may correlate with differing trough concentrations. While controlling for group, on average, we predict subjects with a 1 g/dL higher baseline albumin level to have a 0.2266 lower log (trough) concentration (p=0.02). **CONCLUSIONS** The vancomycin dosing protocol of 20 mg/kg/dose IV every 8 hours achieved higher trough concentrations in pediatric CTS patients than in otherwise healthy children, although goal trough concentrations of 10-20 mg/L were attained in greater than 50% of CTS patients. Future studies would be warranted to identify the appropriate dose for those patients with delayed vancomycin clearance as indicated by elevated trough concentrations.

WARFARIN GOALS FOR THERAPY—ARE WE THERE YET? A CHILDREN'S HOSPITAL EXPERIENCE WITH WARFARIN THERAPY

Joshua LaBrin, Bernard Lee, Kevin Graner, Chad Brands.
Mayo Clinic, Rochester, Minnesota, United States, Vanderbilt University School of Medicine, Nashville, Tennessee, United States. graner.kevin@mayo.edu

INTRODUCTION Despite the widely recognized risks of anticoagulant therapy, most pediatric patients are started on oral warfarin in the absence of standardized clinical protocols. Given the differing intensity of anticoagulation recommended for clinical and surgical indications, it is imperative that all providers be aware of the targeted level of anticoagulation, specifically the INR (International Normalized Ratio). The Goal Range INR (GRINR) would ideally be found in the medical record, readily retrievable to all involved in a pediatric patient's care. Research has noted the lack of adequate documentation of numerous items of clinical significance related to warfarin dosing, but not specifically the GRINR. We sought to examine our recent practices on warfarin therapy in the children's hospital setting. This initiative served as the first step in development of a framework for standardized warfarin dosing by pediatric clinicians and pharmacists. **METHODS** Retrospective medical records review included physician and nursing notes, medication administration records, hospital summaries, and pharmacy records of consecutive pediatric patients (age 17 and under) hospitalized at Mayo Children's Hospital between 1/1/2007 and 12/31/2008. Evidence of research authorization was confirmed before inclusion. **RESULTS** 135 patients representing 176 inpatient courses of warfarin were elucidated from the specified period of observation. 33 patients' courses (18.75%) were found to have no documentation of GRINR during their hospitalization, while 81 patients' courses (46.02%) were found to have the GRINR documented solely on the discharge summary. 136 courses (77.27%) of warfarin therapy were initiated after obtaining a baseline INR value (within 48 hours prior to first dose). 121 warfarin naïve patients (no warfarin use within 7 days) were initiated on therapy with a goal INR documented at some point during hospitalization. The average starting warfarin dose was 0.078 mg/kg (range: 0.014-0.377 mg/kg, SD: 0.047 mg/kg) amongst all weight distributions. The mean length of warfarin therapy until goal was achieved was 5.35 days (range: 1-58 days, SD: 7.57 days). 57 (47.11%) patients reached the GRINR, of which only 38 (31.4%) were sustained at GRINR at the time of discharge. **CONCLUSIONS** Patients given warfarin during hospitalization were found to lack appropriate documentation of GRINR. Highly variable dosing and monitoring regimens resulted in inconsistent outcomes for pediatric warfarin therapy as measured by the INR. Our data strongly suggests a need for the development of a standardized pediatric warfarin dosing protocol based on GRINR that would be universally documented and retrievable in the medical record in children's hospitals.

A RETROSPECTIVE REVIEW OF ENOXAPARIN DOSING AND ANTI-XA LEVELS IN INFANTS LESS THAN THREE MONTHS OF AGE

Laura Hall, Paige Fuller, Jennifer Domm,

Christopher Slaughter, Elizabeth Yang. *Monroe Carell Jr. Children's Hospital at Vanderbilt, Nashville, TN, United States.* laura.hall@vanderbilt.edu

INTRODUCTION Enoxaparin is a low-molecular weight heparin commonly used in pediatric patients for prophylaxis and treatment of thromboembolic events. Due to differences in pharmacokinetics and volumes of distribution, the initial dose of enoxaparin for infants less than two months of age is higher than initial dosing recommended for older infants. However, at our institution, infants less than three months of age often require several dosage increases in order to reach therapeutic levels, increasing the risk of further clot formation. **PURPOSE** To evaluate if initial dosing recommendations from the CHEST guidelines are sufficient for infants less than two months of age to reach therapeutic anti-Xa levels and if higher initial dosing recommendations should be expanded to include infants less than three months of age. **METHODS** This retrospective review examined infants less than three months of age who received treatment doses of enoxaparin between September 2005 and September 2009. Data collected included patient characteristics, such as age at initiation and initial enoxaparin dosing. All infants were evaluated to determine final dosing (milligram/kilogram/dose) required to reach therapeutic anti-Xa levels, number of dosage adjustments required, and time (days) to reach therapeutic levels. Infants were further subdivided to determine if there were differences in enoxaparin dosing in preterm infants or infants with cardiac defects. **RESULTS** Eighty-seven infants less than three months of age received treatment doses of enoxaparin during the study period. Six patients did not reach therapeutic levels. Fifty-four term infants and 27 premature infants were evaluated, with sixteen infants being ≥ 60 days of age at initiation. Patients ≥60 days were initiated on 1 mg/kg/dose of enoxaparin. The mean treatment dose for non-cardiac term infants less than 60 days was 2.1 mg/kg/dose and 2.37 mg/kg/dose in non-cardiac preterm infants, with initial therapeutic levels of 14% and 0%, respectively. The mean dose for cardiac term infants less than 60 days was 1.72 mg/kg/dose and 2.12 mg/kg/dose in cardiac premature infants, with initial therapeutic levels in 37% and 33%, respectively. The mean dose for non-cardiac term infants ≥60 days was 1.62 mg/kg/dose and 2.05 mg/kg/dose in non-cardiac preterm infants, with initial therapeutic levels of 0% in both groups. The mean dose for cardiac term infants ≥60 days was 1.75 mg/kg/dose and 1.63 mg/kg/dose in cardiac preterm infants, with initial therapeutic levels of 0% and 25%, respectively. **CONCLUSIONS** The CHEST guidelines resulted in initial therapeutic levels in 25% of patients less than two months and in 6% of patients greater than two months. Higher initial enoxaparin dosing may be required in infants less than three months.

RECONSTITUTION AND MEASUREMENT OF THE DOSE OF AMPICILLIN-CLOXACILLIN DRY SYRUP BY MOTHERS OF BABIES ATTENDING PAEDIATRIC CLINIC AT LAGOS UNIVERSITY TEACHING HOSPITAL

Moses Iorngurum, O Ogunbajo, Edna Iroha. *Department of Clinical Pharmacy & Biopharmacy Faculty of Pharmacy University of Lagos, Lagos, Nigeria, Department of Paediatrics College of Medicine University of Lagos, Lagos, Nigeria, Lagos University Teaching Hospital Idi-Araba, Lagos, Nigeria.* mosestombu@yahoo.co.uk

INTRODUCTION Ampicillin-cloxacillin dry syrup is one of the most frequently dispensed [used] antibiotic preparations for treatment of common bacterial infections in children. It is usually dispensed to mothers or caregivers as dry powder for reconstitution, both in hospital and community health care facilities. Mothers, often uneducated, are absolutely relied upon to effectively administer reconstituted syrup to their babies with only limited instructions at dispensing, brief manufacturers' information on the product, and sometimes-past experience. No study has been reported [to investigators' knowledge] to have assessed mothers' knowledge and practice of reconstituting and measuring the doses of this medicine, in Nigeria or in any other country. **OBJECTIVE** This study investigated the knowledge and practice of reconstitution, storage, measurement of the dose and use of ampicillin-cloxacillin dry syrup by mothers for their babies. **METHODS** One hundred and seven (107) mothers, whose babies were attending the Paediatric

Clinic, were admitted into the study based on defined inclusion and exclusion criteria. They were provided ampicillin-cloxacillin dry syrup, and all other requirements for reconstitution including a suitable work area, at no cost. Their knowledge and skills were simultaneously assessed and corrected while they each reconstituted syrup and measured one dose the way they would normally do at home. **RESULTS** About 91% (97) of mothers either completed secondary school only, 34 (31.8 %) or had tertiary education, 63 (58.9 %) in addition. Majority, 97 (91.5%) had past experience with reconstitution of this medicine, while 9 (8.5%) did not. Only about 50% (54) of mothers gradually added sufficient water initially, to uniformly disperse powder in the bottle before further additions to reach the marked levels; and only 22 (20.5%) knew the crucial importance of viewing the lower meniscus of water at eye level to obtaining correct volumes of liquids in glass bottles. When asked to administer reconstituted syrup to their babies, 24 (22.4%) did not shake the bottle immediately before measuring the dose volumes, which implied that their doses would be wrong. **CONCLUSIONS** Only a relatively small proportion of mothers in this study demonstrated a real capacity to properly reconstitute and correctly measure the dose volumes of ampicillin-cloxacillin dry syrup without assistance. They however had the potential to learn quickly. Extensive education and assistance by paediatric pharmacists will be most useful in this regard. For the uneducated or inexperienced mothers, reconstitution with demonstrations by pharmacists is recommended, while alternative formulations should be considered.

THE NEED TO REORGANIZE AND FOCUS TRAINING AND PRACTICE OF CLINICAL PHARMACY IN NIGERIA

Moses Iorngurum.
Department of Clinical Pharmacy & Biopharmacy Faculty of Pharmacy University of Lagos, Lagos, Nigeria, Lagos University Teaching Hospital Idi-Araba, Lagos, Nigeria. mosestombu@yahoo.co.uk

OBJECTIVE The purpose of the study was to provide evidence that there was need for major changes [reforms] in the way pharmaceutical care and training were being carried out in university hospitals in Nigeria. **METHODS** Four hundred (400) pre-validated self administered questionnaires were posted to the Northern, Central and Southern parts of the country, to be distributed among hospital- and any other pharmacists that were trained in Nigeria. EPI Info Version 6 software was used to analyze completed questionnaires. **RESULTS** Response rate of 75% was achieved, with 300 questionnaires analyzed. Respondents accepted outpatient dispensing to consist of a "hurried exchange" with "scanty communication" between pharmacist and patients to be "true", 189 (63.0%) or "partly true" , 96 (32.0%). Pharmacist interaction with inpatients was described to occur "always", 17 (5.7%) "sometimes", 116 (38.7%) "rarely", 136 (45.3%) "not at all", 27 (9.0%) and non-response, 4 (1.3%). The dispensing process in university hospitals compared with secondary or primary care centers were "very similar" or "similar" to 163 (54.5%), while "different" and "very different" made up only 124 (41.5%). Clinical pharmacy lecturers of associated universities should be appointed consultants to university hospitals, 238 (79.4%), as they had the potential of providing the highest level of pharmaceutical care possible in the country, 256 (85.4%). **CONCLUSION** The investigation confirmed that reforms were required in order to transform pharmaceutical care, training, research and primary care in all ramifications in Nigeria. A new organizational structure for the faculty of pharmacy has been recommended to facilitate the delivery of pharmaceutical services and training at the highest level.

RECOMMENDATIONS OF 40 CHILDREN AGED 5-16 YEARS ON PROLONGED MEDICATION TO THE MINISTER OF HEALTH AND PRESIDENT OF NIGERIA

Moses Iorngurum, E Ogundiniyi, Edna Iroha.
Department of Clinical Pharmacy & Biopharmacy Faculty of Pharmacy University of Lagos, Lagos, Nigeria, Department of Paediatrics College of Medicine University of Lagos, Lagos, Nigeria, Lagos University Teaching Hospital Idi-Araba, Lagos, Nigeria. mosestombu@yahoo.co.uk

OBJECTIVES The study investigated the recommendations of hospitalized children

for improved health care. The research was part of a larger study that enquired into the experiences of hospitalized children of various ages in a university hospital in Nigeria. Methods: This aspect of the in-depth interview investigated what each child would like the Minister of Health and President of Nigeria to do to make their treatment better in "this" hospital. They had spent between one week and above one year on admission in two medical and one surgical wards of Lagos University Teaching Hospital. Children knew that their answers were recommendations to health authorities for their welfare. **RESULTS** Their mean age was 9.0+2.7 years, and male to female ratio was 1:1. Twenty six (65.0%) were under treatment for various medical conditions, while 14 (35.0%) were under surgical care. Thirty (75.0%) adults who accompanied children on admission were mothers. Thirty eight (95.0%) children wanted to know the name of their illness, and 35 (87.5%) "really" wanted to know its cause(s), Thirty nine (97.5%) wanted to know how the treatment would help them get well, 38 (95.0%) wanted to know whether the treatment would cure the disease. Thirty nine children (97.5%) wanted to know how long they needed to continue taking their medicines, the times they needed to take them, how the medicines would make them feel better, and the reason why they MUST always take their medicines. Thirty five (87.5%) wanted to be told whether their medicines would have (bad) side-effects. Thirty six children (90.0%) wanted the pharmacist [whoever s/he was] to talk with them about their medicines, while thirty two (80.0%) wanted a place to play in the children's ward. Thirty seven children (92.5%) wanted their mothers to stay in the hospital with them, while 2 (5.0%) declined, empathizing that she should rest from the stress of hospital stay she had already gone through, or take care of a younger sibling at home. Thirty seven children (92.5%) wanted brighter colors and pictures on the walls of the children's ward. **CONCLUSIONS** Hospitalized children require essential information, education and effective communication that them to actively participate in their own life-long care rather than passively consuming health services. Pharmacists should be actively involved in general and specialized care of hospitalized children. Company of mothers should be promoted for its value to hospitalized children. Adequate attention should be paid to provide good aesthetic features, play facilities and motivational paintings in the paediatric ward environment in our hospitals.

METHADONE IN CRITICALLY ILL CHILDREN: THE POWER STUDY—PREVENTION OF OPIOID WITHDRAWAL: A RETROSPECTIVE EVALUATION AND REVIEW

Sonia Jeffries, Rumi Pattar, Alexander Pitfield, Roxane Carr.
University of British Columbia, Vancouver, BC, Canada, Children's and Women's Health Centre of British Columbia, Vancouver, BC, Canada. sjeffries@cw.bc.ca

INTRODUCTION Opioids are commonly used in the pediatric intensive care unit (PICU) to provide analgesia and sedation. Opioid withdrawal frequently occurs upon discontinuation. Our institution has a protocol for methadone use to prevent opioid withdrawal in children who received a continuous intravenous infusion (CIVI) of morphine for greater than four days in the PICU. **OBJECTIVES** To determine if patients were tapered according to protocol, and IV morphine to oral methadone conversion ratio used. Secondary objectives were to determine if methadone dosage used produced the desired clinical results; to evaluate methadone adjustments; and to describe incidence of adverse effects. **METHODS** A retrospective chart review of pediatric patients who had received CIVI morphine for greater than four days, and methadone, in the PICU between May 2008 and August 2009. Validated scoring systems, the Withdrawal Assessment Tool and State Behavioral Score, were used to assess withdrawal symptoms and sedation. **RESULTS** A total of 43 patients were included with a median age (range) of 8 (0.25-201) months. Seventy-two percent of patients were not started on the protocol, and no patient followed it to completion. Median length of wean (range) was 10 days (0-91 days). A conversion ratio of 1:0.8 and 1:1 of IV morphine to oral methadone was used for anticipated 5 or 10 day wean, respectively. During the first 10 days of wean, 42% of patients experienced withdrawal symptoms. Methadone dose was increased in 26% of patients. Median number of days (range) that patients were sedated was 1 (0 – 9); comfortable was 6.5 (1-64); and agitated

was 2.5 (0-23). Two patients required naloxone. **CONCLUSIONS** Methadone protocol is not frequently followed. The majority of time patients are appropriately sedated; however, 42% experienced withdrawal. Further studies are needed to determine optimal opioid tapering and to minimize withdrawal symptoms and adverse events.

EVALUATION OF INITIAL METHADONE DOSING FOR PREVENTION OF IATROGENIC OPIOID ABSTINENCE SYNDROME IN CHILDREN

Peter Johnson, Jamie Miller, Donald Harrison.
OU College of Pharmacy, Oklahoma City, OK, United States, OU College of Medicine, Department of Pediatrics, Oklahoma City, OK, United States.
peter-johnson@ouhsc.edu

INTRODUCTION Iatrogenic opioid abstinence syndrome (IOAS) is a frequently observed complication in critically ill infants/children receiving long-term sedation/analgesia. Methadone is a commonly prescribed agent for IOAS; however, there is a paucity of data on the recommended initial dosage of methadone required to prevent IOAS. The purpose of this study is to describe initial methadone doses utilized in infants and children for prevention of IOAS and to determine the appropriateness of dose based on response to therapy. **METHODS** Data was collected retrospectively from January 1- December 31, 2008 and included demographics, continuous intravenous infusion (CIVI) opioid regimen, concomitant sedative/analgesics, methadone regimen, and IOAS symptoms. The primary objective of this study was to identify the initial methadone dosage regimen utilized for IOAS in patients <18 years. Secondary objectives included 1) a comparison of methadone dose changes (e.g., increase or decrease) within 72 hours of IV opioid discontinuation and 2) opioid CIVI requirements based on initial methadone doses above and below the median level (i.e., mg/kg/day). Between-group analysis was performed using descriptive and inferential statistics. A step-wise regression analysis will be employed to assess relationships between the initial methadone dose (mg/kg/day) and independent variables including age, cumulative IV opioid duration, peak IV opioid dose, overlap time between IV opioid and methadone, and IV opioid dose prior to discontinuation. **RESULTS** Fifty-five patients were included for analysis. The median age (range) was 0.45 years (0.003-12). CIVI of fentanyl were continued for a mean of 321.2 ± 273.6 hours with a median cumulative dose of 667.1 mcg/kg (115.8-5751.7). The initial median methadone dose was 8 mg/day (0.6-120) or 0.84 mg/kg/day (0.24-4.24) with the majority (81.8%) receiving this in 4 divided doses. There was a significant difference in the mean cumulative fentanyl mcg/kg dose between children requiring a dosage change whose initial dose was below (n=27) or equal to/greater than the median initial dose (n=28); 515.5 ± 284.1 vs 1752.3 ± 1365.8, p<0.01. Twenty-nine patients (52.7%) required a dosage change with twenty-four children (82.7%) requiring a dosage increase secondary to withdrawal. There was no significant difference in the number of children requiring a dosage change < 0.84 mg/kg/day vs >0.84 mg/kg/day, p=0.17. **CONCLUSIONS** In this cohort, the initial methadone dosage regimens varied greatly. Approximately half of the patients required a dosage change from their initial methadone regimen. Based on this data, it seems that a more standardized approach to methadone dosing to prevent IOAS in our institution may prevent the need for adjustments for the initial methadone dose.

RELATION BETWEEN VALPROIC ACID AND THROMBOCYTOPENIA IN PEDIATRIC ONCOLOGY SETTING

Sherif Kamal, Ahmed Mahmoud.
Children cancer Hospital Egypt, Cairo, Egypt.
shka_1999@yahoo.com

INTRODUCTION Valproic acid is used in our setting as antiepileptic drug either alone or in combination with other antiepileptic drugs. Thromhocytopenia in association with valproic acid therapy has been reported in patients of various ages with incidences ranging from 1 to 32%. Regarding the pathophysiology of the Thromhocytopenia associated with valproic acid therapy, there is evidence to suggest that valproic acid can evoke an immune response with the production of antibodies directed against platelets. Sandler described circulating and bound platelet antibodies of the IgM type, especially in pediatric oncol-

ogy setting where thromhocytopenia is common it is very essential to study this association. **METHODS** To evaluate this association in a pediatric population, we retrospectively studied 55 children treated with valproic acid(VPA) at our institution in April 2010.The patient medical files were reviewed The Incidence of thrombocytopenia were recorded based onthat Thrombocytopenia was defined as a platelet count ~200 x 103/mm3.The valproic acid levels of these patients were also recorderded in this period of time. **RESULTS** We retrospectively studied children treated with valproic acid(VPA) at our in April 2010. The Incidence of thrombocytopenia in Valproic acid population was 17% which is within the range of the benchmark. Only 50 % of the cases having thrombocytopenia showed normal therapeutic level values, 25% of the patients having thrombocytopenia showed higher level of valproic acid and 25% showed subtherapeutic levels and required increase in dose. **CONCLUSION** The Incidence of thrombocytopenia in valproic acid population is less than 17% which is within the range of the benchmark. The correlation between the incidence of thrombocytopenia and the drug level need to be further studied and this is next on our agenda. But we recommend that platelet counts should be closely monitored in patients recieving valproic acid especially in patients were we are going to increase the dose due to subtherapeutic levels.

RETROSPECTIVE REVIEW OF VANCOMYCIN SERUM CONCENTRATION TARGETS IN PEDIATRIC PATIENTS

Audrey Kennedy, Sherry Luedtke.
Texas Tech University Health Sciences Center, Amarillo, Texas, United States. audreyrkennedy@hotmail.com

OBJECTIVES Since vancomycin's reformulation and increased use in the 1980s, Gram-positive infections, namely Staphylococcus aureus, have developed resistance mechanisms. New recommendations targeting higher vancomycin troughs have been established; however, no such guidelines have been developed for use in pediatric patients. To improve treatment success, increased serum vancomycin concentrations are recommended. The primary objective of this study is to ascertain the frequency of pediatric patients with a non-therapeutic range for a given indication at two teaching based hospitals. Secondary objectives are to characterize the dosing regimens for vancomycin use based on indications and to identify factors associated with suboptimal levels. **METHODS** A retrospective chart review of pediatric patients who received therapeutic drug monitoring of vancomycin at Northwest Texas Hospital and University Medical Center from September 1, 2007 through August 31, 2009 will be performed. Patients were identified and screened for inclusion in the chart review. All patients receiving vancomycin in which serum concentrations were drawn were evaluated. The primary outcome measures are serum vancomycin concentrations and indications for use. The secondary outcome measures are dosing regimens, changes in regimens based on vancomycin levels, and adverse drug events. Descriptive statistics and analysis of variance for repeated measures will be used to analyze the data as appropriate. **RESULTS** A total of 214 patients have been identified, of which to date, 17 have been excluded. Data collected for analysis includes patient demographics, institution where levels were obtained, vancomycin indication, culture data, dosing regimens, changes in dosing regimens based on levels, and adverse events. Data collection is ongoing. Preliminary data revealed 77% of levels are non-therapeutic. The most common indications include pneumonia (32%), skin and soft tissue infections (32%), bone/joint infections (16%), and bacteremia (12%). The average starting and ending doses were 12.4 mg/kg/dose and 13.7 mg/kg/dose, respectively. Further analysis to determine factors associated with non-therapeutic levels will be performed upon completion of data collection. **CONCLUSIONS** The efficacy of vancomycin for severe infections is frequently compromised secondary to suboptimal levels. The high rate of non-therapeutic levels observed in this study will be used to enhance awareness and educate prescribers. Identification of factors influencing vancomycin therapy will be used to gain consensus among prescribers and develop institutional guidelines for empiric dosing and establish therapeutic targets in pediatric patients.

IMPLEMENTATION OF A PHARMACIST-DRIVEN PEDIATRIC PATIENT DISCHARGE COUNSELING SERVICE: A PILOT STUDY

Lindsey Klish, Sonya Patel, Marjorie Lazarre, Sarah Arnold.
Yale-New Haven Hospital, New Haven, CT, United States. lindsey.klish@ynhh.org

OBJECTIVE The American Society of Health-System Pharmacy's 2015 Initiative aims to have 75% of inpatients discharged on complex medication regimens receive pharmacist counseling. Due to varying dosage forms and concentrations of medications, pediatric patients are often discharged on regimens which are difficult to comprehend. In an effort to comply with ASHP's initiative and improve patient care, Yale-New Haven Children's Hospital performed a pilot study to determine the effect discharge counseling has on hospitalized pediatric patients.The primary objective of this study is to determine if pharmacist-led discharge counseling on a pediatric unit improves patient and family satisfaction of their discharge process. The impact of pharmacist-led discharge counseling on patient's or caregiver's comfort and level of understanding regarding discharge medications will also be assessed. **METHODS** One hundred patients were randomly chosen from a pediatric unit for inclusion into the study and randomized to two arms; those who would receive pharmacist-led discharge counseling prior to their discharge, and those who would not. Daily communication between the pharmacy resident and the pediatric head resident served to identify all patients going home within 48 hours. Counseling was provided to patients and their representatives by a pediatric pharmacist or pharmacy resident. All patients included in the study received a follow-up phone call within 48 hours of being discharged to measure patient satisfaction and understanding of outpatient medications. The data was collected and evaluated. **RESULTS** Patient demographics did not significantly differ between groups. Twenty-three patients in the standard of care and twenty-two patients in the pharmacist-led counseling group were lost to follow-up. There was no significant difference seen between groups in regards to satisfaction with hospital experience, discharge process, comfort with medications, ability to obtain medications, or understanding proper use of medications. There was a statistically significant higher number of questions for the pharmacist in the standard of care group versus the pharmacist-led counseling group. Pharmacists made interventions on prescriptions for 10% of the patients they counseled. **CONCLUSIONS** Pharmacist-led discharge counseling did not have a significant impact on satisfaction scores, however, the average satisfaction score was greater than 90% for all measures. The standard of care group asked more questions during the follow-up phone calls compared to those families who were counseled by a pharmacist. Pharmacists were able to intervene on prescriptions for 10% of patients. With approximately 17 pediatric inpatients discharged from the hospital each day, there is the opportunity to enhance medication use and potentially prevent medication errors for 620 patients each year. This highlights the opportunity to provide increased pharmacy services, with the potential of optimizing care with pharmacist review of discharge medications.

ANTIBACTERIAL ALLERGY ASSESSMENTS IN A PEDIATRIC POPULATION

Lauren E. Miller, Chad A. Knoderer, Elaine G. Cox, Martin B. Kleiman.
Department of Pharmacy, Riley Hospital for Children - Clarian Health, Indianapolis, IN, United States, Department of Pharmacy Practice, Butler University College of Pharmacy and Health Sciences, Indianapolis, IN, United States, Department of Pediatrics, Ryan White Center for Pediatric Infectious Disease, Indiana University School of Medicine, Indianapolis, IN, United States. cknodere@butler.edu

INTRODUCTION Patients as well as parents or guardians may commonly confuse adverse drug reactions with allergic reactions and may mistakenly report these intolerances as allergies when the reactions do not represent a true hypersensitivity reaction. Inappropriately reporting and documenting allergies to antibacterials may result in a shift towards utilization of alternative antibacterials or antibacterial classes with wider spectrums of activity, narrower safety profiles, and higher costs. The objective of our study was to determine the incidence of true antibacterial hypersensitivity reactions in children with parent/guardian reported antibacterial allergies using a standard allergy assessment tool. **METHODS** This was a prospective study of patients aged 1 month to 18 years who were admitted to the hospital with a medical record

documented antibacterial allergy. Patients were identified using an electronic hospital pharmacy database. Guardians of 100 patients, who were selected at random from all patients with a medical record documented antibacterial allergy, were interviewed using an allergy assessment tool. The questions included on the assessment tool were a compilation of recommended information for an allergy history based on previous research on the validity of charted hypersensitivities in adults. After the interview the documented reactions were categorized as true allergy, adverse drug reaction, unknown, or no reaction based upon the allergy assessment tool. **RESULTS** Guardians of 100 pediatric-aged patients (57% male) with a documented antibacterial allergy were interviewed. The mean age of the patients was 8.77 (± 4.76) years. Charted antibacterial allergies consisted of penicillins (40%), cephalosporins (25%), sulfonamides (18%), macrolides (9%), vancomycin (4%), clindamycin (2%), ciprofloxacin (1%), and metronidazole (1%). After interviewing guardians using the allergy assessment tool 58% of charted allergies were categorized as true allergic reactions with 27% categorized as adverse drug reactions and 3% categorized as no reaction. Twelve percent were unable to be categorized based upon the information gathered from the interview. Penicillins, cephalosporins, and sulfonamides were the most common reported antibacterial allergies, however, true hypersensitivity reactions were determined in only 72.2%, 77.3%, and 66.7% of those reports, respectively. **CONCLUSION** Fewer than 60% of parent/guardian-reported and medical record documented antibacterial allergies were able to be categorized as true hypersensitivity reactions when using an allergy assessment tool. These findings underscore the importance of thorough antibacterial allergy assessments and improved education for practitioners gathering medication histories. Use of a standard allergy assessment tool to obtain medication allergy histories in a pediatric-aged population may optimize utilization of antibacterials.

ARGATROBAN AND LEPIRUDIN UTILIZATION IN A PEDIATRIC POPULATION: A FIVE YEAR EXPERIENCE

Emma K. Thone, Kathleen A. Doan, Chad A. Knoderer.
Department of Pharmacy Practice, Butler University College of Pharmacy and Health Sciences, Indianapolis, IN, United States, Department of Pharmacy, Riley Hospital for Children - Clarian Health, Indianapolis, IN, United States. ethone@butler.edu

INTRODUCTION Heparin induced thrombocytopenia (HIT) is an antibody-mediated adverse reaction to unfractionated or low-molecular weight heparin. Once diagnosed, direct thrombin inhibitors are recommended for anticoagulation in patients with HIT. Argatroban and lepirudin are commonly utilized for HIT management in adults and dosing guidelines are established for this population. The use of the two agents in children is not well established. The objective of this study was to review the use of direct thrombin inhibitors argatroban and lepirudin in a pediatric population. **METHODS** This was a retrospective chart review of pediatric-aged patients (<20 years old) who received argatroban or lepirudin between July 2003 and December 2008 at a children's hospital. The primary outcomes measured were the effective drug dose required for resolution of thrombosis and thrombocytopenia, incidence of adverse events, and death. Clinical data collected to evaluate appropriateness of use included: indication for therapy, presence of heparin-induced antibodies, and presence of thrombosis or thrombocytopenia. Days to thrombocytopenia resolution, INR, aPTT, and platelet count were also collected. Major bleeding events, thrombotic events, and death were recorded. **RESULTS** Twenty-two patients (68% male) with a median (range) age of 2 years (3 weeks-19 years) met initial inclusion criteria and were included in the statistical analysis. Argatroban and lepirudin were used in 54% (n=12) and 46% (n=10) of patients, respectively. The mean (range) duration of argatroban and lepirudin therapies were 5.3 (1-16) and 14.2 (2-62) days, with titration to mean (SD) maximal doses of 1.4 (0.62) mcg/kg/min and 0.087 (0.048) mg/kg/hr, respectively. Indications for direct thrombin inhibitor therapy included: HIT (n=6, 27.3%), HIT with thrombus (n=9, 40.9%), need for anticoagulation in patient with HIT history (n=6, 27.3%), and thrombus treatment in a patient with suspected allergy to low molecular weight heparin (n=1, 4.5%). Positive HIT antibodies were detected in 93% (n=14)

of patients with HIT. Thrombocytopenia resolution occurred in 46.7% (n=7) of patients with HIT after a mean duration of direct thrombin inhibitor therapy of 2.5 (SD: 1.4) days. Two patients with HIT had no change in clinical status after therapy. Thrombus resolved in 55.6% (n=5) of patients with HIT with thrombus. Adverse effects were observed in eight patients, with bleeding occurring in each of those patients. Bleeding occurred in 58.3% (7/12) of argatroban compared to 10% (1/10) of lepirudin patients (p=0.031). **CONCLUSION** This study will add to the limited pediatric argatroban and lepirudin data and help to further establish safe and effective pediatric dosing.

THROMBOEMBOLISM PREVENTION FOR PEDIATRIC POST-OPERATIVE CARDIAC PATIENTS

Katherine Malloy, Tara McCabe, Debra Kozik, Horacio Zaglul, Robert Kuhn.
UKHealthCare, Lexington, KY, United States.
kmma224@gmail.com

INTRODUCTION Venous thromboembolism (VTE) in pediatric patients may have a higher incidence than previously reported due to advances in medicine allowing for improved survival in critically ill patients. Patients at greatest risk of thromboembolic complications include those less than one year of age, those with in-dwelling catheters, and those undergoing surgical procedures. Current guidelines do not recommend VTE prophylaxis for cardiac procedures or central lines; however, due to an increase in thrombotic complications, our pediatric intensive care unit retrospectively evaluated post-operative cardiac patients for VTE risk with and without the use of enoxaparin. **OBJECTIVE** The primary objective was to describe the incidence of VTE in post-operative cardiac patients with and without therapeutic enoxaparin. Secondary objectives included examining proxy measures of disease severity that may translate to additional VTE risk in select patients. **METHODS** A retrospective review of post-operative cardiac patients at a tertiary pediatric intensive care unit (PICU) was conducted between July 1, 2008 and December 31, 2009. The incidence of thromboembolic complications with and without the use of therapeutic enoxaparin was examined. Secondary outcomes to determine disease severity included number of in-dwelling catheters, paralytic use, infections, length of stay, bleeding, heparin infusion rates, and fluid restriction criteria. Due to variations in prescribing patterns, post-operative management practices, and a small sample size, statistics were not utilized. **RESULTS** One hundred thirteen patients underwent a cardiac procedure during the study period. Of these, nine patients experienced a thromboembolic complication for a post-operative VTE incidence of 7.9%. Compared to patients without complications, patients with thrombi were younger (1.6 years vs. 3.0 years), had documented infections (56% vs. 7.7%), received paralytics (56% vs. 2.9%), and had longer ICU stays (40.2 days vs. 8.2 days). **CONCLUSIONS** Due to the retrospective nature of this report, causality cannot be determined. It is not known whether patients' severity of illness increased due to a thrombus or if an increased severity of illness precipitated a thrombus. Future multicenter studies to examine post-operative thromboembolism incidence and preventative VTE measures are needed to better understand these dynamic patients as well as to re-evaluate current VTE recommendations for prevention in high-risk patients.

TREATMENT OF PLASTIC BRONCHITIS IN A PEDIATRIC PATIENT STATUS POST FONTAN PROCEDURE WITH AEROSOLIZED TISSUE PLASMINOGEN ACTIVATOR

Tara McCabe, Katherine Malloy, Deborah Kozik, Dawn Turner.
University of Kentucky HealthCare, Lexington, KY, United States. tamccabe@gmail.com

INTRODUCTION Plastic bronchitis is a rare disease in which bronchial casts develop acutely and usually recurrently causing airway obstruction. There are two types of plastic bronchitis, Type I (cellular) and Type II (acellular). Treatments that have been trialed in previous cases, targeting fibrin and mucin, include inhaled acetylcysteine, dornase alfa, inhaled albuterol, inhaled or oral steroids, azithromycin, unfractionated heparin intravenous infusion, and aerosolized urokinase or tissue plasminogen activator (tPA). Information on aerosolized tPA is only found in case reports with limited descriptions of dosing. The

goal of this case report is to further detail the use of aerosolized tPA through details of formulation, administration, precautions and adverse effects. **CASE REPORT** A three year old male with single ventricle physiology status post fenestrated Fontan procedure developed bronchial casts seven days after surgery. He was also on extracorporeal membrane oxygenation (ECMO) for 5 days after surgery and had been decannulated for one day prior to developing these casts. Due to desaturations and inability to ventilate he was placed back on ECMO and subsequently through rigid bronchoscopy a large bronchial cast was removed. Options for prevention of the formation of these casts were sought. Ultimately, the patient was placed on inhaled albuterol, inhaled acetylcysteine, dornase alfa, azithromycin, aerosolized tPA, and the unfractionated heparin infusion was continued after the second decannulation from ECMO. A test dose of 4 mg of aerosolized tPA was given followed by 5 mg every 4 hours. The aerosolized tPA was dispensed as a 1 mg/mL concentration, mixed with normal saline, and stored in the refrigerator. Anyone in the room while tPA was being aerosolized wore protective precautions (i.e. mask, gown and gloves) in order to reduce unnecessary exposure to tPA. All of these treatments have been continued as tolerated due to the unknown bronchial cast pathology. He was decannulated after three days of ECMO and continues to be mechanically ventilated one month later with no further visualization of cast formation through flexible bronchoscopy. **DISCUSSION** This condition is a documented complication that can occur in patients after congenital heart surgery or with respiratory diseases; such as cystic fibrosis, asthma, or acute chest syndrome. Pharmacologic treatment of plastic bronchitis is derived based on the pathology of the cast with bronchoscopy being utilized when airway obstruction is life threatening. Currently there are four documented cases of using aerosolized tPA in pediatric patients in the literature, only one describing long term use (i.e. greater than one year). In prior case reports, no adverse effects from aerosolized tPA have been documented. **CONCLUSION** Aerosolized tPA is an effective treatment option for plastic bronchitis with fibrin as part of its pathology.

ENOXAPARIN DOSING IN PEDIATRIC PATIENTS

Ashley Nebbia, Jaclyn Sawyer, Ranjit Chima, Dawn Butler, Cynthia Barclay.
Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States. anebbia@me.com

INTRODUCTION Enoxaparin dosing guidelines are available for pediatric patients; however, therapeutic monitoring with anti-factor Xa has shown inconsistent results using current dosing guidelines. Due to the recent rise in thromboembolic events in pediatric patients, it is imperative to determine accurate dosing. **OBJECTIVE** To identify the appropriate enoxaparin dose required to achieve a therapeutic anti-factor Xa level in pediatric patients. It was hypothesized that patients less than 5 years of age would require higher than guideline recommended doses of enoxaparin to achieve therapeutic anti-factor Xa levels. **METHODS** Charts were reviewed for inpatients less than 18 years of age who received treatment doses of enoxaparin from January 2008 to September 2009. Patients were excluded for an absence of or incorrect timing of anti-factor Xa levels or if patients received dialysis. The primary outcome measure was the enoxaparin dose required to achieve therapeutic anti-factor Xa levels. Secondary outcomes included the number of anti-factor Xa levels and the number of dose adjustments required to achieve a therapeutic anti-factor Xa level. Bleeding events were also assessed. **RESULTS** Eighty-four percent of dosing episodes (92/109) achieved therapeutic anti-factor Xa levels. Patients age 0 to <2 months (n=7), 2 to <12 months (n=21), 1 to <2 years (n=8), and 2 to <5 years (n=9) required mean doses of 1.67 ± 0.29 mg/kg SQ q12h, 1.72 ± 0.87 mg/kg SQ q12h, 1.17 ± 0.62 mg/kg SQ q12h, and 1.38 ± 0.41 mg/kg SQ q12h, respectively. Patients ages 5 to <12 years (n=19) and 12 to <18 years (n=34) required mean doses of 1.17 ± 0.53 mg/kg SQ q12h and 0.98 ± 0.22 mg/kg SQ q12h, respectively. Patients less than 5 years required one additional anti-factor Xa level and dose adjustment compared to patients over 5 years of age to achieve a therapeutic anti-factor Xa level. Major clinical bleeding events were reported in three dosing episodes. **CONCLUSIONS** Generally, patients less than 5 years of age required higher than guideline recommended doses of enoxaparin to achieve therapeutic anti-factor Xa levels. Patients 5 years of age and older achieved therapeutic levels

at guideline recommended doses. Prospective studies are needed to determine new treatment guideline starting doses of enoxaparin.

IMPACT OF A PRE-AUTHORIZATION PROGRAM ON UTILIZATION OF INTRAVENOUS ACYCLOVIR IN CHILDREN WITH SUSPECTED HERPES SIMPLEX VIRUS INFECTIONS

Kristen R. Nichols, Chad A. Knoderer, Elaine G. Cox, John C. Christenson.
Department of Pharmacy, Riley Hospital for Children - Clarian Health, Indianapolis, IN, United States, Department of Pharmacy Practice, Butler University College of Pharmacy and Health Sciences, Indianapolis, IN, United States, Department of Pediatrics, Ryan White Center for Pediatric Infectious Disease, Indiana University School of Medicine, Indianapolis, IN, United States. knichol4@clarian.org

INTRODUCTION Use of intravenous (IV) acyclovir has greatly decreased mortality associated with herpes simplex encephalitis and neonatal herpes simplex virus (HSV) infections. In February 2009 a nationwide shortage of IV acyclovir prompted the antimicrobial stewardship program at our institution to implement a pre-authorization requirement for IV acyclovir use. Prior to the shortage, there was a perception that IV acyclovir was over-used in patients without sufficient clinical evidence of HSV infection. Because of this, the pre-authorization requirement remained in place following shortage resolution. The objective of this study was to determine the effect of a pre-authorization requirement for the use of intravenous acyclovir on the incidence of acyclovir omission in patients with proven or suspected neonatal HSV or pediatric central nervous system or disseminated HSV infections. **METHODS** A retrospective chart review was performed to compare intravenous acyclovir use before and after implementation of a pre-authorization requirement. Pediatric patients admitted to Riley Hospital for Children between January 1, 2007 and January 31, 2009 who had positive laboratory diagnostic results for HSV, a hospital diagnosis code indicating HSV infection, or who were treated with IV or PO acyclovir, valacyclovir, ganciclovir, or foscarnet were eligible for inclusion. It was determined if each patient with suspected or proven neonatal HSV or pediatric CNS or disseminated HSV infection had received IV acyclovir. Incidence of acyclovir omission in proven HSV before and after institution of pre-authorization requirement was compared. Secondary outcomes included IV acyclovir utilization, mean duration of IV acyclovir therapy, mean duration of hospitalization in patients receiving IV acyclovir, number of IV acyclovir courses, and number of IV acyclovir courses greater than 48 hours. **RESULTS** Three hundred and fifty-four children were included; 246 in the pre-intervention group and 108 in the post-intervention group with median (range) ages of 40 days (0-17.9 years) and 38 days (0-17.6 years), respectively. There was no acyclovir omission in either group. There were 1.4 courses of intravenous acyclovir per 100 patient admissions in the pre-intervention group and 1 course of intravenous acyclovir per 100 patient admissions in the post-intervention group (p=0.098). Mean duration of acyclovir therapy was 5.3 days per 1000 patient days prior to pre-authorization requirement and 4.2 days per 1000 patient days after implementation (p=0.882). Length of stay in patients who received intravenous acyclovir was 11.9 days versus 11.2 days in the pre and post groups, respectively (p=0.776). **CONCLUSION** Implementation of a pre-authorization for use of IV acyclovir did not result in omission of acyclovir therapy in any pediatric patient with HSV infection. Acyclovir pre-authorization does not affect number or duration of acyclovir courses, or length of stay in children receiving acyclovir. These findings suggest that the initial perception of IV acyclovir over-use was inaccurate.

DEXMEDETOMIDINE VERSUS STANDARD THERAPY FOR SEDATION IN MECHANICALLY-VENTILATED PREMATURE NEONATES

Keliana O'Mara, Peter Gal, John Wimmer.
Women's Hospital of Greensboro, Greensboro, NC, United States. keliana.omara@gmail.com

INTRODUCTION There are currently no published studies of dexmedetomidine use in premature neonates for routine sedation. The aim of this study is to evaluate the efficacy and safety of dexmedetomidine versus standard therapy with fentanyl for sedation in

mechanically-ventilated premature neonates. **METHODS** Design: Retrospective, observational case-control. Setting: Community hospital, level III neonatal intensive care unit (NICU). Participants: Premature neonates requiring sedation for mechanical ventilation. Interventions: A total of 48 premature neonates were included in the study. Patients either received fentanyl (FENT) continuous infusion or scheduled bolus doses (n=24) or dexmedetomidine (DEX) continuous infusion (n=24). Each group was allowed to receive as needed boluses of fentanyl or lorazepam. Medications were adjusted based on Premature Infant Pain Profile (PIPP) and sedation scores.Measurements: The primary and secondary outcomes of this study were the efficacy of sedation and frequency of adverse events associated with dexmedetomidine and fentanyl. Days on mechanical ventilation, stooling patterns, feeding tolerance, and neurologic outcomes were also evaluated. **RESULTS** There were no significant differences in baseline demographics between the DEX and FENT patients in gestational age (25.5 v. 24.9 weeks, p=0.095), birth weight (0.832 vs. 0.675 kg, p=0.051), Clinical Risk Index for Babies-II Score (10 vs. 11, p=0.167), or antenatal steroids (87.5% vs. 79.2%, p=0.432). Patients in the DEX group required less total adjunctive sedation and experienced more treatment days free of additional sedation when compared to FENT (54.1% vs. 16.5% p<0.0001). There was no difference in baseline or treatment period hemodynamic parameters between the two groups. Duration of mechanical ventilation was shorter in the DEX group (14.4 vs. 28.4 days, p<0.001). Meconium passage (7.5 vs 22.4 days, p<0.0002) and time from initiation to achievement of full enteral feeds (26.8 vs 50.8 days, p<0.0001) were shorter in the DEX group. There was no significant difference in incidence of severe intraventricular hemorrhage (Grade III-IV) or perviventricular leukomalacia. **CONCLUSIONS** Dexmedetomidine has rarely been used in NICU patients, but was found to be safe and effective for sedation in the premature neonates included in this study. It appears to have a superior short-term safety profile compared to fentanyl in terms of less gastrointestinal and respiratory adverse effects. Prospective randomized-controlled trials are needed to determine the generalizability of these findings in the neonatal population before its use can become widespread.

DRUG UTILIZATION IN END-OF-LIFE PALLIATIVE PEDIATRIC PATIENT'S AT ROGER'S HOUSE HOSPICE AND AT THE CHILDREN'S HOSPITAL OF EASTERN ONTARIO

Neil Jobanputra, Régis Vaillancourt, Elena Pascuet, Andy Ni, Chris Vadeboncoeur, William Splinter, Marion Rattray, Lloyd Cowin.
Children's Hospital of Eastern Ontario, Ottawa, ON, Canada, University of Nottingham, Nottingham, United Kingdom, University of Ottawa, Ottawa, ON, Canada, Roger's House, Ottawa, ON, Canada.
epascuet@cheo.on.ca

INTRODUCTION Pediatric palliative care is an essential and comprehensive model of care for children with life-threatening or progressive life-limiting conditions. Use of pain medications including opioids is often feared by families, as they perceive it as an indication that death is approaching. Care differences may be seen when comparing care provided in hospice to that provided in hospital. This study assesses medications administered at end-of-life, evaluates average daily dose (mg/kg/day) per medication and compares drug utilization and trends in hydration in hospital versus hospice.
METHODS Retrospective chart review of end-of-life pediatric patients who died at the Children's Hospital of Eastern Ontario (hospital) or Roger's House (hospice) from January 2005 to December 2009. Variables collected 7 days prior to death included: drug, route of administration, dose, # doses/day, and rate of hydration. Patient diagnosis coded by International Classification of Diseases (ICD-10). Medications categorized using Anatomical Therapeutic Chemical (ATC) classification system. **RESULTS** 187 different drugs prescribed in 91 subjects. There was a statistically significant increase in the # of patients who received antibacterials, diuretics, blood substitutes, muscle relaxants, and mineral supplements in hospital versus hospice. There was a statistically significant increase in patients who received scopolamine, dimenhydrinate, methotrimeprazine at the hospice versus hospital. No statistical significance seen between medication doses in either hospital or hospice for any medication except scopolamine. Hydration rates were significantly higher in hospital compared to the hospice. **CONCLUSION** Analgesics and psycholeptics

were used frequently in both centres. There were no distinct trends noted in medication dosages prescribed at either of the centres, which may reflect patient and/or individual physician/nurse practitioner considerations. Care in a hospice is primarily focused on symptom management whereas in an acute care hospital the focus is more on acute care. The hospice practice of minimal artificial hydration differs from hospital acute care practice.

VALIDATION OF A SET OF ASTHMA ILLUSTRATIONS IN CHILDREN WITH CHRONIC ASTHMA IN THE EMERGENCY DEPARTMENT

Danica Irwin, Régis Vaillancourt, Elena Pascuet.
Children's Hospital of Eastern Ontario, Ottawa, ON, Canada. epascuet@cheo.on.ca

INTRODUCTION National and international asthma guidelines support the use of written asthma action plans. However those presented in text format are difficult for pediatric patients and those with low literacy skills to comprehend. Pictograms enhance comprehension of information in action plans. **OBJECTIVES** To validate a set of asthma illustrations in children with chronic asthma presenting to an Emergency Department (ED) for their eventual inclusion into an action plan. **METHODS** Semi-structured interviews using guessability and translucency questionnaires tested the comprehensibility of 15 illustrations (8 representing different levels of asthma control and 7 representing asthma triggers) in asthma patients seen in the pediatric hospital ED over the 10-month study period. For patients 1-9 years of age (group A) the questionnaire was performed on the parent, patients 10-17 years of age (group B) completed the questionnaire themselves. Literacy was assessed using the Rapid Estimate of Adult Literacy in Medicine (REALM) or REALM-teen scales. **RESULTS** 80 patients enrolled in the study. After the first 30 patients were interviewed, modifications were made to 7 of the original 15 pictograms to improve comprehension. Data analysis was performed on the subsequent 50 patients (25 in each of Group A and B). Guessability was 94% (Group A) and 97% (Group B). On a 1-7 translucency scale, the pictograms were rated as ≥6 by 92% of all participants. Literacy assessments found both groups to be equivalent in having the ability to read most patient education material. **CONCLUSIONS** The 15 illustrations were validated to be useful and comprehensible tools for inclusion into an action plan

AVERAGE PEDIATRIC VANCOMYCIN DOSE REQUIRED TO OBTAIN THERAPEUTIC TROUGH CONCENTRATIONS

Amanda Rohlf, Jamalee Huntley, Carla Zeilmann, Jeffery Jones.
St. John's Hospital, Springfield, MO, United States, Drury University, Springfield, MO, United States. amanda.rohlf@mercy.net

OBJECTIVE In January 2009 the American Society of Health-System Pharmacists (ASHP) in collaboration with the Infectious Diseases Society of America (IDSA) and Society of Infectious Disease Pharmacists (SIDP) released new vancomycin treatment guidelines recommending higher trough concentrations. This study was to determine if current empiric vancomycin weight based dosing suggested by Pediatric Dosage Handbook achieved the new trough concentrations recommended by the IDSA guidelines in pediatric patients. **METHODS** A retrospective, single-center, observational study was completed to determine the average weight based vancomycin dose needed to achieve therapeutic trough concentrations in pediatric patients with goal troughs of 10-15 mg/L in uncomplicated infections and 15-20 mg/L in complicated infections. Initial empiric dosing for these goal concentrations was 40 mg/kg/day and 60 mg/kg/day respectively. Included patients were one to 17 years of age who received intravenous vancomycin from January 11, 2009 through January 12, 2010 with a vancomycin trough concentration recorded. Trough concentrations were excluded if the patient had pre-existing renal disease, obtained vancomycin through home infusions, was pregnant, or if the trough was incorrectly timed. Study patients were split into two cohorts according to diagnosis and corresponding goal trough concentration according to the IDSA vancomycin guidelines. In each cohort vancomycin troughs were separated into subtherapeutic, therapeutic and supratherapeutic trough concentrations and an average dosage for each group was cal-

culated. Data was collected on patients' weight, height, age, sex, trough concentration, total daily vancomycin dose per kilogram, and other diagnoses including cancer, cystic fibrosis and burns. **RESULTS** A total of 150 vancomycin trough concentrations in 77 patients met the inclusion criteria. Forty-four troughs were excluded resulting in 106 vancomycin trough concentrations in the final study results. Of those included troughs a total of 41 were drawn in patients with goal trough concentrations of 10-15 mg/L and 65 were drawn in patients with complicated infections requiring goal trough concentrations of 15-20 mg/L. In the cohort with goal trough concentrations of 10-15 mg/L, 28 (68%) of the troughs were considered subtherapeutic (<10 mg/L), 12 (29%) were therapeutic (10-15 mg/L) and only 1 (2%) trough was supratherapeutic (>15 mg/L). In the cohort with goal trough concentrations of 15-20 mg/L, 47 (72%) of the troughs were subtherapeutic (<15 mg/L), 16 (25%) were therapeutic (15-20 mg/L) and 2 (3%) troughs were supratherapeutic (>20 mg/L). The average vancomycin dose required for therapeutic troughs of 10-15 mg/L and 15-20 mg/L was 52.7 mg/kg/day and 69.9 mg/kg/day respectively. **CONCLUSION** The average vancomycin dose required to obtain therapeutic trough concentrations of both 10-15 mg/L and 15-20 mg/L are higher than current recommended initial empiric dosing.

EICOSAPENTAENOIC ACID ATTENUATES BILE ACID-INDUCED APOPTOSIS VIA THE FAS AND TRAIL-R2 DEATH RECEPTORS IN HEPG2 CELLS

Emma Tillman, Brien Neudeck, Richard Helms, Dennis Black.
University of Tennessee Health Science Center, Memphis, TN, United States, Children's Foundation Research Center, Memphis, TN, United States, Center for Pediatric Pharmacokinetics and Therapeutics, Memphis, TN, United States. etillman@uthsc.edu

INTRODUCTION Parenteral nutrition (PN)-associated liver disease (PNALD) occurs in patients receiving long-term PN and may progress from cholestasis to cirrhosis, hepatic failure and death. Recent clinical studies in infants with PNALD have demonstrated improvement and even reversal of PNALD with omega-3 fatty acid supplementation, although the mechanism of action is not well understood (Gura et al. Pediatrics 118:197, 2006; Gura et al. Pediatrics 121:678, 2008). The aim of these studies was to determine if the protective effect of omega-3 fatty acids is due to a decrease in cellular apoptosis in response to bile acid-mediated toxicity, as well as to further determine the involvement of the Fas and TRAIL-R2 pathways in this process. **METHODS** Cultured HepG2 cells were treated with 200 μM chenodeoxycholic acid (CDCA) in the presence and absence of 10 μM eicosapentaenoic acid (EPA). Controls included cells incubated with vehicle alone (EtOH) and EPA alone. Apoptosis was evaluated at 24 hrs using a caspase 3/7 assay, as well as visual assessment of cellular apoptosis using nuclear staining with ethidium bromide (EB) and acridine orange (AO) dyes with fluorescent microscopy. Specific apoptotic mediators (Fas and TRAIL-R2) were evaluated at 2 hrs using quantitative real-time RT-PCR. **RESULTS** Incubation with CDCA induced apoptosis in HepG2 cells as demonstrated by nuclear EB/AO staining and increased caspase 3/7 activity, and the degree of apoptosis was reduced by co-incubation with EPA. In cells treated with CDCA alone, caspase 3/7 activity increased 17-fold, and this increase was attenuated by 52% with EPA co-incubation ($p=0.0015$). There was a 5.9- and 1.3-fold increase in expression of Fas and TRAIL-R2 mRNA levels, respectively, when incubated with CDCA alone, as compared to a 4.0- and 1.1-fold increase, respectively, when incubated with both CDCA and EPA ($p<0.001$). **CONCLUSION** Bile acid-induced apoptosis in cultured hepatocytes involves increased expression of both Fas and TRAIL-R2 and is reduced in the presence of EPA. These data support the therapeutic use of EPA in the prevention and treatment of PNALD.

IMPACT OF PALIFERMIN ON PARENTERAL NUTRITION AND OPIATE USE IN PEDIATRIC STEM CELL TRANSPLANT

Jessica Walker, Jason Arimura, Rajni Agarwal.
Lucile Packard Children's Hospital, Palo Alto, CA, United States. jwalker@lpch.org

INTRODUCTION Palifermin is a keratinocyte growth factor approved for use to decrease the incidence and severity of oral mucositis in

patients receiving myelotoxic therapy. It is not indicated in pediatric patients and, to date, there have been no studies exploring its use in this population. The objective of this study was to determine if palifermin use had an impact on the development of mucositis and the subsequent need for parenteral nutrition and pain control. **METHODS** This study is a retrospective chart review of pediatric patients receiving stem cell transplant during the last six years. Patients were placed into two groups according to whether or not they received palifermin as part of their protocol. Patient data that was collected included the following: induction therapy used, related/unrelated donor status, post-transplant anti-graft versus host disease, age at transplant, weight at transplant, days on parenteral nutrition after transplant, days requiring opiates, and total dose of opiates (standardized to oral morphine equivalent). A two-sample T-test was used to compare the groups. **RESULTS** Patients receiving palifermin as part of their stem cell transplant regimen required an average of 32 fewer days of parenteral nutrition compared to the control group; 59 days in the control group versus 27 days in the treatment group ($p<0.01$). The average difference in duration of opiate use was 17 days lower in the treatment group ($p=0.04$). Patients in the treatment group required 71% less opiates when compared to the control group ($p<0.01$). **CONCLUSION** Pediatric patients receiving palifermin as part of their therapy had a significant decrease in parenteral nutrition and opiate requirements after stem cell transplant. Palifermin may also reduce the total cost in stem cell transplantation care. Although palifermin is expensive, there are indirect costs associated with parenteral nutrition and opioid utilization.

THE USE OF GRANULOCYTE COLONY STIMULATING FACTOR (G-CSF) FOR CONGENITAL NEUTROPENIA IN A NEONATE: A CASE REPORT

Eloise Woodruff.
Children's Hospital of The King's Daughters, Norfolk, VA, United States. eloise.woodruff@chkd.org

INTRODUCTION Congenital Neutropenia (CN), defined as an abnormally low number of neutrophils, is a rare hematologic disorder in the neonatal population. Factors which may cause neutropenia include pseudomonas infection, drug side effects, maternal hypertension or congenital etiology. A MEDLINE search revealed limited pharmacologic options for the management of congenital neutropenia. However, literature suggests that recombinant granulocyte colony stimulating factor (G-CSF) has been effective in reducing morbidity and mortality. Dosing found for severe congenital neutropenia was up to 100mcg/kg/day, a 10-20 fold increase in traditional dosing. Additionally, some patients with congenital neutropenia have genetic mutations in the G-CSFR gene, prohibiting the effects of G-CSF. **CASE REPORT** I report the use of G-CSF in a preterm infant with persistent, severe, congenital neutropenia. DH's initial absolute neutrophil count (ANC) was 800 cells/mL on day of life #1. She completed a 48-hour empiric course of Ampicillin and Gentamicin. At 5 days old, DH developed respiratory distress with pneumonia requiring antibiotics and jet ventilation. Her ANC at the time of crisis was 264 cells/mL. Blood cultures and tracheal aspirate revealed Pseudomonas Aeruginosa. G-CSF was initiated at 10 mcg/kg intravenously. DH's antibiotics were changed to Zosyn and Gentamicin based on the culture sensitivities. She completed 21 days of therapy. Her ANC after the resolution of infection did not return to normal levels (804 cells/mL). Although neutropenia may be a side effect of Zosyn, we believe that the drug was only a partial contributor to neutropenia since the incidence of drug-induced neutropenia is 1 case per million persons per year. The following regiment was recommended by the Hematology/Oncology service: G-CSF based on her ANC: 10 mcg/kg if ANC=500-1000 and 50 mcg/kg if ANC = <500. She was maintained on a daily dose of 35mcg/kg, based on the dose response of G-CSF on the ANC. Upon discharge, she remained stable however DH required 55 mcg/kg/day based on persistent neutropenia (ANC=202). As an outpatient, DH's G-CSF dose was increased to 85mcg/kg with limited change to her ANC. DH's neutropenia was refractory to conventional treatment, therefore G-CSF was discontinued. Two weeks after discontinuation, a bone marrow aspirate was performed. Results showed complete absence of neutrophil precursor cells consistent with congenital neutropenia. Genetic testing on the ELA2 and HAX1 genes was negative. Since

discharge, she has done well despite her congenital neutropenia. Her baseline neutrophil count as an outpatient is 200 and the differential has been nearly all lymphocytes. DH's severe CN is concerning despite negative genetic testing. **CONCLUSION** G-CSF may be beneficial in some cases of Congenital Neutropenia. However, in this neonate, G-CSF dosing up to 85 mcg/kg/day was not effective in increasing the ANC greater than our goal of 1000 cells/mL.

A STATE-WIDE COLLABORATIVE TO IMPROVE MEDICATION SAFETY IN CHILDREN'S HOSPITALS

Cynthia Barclay, Anne Lesko, Shelly Morvay, Beth Carberry, Cindy Dusik, Evangeline Ramsay, Stacy Roehrs.
Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, Nationwide Children's Hospital, Columbus, OH, United States, Cleveland Clinic Children's Hospital, Cleveland, OH, United States, Toledo Children's Hospital, Toledo, OH, United States, Rainbow Babies and Children's Hospital, Cleveland, OH, United States, Dayton Children's Hospital, Dayton, OH, United States. cynthia.barclay@cchmc.org

INTRODUCTION Medication safety continues to be a high priority for children's hospitals across the country. In June, 2009, the Solutions for Patient Safety collaborative of children's hospitals across the state of Ohio was established to address patient safety within the state's eight pediatric hospitals. Medication safety was one workgroup formed as part of this initiative. The collaborative set a global aim to significantly reduce harm associated with medications at Ohio's eight children's hospitals. The collaborative set two goals for the medication safety project: 1. Eliminate injury or harm to any child due to preventable adverse drug events by March, 2012; 2. Have adverse drug event (ADE) trigger tool methodology in place at all participating hospitals by January, 2010. **METHODS** The collaborative uses improvement science methodology to guide its work. Hospitals utilize PDSA cycles to test new interventions associated with the ADE process. The group conducts monthly work group conference calls and quarterly face to face learning sessions to share progress on improvement initiatives and plan future interventions. The hospitals use standardized ADE trigger tool methodologies to report an overall ADE rate and an opiate ADE rate to a central database. **RESULTS** To date, all participating hospitals have completed ADE trigger tool training and have submitted total ADE data and opiate ADE data from January, 2009 to present. The medication safety work group identified ADEs around opiate PCA use as an area of high risk and developed standardized PCA order set guidelines for use throughout the hospitals. The group also developed improvement strategies to decrease the number of constipation ADEs associated with opiate use. **DISCUSSION** This project has demonstrated the ability of competing hospitals to collaborate on a state-wide goal to reduce harm from medications. In addition to helping the individual hospitals improve problem areas, the collaborative has demonstrated to the state business consortium and the state legislature that the participating hospitals are committed to improving health care. The participants have found the sharing of information through monthly reports and the discussions during quarterly learning sessions to be especially helpful to their individual improvement efforts. However, the project has not been without barriers. The agreement to be transparent in the sharing of ADE data required approval from each hospital's legal department, which took many months. It has also been a challenge to obtain prescriber agreement from all eight institutions regarding specific improvement initiatives. However, the improvement initiatives identified through ongoing ADE data analysis are continuing. **CONCLUSIONS** This state-wide collaborative shows the successes and challenges associated with competing hospitals coming together over a common desire to reduce harm to their patients. The participating hospitals have demonstrated their ability to work together as conscientious stewards of the medication use cycle.

DEVELOPMENT OF A PROTOCOL FOR VANCOMYCIN IN CARDIOPULMONARY BYPASS IN PEDIATRIC PATIENTS

Emily Kinsaul, Kim W. Benner, Santiago Borasino.
Samford University McWhorter School of Pharmacy, Homewood, AL, United States, University of Alabama

at Birmingham, Birmingham, AL, United States. kwbenner@samford.edu

INTRODUCTION Cardiopulmonary bypass (CPB) is frequently indicated during cardiac surgery and has been known to affect the pharmacokinetics of commonly used medications, including vancomycin, frequently used preoperatively to prevent post-operative infection. A recent study in pediatric patients undergoing cardiac surgery suggested that one intravenous (IV) vancomycin dose of 15 milligram/kilogram (mg/kg) may not provide adequate serum concentrations throughout CPB, increasing the patient's risk of a post-operative infection. Adult studies of vancomycin in CPB have revealed a decrease in vancomycin concentrations during CPB, albeit not below the minimum inhibitory concentration (MIC) of susceptible organisms. However, pediatric studies have been conflicting. In patients undergoing cardiac surgery with CPB, our hospital currently administers vancomycin at the clinician's discretion without collection of serum concentrations. The purpose of this research was to develop a consistent protocol for vancomycin administration during CPB based upon available literature. **METHODS** The new protocol was developed by conducting a literature search and locating/evaluating cohort studies and clinical trials conducted in adults and pediatrics undergoing cardiac surgery with CPB receiving vancomycin as a prophylactic antibiotic to prevent post-operative infection. The cardiac surgeons were consulted for approval of development. **RESULTS** In the new protocol, a 15 mg/kg dose of IV vancomycin one hour prior to incision and a larger dose of 20 mg/kg vancomycin in the CPB priming solution are proposed to maintain concentrations above the MIC for susceptible organisms. In addition, patients undergoing cardiac surgery with CPB will also be administered IV vancomycin 15 mg/kg every eight hours post-operatively for 48 hours upon admission to the intensive care unit with the new protocol. Serum concentrations of vancomycin will now be checked at the time of incision, 15 minutes post initiation of CPB, upon arrival to intensive care unit (ICU) and prior to 3rd dose in the ICU. This will allow for calculation of the patients elimination of vancomycin and removal by CPB. **CONCLUSIONS** With the implementation of this new protocol, vancomycin will now be consistently administered to pediatric patients before, during and after cardiac surgery. Based on available literature, this should maintain vancomycin serum concentrations above the MIC for the entire length of the CPB. Appropriate evaluation of the implemented protocol is the focus of a future study.

EXPERIENCE WITH PROBIOTIC REPLACEMENT IN NICU

Kelly Burch, Gary Dreyer, M. Michael Maurer, Edward Schwarz.
St. John's Mercy Children's Hospital, St. Louis, MO, United States. kelly.burch@mercy.net

In 2007, we implemented a number of practices directed at preventing necrotizing enterocolitis in infants under 1500 grams birth weight in our 80 bed NICU. Several evidence based strategies were simultaneously implemented: a feeding protocol, abandoning routine H2 blockade during NSAID therapy for PDA, emphasis on tube handling and changing practice, use of donor human milk when mother's milk is unavailable, improvements in PICC line and TPN use, and use of probiotics. Administering probiotics is one of the most intriguing strategies in NEC prevention, but enthusiasm for this therapy is tempered by concerns regarding safety. We undertook a number of cycles of improvement to anticipate or solve problems related to tube occlusion, drug interactions, organism viability, avoidance of nosocomial sepsis, and bar coding. We developed a closed system method of dispensing the product in the oral syringe that is used to dilute the product with milk and adminster it to the patient. This practice minimizes potential aerosolization of the probiotic powder into the NICU. All doses are scheduled for a time of day when daily IV changes are not likely to occur.

We reviewed microbiology, pharmacy and neontaology databases for information on probiotic therapy, bloodstream infection, and NEC events. Our experience allows us to describe 3 years', 28,000 patient*days' in over 1000 patients' safety related outcomes with administration of a probiotic product to NICU patients. No patient had one of the administered organisms isolated from the bloodstream. The frequency of clinically

diagnosed NEC combined medical + surgical (M+S) decreased from 1.5% in 2006 (20/1316) to 1% in 2009 (9/893). In the population of patients under 1500 g at birth, the frequency of clinically diagnosed NEC (M+S) decreased from 8% in 2006 (12/155) to 3.8% in 2009 (7/173). It is difficult to attribute improvements in NEC frequency to probiotic replacement, but these results are encouraging. We offer these observations to others who may wish to implement probiotic therapy in NICU without increasing risk of sepsis while avoiding the need to independently solve a number of practical problems associated with this therapy.

SMART PAIN PUMP PEDIATRIC LIBRARY

Jared Cash, Sheldon Furst.
Primary Children's (Intermountain Healtcare), Salt Lake City, Utah, United States, University of Utah, Salt Lake City, Utah, United States. jared.cash@imail.org

INTRODUCTION The use of smart infusion pumps in a hospital setting is one of the fastest growing and most universal new medication safety technologies used in hospitals. Pain pumps for patient controlled analgesia (PCA) are the most recent type of pump to have this smart technology. A set of parameters called a library must be developed and maintained for each medication in order to use their safety potential. The purpose of this abstract is to share a library developed for pediatric patients using a smart pain pump with other sites as well as facilitate discussions about optimal safety parameters. **CASE DESCRIPTION** A soft limit refers to a limit that can be overridden and a hard limit is one that does not have an override option. The first set of medications to be described is used intravenously for opioid naïve patient PCAs. Morphine 1 mg/mL has a continuous soft limit (CSL) of 0.05 mg/kg/hr and continuous hard limit (CHL) of 0.1 mg/kg/day. Demand soft max (DSM) is 0.05 mg/kg and demand hard max (DHM) is 0.1 mg/kg. Hourly soft max (HSM) is 0.1 mg/kg/hr and hour hard max (HHM) is 0.2 mg/kg/hr. The clinician bolus soft max (CBSM) is set at 0.1 mg/kg and clinician bolus hard max (CBHM) at 0.15 mg/kg. Hydromorphone 20 mcg/mL and 100 mcg/mL are set at CSL-7 mcg/kg/hr, CHL-15 mcg/kg/hr, DSM-7 mcg/kg, DHM-15 mcg/kg, HSM-15 mcg/kg/hr, HHM-30 mcg/kg/hr, CBSM-10 mcg/kg, and CBHM-20 mcg/kg. The next PCA library entries are designed for opioid tolerant patients and are labeled as "high dose." They also have a higher drug concentration. Morphine 5 mg/mL and hydromorphone 500 mcg/mL have their limits tenfold higher than their opioid naïve equivalents. Fentanyl 50 mcg/mL is set at CSL-10 mcg/kg/hr, CHL-20 mcg/kg/hr, DSM-5 mcg/kg, DHM-10 mcg/kg, HSM-20 mcg/kg/hr, HHM-40 mcg/kg/hr, CBSM-10 mcg/kg, and CBHM-20 mcg/kg. The dose lock outs times have a soft minimum of 10 minutes and hard minimum of 5 minutes. The soft and hard maximum is 1 hour. The weight based dosing stops at 60kg after which adult parameters are used. Limits were reduced 20% for the lowest weight class of 1-10kg. The second set of medications in the library is for epidurals. Bupivacaine 0.1% is set at CSL-0.3 mL/kg/hr, CHL-0.4 mL/kg/hr, DSM-0.1mL/kg, DHM-0.2 mL/kg, HSM-0.4 mL/kg/hr, HHM-0.4 mL/kg/hr, CBSM-0.2 mL/kg, and CBHM-0.4 mL/kg. Bupivacaine 0.0625% is set at CSL-0.4 mL/kg/hr, CHL-0.6 mL/kg/hr, DSM-0.15 mL/kg, DHM-0.3 mL/kg, HSM-0.6 mL/kg/hr, HHM-0.6 mL/kg/hr, CBSM-0.3 mL/kg, and CBHM-0.5 mL/kg. After much discussion, it was decided that epidurals with a local anesthetic and a narcotic are dose limited by the bupivacaine component so the limits for all other combinations match that of the local anesthetic. The dose lock out times have a soft and hard minimum of 15 minutes and a soft and hard maximum of 2 hours. The weight based dosing stops at 30kg after which adult parameters are used. Limits were reduced 25% for the lowest weight class of 1-5 kg.

THE IMPACT OF A PHARMACIST-MANAGED RSV PREVENTION CLINIC ON PALIVIZUMAB COMPLIANCE AND RSV ASSOCIATED HOSPITALIZATION.

Jennifer Chow, Michael Chicella, Anthony Christensen, Eloise Woodruff, Mital Desai, Carolyn Moneymaker, John Harrington, James Dice.
Children's Hospital of The King's Daughters, Norfolk, VA, United States, Eastern Virgina Medical School, Norfolk, VA, United States. jennifer.chow@chkd.org

INTRODUCTION Respiratory syncytial virus

(RSV) is the most common cause of bronchiolitis and pneumonia in infants. It is also the leading cause of hospitalizations in infants less than a year in the United States. Palivizumab is an RSV-specific monoclonal antibody that is administered once a month during RSV season to prevent RSV infection that requires hospitalization. Noncompliance with the dosing regimen appears to be the factor commonly associated with drug failure. Studies of other pharmacist managed clinics have demonstrated that pharmacists can increase compliance and therefore improve patient outcomes. The purpose of this study was to determine the impact of a pharmacist-managed RSV Prevention Clinic on palivizumab compliance and RSV associated hospitalization. **METHODS** During the 2009-2010 RSV season, a pharmacist-managed RSV Prevention Clinic was established in the General Academic Pediatrics clinic at CHKD. Once eligible patients were identified the pharmacist contacted the parents/caregivers and set up an appointment to receive palivizumab. During the appointment the pharmacist was responsible for providing education on RSV, importance of receiving palivizumab, and steps to decrease RSV exposure and transmission. The pharmacist administered palivizumab to the patient and when necessary triaged the patient to see other health-care professionals. In order to determine the impact of this clinic on patient compliance we compared data from the 2008-2009 RSV season (group 1) which was prior to the establishment of the pharmacist-managed clinic to data compiled from the 2009-2010 RSV season (group 2). Group 2 data was after the pharmacist-managed clinic was established. Data compared included demographic data, number of shots administered, RSV testing, and RSV hospitalizations (>24 hours in hospital). Compliance was determined as the number of patients who received eligible doses in consecutive months. **RESULTS** Eighty-six infants were identified as palivizumab eligible in group 1 and 75 infants were eligible in group 2. Sixty-seven infants (78%) in group 1 receive at least one dose of palivizumab, whereas 71 patients (95%) in group 2 received at least one dose of palivizumab. Nineteen infants (28%) in group 1 received all doses of palivizumab as compared to 63 infants (89%) in group 2 ($p<0.01$). With regard to compliance, only 18 patients (27%) in group 1 received all eligible doses in consecutive months as compared to 60 patients (85%) in group 2 ($p<0.01$). In group 1, eight patients developed RSV and 5 of those required hospitalization. In group 2, three patient developed RSV and one of those required hospitalization. **CONCLUSIONS** A pharmacist-managed RSV Prevention clinic statistically increased compliance with palivizumab dosing and decreased RSV infections and hospitalizations by over 50%.

A COMPREHENSIVE PROGRAM FOR PRESCRIBING ERROR DETECTION AND REDUCTION IN A PEDIATRIC DEPARTMENT

Michelle Condren, Brooke Honey.
University of Oklahoma College of Pharmacy, Tulsa, OK, United States. michelle-condren@ouhsc.edu

INTRODUCTION Pharmacists working with a School of Medicine's Pediatric Department have developed a multi-faceted program to decrease prescribing errors in pediatric patients. The program has successfully decreased errors in outpatient prescriptions and has been well received. **PROGRAM DESCRIPTION** In 2007, after implementation of an electronic medical record (EMR) in the clinic, all prescriptions were reviewed for one month. During this review, several sources of error were identified. Based on errors discovered in this review, prescription surveillance, feedback, system changes, in-services, and skills assessment have been implemented. A report generated daily allows prescriptions written in the clinic to be reviewed by the pharmacist, pharmacy resident, or student. When an error is discovered, feedback is provided to the resident and attending and the error is resolved.

Many changes have been made to the EMR. Custom medication lists have been created to include only recommended dosage forms and, when appropriate, are populated with dosing recommendations and instructions. To avoid confusing pounds with kilograms, patient weights now only display in kilograms and an alert displays when the weight changes by 2 standard deviations. Miscalculations by the system's dosing calculator have been corrected.

Two routine in-services have been implemented. The first is targeted toward medical residents during their inpatient pediatric experience. Each resident completes an assessment to determine

their ability to utilize references to determine proper doses and to calculate an appropriate dose. These assessments are graded, returned, then discussed as a group to highlight common mistakes and strategies for prevention. The second in-service is targeted toward medical and physician assistant students. All students completing their pediatric experience attend an in-service on writing prescriptions for children involving the use of references, dosage calculations, and effective use of the EMR. **PROGRAM OUTCOMES** Before implementation, 10.4% of prescriptions contained an error. This has been reduced by 45% to a rate of 5.7% ($p<0.001$). Errors resulting in a dose above the recommended range have decreased from 5% to 0.8%, an 84% reduction ($p<0.0001$). Average scores on resident assessments are 70% with improvement to 81% on repeat assessment ($p=0.004$). Residents in the pediatric department perform better on assessments and have fewer prescribing errors compared to residents from other departments. In surveys, physicians have commented that the pharmacist's involvement in error detection and reduction is of great value. The program has also been successful in training pharmacy students to identify, resolve, communicate, and report prescribing errors. **CONCLUSIONS** The introduction of multiple interventions to facilitate error reduction has been successful and sustainable. Providing additional training to non-pediatric medical residents rotating through the pediatric clinic will be essential to further reduce the overall error rate. Continual education of all medical professionals is vital to preventing errors.

DEVELOPMENT OF A WOMEN'S HEALTH INDEPENDENT STUDY ELECTIVE BY P3 STUDENTS

Helen Fiechtner, Mallory Onisk, Sarah Nagel. *College of Pharmacy, South Dakota State University, Sioux Falls, SD, United States.* helen.fiechtner@usd.edu

INTRODUCTION A comprehensive Advanced Pharmacy Practice Experience (APPE) in women's health is currently not offered by the College of Pharmacy. Two pharmacy students, under the direction of a faculty member, developed a P3 independent study elective allowing them to gain education and experience in topics specific to women's health and wellness. **PROGRAM DESCRIPTION** The College of Pharmacy and the community do not have a comprehensive women's health practice site offering pharmacy students an opportunity to complete an APPE in women's health. However, several community pharmacists have developed specialty areas within women's health which are excellent educational sites. During the time for APPE selection, two P3 students requested the option to create a Women's Health Independent Study Elective (2 credit) to give them more experience in the area of women's health. The faculty member agreed to supervise the course, with the understanding that the students would develop the elective.

During early discussions the general format of the class was agreed upon. Potential locations and individuals were identified for some of the experiences. The students would cover seven topics using various activities throughout the semester. The activities included reading books, interviewing health care providers, visiting clinics, developing patient education handouts, doing a health screen, researching selected topics and writing reflection papers. Discussions and paper submissions were done via email. Once the seven topics were selected and approved, the students wrote learning objectives. Their topics included Menopause, Osteoporosis, Infertility, Domestic Abuse, Depression, Eating Disorders and Female Gynecological Disease States. Utilizing local resources, they then chose activities that would be done for each health topic. The students were responsible for arranging meetings with the health care providers they were going to interview. The students wanted to include reading literature for two of the topics. After evaluating various books their reading selections were Getting It Through My Thick Skull by Mary Jo Buttafuoco, Stolen Innocence by Elissa Wall & Lisa Pulitizer, and The Baby Trail by Sinead Moriarty. The students enjoyed this elective and hope that the format will be used in future years by other P3 students. They gained knowledge not only about women's health, but also about independent learning strategies. Writing the objectives and arranging the appointments gave them more confidence in using such skills. Both students felt that one of the strengths of this elective was interviewing

different health care providers and observing these individuals who were passionate about their profession and women's health care. **CONCLUSION** Other Colleges of Pharmacy may find the student lead format useful for providing education and experience in areas of student interest when there is not an established practice site.

THE EFFECT OF A MEDICAL RESIDENT EDUCATIONAL PROGRAM ON EMERGENCY DEPARTMENT PHARMACY INTERVENTIONS AND MEDICATION ERRORS

Megan Foster, Randy Bradley, Donald Lighter, Brandon Edgerson, Sandip Godambe.
Le Bonheur Children's Medical Center, Dept. of Pharmacy, Memphis, TN, United States, University of Tennessee-Knoxville, Dept. of Business Administration, Knoxville, TN, United States, Institute of Health Care Quality, Knoxville, TN, United States, University of Tennessee Health Science Center, Dept. of Pediatric Emergency Medicine, Memphis, TN, United States. fosterm@lebonheur.org

INTRODUCTION Because of its chaotic atmosphere, the pediatric emergency department (ED) is very susceptible to medication errors. Medical residents are especially at risk for making these errors. The presence of a pharmacist in the ED has been shown to decrease the number of medication errors. **OBJECTIVE** To implement a medical resident educational program with the involvement of attending physicians and an ED pharmacist and determine the effects on the frequency of ED pharmacy interventions and medication errors. **DESIGN/METHODS** The ED pharmacist recorded all pharmacy interventions on weekdays from 3 pm-11 pm using a pre-existing database during the 3-month observation and intervention phases. Data from a random 3-month period prior to the study initiation were also evaluated. The data were divided into categories based on the type of intervention and level of training. Weekly data were analyzed using statistical process control (SPC) u chart analyses. Chi-square analyses of independence were also performed. Resident educational interventions consisted of monthly lectures and daily discussions while on staff in the ED. Resident feedback was elicited through blinded internet surveys. **RESULTS** A total of 3507 interventions occurred during the 9-month period. There was a statistically significant decrease in the overall number of adverse drug events (ADE) and dose adjustments (DA) during the intervention phase ($p<0.03$). The number of medication order clarifications decreased during the intervention phase as well. Discharge prescription clarifications increased, partially because of the increase in ED patient volume related to H1N1 influenza. The total number of drug information questions asked by the ED staff increased. Root cause analysis suggests that our educational intervention was mostly responsible for the positive changes noted with ADE and DA. The residents and ED physicians responded positively to the presence of the pharmacist in the ED and the educational intervention. **CONCLUSIONS** The implementation of a medical resident educational program increased staff awareness of the potential for medication errors, increased the utilization of clinical pharmacy, and decreased the overall number of medication errors in the ED. The intervention was well received by the residents and the ED clinical staff. There was clearly a need for an ED pharmacist 24 hours per day.

STANDARDIZATION OF PEDIATRIC DOSES AND DOSING RANGES, PRACTICAL IMPLEMENTATION AND PRACTICE

Andrea Gerwin, Lisa Englert, Sarah Scarpace, Julie Wilson-Ganz.
University of California, San Francisco Medical Center, San Francisco, CA, United States, University of California, San Francisco Children's Hospital, San Francisco, CA, United States. andrea.gerwin@gmail.com

INTRODUCTION Patient specific doses are not commercially available for pediatric populations secondary to the wide range and specificity of doses utilized. The majority of doses prepared require multiple calculations and manipulations before ultimately reaching the patient. This highly involved process presents many opportunities for errors to occur. Currently, there are no widely accepted recommendations for the standardization of pediatric doses and dosage ranges. **OBJECTIVE** The objective of this study is to determine which pediatric medication doses or dosing ranges could safely and easily be standardized and to implement these changes

in to the practice at UCSF Children's Hospital. **METHODS** A retrospective review of all oral medications dispensed in the pediatric hospital from June 2009 to August 2009 was performed. A survey was created and circulated to children's hospitals across the country. The purpose was to assess the interest level and use of standardized doses. **RESULTS** There were over forty thousand different oral medication orders in this three-month period. Approximately eight thousand medication orders were isolated for analysis representing 33 different medications and over 749 different doses. Medications were selected for standardization based on frequency of use as well as safety and feasibility of standardization. One example medication selected for standardization was acetaminophen. Over 160 different doses were dispensed during the three-month period. After standardization, the same population of patients could be treated with the 12 new acetaminophen standard doses showing a 92.6% decrease in number of different doses. Five additional medications were selected for standardization and implementation. Approximately 30% of institutions surveyed had at least one medication with standard dosing and 94% were interested in learning how other institutions are creating standard doses and dosing ranges. **CONCLUSIONS** Standardization of pediatric doses and dosing ranges of the six selected medications will be adopted by UCSF's Children's Hospital. The implementation of these standards will serve to improve patient safety, decrease medication errors, and improve medication delivery efficiency. Interest in standardized dosing was prevalent among institutions surveyed.

PHARMACEUTICAL CARBOHYDRATE CONTROL AND THE KETOGENIC DIET

Kevin Graner, Brian Gardner, Danielle Coppola, Clement Akogyeram, Benard Lee.
Mayo Eugenio Litta Children's Hospital, Rochester, Minnesota, United States, Hackensack University Medical Center, Hackensack, New Jersey, United States, Ernest Mario School of Pharmacy at Rutgers University, Piscataway, New Jersey, United States, Mayo Clinic, Rochester, Minnesota, United States.
graner.kevin@mayo.edu

INTRODUCTION The coordination of the ketogenic diet (KD) is a highly time intensive process. For years, pharmacists struggled to provide timely medication carbohydrate content information and appropriate carbohydrate reduction strategies. As use of the KD grew, we sought to meet the demands with a formalized multidisciplinary management plan, creation of a comprehensive web-accessible database, and pharmacy-based alert system. Planning and implementation took 1.5 years. **BACKGROUND** The KD is a high-fat, moderate-protein, low-carbohydrate diet indicated to manage several forms of intractable pediatric epilepsy. To accurately and effectively initiate and maintain the KD, it is critical to calculate medication carbohydrate contributions. A major challenge to this process is the plethora of commercial medications and dosage forms available from multiple brand and generic manufacturers. Static published literature and secondary references cannot adequately meet the demands for timely, precise, and constantly developing medical information. There was no process to assure medication carbohydrate contents were assessed on a daily basis, and no tool existed for pharmacists to readily retrieve consistent information. A dynamic process was needed to best serve this high acuity population by providing a timely and accurate carbohydrate calculation, reduction strategy, and reactive dietary adjustments. **METHODS** During 2007, there was a series of multidisciplinary meetings to formalize each discipline's role in the care of KD patients. Pharmacy offered to provide a daily assessment of medication carbohydrate content and suggest carbohydrate content reduction strategies. Over two months, all our archived disparate medical information on 853 medication dosage units and forms were compiled into a comprehensive database and posted online. In July 2008, the CPOE and pharmaceutical care systems were modified to include a prescriber initiated KD monitoring alert identifying KD patients. These cues alerted the pharmacist to review the medication profile, calculate the daily medication carbohydrate load utilizing the database, and document it with carbohydrate reduction strategy recommendations in a formalized medical record note. **CONCLUSION** In two years, the database has grown to 1,090 sourced and updated medication entries. The program has served 70 patients (145 admissions) initiated or maintained on the KD. 237 pharmacist notes have been incorporated

into the electronic medical record, 947 pharmacist monitoring notes created, and 111 documented pharmacist interventions (108 accepted) have been made. The pharmacist now plays a well-defined and critical role in KD management of pediatric seizures and expediting these patients toward their therapeutic goals.

DEVELOPMENT OF A PEDIATRIC NURSING UNIT BASED PHARMACIST TRAINING PROGRAM

Lizbeth Hansen, Kay Kyllonen, Deb McNutt, Beth Carberry, Rebecca Taylor.
Cleveland Clinic, Cleveland, OH, United States. lizbethhansen@gmail.com

INTRODUCTION The general pediatric wards of the hospital requested the services of a nursing unit based pharmacist team to participate in multi-disciplinary rounds, medication counseling and discharge, and patient profile review. The department had previously trained pharmacists to practice in adult areas. However, a new curriculum was required to specifically train pediatric pharmacists. **METHODS** A subcommittee of the practice model committee was formed to review the literature, recommend appropriate modules, deliver the course, and create all assessments for the three pharmacists that were selected. Diagnosis data was used to determine the most common drug-related group codes that were assigned to the pediatric wards. Assessments were modified from the adult curriculum. **RESULTS** Based on the diagnosis data and clinical experience, the subcommittee created training modules based on the following therapeutic areas: asthma, bronchiolitis, pharmacokinetics, enteral/parenteral nutrition, pain management, emergency code drugs, patient counseling, antibiotics, immunizations, common diagnostic tests, developmental pharmacology, drug information primer, and the intervention database. The training was delivered over one week. Three pharmacists completed the training with an average of 87 percent on all 6 assessments. **CONCLUSIONS** A pediatric nursing unit based pharmacist training program was created and offered to three pharmacists. All pharmacists passed the assessments with an average score of 87 percent and are all currently practicing in the pediatric wards. The subcommittee continues to revise the training modules and expects to expand to all pharmacists within the pediatric satellite. Ongoing education, mentoring and evaluation processes are also in development.

MUPIROCIN PROPHLYAXIS

Amy Holmes.
Forsyth Medical Center, Winston Salem, NC, United States. apholmes@novanthealth.org

Following an outbreak of Staphylococcus aureus infections in early 2009, the NICU convened a multidisciplinary committee to closely scrutinize and evaluate their infection control practices. A novel recommendation presented by a pediatric infectious disease specialist was the administration of mupirocin to the umbilical stumps in all patients with umbilical vein catheters. This recommendation was based on knowledge that mupirocin had been successfully used to control an outbreak of Staphylococcus aureus infections in a NICU setting. Furthermore, mupirocin has been demonstrated to reduce the risk of exit-site infection and subsequent peritonitis from Staphylococcus aureus in pediatric patients undergoing peritoneal dialysis. In these patients, mupirocin was applied to the catheter exit-site on a routine schedule. Beginning in May 2009, the NICU has applied twice daily mupirocin to the umbilical cord stumps of all patients with umbilical vein catheters. Application is continued until the catheter is removed. No adverse effects from administration of mupirocin have been reported. In the past year, there have been no bloodstream infections with Staphylococcus aureus in the NICU.

AUSTERE PEDIATRIC PHARMACY - FIRST TWO WEEKS IN HAITI POST-EARTHQUAKE

Shannon Manzi.
Children's Hospital Boston, Boston, MA, United States, MA-1 DMAT, NDMS, Washington, DC, United States. shannon.manzi@childrens.harvard.edu

The Haitian Earthquake resulted in over 230,000 deaths and more than 300,000 injured. The first U.S. government based healthcare team arrived on the ground within 48 hours of the earthquake,

bringing with it a pediatric pharmacist, pediatric surgeon, a pediatric emergency physician, and a neonatal nurse, as well as 31 other cross-trained adult providers. More than 40% of the surviving victims of the earthquake were children. This is directly proportionate to the high birth rate in Haiti and the fact that approximately 60% of the Haitian population is under the age of 24 years. This presentation will focus on pediatric illnesses medical conditions seen in our field hospital with emphasis on aspects of illness and injury, pathophysiology, evaluation and management that are unique to children. The speaker will discuss the medical, surgical, psychosocial and particularly the pharmacologic interventions provided, focusing on the obstacles that had to be overcome to evaluate and care for some of these children. This will include discussing the challenges of working within a cache designed for domestic disasters in a devastated developing country. Alternative delivery and dosage forms, as well as environmental factors such as extreme heat and humidity, will be reviewed.

The National Disaster Medical System (NDMS) of disaster teams (DMATs) will be described. We will also explore challenges to "volunteering" of healthcare professionals, credentialing and extended training, the ethical implications affected standards of care in limited resource environment and the difficulty creating just-in-time training modules such as our newly developed disaster simulation course designed to prepare healthcare providers who are planning a medical mission to Haiti. The participants will be asked at the end of the session to identify further training opportunities that would better enable them to care for children in a disaster environment.

IMPLEMENTATION OF A PEDIATRIC PHARMACY EDUCATIONAL PROGRAM FOR HOSPITAL PHARMACISTS

Rachel Meyers, Jennifer Costello.
Rutgers University, Piscataway, NJ, United States, Saint Barnabas Medical Center, Livingston, NJ, United States. rmeyers@sbhcs.com

An educational program for improving pediatric content knowledge and pharmacist confidence among hospital pharmacists was implemented. Pharmacists were asked to voluntarily participate in this prospective educational exercise. A pre-intervention confidence assessment, post-intervention confidence assessment and a demographic questionnaire were administered to the pharmacists. Two pediatric-trained pharmacists collaborated and presented a total of eight lectures to the pharmacists participating in the program. To identify improvement in pharmacist competency, a pre-lecture test and post-lecture test were utilized to evaluate the program. Five of the six confidence scores improved from the pre-intervention to the post-intervention stage. Competency test scores for all eight post-lecture tests were higher than the pre-lecture test scores. Two of the lectures had improvements in test scores that were statistically significant. Our study showed that even a small educational program covering pediatric pharmacotherapy can have an impact on both confidence and competency of pharmacists in this area.

IMPACT OF PHARMACIST'S INTERVENTION IN PREVENTING SERUM CONCENTRATIONS IN UNCOMPLICATED PEDIATRIC PATIENTS RECEIVING VANCOMYCIN FOR LESS THAN 72 HOURS

Ashley Myers, Leslie Stach, Tracy Sandritter.
Children's Mercy Hospitals and Clinics, Kansas City, MO, United States, University of Missouri at Kansas City, Kansas City, MO, United States. aamyers@cmh.edu

INTRODUCTION Vancomycin levels are useful in guiding care but there are circumstances where unnecessary concentrations are obtained. A retrospective medication utilization evaluation (MUE) of two months revealed 43 non-indicated concentrations (drawn before 72 hours) according to an algorithm of pooled criteria from previous studies on the use of appropriate vancomycin levels. The purpose of this study was to determine the impact of a pharmacist's intervention in preventing non-indicated vancomycin serum concentrations in uncomplicated pediatric patients receiving vancomycin for less than 72 hours. **METHODS** This was a prospective interventional study with IRB approval that occurred in the months of January and March of 2010. Inclusion criteria were all patients with IV vancomycin orders which were identified by using a computer generated report. The patient's charts

were reviewed for vancomycin serum concentration orders. The orders were evaluated for appropriateness through the same algorithm utilized in the MUE. Reasons for indicated concentrations included: elevated serum creatinine, urine output <1mL/kg/hour, shock, high dose, or a plan for treatment greater than 5 days. A pharmacist attempted to cancel and/or reschedule vancomycin concentrations found to be non-indicated. Outcomes that were evaluated between the accepted and unaccepted recommendations were: fever at 4 and 7 days, trough drawn within 7 days if continuing therapy, white blood cell count at 7 days, and mortality. **RESULTS** Demographics were not significantly different between the MUE and the intervention groups. MUE: 111 patient courses, 102 patients, 222 levels before 72 hours, 43 patient courses with non-indicated concentrations. Intervention: 88 patient courses, 86 patients, 130 levels before 72 hours, 40 patient courses had non-indicated concentrations ordered. Intervention resulted in discontinuing or rescheduling 21 non-indicated serum concentrations in 15 patient courses. The average number of non-indicated concentrations dropped from 0.61 concentrations per patient course in the MUE to 0.34 non-indicated concentrations in the intervention phase (p=0.01). The most common reasons for indicated concentrations per patient course included elevated serum creatinine, shock, and no known pathogen with planned treatment for greater than 5 days for both phases. Of the 34 patient courses in the intervention phase with non-indicated concentrations, 10 (29%) were successfully prevented, 5 (15%) were prevented, then reordered and drawn, 2 (6%) were drawn by physician's choice, and 17 (50%) were missed. The intervention did not result in any significant changes in patient outcomes. **CONCLUSION** Pharmacist intervention did result in a significant decrease in the average number of non-indicated concentrations drawn per patient course. Our research suggests there is a need to develop a pharmacokinetic service that includes 24 hour pharmacist coverage and to further educate hospital staff on appropriate pharmacokinetic monitoring.

IMPLEMENTATION OF AN INTERNAL PRECEPTOR DEVELOPMENT WORKSHOP SERIES AT A FREE-STANDING CHILDREN'S HOSPITAL

Kimberly Novak.
Nationwide Children's Hospital, Columbus, Ohio, United States. kimberly.novak@nationwidechildrens.org

INTRODUCTION Evaluation and improvement of preceptor teaching skills is an integral component of all residency programs, and all ASHP accreditation standards for PGY1 and PGY2 pharmacy residencies share this common principle. Principle 4.3 states: "Program evaluation and improvement activities will be directed at enhancing achievement of the program's choice of outcomes. RPDs will evaluate potential preceptors based on their desire to teach and their aptitude for teaching (as differentiated from formal didactic instruction) and provide preceptors with opportunities to enhance their teaching skills. Further, RPDs will devise and implement a plan for assessing and improving the quality of preceptor instruction including, but not limited to, consideration of the residents' documented evaluations of preceptor performance. At least annually, RPDs and, when applicable, preceptors will consider overall program changes based on evaluations, observations, and other information." While resident feedback is a useful retrospective tool for improving quality of preceptor instruction, the most effective mechanism for continuous quality improvement for preceptors is nebulous, particularly for multi-residency sites with diverse programs and preceptors. **OBJECTIVE** Implement an internal preceptor development program at a free-standing children's hospital with a diverse PGY2 Pediatric Pharmacy Residency, PGY1 Community Pharmacy Residency, and MS/PGY1/PGY2 Residency in Health-System Pharmacy Administration programs. **METHODS** A preceptor development workshop series was developed in July 2009 to promote collaborative and continuous quality improvement opportunities for 23 pharmacy residency preceptors. Interactive monthly workshops were scheduled throughout the residency year on topics such as improving criteria-based evaluations, optimizing ResiTrak™ skills, mentorship, communication skills, and precepting leadership. Preceptors from all programs rotated as workshop leaders, and advance reading materials were provided by the workshop coordinator. Preceptors were mandated to participate in at least six workshops, and documentation of pre-

ceptor development activities was submitted for annual employee evaluations. Preceptors unable to attend workshop sessions due to scheduling conflicts were given the option of submitting documentation of independent preceptor development or teaching continuing education. **RESULTS** After 11 of 12 scheduled workshops, mean preceptor attendance was 13 preceptors per session (range 11-16) and 6 sessions per preceptor (range 0-11). 65 percent of preceptors had attended at least 5 of 11 sessions. Several preceptors submitted documentation of independently-obtained teaching continuing education hours to substitute for or augment their workshop participation. Preceptors from all programs have embraced this new forum for preceptor development and have been active participants in both workshop leadership and in discussion. Subjective observation suggests that summative resident evaluations across all three residency programs have improved in both quality and timeliness. **CONCLUSIONS** Implementation of an internal preceptor development program was successful in establishing a mechanism for diverse residency preceptors to continuously improve the quality of their teaching and precepting skills. Future directions will involve incorporation of preceptor feedback for further workshop development, implementation of reflective preceptor self-evaluation, and collaboration with other local residency sites in preceptor development activities.

FAILURE MODE EFFECTS ANALYSIS (FMEA) FOR MORPHINE PRESCRIBING PRACTICES

Elaine Wong, Chris Vadeboncoeur, Gina Neto, Hilary Writer, Rosemary Horlin, Elena Pascuet, Régis Vaillancourt.
Children's Hospital of Eastern Ontario, Ottawa, ON, Canada. epascuet@cheo.on.ca

INTRODUCTION At the Children's Hospital of Eastern Ontario, medication related events represent the highest percentage of patient safety incidents (28%). Of these, there have been 38 morphine related events (5.7% of medication incidents). Due to the voluntary nature of the Safety Reporting System, the recorded number of 38 reported events is likely an underestimation. Although not the sole contributing factor, prescribing practices contributed to a number of these incidents. **OBJECTIVE** To identify and prioritize potential failures in morphine prescribing, with the objective of improving patient safety by identifying and acting upon those parts of the morphine prescribing process which are most in need of change. **STUDY DESIGN & METHODS** A failure mode effects analysis (FMEA) was used by the multidisciplinary team to diagram the process of prescribing morphine and to brainstorm potential failure modes and predict their effects should the failures occur in real-time. Following this, the team identified causes of failure modes and prioritized these using severity, detectability and frequency. **RESULTS** A total of 70 failure modes were identified and prioritized these using severity, detectability and frequency as scores. Single point weaknesses are steps so critical that their failure would result in a system failure or adverse event. These were found to be distributed across the entire process (n=23). Secondly those scored with severity 5, meaning a severe or catastrophic effect should a failure of the step occur (n=12). Finally, risk priority number (RPN) which is calculated based on frequency, detectability and severity (n=5). **CONCLUSIONS** By identifying the potential failures in morphine prescribing, developing strategies and recommendations that include the following: 1) development of corporate dosing guidelines; 2) development of a verbal order policy; 3) promotion of pre printed orders hospital wide; and 4) support for computerized physician order entry with forcing functions.

OPTIMIZATION OF MEDICATION RECONCILIATION ON ADMISSION FOR PEDIATRIC INPATIENTS

Elaine Wong, Régis Vaillancourt, Pierre Katz.
Children's Hospital of Eastern Ontario, Ottawa, ON, Canada, Université de Tours, Tours, France. epascuet@cheo.on.ca

INTRODUCTION Medication reconciliation (MR) is a process designed to provide the most complete and accurate list possible of all medications during transfer of care. The pharmacy department is reviewing the existing MR process completed by a team of Pharmacy Assistants (PA's) to optimize patient care and capture all inpatient admissions. **PROGRAM DESCRIPTION** At its conception, MR was performed by a single PA. However, the

process is now supported by a team of 4 PA's 7 days a week. In an effort to harmonize the MR process, the process is being reviewed to establish best practice and improve the ability to capture all inpatient admissions. Specific objectives include: 1) prioritizing patients requiring MR based on unit /diagnosis; and 2) creating a decision tree to identify the need for pharmacist involvement.

Steps taken to implement new program: 1) Observe current practice of MR as performed by each PA; 2) Diagram current process and propose changes for quality improvement; 3) Audit successes and barriers to revised MR process; 4) Reassess for additional training or educational needs.

RESULTS From January to March 2010, over 1810 admissions to hospital in which 865 medication history interviews were conducted (57.5% of 1504 eligible admissions (defined as >24hrs admissions, non-oncology patients, non-neonates). The number of MR per PA varied from 50.3% to 66.2%. The number of MR greatly varied between them (7.6-10.8/day), as did the number of medication histories completed prior to admission (2.3-7.2%). **CONCLUSION** A harmonized MR process upon admission is intended to increase efficiency and effectiveness in obtaining and documenting medication histories. The decision tree will help reduce the number of clarifications requiring intervention by a pharmacist and improve timeliness in reconciliation of medication discrepancies.

DEXMEDETOMIDINE USE IN PEDIATRIC INTENSIVE CARE SETTINGS

Kim Carter, Emily Rowe, June Amling, Christiane Corriveau.
Children's National Medical Center, Washington, DC, United States. erowe@cnmc.org

INTRODUCTION Dexmedetomidine is an intravenous β2-agonist that has sedative and analgesic properties. It is currently FDA-approved in adults for use as continuous sedation for up to 24 hours and as procedural sedation. At this time, there are no standards to guide practice regarding the use of this drug in the pediatric intensive care unit (ICU) setting. **METHODS** This study sought to characterize the use of dexmedetomidine in the pediatric and cardiac intensive care units (PICU and CICU) at Children's National Medical Center (CNMC). A retrospective medication use evaluation was conducted for a convenient sample of 50 patients admitted to the PICU and CICU between July 2008 and January 2010 who received a continuous infusion of dexemedetomidine while mechanically ventilated. Patients with a surgical critical airway and patients who underwent single-stage laryngealtracheal reconstruction were excluded since these patients already have a standardized sedation protocol involving the use of dexmedetomidine. The primary end-point was the average percentage reduction in concomitant benzodiazepine and opioid dosing associated with the use of dexmedetomidine. Secondary end-points included mean time of initiation of dexmedetomidine compared to time of intubation and extubation, average initial infusion rates and titration of dexmedetomidine, and the incidence of hypotension and/or bradycardia associated with the use of dexmedetomidine. **RESULTS** There was an average of a 40%-60% drop in concomitant opioid and benzodiazepine infusion rates when dexmedetomidine was administered. Patients in the PICU on average started dexmedetomidine on day 7.1 of intubation; while in the CICU, patients on average started dexmedetomdine on day 1.5 of intubation. The average time from initiation of dexmedetomidine to extubation was 12.8 days in the PICU and 2.9 days in the CICU. Average age of patients treated with dexmedetomidine in the PICU was 5.2 years and was 1.8 years in the CICU. Patients in the CICU received infusion rates of 0.1-2 mcg/kg/hr for an average of 1.3 days while patients in the PICU receiving infusion rates between 0.05-3mcg/kg/hr for an average of 6.2 days. Five patients were identified as experiencing adverse events thought to be related to dexmedetomidine administration. Four patients required discontinuation of dexmedetomidine infusion and 1 patient required a reduction in infusion rate. **CONCLUSION** This study was not powered and there was no control group for comparison. Uncontrolled variables may have influenced the titration schedules of opioid and benzodiazepine infusions including changes in patient status and ongoing procedures. Dexmedetomidine can be safe in pediatric patients even at higher infusion rates and with extended durations compared to those reported in the literature.

COLLABORATIVE PHARMACY AND CLINICAL NUTRITION PROCESS IMPROVEMENT INITIATIVE AROUND TOTAL PARENTERAL NUTRITION IN AN INNER-CITY PEDIATRIC HOSPITAL

Phuong Sander, Matthew Wallace, William Agostinucci, Claire Dalidowitz, Margaret Burke.
Connecticut Children's Medical Center, Hartford, CT, United States. psander@ccmckids.org

INTRODUCTION A review of all reported medication variances that occurred in 2008 within a 147-bed, inner-city pediatric acute care facility showed that 34% of medication variances were high risk medications as defined by the hospital's Pharmacy and Therapeutics Committee. Total parenteral nutrition (TPN) accounted for 32% of these variances. The objective of this study was to develop and test the impact of a comprehensive process improvement intervention. **METHODS** A prospective evaluation of the effectiveness of a collaboratively-developed, comprehensive process improvement intervention followed a retrospective assessment of high risk medication variance occurrences in April – June 2009. Three months (July – September) were allowed for the plan to be implemented. The outcome of incidence of TPN-related medication variances was measured over 3 subsequent months (October – December 2009). Variances were then categorized using the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) classification for severity of variances. The intervention was developed based on observing daily activities of practicing pharmacists and dietitians. The intervention was comprehensive and included pharmacist education, reassessment of the appropriate ranges for TPN software alarms, identification and new process for assessment of high risk patients, and the addition of lipids to the "high alert" list which mandates independent double-check processes. Statistical comparison of pre- and post-intervention incidence rates was analyzed using chi-squared statistical test. **RESULTS** Baseline incidence of variances involving TPNs in the 3 month pre-intervention period was 36 per 1504 TPNs administered (22 were NCC MERP category B, 14 were category C, and 0 were category D or greater). The post-intervention incident was 12 per 1093 TPNs administered (3 were NCC MERP category B, 7 were category C, and 2 were category D) (p=0.0155). Accompanying the 67% reduction in TPN-medication-related variances, was a 34% reduction in mean number of software alarms per TPN. **CONCLUSIONS** This study showed that collaborative development of a comprehensive, hospital-specific intervention, designed based on careful process observation can be effective in improving the outcome of incidence of TPN-related medication variances. Continued observation is required to determine if impact of intervention is sustained.

SEVEN DAY STERILITY AND STABILITY TESTING TO REDUCE WASTE AND COST OF INTRAVENOUS CHLOROTHIAZIDE

Julie Sinclair-Pingel, Alison Grisso, Sheila Dawling, Joni Williams, Linda Bonner.
Monroe Carell Jr. Children's Hospital at Vanderbilt, Nashville, TN, United States. julie.sinclair@vanderbilt.edu

INTRODUCTION Chlorothiazide is the only thiazide diuretic available in an intravenous dosage form. Loop diuretics, the mainstay of therapy when the IV route is preferred, may not provide adequate diuresis alone thus requiring the synergistic addition of an injectable thiazide diuretic. IV chlorothiazide is available in 500 mg single dose vials with an average wholesale price of $357.24 per vial. Due to the high cost of IV chlorothiazide and the lack of other IV thiazide diuretics, our institution has implemented many cost containment efforts. While previous efforts have focused on appropriate use, the most recent effort focuses on prevention of waste. USP797 guidelines require that all single use vials that are needle-punctured in ISO Class 5 air be used within 6 hours. Since the standard dose at our institution is 10mg/kg to a maximum of 50 mg, it is possible to waste 90% of a vial if additional doses are not needed within 6 hours. Prepared doses of IV chlorothiazide are considered Low-Risk compounded sterile products by USP797 and may be stored for up to 48 hours at room temperature without further sterility testing. With support from laboratory services, we developed a study to validate the sterility and stability of prepared standard doses of IV chlorothiazide beyond 48 hours to reduce waste and cost.

METHODS IV chlorothiazide was reconstituted to 25 mg/mL in an ISO Class 5 environment. Twenty-one aliquots were drawn into 3ml syringes which were stored either under refrigeration or at room temperature. Two syringes from each group were removed daily for 7 days to be analyzed for either sterility or stability. Sterility testing was preformed after 7 days of incubation in Thioglycollate broth and stability testing was preformed using High Pressure Liquid Chromotography. **RESULTS** All samples analyzed for sterility were found to have no growth at seven days in both temperatures. Additionally, day seven samples analyzed for stability were shown to have ≤ 10% change in drug concentration from day zero. **CONCLUSIONS** Based on the results of this study, the dispensing of IV chlorothiazide has changed. Vials are diluted according to USP797 guidelines. The contents of each vial are then drawn into ten 50 mg standard dose syringes. Each syringe is given a 7 day expiration date and stored under refrigeration. When a dose is ordered, a syringe is removed from the refrigerator and labeled for the patient. If the dose required is less than 50 mg, excess drug is removed from the syringe in an ISO Class 5 environment prior to addition of the patient specific label. Based on our current use of IV chlorothiazide, we estimate that preparation of syringes with a 7 day expiration will reduce waste and cost by as much as 75%.

CHKD SYNAGIS® NOTIFICATION FAX PROGRAM: A 5 YEAR REVIEW OF SUCCESSFUL RESPIRATORY SYNCYTIAL VIRUS PROPHYLAXIS IDENTIFICATION

Eloise Woodruff, Kim Huber, James Dice.
Children's Hospital of The King's Daughters, Norfolk, VA, United States. eloise.woodruff@chkd.org

PURPOSE In the fall of 2005, the Children's Hospital of The King's Daughters (CHKD) implemented the Synagis® Notification Fax Program. This program has identified infants from the Neonatal Intensive Care Unit (NICU) who require palivizumab prophylaxis at their pediatrician's office during the respiratory syncytial virus (RSV) season. The objective of this study was to determine the number of infants successfully prophylaxed against RSV due to the Synagis® Notification Fax Program. **METHODS** Through the Synagis® Notification Fax Program, the clinical NICU pharmacists were responsible for identifying infants who were eligible to receive palivizumab and determined candidacy for one palivizumab dose prior to discharge. Additionally, the NICU pharmacists transmitted a fax to the infant's pediatrician upon discharge alerting them that their patient may meet the American Academy of Pediatrics guidelines for RSV prophylaxis. **RESULTS** At the start of this project, 106 faxes were sent to the pediatricians for 201 (62%) infants identified and discharged between November 1, 2005 and April 1, 2006. During subsequent years, we transmitted 90 faxes for 244 (37%) identified in 2007, 82 for 143 (57%) in 2008, 110 for 165 (66%) in 2009 and 77 for 192 (40%) in 2010. The most common reasons why patients eligible for palivizumab prophylaxis either did not receive a dose of palivizumab or that their pediatrician did not receive a fax were: transfer to another unit within CHKD not actively involved in the Synagis® Notification Fax Program, transfer to an outside facility, death due to a non-RSV related illness, or the patient remained in the NICU for the duration of the RSV season. After the implementation of the Synagis® Notification Fax Program, annual RSV hospitalizations of patients whose pediatrician received a fax are as follows: 2006: 4 of 106 (3.7%); 2007: 4 of 90 (4.4%); 2008 7 of 82 (8.5%); 2009: 7 of 110 (6.3%); and 2010: 1 of 77 (1.3%). **CONCLUSION** Increased candidate identification for RSV prophylaxis through the Synagis® Notification Fax Program has contributed to the decrease in RSV-related hospitalizations overall at CHKD. This program has assisted pediatricians in identifying high-risk infants that may have otherwise been missed during a scheduled visit. The success of the Synagis® Notification Fax Program has been the springboard for the expansion of RSV prophylaxis programs at CHKD, including the Pharmacist-Managed RSV Prevention Clinic.

BARCODE ASSISTED PHARMACY MEDICATION TRACKING: IMPROVING SAFETY, ACCOUNTABILITY AND QUALITY CONTROL IN A PEDIATRIC TEACHING HOSPITAL

Peter Lutz, Crystal Tom, Gregory Aldridge, Christopher Hynds, Dennis Gotto, James West,

John Watson, Al Patterson.
Children's Hospital Boston, Boston, MA, United States. crystal.tom@childrens.harvard.edu

INTRODUCTION Children's Hospital Boston Department of Pharmacy verifies approximately 2500 orders and dispenses over 7200 doses daily. The body of literature supporting the use of barcode-assisted medication dispensing is growing. In order to adopt this best practice, we embarked on a project to utilize this technology. Pharmacy Medication Tracking is an application that tracks the life cycle of an order from order placement through dose administration. Implementation of barcode assisted Pharmacy Medication Tracking will result in improved safety, accountability and quality control.
PROGRAM DESCRIPTION A task force of application and development specialists, pharmacy managers, and pharmacy technicians met routinely over 2 years. The application and pharmacy workflows were designed to meet the specifications of pharmacy and nursing. Workflow overview: Prescriber places order. Pharmacist verifies order and assigns a product. Using a barcode scanner interfaced with the Pharmacy Med Tracking application through a touchscreen computer, the technician/intern scans a pre-barcoded delivery container, each order barcode, and the medication barcode of each item being filled. Technician/intern changes the delivery container status to ready for pharmacist verification. Pharmacist verifies that all filled items are consistent with the order and product assigned using on-screen information and changes the status to verified or returns the bag to the technician/intern for correction. Verified bag is placed in the delivery bin and retrieved by the pharmacy courier, who utilizes a handheld mobile computer to scan the delivery container, scan the pharmacy departure barcode, scan the medication delivery destination barcode, and deliver to the appropriate destination. At any point in time, a user can check the status of an order using the order lookup function on the web interface to determine the location of the bag and whether it is ready to be verified, ready for delivery or out on delivery.

Pharmacy Medication Tracking provides many layers of safety during the packaging and delivery of medications. Built in safety checks include 1) Checks the ordered medication against the picked medication; 2) All orders must have a picked medication to be allowed to be sent to the pharmacist for verification; 3) Allows only one patient per bag; 4) Does not allow cancelled, suspended and modified/non-verified orders to be scanned into a bag; 5) All bags must be verified by a pharmacist to be allowed to depart the pharmacy; and 6) System will check the delivery location against the patient's location. If the patient has moved, the courier will be notified of the patient's new location.

Barcode assisted Pharmacy Medication Tracking evolves pharmacy dispensing to include numerous safety checks, electronic documentation of important dispensing actions, allows nurses to view order/dispense status and provides administrators the ability to determine critical metrics such as delivery turnaround times, system/personnel performance, and specific patient/order related event statistics.