16TH ANNUAL MEETING ABSTRACTS

EVALUATION OF EMERGENCY DEPARTMENT VISITS AND TREATMENT OF ACCIDENTAL INGESTION. Jenkins L, Eiland L, Cramer R. Huntsville Hospital for Women and Children, 101 Sivley Rd, Huntsville, Alabama 35801; email: laurensjenkins@gmail.com

Objectives: To evaluate cases of accidental ingestion presenting to an emergency department and to determine whether recently-published position papers and policy statements regarding ipecac and activated charcoal use have influenced treatment practices for accidental ingestion in the pediatric population.
Methods: A retrospective chart review was conducted of pediatric patients who presented to a community hospital emergency department (ED) during the years 2000 and 2005 with a diagnosis code of accidental medication ingestion or overdose. One hundred fifty nine electronic charts were obtained and 106 of these charts were evaluated for use in this study. The following data was collected: patient age, gender, date of incident, mode of arrival to ED, specific drug ingested, amount ingested, whether or not the drug was prescribed to the patient, outpatient and ED interventions and outcomes, and whether or not poison control centers were contacted. Interventions were compared with recommended treatments documented in the Poisondex database and trends were examined between 2000 and 2005.
Results: 106 charts were evaluated (n = 54 in 2000 and n = 52 in 2005) of patients aged 17 months to 18 years (mean age 3.75 years in 2000 and 3.69 years in 2005). Fifty-four cases documented poison control center contact. Sixty-six patients' ingested medications not prescribed to them, while nine patients ingested their own prescription medications. Analgesics and anti-inflammatory medications were most frequently ingested (26 ingestions) with antidepressants, antihistamines and decongestants following closely behind in occurrence (15, 15, and 13 ingestions, respectively). Thirty-six patients received activated charcoal treatment in 2000 versus only two patients in 2005. Syrup of ipecac was not administered in the ED to any patients in 2000 or 2005.
Conclusions: The utility of syrup of ipecac and activated charcoal has diminished over the years, especially with recent reports questioning the overall efficacy of ipecac and the efficacy of activated charcoal one hour after ingestion. Treatment of study patients reflected national trends of decreased use of syrup of ipecac and more recently, activated charcoal. Time since ingestion is often unknown, making appropriateness of charcoal therapy difficult to determine in many cases. This study found appropriate treatment of accidental ingestion in this institution based on recently- published guidelines and policy statements.

ANALYSIS OF PRESCRIPTIONS DISPENSED FOR PEDIATRIC PATIENTS AT A LOCAL COMMUNITY PHARMACY. Little T, Benner K. Samford University McWhorter School of Pharmacy, 800 Lakeshore Drive, Homewood, Alabama 35229; email: kwbenner@samford.edu

Objectives: The pediatric population has been identified as the population at the greatest risk for medication errors and adverse drug events. Therefore, inclusion of pediatric specific education in creating general practitioners of pharmacy is essential. This training has traditionally not been a core requirement within a doctorate of pharmacy program. The Accreditation Council for Pharmacy Education (ACPE) now identifies the pediatric population as a focus in preparing pharmacists to become general practitioners of pharmacy. Professional pharmacy curricula should include education to treat the unique pediatric patient. The significant proportion of pediatric patients and the challenges identified to be unique to the pediatric population unlock an opportunity for pharmacists to apply their education and training within the community setting. The purpose of this analysis was to determine the percentage of pediatric prescriptions dispensed at one local community pharmacy and analyze the data based upon gender, age, and drug class.
Methods: The community site that was studied was a local chain pharmacy in a rural area

of Alabama. The prescription register was printed out for one-month period of time during a presumably busy winter season. Patients less than 18 years old were manually selected from the database. The information obtained included date prescription was filled, age and gender of the patient, drug and drug class dispensed. Drug classes were compared based on age and that of the adult community.

Results: 765 prescriptions out of 9,549 (8%) were filled for pediatric patients during the study period. The average age of the study population was 8 years old. The top five drug classes that were dispensed for five different age groups were compared. Penicillins were the top drugs dispensed for the less than one year and 1-5 year age group, while stimulants were dispensed most for the 5–10, 11–14 and 15–17 year age group. The top ten drug classes dispensed for pediatric patients overall were compared to that dispensed for the adult community at this site and at large. These drugs identified differed significantly from those dispensed for the adult population of the same location and the general population in the United States.

Conclusions: Due to the prevalence of pediatric patients who require prescription drugs and the differing agents dispensed, the general practitioner of pharmacy needs to be well educated in pediatric pharmacy to appropriately and adequately treat this special population.

STUDENT EVALUATION OF VARIOUS TEACHING TECHNIQUES IN A PEDIATRIC ELECTIVE COURSE. Robinson C, Siu A, Sturgill MG. Rutgers University, 160 Frelinhuysen Road, Piscataway, New Jersey 08854; email:crobins1@rci.rutgers.edu

Background: The Pediatric Pharmacotherapy elective course was first offered at Rutgers University during the 2001 Spring semester. Over the next six years, several different teaching techniques were incorporated to offer the students a more realistic, interactive and fun learning experience including hospital site visits, hands-on/group activities in the classroom, and student topic and case presentations. Course grades were initially based on four non-cumulative examinations administered throughout the course. Grade distribution was altered as new techniques were added and "weekly" quizzes were substituted for examinations. The class size and number of Pediatric faculty has varied from year to year. Course enrollment increased from 15-18 students to 37 students in 2007. Two to five faculty with Pediatric practice sites have participated in the course. Due to the increasing number of students and varying Pediatric faculty resources, conducting these activities became challenging.

Objective: We sought the student perception of the value of each component of the course in developing a better understanding and comfort with specific topics and the pediatric population, in general, to determine what, if any, course modifications should be made.

Methods: A survey was distributed on the second to last day of class and emailed to the class list-serve. The students were asked to rate the value (1 = no value; 2 = low value; 3 = neutral; 4 = valuable; 5 = priceless) and provide supporting comments regarding each technique. Surveys were anonymously collected on the last day of class.

Results: A total of 32/37 (86%) of the surveys were completed. The component rated as the most valuable was the hospital site visit (mean 4.85, range 4-5) followed by hands-on/group activities in the classroom (mean 4.72, range 4 to 5), topic/case presentations as a presenter (mean 4.5, range 3 to 5), weekly quizzes (mean 4.5, range 3 to5), didactic lectures (mean 4.48, range 3 to 5) and topic/case presentations as a listener (mean 3.97, range 2 to 5). Majority of students provided constructive comments supporting their rating and suggestions for improvement.

Conclusions: All of the current teaching techniques in the Pediatric Pharmacotherapy elective course were perceived to be valuable by the students. Although challenging, each of the components will be retained and some modified based on the student suggestions.

HYPERTONIC SALINE FOR INHALATION: DURATION OF MICROBIAL FREE. Ramsey E, Kuhn R, Deady K, Anstead M, Overman S, Ribes J. University of Kentucky HealthCare, Department of Pharmacy, 800 Rose Street, C-117, Lexington, Kentucky 40515-0293; email: ezrams2@uky.edu

Objective: Clinical trials have shown that hypertonic saline (7% NaCl) showed significant improvement in mucus clearance, and improved lung function in patients with cystic fibrosis. Currently, there are no commercially produced 7% hypertonic saline solutions. At our institution, we have developed an extemporaneously prepared multi-dose solution to overcome this. Studies have proven that aqueous NaCl solutions are stable at room temperature, but there is little data in terms of microbiologic growth. Therefore, the objective of this study is to determine the length of time that a multi-dose preparation of 7% hypertonic saline is free of microbial growth.
Methods: *Phase 1-* Four control solutions of the extemporaneous 7% hypertonic saline were prepared and stored at 4°C and 26°C. One sample in each pre-specified temperature was prepared with non-touch contamination practices, the other with touch contamination. To assess microbial growth, one of the two aliquots from each of the solutions obtained on days 0, 2, 4, 6, 7, and 10 were plated on blood agar (BAP) and Mackonkey agar (MAC) and also added to thioglycolate nutrient broth (Thio) and incubated at 35°C. Each plate and Thio tube was inspected daily and any growth recorded and identified. Microbiological growth in any culture medium was treated as a terminal event. This phase was completed in duplicate. *Phase 2-* Twelve additional test 7% hypertonic saline solutions were prepared identically, but subsequently inoculated with two concentrations of different pathogens common to CF patients, *Pseudomonas aeruginosa* and *Staphylococcus aureus.* Growth curves of the inoculated solutions were determined by daily plating of 100 and 500 mcL aliquots of each solution onto BAP for 10 days. The plates were incubated at 35°C and colony counts of each plate were conducted at 24 hours.
Results: *Phase 1-* Eight sample solutions were investigated for 10 days. 91.25% were found to be free from microbial growth, with the positive specimens primarily mixed skin flora. *Phase 2-* Growth curves of the inoculated solutions decreased in all solutions stored at both room temperature and in the refrigerator; a greater decrease in organisms was noted in the solutions stored at room temperature.
Conclusions: Extemporaneously prepared 7 day supplies of 7% hypertonic saline solutions remain free of infectious pathogens when prepared at home and do not support the growth of pathogens common to the CF patient, especially when stored at room temperature. This validates our extemporaneous formulation of hypertonic saline.

IMPACT OF THE JCAHO MEDICATION RECONCILIATION MANDATE IN CHILDREN WITH CHRONIC COMPLEX MEDICAL ILLNESS. Stone B, Boehme S, Cash J, Srivastava R. Primary Children's Medical Center, 100 N Medical Dr, Salt Lake City, Utah 84113; email: sabrina.boehme@intermountainmail.org

Objective: JCAHO mandated that all acute-care hospitals reconcile medications at transitions in care. The impact of this has not been previously described. This study compares the accuracy and availability of information sources and admitting orders before and after a medication reconciliation intervention.
Methods: Prospective QI study in children with complex medical illness (CMI) admitted to a tertiary care hospital from 10/10 to 11/19/06 compared to baseline data collected two years ago. All non-ICU medical admissions were screened for children with CMI. An experienced pharmacist collected medication information from the intervention form and 6 other sources: parent, medical record, outpatient pharmacy, primary provider, admitting history, and admitting orders. A reconciled medication list was synthesized for each patient. Sources were compared to this gold standard. Effort was measured as number of attempts to contact, and time spent. Primary outcomes were comparisons between pre and post intervention data regarding accuracy and availability of sources, accuracy of admission orders and evaluation of true errors. P-values for the comparisons were calculated using Fisher's Exact Test.
Results: 217 vs. 424 admissions were screened and 32 vs. 64 identified as CMI in the pre and post-intervention periods respectively. Establishing the gold standard required a mean of 90 and 38 minutes/patient pre/post periods. Accuracy and availability of the six sources are shown in the Table. Admission

Year	Total Errors (%)	Patients Affected (%)	Omissions (%)	Dosage (%)	Formulation (%)	Freq (%)	Route (%)	Other (%)
2005 (n = 173 meds, 23 pts, 30 errors)	17.3	62.5	40	30	13.3	16.7	0	0
2006 (n = 532 meds, 54 pts, 89 errors)	16.7	62.9	31.5	29.2	13.5	11.2	12.4	2.2

order errors totaled 79/441, or 17.9% (10.8% pre). 34/54(post-63%, pre-56%) patients experienced at least one error. The reconciliation instrument was 83% accurate. Errors were corrected immediately through established pharmacy protocol.

Conclusions: Implementation of a JCAHO-compliant medication reconciliation at hospital admission instrument did not reduce medication errors in children with CCMI, although the overall process is improved.

COMPARISON OF GLOMERULAR FILTRATION RATE (GFR) BY THREE METHODS IN PEDIATRIC ONCOLOGY PATIENTS. Miller M, Soni S, Hayes J, Pai V. Columbus Children's Hospital, 700 Children's Drive, Columbus, Ohio 43205; email: msmiller@columbus.rr.com

Background: Renal excretion capability guides dose modifications for nephrotoxic or renally eliminated chemotherapy agents. Technetium 99 diethylenetriamine pentaacetate (Tc99-DTPA), a radiopharmaceutical completely excreted by glomerular filtration, is used to measure GFR in pediatric oncology protocols to calculate doses of renally eliminated chemotherapy. Limited accessibility of Tc99-DTPA has led protocols to recommend serum creatinine (SCr) as an alternative to Tc99-DTPA GFR estimation; however, studies have shown SCr to grossly overestimate GFR in adults and children.

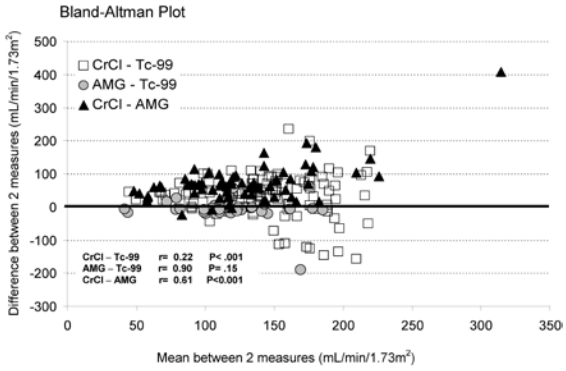
Objectives: 1) Compare the GFR calculated using SCr and the Schwartz equation (CrCL) to GFR measured by Tc99-DTPA (Tc99CL) and GFR estimated by aminoglycoside (AMG) renal clearance (AMGCL) 2) Compare Tc99CL with AMGCL.

Methods: Medical records of pediatric oncology patients receiving Tc99-DTPA renal scans and serum AMG concentration measurements between 2000 and 2006 were retrospectively reviewed. Patients with septic shock, multi-organ failure, vasopressor therapy between Tc99-DTPA renal scan and AMG serum concentrations, or a calculated AMG volume of distribution varying by >50% of the population range during the GFR estimations were excluded. Data such as age, gender, race, diagnosis, weight, height, nutritional status, SCr, Tc99CL, AMG dose, AMG frequency and administration times were collected. The CrCL calculations were based on SCr drawn concurrently during the other two methods of GFR estimation. The CrCL was compared to Tc99CL (CrCL vs Tc99CL). The CrCL was compared to AMGCL calculated using serum AMG concentration measurements and Sawchuk-Zaske one-compartment model equations (CrCL vs AMGCL). The Tc99CL was also compared to AMGCL calculated by using AMG serum concentrations measured within 4 weeks of the renal scan (Tc99CL vs AMGCL). Statistical tests used include descriptive analyses, paired t-tests and Bland-Altman plots.

Results: Forty-six eligible patients with 115 Tc99CL, 115 SCr and 66 AMGCL measurements were placed in the three comparison groups. The Bland-Altman plot illustrated that CrCL overestimates GFR when compared to AMGCL (Mean difference = +71.7 ± 59 mL/min/1.73 m^2, t = 9.8, P < .001; r = 0.61) as well as Tc99CL (Mean difference = +32.0 ± 62.6 mL/min/1.73m^2, t = 5.47, P < .001; r = 0.22). AMGCL was found to be similar to Tc99CL with the difference between the two measurements being statistically insignificant (Mean difference = –9.1 ± 34.7 mL/min/1.73m^2, t = –1.6, P = .15, r = 0.899).

	Tc-99 vs. CrCl	AMG vs. CrCl	Tc-99 vs. AMG
Total Pairs (n)	115	66	35
CrCl			
Median±SD	157±48.2[a]	152.5±68.8[a]	-
(Range)	(61-304)	(67-518)	
AMG Cl			
Median±SD	-	90.5±37.2[b]	110±32.5[b]
(Range)		(24-180)	(35-180)
Tc-99 Cl			
Median±SD	119±51.7[c]	-	116.3±41.2[c]
(Range)	(21.9-287.9)		(44.9-264)
Mean AMG Dose	-	7.5[d]	7.5[d]

a= creatinine clearance (Schwartz) mL/min/1.73m^2
b= aminoglycoside clearance mL/min/1.73m^2
c= technetium-99 GFR mL/min/1.73m^2
d= mg/kg/day



Conclusions: Creatinine clearance calculated using SCr is not an accurate measure of GFR compared to Tc99CL and AMGCL. Aminoglycoside clearance appears to be a more accurate measure of GFR compared to CrCL. A prospective study obtaining all three measures simultaneously is necessary to confirm these results.

PHARMACODYNAMIC TARGET ATTAINMENT OF ORAL BETA-LACTAMS FOR THE EMPIRIC TREATMENT OF ACUTE OTITIS MEDIA IN CHILDREN. St. Germain R, Kuti J, Doern G, Girotto J, Nicolau D. University of Connecticut School of Pharmacy, Storrs, Connecticut, and Connecticut Children's Medical, Center, 282 Washington Street, Hartford, Connecticut 06106; email:reneestgermain@gmail.com

Objective: Acute otitis media (AOM) in children is commonly caused by *Hemophilus influenzae* or *Streptococcus pneumoniae*. Increasing beta-lactam resistance among these organisms complicates the choice of empiric oral antibiotic therapy for clinicians. In this study, we determined the probability of achieving bactericidal pharmacodynamic exposures for frequently used oral β-lactam regimens as empiric treatment against pathogens most commonly implicated in AOM, based on prevalence and contemporary resistance rates.

Methods: Using a 5,000 patient Monte Carlo simulation, steady-state concentration time profiles were calculated for oral amoxicillin 13.3 mg/kg TID (standard-dose) and 30 mg/kg TID (high-dose), amoxicillin/clavulanic acid 45 mg/kg BID, cefpodoxime 5 mg/kg BID, cefprozil 15 mg/kg BID, ceftibuten 9 mg/kg QD, and cefuroxime 15 mg/kg BID. Weight-based dosing from a population of 5-year old males (CDC growth charts) and estimates of pharmacokinetic parameters from the literature were employed during simulation. The percent of simulated patients who achieved free drug concentrations above the minimum inhibitory concentration (MIC) for 50% of the dosing interval (50% *f*T>MIC) were determined using the MIC profiles of 293 *H. influenzae* and 451 *S. pneumoniae* characterized during the 2004 GRASP U.S. surveillance study. The prevalence of these organisms as causes of AOM was extrapolated from the literature and weighted against the probability of pharmacodynamic target attainment (PTA) for each pathogen. The contribution of a Pollyanna effect for each organism was also considered when estimating clinical effectiveness.

Results: Against *H. influenzae*, cefpodoxime (99%), ceftibuten (94%), and amoxicillin/clavulanate (90%) achieved the highest PTA. Against *S. pneumoniae*, only high-dose amoxicillin (90%), standard-dose amoxicillin (84%), and

amoxicillin/clavulanate (84%) achieved high PTA. However, when considered together according to the relative frequency with which these organisms cause AOM, PTA was highest for cefpodoxime (89.6%), followed by amoxicillin/clavulanate (87.8%), high-dose amoxicillin (84.4%), standard-dose amoxicillin (77.2%), ceftibuten (61.0%), cefprozil (35.0%), and cefuroxime (32.1%). The contribution of a Pollyanna effect would increase the probability of clinical effectiveness for all agents, with amoxicillin/clavulanate (92.1%), cefpodoxime (91.9%), and high-dose amoxicillin (90.9%) having the highest PTA.

Conclusions: In view of current resistance rates with *H. influenzae* or *S. pneumoniae* and typical pharmacokinetic profiles, among the regimens considered in this investigation, empiric therapy with amoxicillin/clavulanate, cefpodoxime, or high-dose amoxicillin regimens will provide the greatest likelihood of a positive clinical outcome for patients with AOM.

IMPROVED USE OF ANTIBIOTICS RESULTING FROM IMPLEMENTATION OF A MEDICATION ORDER SET FOR FEBRILE NEUTROPENIA. St. Germain R, Crudi L, Girotto J. University of Connecticut / Connecticut Children's Medical Center, 282 Washington Street, Hartford, Connecticut 06106; email: jen_maurizio@sbcglobal.net

Purpose: Children with febrile neutropenia (FN) are at high risk for infectious complications. Initiation of early appropriate antibiotic therapy has led to decreased morbidity and mortality. Although current guidelines provide suggestions for empiric therapy, these were not consistently being followed at our institution. As a result, a febrile neutropenia order set (FNO) was developed and implemented. In this study, we evaluated the impact of the FNO on appropriateness of antibiotic utilization.

Methods: A retrospective review of medical records of children hospitalized at our institution for FN from June 1, 2006 to November 1, 2006 was conducted and compared to data previously collected (February 1, 2004 to February 1, 2005) to assess the effects of implementation of a standardized FNO. Patients were identified via ICD-9 codes (288.00-288.09 OR 780.6), and then confirmed to have FN. Multiple admissions were included for repeat patients. The same data collection tool was used for both evaluations to collect demographics, FN therapies, additional antibiotic therapies, laboratory data, pathogen susceptibilities, and efficacy evaluation. FN therapy was classified as a success or failure. Data were compared using Mann Whitney U test or chi-squared, where appropriate.

Results: 28 patients were included in the current post-FNO evaluation and compared to 43 patients in the pre-FNO evaluation. Age, weight, and percent of patients with a positive culture were similar between groups; while gender (51% vs. 78% males; P = .04), initial temperature (median 101.5°F vs. 101.1°F; P = .001), and ANC (120 vs. 160; P = .005) were different between pre- and post-implementation, respectively. The positive cultures included 1 gram-positive and 5 gram-negative in the pre-implementation, and 12 gram-positive and 3 gram-negative organisms post-implementation. There were no differences between use of ceftazidime/cefepime (77% vs. 86%; P = .5), vancomycin (30% vs. 32%; P = .9), gentamicin (9% vs. 11%; P = 1), clindamycin (7%; P = 1), or ciprofloxacin (0% vs. 7%; P = 0.2). However, decreases in the empiric use of nafcillin (49% vs 0%; P < .001) and ceftriaxone (21% vs. 0%; P = .009) were demonstrated. Further, differences were shown in the number of initial regimens that included >1 beta-lactam (51% vs 0%; P < .001). There were no differences between groups with regard to success of initial antibiotic regimen (67% vs. 64%; P = .98) or infection related length of stay (median 5.0 vs. 6.5 days; P = .4). No patients died during either evaluation.

Conclusions: The implementation of the FNO has helped to standardize the selection of empiric FN therapy at our institution. Additionally, it has aided in eliminating the use of double beta-lactam therapy by switching to cefepime as beta-lactam monotherapy.

IMPACT OF APPROPRIATE ANTIBIOTIC UTILIZATION ON CLINICAL OUTCOMES IN COMPLICATED SKIN AND SOFT TISSUE INFECTIONS (CSSTIS) IN CHILDREN. St Germain R, Matson K, Ford J, McCabe T, Low J, Girotto J. University of Connecticut / Connecticut Children's Med Center,

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Objective: The incidence of complicated skin and soft tissue infections in children has been increasing. At the same time, antibiotic resistance to common organisms associated with these infections has also risen. As such, it has recently become uncertain what the best empiric therapy is for children hospitalized with cSSTIs. Therefore, the objective of this study was to determine if inappropriate therapy is more likely to result in a hospitalization of > 3 days.
Methods: A retrospective review was conducted evaluating children hospitalized in 2005 at 3 children's hospitals in the Northeast with a cSSTI, as identified via ICD-9 codes. CSSTIs included: abscess requiring surgical incision and drainage, deep/extensive cellulitis, or infected ulcers/wounds. Inappropriate therapy was defined as initial antimicrobial agent(s) without in vitro activity against the causative organism(s). Patients were excluded if they were > 18 years, lacked pathogen identification or susceptibility, received prior appropriate therapy, had been previously evaluated or had medical records providing incomplete information. The association between infection related length of stay and appropriateness of initial antibiotic therapy was explored using multivariate logistic regression.
Results: A total of 135 patients were included. The study population consisted of 60% males with a median patient age of 6.0 years (IQ_{25-75} 1.4–13.0 yr). 77% of patients were susceptible to initial treatment(s), which most frequently included: clindamycin (n = 33), vancomycin (n = 27), or cefazolin (n = 22). Common pathogens isolated included: methicillin-sensitive *S. aureus* (n = 58), methicillin-resistant *S. aureus* (n = 46), *S.* non-*aureus* (n = 11), *E. coli* (n = 7), and *P. aeruginosa* (n = 6). Inappropriate empiric therapy was not associated with a > 3 day hospitalization on multivariate analysis. Only previous hospitalization within the past year [Adjusted odds ratio (OR) 3.33, 95% confidence interval (95% CI) 1.45-7.67; P = .005] was independently associated with increased risk of infection related hospitalization >3 days. Additionally, presence of a permanent intravenous line demonstrated a trend towards increased risk of hospitalization >3 days [Adjusted OR 5.41, 95% CI 0.99-29.53; P = .051]. Although male gender was not identified to be an independent predictor, it demonstrated a trend towards decreased risk of infection related hospitalization >3 days [Adjusted OR 0.48, 95% CI 0.23-1.02; P = .057].
Conclusions: Data from this retrospective evaluation suggest that initial inappropriate antibiotic therapy does not appear to be associated with a hospitalization of > 3 days. A prospective evaluation is needed to solidify the role of initial inappropriate therapy on duration of hospitalization in children.

SAFETY OF INTRAVENOUS KETOROLAC USE IN INFANTS FOLLOWING CARDIOTHORACIC SURGERY. Dawkins T, Barclay C, Dent C, Gardiner R. Cincinnati Children's Hospital Medical Center, 3333 Burnet Avenue, Cincinnati, Ohio 45229; email: tamara.dawkins@cchmc.org

Purpose: The use of intravenous ketorolac in infants <6 months of age is increasing in postoperative cardiothoracic patients. However, there is a paucity of data related to the use of intravenous ketorolac in this patient population. This study was designed to compare the safety of intravenous ketorolac use in a study group versus a control group in infants <6 months of age undergoing cardiothoracic surgery. The primary endpoint of the study was to measure the incidence of renal impairment and hematologic complications in patients <6 months of age who received ketorolac following cardiothoracic surgery.
Methods: A retrospective chart review was conducted on patients admitted to the Cardiac Intensive Care Unit and Cardiac Stepdown Unit who underwent cardiothoracic surgery between January 1, 2004 and April 15, 2007. This study compared patients <6 months of age who received intravenous ketorolac following cardiothoracic surgery to those patients who did not receive intravenous ketorolac post-operatively. Patients undergoing single ventricle staged palliation, having an allergy to ketorolac or other nonsteroidal anti-inflammatory drugs (NSAIDs), and/or displaying abnormal renal and hematologic baseline values were excluded. Data collected included patient demograph-

ics, total ketorolac exposure, pain medication use throughout hospitalization, blood product administration, incidence of renal impairment, and incidence of hematologic complications.

Results: The study included 61 patients (35 non-ketorolac group and 26 ketorolac group). Ten patients in the non-ketorolac group and no patients in the ketorolac group were <1 week of age. Patients in the ketorolac group received at least one dose of ketorolac post-operatively. The mean dose of ketorolac received was 0.5 mg/kg/dose IV every 6 or 8 hours. The mean length of therapy was approximately 2 days. Patients in the ketorolac group had no statistically significant change in pre-operative versus post-treatment hematologic or renal effects compared to the non-ketorolac group. No statistically significant difference was detected for the number of post-operative blood transfusions received in both groups. No statistically significant difference was detected between the two groups with respect to narcotic and non-narcotic analgesic use.

Conclusions: Ketorolac appears to be safe when used in infants <6 months of age with double ventricle anatomy following cardiothoracic surgery. Ketorolac does not appear to significantly increase the risk of hematologic or renal complications compared to patients not receiving ketorolac post-operatively. Ketorolac does not appear to decrease the use of standard analgesic therapy in infants <6 months of age following cardiothoracic surgery.

SURVEY EVALUATING PEDIATRIC EDUCATION AND SELF-EFFICACY OF COMMUNITY PHARMACISTS IN CONNECTICUT: A PILOT STUDY. Hooker S, Girotto J. University of Connecticut/ Connecticut Children's Med Center Department of Pharmacy, 282 Washington Street, Hartford, Connecticut 06106; email: jen_maurizio@sbcglobal.net

Purpose: About one-third of the patients cared for by community pharmacists (CP) are children. As additional knowledge and skills are needed to practice pediatric pharmacy, a survey was conducted to evaluate the current pediatric knowledge and self-efficacy of CP in Connecticut.

Methods: Survey questions were created by the authors and evaluated by a focus group of community and pediatric trained pharmacists. The survey evaluated dosing, vaccines, self-care/referral, and nonprescription medicine. Exempt approval was received from the Uconn IRB. Survey monkey was used to administer the survey and collect the data in an anonymous fashion. Flyers were distributed to a study group of CP and two control groups (pediatricians–expert control and first year pharmacy students–general knowledge control). A chi-squared analysis of contingency table was used to determine if differences existed between groups. Flyers were delivered or mailed to 365-CP and 40-pediatricians. An email was sent out to try and remind CP of the survey and make it easy to click on a link. Students (n = 100) were sent an email during the first semester in the school.

Results: About one-fourth of people targeted responded to the survey. Most CP worked full time (60%) and had worked at least 10 years as a pharmacist (74%). Sixty-three percent reported filling at least 10% of their prescriptions and 67% answer at least 4 questions a day regarding children. CP reported that 77%-96% of questions were either very applicable (VA) or somewhat applicable (SA). Opinions regarding applicability were similar between groups except with regards to amoxicillin dosing (58%–87.5%; P = .005). CP chose the preferred answer between 16%–60% of the time compared to students 0%–55% and pediatricians 63%–100%. Differences between groups existed for all questions (P < .01) except those regarding self-care/referral (P = .07). CP were most likely to choose the best answer for self-care/referral and least likely questions regarding a new vaccine. Significant differences between groups existed with regards to self-efficacy (P < .01 for all questions). Specifically, CP reported high self-efficacy (i.e., "much confidence" or "completely confident") 14%–66% compared to 62.5%–100% of pediatricians and 0%–17% of students.

Conclusions: This study suggests that there are differences in knowledge and self-efficacy between groups with regards to scenarios that are at least somewhat applicable in the community setting. Therefore, increasing knowledge and self-efficacy of Connecticut CP to keep current with pediatric practice may be needed. A larger study with increased participation is needed to verify these results.

DECREASING MEDICATIONS ERRORS IN THE PEDIATRIC POPULATION THROUGH AN IMPROVED MEDICATION ORDER ENTRY PROCESS. Gorrell J, Poore L, Patterson C, Spence C, High J. Charleston Area Medical Center, 800 Pennsylvania Ave, Charleston, North Carolina 25302; email: jennifer.gorrell@camc.org

Purpose: One of the most vulnerable patient populations to medication errors is the pediatric patient. As a result of several recently publicized national incidents, this project was designed to improve medication safety and decrease medication errors in the pediatric population by standardizing dose verification during the order entry process.
Method: Standard practice for processing pediatric orders at this institution includes dose verification with an appropriate reference for every order based on the patient's weight. This verification process is documented in the additional "*sig*" field on the order entry screen. While this practice is considered "standard", there is no official policy, procedure, or education process in place for pharmacy. In an effort to evaluate compliance, 198 random medication orders for patients admitted to the general pediatric unit, pediatric intensive care unit and the neonatal intensive care unit were evaluated for the documentation of dose verification.
Results: Of the evaluated orders, 168 (84.8%) contained all required elements of dose verification. As a result of this finding, a policy and procedure are in the development phase, to be followed by an educational campaign to increase documentation of dose verification on all orders, for pediatric patients. Following the educational campaign, scheduled to be completed in late June and July, 198 additional random medication orders will be evaluated for the required documentation.
Conclusions: Due to the vulnerability of the pediatric population and the variability at order entry, standardization of the process is necessary.

IMPACT OF A PRACTICE GUIDELINE ON EMERGENCY CONTRACEPTION USE IN A PEDIATRIC EMERGENCY DEPARTMENT. Rowe E, Sun S, Hasan N, Eades S. Children's National Medical Center, 111 Michigan Ave NW, Washington, DC 20010; email:erowe@cnmc.org

Objective: Over 3 million unintended pregnancies occur in the US each year. Half of these unintended pregnancies end in abortion. Emergency contraception (EC) can help prevent pregnancy when taken after unprotected sex. Indications for EC in the emergency department (ED) of a pediatric hospital include patients presenting after unprotected intercourse or sexual assault. Many policy changes regarding the use of EC, have been made on the federal and state levels, including: 1) over-the-counter status for Plan B (a dedicated EC product), 2) pharmacists providing EC without a prescription in several states, and 3) requirement that survivors of sexual assault be offered EC in several states. Major medical association guidelines regarding the use of EC, especially medication regimen choice and simplified dosing instructions, undergo frequent updates. One method of keeping medical staff aware of the current recommendations regarding EC use is through the creation of an institution specific guideline. The goal of this study was to assess the use of EC before and after implementation of an EC guideline in a pediatric emergency room.
Methods: This study was approved by the Institutional Review Board. A clinical guideline consistent with state and federal policies was developed with input from ED medical and nursing staff. Patients who received EC in the ED were identified using the hospital medication management database. Retrospective data was collected from the 4 months proceeding the education sessions through the 4 months following the education sessions. Patient demographic data and data regarding the use of EC, including regimen used (levonorgestrel only or combined estrogen and progestin), indication for use (sexual assault or unprotected sex), and directions for use (how many tablets at what interval), were compared pre and post education to determine if the guideline affected the EC prescribing practice of the ED at Children's National Medical Center.
Results: Preliminary data analysis showed an increase in compliance with prescribing according to guideline recommendations from

6% in the pre-education period to 68% in the post-education period. Statistical analysis is ongoing.
Conclusions: From preliminary data analysis, compliance with EC regimens prescribed increased after guideline implementation and education

REVIEW OF VALPROIC ACID LEVELS AFTER THE INITIATION OF MEROPENEM THERAPY IN PEDIATRIC PATIENTS.
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Background: Recent case reports illustrate the possible drug interaction between carbapenems and valproic acid. Drugs in this class are reported to decrease valproic acid plasma concentrations to sub-therapeutic levels and result in the loss of anticonvulsant effects. These effects may be due to pharmacokinetic interactions which results in valproic acid hepatic metabolism being induced.
Objectives: To evaluate impact of concomitant valproic acid and meropenem administration on valproic acid levels (VPA) and valproic acid dosing requirements.
Methods: Four pediatric intensive care patients were identified via clinical pharmacy consults for management of low VPA levels. These patients were managed by an intensivist, while neurology was consulted for increased seizure activity and antiepileptic medication management. Chart reviews were conducted by pharmacy to determine when and why plasma concentrations were decreasing. Data collection included: valproic dosing, VPA levels and start/stop dates for meropenem therapy.
Results: All patients received continuous valproic acid infusions. Prior to meropenem therapy VPA levels were therapeutic or near therapeutic. Once meropenem was started, levels began to decrease. Valproic acid doses were double or tripled to maintain therapeutic levels in the low end of therapeutic range. (Goal levels were for 80-100 mg/dL per neurology.) If the patients were converted to every 6 hours dosing while remaining on meropenem, the levels would once again decrease to sub-therapeutic levels. Valproic acid levels improved once meropenem was discontinued.
Conclusions: The avoidance of concomitant administration is not well established at our institution, and is made complex by the number of physician services prescribing on each patient. Pharmacy has a role in educating and suggesting alternative therapeutic options. If meropenem is the only option for therapy, it should be used with caution in patients with seizures treated with valproic acid. Close monitoring of levels and potential high dose continuous infusions may need to be utilized.

SAFETY OF COMMERCIALLY AVAILABLE UNIT DOSE VS PATIENT SPECIFIC DOSE (PSD) IN A PEDIATRIC MEDICAL CENTER.
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Objective: A unit dose medication distribution system has been described in the medical literature for over 40 years as an effective way to improve medication safety. This concept reduces the risk for dosing errors by an inpatient pharmacy only providing the dose the patient is to receive in individual packages. Widespread use of this system was generally not seen until manufacturers provided more of their products packaged as commercially available unit doses. Unfortunately in pediatrics, these commercially available unit doses are rarely a patient specific dose (PSD). Pediatric pharmacies must struggle to provide patient specific doses rather than just the smallest manufacturer prepared unit dose package. The purpose of this study is to investigate the frequency and safety of PSD medications in a 252 bed academic pediatric medical center.
Methods: One month (March 2007) of medications doses administered in all inpatient, ED, and OR settings was analyzed. Topicals, eye/ear drops, fluids, flushes, gases, TPNs and continuous drips were excluded. The top 250 medications administered were then selected. Medication over and under dose administration errors in 2006 that reached the patient were reviewed for use of patient specific doses. Errors that involved drips, TPNs, fluids, pump programming, tubing connections, and timing were excluded.

Results: 145,928 doses administered with 90,174 doses remaining after exclusions. 242/250 (97%) medications and 84,836/90,174 (94%) doses were dispensed as commercially available or pharmacy prepared unit doses. 137/250 (57%) of medications and 44,727/90,174 (50%) doses were pharmacy prepared vs commercially available unit doses. 184/250 (74%) medications and 53,480/90,174 (59%) doses were dispensed as PSD. 132/184 (72%) PSD medications and 41,108/53,480 (76%) PSD doses were pharmacy prepared rather than commercial. Medications most often not provided as PSD are acetaminophen, morphine-IV, fentanyl-IV, lorazepam-IV, ibuprofen, midazolam-IV, lorazepam-oral, hydrocodone, dexamethasone-IV, and ketorolac-IV. 51/250 (20%) medications were identified as high alert. 12/51 (24%) high alert medications and 3,061/24,364 (13%) high alert doses were dispensed as PSD. 55/57 (96%) of administration calculation errors involved non-PSD, 40/57 (70%) high alert medications, and 8/57 (14%) pharmacy prepared unit doses.

Conclusions: Even though most medication doses may be provided as commercially available or pharmacy prepared unit dose (94%), there are significantly less provided as PSD (59%). This effect is more dramatic with high alert medications as only 13% are PSD but involve 70% of the errors. Most of the patient specific doses (78%) require pharmacy preparation rather than relying on commercial products. The safety of PSD can be seen in the large discrepancy in PSD administration errors (4%) and non-PSD (96%).

DETECTION AND PREVENTION OF PRESCRIBING ERRORS IN A PEDIATRIC CLINIC. Condren M, John B. University of Oklahoma College of Pharmacy, 4502 E. 41st, Tulsa, Oklahoma 74135; email: michelle-condren@ouhsc.edu

Objective: Implementation of an Electronic Medical Record (EMR) system in an academic pediatric clinic provided an opportunity for a clinic pharmacist to review medication orders. This project was completed to determine the frequency and type of prescribing errors occurring in a pediatric clinic, develop educational programs for providers that will increase awareness of errors, and determine the impact of educational interventions on the frequency of prescribing errors.

Methods: A pharmacist and pharmacy students retrospectively reviewed the medication records for all patient encounters in the pediatric acute care clinic from February through April 2007. Prescriptions entered into the EMR were reviewed for completeness and appropriateness. Whenever possible, errors were corrected at the time of discovery and feedback was given to the provider. Collected data was summarized to describe the frequency and types of errors. Data collected in the initial month were used to develop a resident education program for the following month and the error rates from each month were compared.

Results: A total of 3,523 records containing 1,802 new prescriptions were reviewed. Prescribing errors were found in 175 prescriptions (9.7%). Errors in historical data entry were found in 151 (4.3%) of the records. The most common type of error was incomplete prescription (42%), followed by dosing outside the recommended range (34%). An educational intervention for medical residents in
March resulted in a 20% reduction in prescribing errors (8.5% compared to 10.4%). This reduction was not sustained in April when new medical residents who had not received the education intervention began staffing the clinic. Information disseminated about errors occurring due to the use of the EMR dosing calculator reduced the number of prescriptions that exceeded the upper limit of the recommended dosing range from 18% to 6.4% of prescriptions.

Conclusions: Prescribing errors are common in an academic pediatric clinic utilizing Electronic Medical Records. Incomplete prescriptions and dosing errors were the most commonly identified errors. Identifying the types, frequency, and cause of errors was beneficial for developing focused educational programs that decreased prescribing errors. Programs for other providers in the clinic need to be developed to further decrease the frequency of errors. This information also increased the awareness that improvements to the EMR system and its utilization need to be explored.

REDUCTION OF WEIGHT-BASED DOSING ERRORS FOLLOWING IMPLEMENTATION OF A CHILDREN'S FORMULARY AND DOSAGE HANDBOOK. Jaderlund C, Ur J, Hermes DeSantis E, Michaels L. Bristol-Myers Squibb Children's Hospital at Robert Wood Johnson University Hospital, 1 Robert Wood Johnson Place, New Brunswick, New Jersey 08901; email: christine.jaderlund@rwjuh.edu

Objective: Pediatric prescribers rely on a variety of resources when calculating medications for their patients. Commonly acquired dosing resources often vary in their published weight-based dosing and may contain dosages different from those commonly used in clinical practice. The potential for error introduced by the use of variable quality formularies is compounded by a routine need to perform weight-based calculations on patients over a wide range of sizes. With the goal of improving safety and reducing weight-based medication errors, a hospital specific dosing handbook was developed and distributed to all pediatric prescribers within the Children's Hospital.
Methods: The Co-Chairs of our Pharmacy and Therapeutics Committee (PharmD and MD) authored and edited the Children's Formulary and Dosage Handbook. Using a commercially available database purchased through a well known pediatric formulary publisher, the handbook was edited and revised to reflect the Children's Hospital formulary, approved weight based dosage ranges, and treatment policies. A personalized index included guidelines and information requested by the pediatric subspecialties. The book was distributed in July to coincide with the start of the academic year and was provided to all interns, residents, fellows, admitting physicians, and prescribing nurses. Copies were placed in all inpatient pharmacy satellites and the hospital wards. Medical errors were tracked using a previously established reporting system.
Results: Data were compared pre and post intervention. Before use of the handbook, weight-based errors were steadily increasing with 37 in the 1st quarter of the academic year, 41 errors in the 2nd, and 54 in the 3rd. In the 4th academic quarter, immediately prior to distribution of the handbook, 57 weight-based errors were documented. In the 1st quarter of the academic year following release of the handbook, only 26 weight-based errors were reported representing a 50% immediate reduction in errors. The improvement was sustained into the 2nd quarter with 27 errors reported.
Conclusions: This study demonstrated the successful implementation of an intervention targeted at reducing weight-based dosing errors in pediatric patients. The provision of a uniform resource tailored to the specific practices of the Children's Hospital resulted in an impressive reduction of errors as compared to historic trends. Long-term effectiveness of the intervention remains to be proven, but the immediate benefits observed demonstrate the importance of hospital specific dosing guidelines.

SAFETY AND PHARMACOKINETICS OF THE SYNERA™ PATCH IN PEDIATRIC PATIENTS: A RANDOMIZED CLINICAL STUDY. Yaster M, Jones S, Finkel J, Nauert B, Campbell J. Endo Pharmaceuticals, 1 Endo Boulevard, Chadds Ford, Pennsylvania 19317; email: Campbell.John@Endo.com

Objective: Synera is a topically applied anesthetic (lidocaine 70 mg + tetracaine 70 mg) patch with an oxygen-activated heating component to enhance delivery. It provides dermal analgesia for superficial venous access and dermatological procedures. This open label, single-dose study evaluates the safety, tolerability, and PK of the patch in patients aged 4 mo to 12 yr.
Methods: Patients (4 mo-2 yr, n = 9; 3-6 yr, n = 16; 7-12 yr, n = 17) were randomized to receive 1 or 2 patches for 30 min. Baseline blood samples were obtained from the two older age groups; all had blood drawn at the end of 30 min (patch removal) and after 24 to 48 hrs. Concentrations of lidocaine and tetracaine were determined. For safety evaluation, the skin at the application site was assessed at patch removal and 24 to 48 hr after. Vital signs were measured at blood collection; adverse events (AEs) were recorded.
Results: Too few tetracaine concentrations were above the limit of detection to evaluate statistically. For lidocaine, the C_{max}, T_{max}, and AUC_{0-24} did not differ significantly between

	SELECT			STAR	
	Lucinactant N = 436*	Colfosceril N = 418*	Beractant N = 208*	Lucinactant N = 104*	Poractant N = 106*
Reintubation (%)	34.6	40.4	42.8†	32.7	47.2†
Mortality at 28 d/ 36 wk PMA (%)	4.1/6.2	6.0/8.4	6.3/8.7	1.9/3.9	4.7/5.7

**All randomized and extubated neonates. †P < .05 for lucinactant vs comparator.*

patients receiving one patch compared to two patches. A significant age effect was revealed for C_{max} (P > .001) and $AUC_{0\text{-}24}$ (P = .005) with higher values observed in younger patients but not for T_{max} (P = .056). Five patients reported 7 AEs, 2 experiencing very slight or well defined skin erythema involving the application site that resolved shortly after removal of the patch. 1 patient experienced a 20 sec seizure considered unrelated to the patch.

Conclusions: Peak plasma lidocaine levels following patch application were at levels significantly below those associated with toxicity even in the youngest patients studied. The highest level was 331 ng/mL, which is less than 1/3 of the therapeutic concentration used to treat arrhythmias and 1/15 of the lowest concentration associated with toxicity. 1 or 2 patches was well tolerated in this study. Local erythema secondary to the patch was mild and of no clinical significance and was primarily related to the patch and delivery system.

SURFAXIN (LUCINACTANT) REDUCES REINTUBATION RATES WITH IMPROVED OUTCOMES VS OTHER SURFACTANTS—RESULTS OF TWO RANDOMIZED, CONTROLLED TRIALS.

Guardia C, Moya F, Sinha S, Gadzinowski J, Mazela J, Liu G. Discovery Labs, 2600 Kelly Road, Suite 100, Warrington, Pennsylvania 18976; email: jpluim@discoverylabs.com

Background: Many infants who are extubated after initial surfactant administration require reintubation. Repeated or prolonged reintubation may place them at higher risk of adverse outcomes. We examined extubation and reintubation rates and their impact on key clinical outcomes in infants treated with lucinactant vs colfosceril and beractant from the SELECT trial (Moya, et al. Pediatrics 2005;115:1018) and vs poractant from the STAR trial (Sinha, et al. Pediatrics 2005;115:1030).

Methods: The rates of initial extubation, subsequent reintubation, and death or BPD were compared using logistic regression adjusted for birth weight stratum and center.

Results: Overall rates of extubation were similar across treatments in both trials (range 80.6%–83.9% for all randomized neonates; P = NS). The reintubation rate following initial extubation was significantly lower (P < .05) for infants treated with lucinactant compared with beractant or poractant (Table). Proportionally more lucinactant-treated infants who were extubated survived compared with other surfactants, but this difference did not reach significance. Survival without BPD at 36 wk PMA among infants extubated favored lucinactant vs colfosceril (72.2% vs 66.0%, P = .034).

Conclusions: Initial extubation rates were similar among infants treated with lucinactant and other surfactants; the rate of subsequent reintubation was significantly lower with lucinactant. Major morbidity and mortality in reintubated patients also were lower with lucinactant, mirroring primary observations previously reported.

LONG-TERM OUTCOMES OF THE NOVEL PEPTIDE-CONTAINING SYNTHETIC SURFACTANT, SURFAXIN (LUCINACTANT) VS. ANIMAL-DERIVED AND SYNTHETIC, NON–PROTEIN-CONTAINING SYNTHETIC SURFACTANTS IN VERY PRETERM INFANTS.

Guardia C, Moya F, Sinha S, Gadzinowski J, Mazela J, Liu G. Discovery Labs, 2600 Kelly Road, Suite 100, Warrington, Pennsylvania 18976; email: jpluim@discoverylabs.com

Background: We have reported results of two randomized, controlled trials comparing lucinactant (Surfaxin), a new generation, peptide-based synthetic surfactant, with non-protein-containing synthetic colfosceril (Exosurf) and bovine-derived beractant (Survanta) (SE-

LECT trial; N=1294, Moya F, et al. Pediatrics, 2005:115:1018-29.), and with porcine-derived poractant (Curosurf) (STAR trial ; N=252, Sinha S, et al. Pediatrics, 2005:;115:1030-8.) for prevention of respiratory distress syndrome (RDS). In the SELECT trial, Surfaxin significantly reduced the incidence of RDS at 24 h, RDS-related mortality at 14-d and bronchopulmonary dysplasia (BPD) at 36 wks post menstrual age (PMA) compared with Exosurf, and RDS-related mortality vs. Survanta. The STAR trial demonstrated similar results for 28-day and 36-wks survival without BPD for Surfaxin and Curosurf.

Objective: To compare long-term outcomes including mortality and morbidity at 1-year corrected age for Surfaxin vs. animal-derived and non-protein-containing synthetic surfactants across the STAR and SELECT trials.

Methods: Infants with gestational age of 24–32 wks and birth weight of 600–1250 g were randomized to treatment with Surfaxin (175 mg/kg), Exosurf (67.5 mg/kg), Survanta (100 mg/kg), or Curosurf (175 mg/kg). An analysis of outcomes through 1-year corrected age across the two studies was performed for all randomized patients. Treatment differences were compared using the Wilcoxon test, stratified by birth weight strata, country, gender, and race.

Results: At 1-year corrected age, survival still favored Surfaxin (73.4%) vs. the animal-derived surfactants (71.2%; P = .05) and Exosurf (69%), observations consistent with the difference in all-cause mortality at 36 wks PMA for Surfaxin-treated patients (20.3%) vs. the animal-derived products (24.1%; P = .01), and Exosurf (23.8%). Overall health and gross neurological outcomes (cerebral palsy, gross tone or reflex abnormality, deafness, blindness, seizures, and gross motor delay) trended in favor of Surfaxin over the comparator surfactants.

Conclusions: The early survival advantage observed through 36-wks PMA in premature infants treated with Surfaxin compared with animal-derived surfactants as well as a synthetic, non–protein-containing surfactant was maintained through 1-year corrected age.

LATE TREATMENT WITH A PEPTIDE-CONTAINING, SYNTHETIC SURFACTANT FOR THE PREVENTION OF BRONCHOPULMONARY DYSPLASIA (BPD).

Guardia C, Bose C, Laughon M, Moya F, Aschner J, Donn SM, Segal R, Liu G. Discovery Labs, 2600 Kelly Road, Suite 100, Warrington, Pennsylvania 18976; email: jpluim@discoverylabs.com

Background: Oxidant injury and lung inflammation in extremely premature infants are associated with the development of bronchopulmonary dysplasia (BPD). Surfactant dysfunction resulting from these events may contribute to the pathogenesis of BPD. Treatment of at-risk infants with lucinactant (SURFAXIN), a synthetic, peptide-containing surfactant believed to mitigate these problems, may decrease the incidence or severity of the disease.

Objective: This was a multi-center, phase 2 estimation study to determine whether treatment of infants at risk for BPD with lucinactant is safe, tolerable and increases the incidence of survival without BPD.

Methods: ELBW infants (600-900 g) requiring mechanical ventilation (MV) and $FiO_2 \geq 0.30$ between 3-10 days of age were randomized to receive either sham air (placebo), low dose lucinactant (90 mg/kg total phospholipid (TPL); S-90 mg) or standard dose lucinactant (175 mg/kg TPL; S-175 mg) every 48 hours to a maxium of 5 doses, if they remained on MV.

Results: Of 136 infants enrolled at 34 sites, 44 received placebo, 47 S-90, and 45 S-175. The S-90 group had a significantly higher percentage of males (64%) compared to the placebo group (39%); no other significant differences in baseline characteristics between groups were present. The proportion of infants alive without BPD at 36 weeks PMA in the placebo group was 34%. There was a trend towards a higher proportion of infants alive without BPD in the S-175 group (42%), but a lower proportion in the S-90 group (21%). There were no statistical differences between groups for duration of mechanical ventilation, common complications of prematurity or mortality.

Conclusions: There is a trend towards improved survival without BPD in at risk ELBW infants who receive standard doses of lucinactant between 3 and 10 days of age. This observation justifies further investigation of this dose of lucinactant as a therapeutic intervention for the prevention of BPD.

HOSPITAL COST AND CHARGES FOR THE TREATMENT OF PATENT DUCTUS ARTERIOSUS (PDA). Turck C, York J, Miller H. University of Massachusetts Memorial Medical Center, Worcester, Masschusetts, Akita Biomedical Consulting, San Clemente, California; Navigant Consulting, Baltimore, MA. Navigant Consulting Baltimore, Maryland, Ernest Mario School of Pharmacy, Piscataway, New Jersey; email: jyork1@cox.net

Objective: PDA, a condition where the ductus arteriosus fails to close after birth, afflicts 1 in 2000 births. Inversely related to gestational age and weight, PDA has a greater incidence in preterms. Management options include watchful waiting, surgery or IV cyclooxygenase (COX) inhibitor therapy. Due to its critical nature, PDA can involve significant health care resource utilization. Thus, a survey of several databases was undertaken to characterize PDA's economic profile.
Methods: Data sources included the Healthcare Cost and Utilization Project Kids' Inpatient Database (2003), Maryland Health Services Cost Review Commission's Public Use Hospital Inpatient Database (2004-5), and Centers for Medicare and Medicaid Services' Medicare Cost Reports (2003-5). Incidence, ICD-9 codes, relevant DRGs, and payer guidelines were reviewed. Analysis defined the following: annualized cases, DRG profile, hospital charges, costs, surgical vs nonsurgical resources, drug-related portion of costs, and payer characteristics.
Results: This review identified 42,714 neonatal discharges with a PDA diagnosis. Six DRGs (385-390) accounted for > 85% of PDA diagnoses using ICD-9 747.0. Private insurance and Medicaid constituted more than 90% of the payer mix for these two DRGs.
Twenty percent of PDA discharges for DRG 386 and 5% of DRG 387 underwent a surgical procedure. Surgical cases under DRG 386 and 387 were 70% more costly vs. nonsurgical cases. For those with DRG 386 who required surgery, the average weighted charge and cost were $454,700 and $176,739, respectively. The average weighted charge and cost for the non-surgical management of PDA were $269,282 and $99,733, respectively. Approximately 25,000 neonates were considered COX inhibitor therapy candidates. DRGs 386 and 387 most accurately reflected the true costs and charges incurred where COX would be indicated. Total mean drug charges accounted for ~6% of the average total charges for DRG 386 and 4.5-5% for DRG 387. A single 3-dose course of IV COX inhibitors (~$1,500) represented between 0.84-1.81% of the total cost for DRG 386 ($82,837- $178,436) and 1.2-5% for DRG 387 ($29,824-$122,661). Preterm infants between 500-749 g had the highest average drug charges: $11,000. In this cohort, IV COX inhibitor therapy accounted for ~10% of this group's average total drug charges. COX inhibitors represent ~0.5% of average total inpatient medical charges, between 0.84%-5% of average inpatient costs.
Conclusions: PDA expenditures can be significant, with surgery adding significant expenditures. Drug therapy, in the most expensive infants, represent ~10% of charges. COX inhibitor therapy is ~0.5% of charges and between 0.84%-5% of costs.

ANALYSIS OF 72 HOUR STERILITY OF COMMON INTRAVENOUS CONTINUOUS INFUSIONS USED IN PEDIATRIC PATIENTS. Piro C, Potts A, Toth-Davis J, Frelix A, Grisso A, Sinclair-Pingel J, Willingham H, Wright L. Vanderbilt Children's Hospital, 2200 Children's Way, Suite 4508, Nashville, Tennessee 37232; email: amy.potts@vanderbilt.edu

Objective: Compounding sterile products is a major component of hospital pharmacy practice. Increasing patient morbidity and mortality associated with contamination or improper preparation has prompted national attention. The United States Pharmacopeia (USP) established an enforceable standard for pharmacies addressing drug preparation and storage of compound sterile products (CSPs). Under these guidelines, beyond use dates (BUD) are assigned to CSPs based on contamination risk during drug preparation or storage. For CSPs with the lowest risk, a BUD maximum of 48 hours may be assigned if stored at room temperature unless further sterility testing is done. To also minimize infection risk, the Center for Disease Control (CDC), published guidelines recommending administration set changes no more frequent than every 72 hours. Like USP, administration or hang time recommendations

for continuous infusions are not addressed. In the pediatric population, these two standards make it very difficult to optimize patient care especially in patients receiving continuous infusions. At our institution, we change administration sets every 72 hours. Changing infusions every 48 hours without changing the administration set at the same time is difficult. More frequent manipulation of infusions and administration sets may predispose the patient to hemodynamic instability, infection, air emboli and other adverse events. To minimize adverse events and cost, we chose to evaluate the 72 hour sterility of common continuous infusions used in the pediatric population.

Methods: Thirty-five common intravenous (IV) continuous infusions using 96 standard concentrations and diluents were identified. IV solutions were mixed using sterile technique in the laminar flow hood in accordance with USP guidelines. Medications were excluded for short stability, short durations of use or high cost. A sample from each solution was tested using a full filtration contamination growth medium chamber (QI Medical, Inc.) and tryptic soy broth for aerobic testing. Both syringe and chamber were examined for growth at 72 hours. Any visible discoloration suggesting physical instability was also evaluated.

Results: None of the samples showed visible growth or discoloration after 72 hours.

Conclusions: This study provides sterility data for up to 72 hours for a number of commonly used intravenous infusions in pediatric patients. In our institution, this allows for a more convenient and consistent change of both administration sets and continuous infusions at 72 hours to minimize potential adverse events and cost.

MEDICATION ERROR RATE IN A NEONATAL INTENSIVE CARE UNIT WITH COMPUTERIZED PROVIDER ORDER ENTRY (CPOE) AND ADVANCED DECISION SUPPORT. Piro C, Potts A, Wright L. Vanderbilt Children's Hospital, 2200 Children's Way, Suite 4508, Nashville, Tennessee 37232; email: amy.potts@vanderbilt.edu

Purpose: Neonates are at increased risk for medication errors due to complex dosing regimens, changing pharmacokinetic and pharmacodynamic profiles, and rapid weight fluctuations. Computerized provider order entry (CPOE) is one tool available to prevent medication errors. Though data is available examining the use of CPOE in pediatric critical care and oncology patients, limited data exists for the neonatal intensive care unit (NICU). This high-risk population may further benefit from advanced decision support in addition to basic CPOE to decrease medication errors. The purpose of this study is to evaluate and establish a baseline error rate in a NICU with established CPOE and advanced decision support.

Methods: A retrospective study in a 78-bed NICU within a free-standing tertiary-care children's hospital is described. CPOE with advanced decision support was previously implemented in the NICU in March 2003. All medication orders entered from January 1, 2006 to July 1, 2006 were evaluated. Orders for total parenteral nutrition, intravenous fluids, and chemotherapy were excluded. Medication orders were analyzed for total percentage of medication errors and further classified into type of error including, inappropriate dose, interval or route, duplicate therapy, missing information, and wrong drug.

Results: A total of 14,570 orders were reviewed for 622 patients. The average post-conceptional age (PCA) was 37.1 ± 7.1 weeks at the time of the order. Approximately 94% of total orders were directly entered by the prescriber and 5.79% as verbal orders. An error rate of 2% (n = 294) was found after medication order analysis. Of the orders classified as an error, the average PCA at the time of order was 37.6 ± 7.49 weeks. Verbal orders accounted for only 4.08% (n = 12) of the medication errors. The most common types of error were inappropriate dosing (57.2%, n = 168), inappropriate interval (10.5% n = 31), and missing information (6.8%, n = 20). Drugs most frequently associated with a medication error were also evaluated.

Conclusions: This study is the first to offer a baseline medication error rate for orders entered in a NICU with established CPOE and advanced decision support. Opportunities to further enhance the computerized system were also identified as a result of this study.

EVALUATION OF THE TWO-BAG SYSTEM IN PEDIATRIC PATIENTS WITH

DIABETIC KETOACIDOSIS. So T-Y, Grunewalder E. Moses H Cone Hospital, 2325 Alderbrook Dr., High Point, North Carolina 27265; email: tszsounc@gmail.com

Background: Changes in fluid, serum glucose, and electrolytes often occur in pediatric patients with diabetic ketoacidosis (DKA). Frequent modifications of intravenous fluids are necessary to adapt to such changes. Two-bag or one-bag system is often used to manage pediatric DKA patients. However, one-bag system has several limitations, such as slow response time and increase in hospital cost.
Objectives: To evaluate whether the two-bag system provides better clinical benefits in pediatric patients with DKA as compared to the one-bag system.
Methods: This is a retrospective, non-blinded chart review. Inclusion criteria were subjects with age ≤ 18 yr and whose admission had the code of DKA as the diagnosis. Baseline clinical and demographic data were collected: age, gender, weight, past medical history, concomitant diabetes medications, initial insulin rate, intravenous fluids used, and all pertinent labs that are usually gathered in patients with DKA (e.g., CBG, bicarbonate, pH, ketones, etc). Descriptive statistic was used in the analysis of the data.
Results: A total of 31 subjects were in this study, of which 9 (29%) were in the one-bag system group and 22 (71%) were in the two-bag system group. Baseline characteristics were similar between the two groups. Mean (SD) rate of CBG correction was 31.04 mg/dL/hr (20.61) in the two-bag group and 21.04 mg/dL/hr (16.26) in the one-bag group (P = .297). However, rate of bicarbonate correction was faster with the two-bag system than the one-bag system (0.949 ± 0.553 mEq/L/hr and 0.606 ± 0.297 mEq/L/hr, respectively) (P = .047). The two-bag system also had faster time to ketone (P = .04) but not pH correction (P = .172).
Conclusions: In this study, two-bag system provided faster rate of bicarbonate and time to ketone correction as compared to the one-bag system. Two-bag system also provided a trend towards faster rate of glucose and time to pH corrections.

APPROPRIATE CNS DOSING OF VANCOMYCIN IN PEDIATRIC PATIENTS REQUIRING TWO-HOUR INFUSIONS. Schlein A, Gardner B, Graner K. Mayo Eugenio Litta Children's Hospital Mayo Clinic, 200 First Street SW, Rochester, Minnesota 55905; email:gardner.brian@mayo.edu

Objective: Vancomycin blood brain barrier penetration is unpredictable, with CSF levels estimated to be 7–21% of serum levels when the meninges are inflamed. Because of this variable penetration, pediatric patients are prescribed 15 mg/kg/dose q 6h to target peak serum levels of 30–40 mg/L one hour after a one hour infusion. Pharmacokinetic studies have shown that children eliminate vancomycin 2–3 times faster than adults. Because of this rapid clearance, pediatric patients with Redman syndrome receiving vancomycin 15 mg/kg/dose over two hours would likely achieve subtherapeutic CSF concentrations.
Methods: A retrospective chart review from 3/96-8/06 was conducted to determine optimal CNS dosing of pediatric patients requiring two hour infusions. Inclusion criteria were: age 1 month to 18 years, vancomycin ≥ 50 mg/kg/day, and documented peaks and troughs. Exclusion criteria were renal dysfunction (CrCl < 90 mL/min). Data collected included: demographics, infection diagnosis, vancomycin regimen/levels, concurrent nephrotoxic medications, and renal labs. Subject-specific pharmacokinetic parameters were calculated utilizing the modified two-point Sawchuk-Zaske method. Mean pharmacokinetic parameters were then used to calculate "ideal" two hour infusion regimens. Peak and trough values were calculated for the standard and "ideal" regimens utilizing subject-specific pharmacokinetic parameters. JMP v6.0.0 was utilized for statistical analyses. Paired t-test compared mean peak and trough values, and McNemar's test compared the proportion of subjects predicted to achieve therapeutic peaks and troughs on each regimen.
Results: 51 subjects were included for analysis. Mean $t_{1/2}$, k_e, and V_d with 95% confidence intervals were 2.55h (2.34–2.77), 0.29 h-1 (0.27–0.31), and 0.57 L/kg (0.48–0.66), respectively. Targeting a peak of 30–40 mg/L and trough of 5–15 mg/L, "ideal" regimens of 25 mg/kg q 6h, 25 mg/kg q 8h, and 30 mg/kg q 8h

infused over two hours were compared. Using subject-specific pharmacokinetic parameters, each "ideal" regimen was calculated to produce a significantly higher percentage of target peak and trough levels than the standard 15 mg/kg q 6 h infused over 2 h (5.9% vs. 35.3% vs. 37.3% vs. 33.3%). No significant difference was found between the three "ideal" regimens.
Conclusions: The study population had similar pharmacokinetic parameters previously reported in the literature. As predicted, 15 mg/kg q 6 h infused over two hours produced subtherapeutic drug levels, with goal peaks and troughs estimated to occur in only 5.9% of subjects. In Redman syndrome patients with CNS infections, subtherapeutic levels achieved with the standard regimen could lead to suboptimal outcomes. To prevent delay in achieving therapeutic CSF vancomycin levels, we would recommend 25 mg/kg q 6-8 h in patients requiring two hour infusions with suspected CNS infection.

ENOXAPARIN DOSE-RANGE STUDY IN PEDIATRIC PATIENTS. Fung L, Klockau C. Children's Mercy Hospital and Clinics, 2401 Gillham Road Kansas City, Missouri 64108; email: lsfung@cmh.edu

Background: Current dosing guidelines for the low molecular weight heparin, enoxaparin, in the pediatric population fail to consistently achieve therapeutic anti-factor Xa levels. Higher doses of enoxaparin are required in younger patients due to a larger volume of distribution, higher rate of clearance, and lower concentrations of antithrombin. Further stratification of age groups in the dosing guidelines may be warranted to potentially improve patient outcomes.
Objective: The objective of this dose range study is to expand on how the relationship between age and weight-based doses in pediatric patients lead to therapeutic levels of anti-factor Xa. Secondary outcomes evaluated include the number of dose changes required to achieve a therapeutic level in each age group, the success rates of achieving and maintaining therapeutic levels, the effect of serum antithrombin concentrations on anti-Xa levels and the need for higher doses, and if different concentrations of enoxaparin play a role in levels.
Methods: Single center, retrospective study. Patients hospitalized at Children's Mercy and treated with enoxaparin were identified using the institution's database. Information regarding patient age, weight, primary diagnosis, indication for enoxaparin use, enoxaparin dose(s), and corresponding anti-factor Xa levels were evaluated. Patients were excluded from the study if enoxaparin was prescribed for prophylactic purposes, creatinine clearance < 30 mL/min/1.73m^2, and if levels were not drawn at anytime during therapy. Therapeutic anti-factor Xa levels are defined as 0.5 to 1.0 units/mL.
Results: 300 charts were reviewed from January 2001 through November 2006. 150 patients met the inclusion criteria. Infants represented half of the study population. Average doses required to achieve therapeutic levels were 1.8 mg/kg for patients <1 month, 1.64 mg/kg for 1 month to 1 year, 1.45 mg/kg for 1 year to 6 years, and 1.05 mg/kg for patients >6 years of age. An average of 3.24 dose changes were required for neonates before achieving therapeutic levels, and inversely related to patient age. The success rates for achieving and maintaining therapeutic levels were 41 percent for both parameters. Patients with low serum antithrombin levels were more likely to have low anti-Xa levels, requiring constant dose escalations than those with normal or high levels, 52% vs 40% vs 18%, respectively. Patients receiving diluted concentrations, 10 mg/mL or 20 mg/mL, experienced lower anti-Xa levels than patients who received the standard manufactured concentration of 100 mg/mL, 61% vs 33%.
Conclusions: Based on this dose-range study, modifying the current dosing guidelines for enoxaparin may be necessary.

POST-IMPLEMENTATION EVALUATION OF AN EXTENDED INTERVAL AMINOGLYCOSIDE PROTOCOL IN PEDIATRICS. Fowkes C, Kondor B, Gerber P, Hamilton D, Carr R. University of British Columbia / Children's and Women's Health Centre of British Columbia, 4500 Oak Street, Vancouve, British Columbia, V6H 3N1, Canada; email: rcarr@cw.bc.ca

Background: Despite the growing body of literature and clinical experience supporting

the use of extended interval aminoglycosides (EIA) in adults, data in pediatric patients are limited and EIA is not widely used in children. In May 2006, an EIA protocol for select pediatric patients was developed at BC Children's Hospital (BCCH), resulting in two aminoglycoside dosing and monitoring protocols (EIA and traditional dosing (TAD) existing within one institution. This led to concerns regarding potential errors in dosing and monitoring, and confusion in timing and interpretation of drug concentrations.

Objectives: To compare adherence to TAD versus EIA protocol dosing and monitoring parameters. To determine whether patients receiving EIA met criteria outlined in the protocol. To determine the number of patients switching from EIA to TAD based on renal function and/or serum drug levels.

Methods: Medical records of patients (≤ 18 years old) who received gentamicin or tobramycin between June and December 2006 at BCCH were retrospectively reviewed. Chi-square and Fisher's exact tests were used to analyze primary outcomes.

Results: Data for 89 patients (48 TAD and 41 EIA) were collected. Median age was 3.0 years (range 4 days to 17 years) and mean dose was 2.9 ± 3.3 and 6.6 ± 1.1) mg/kg/dose in the TAD and EIA groups, respectively. Adherence to protocols was 67% for TAD and 37% for EIA (P=.005). Adherence to EIA protocol inclusion/exclusion criteria was 81%. Appropriate monitoring was 73% in the TAD group versus 49% in the EIA group. Dose changes were required more frequently in the TAD group (21% vs. 7%). Regimen changes were more frequent in the EIA group (5% vs. 0%)

Conclusions: The TAD protocol was adhered to more frequently than the EIA protocol. Further studies are required to determine if there are differences in clinical outcomes and medication errors between the two dosing protocols.

ANALYSIS OF GENTAMICIN MONITORING AT A PEDIATRIC HOSPITAL. Klein K, Schumacher C, Anderson N, Pasko D. University of Michigan Health System and College of Pharmacy, MCHC F2758, Box 0221, 1500 E. Medical Center Dr., Ann Arbor, Michigan 48109; email: kriklein@umich.edu

Objective: to evaluate the appropriateness of interventions made in response to gentamicin levels in pediatric surgery and cardiothoracic intensive care patients.

Methods: A retrospective chart review was performed in patients on the pediatric cardiothoracic unit or pediatric surgery service who received gentamicin therapy between January 1 and December 31, 2005. Appropriateness of the initial regimen (dose and interval), appropriateness of levels obtained by the medical team and the pharmacists, and appropriateness of interventions made by the medical team and the pharmacists were assessed. The definitions of appropriate drug dosing and monitoring were created based upon the current practices and existing policies regarding therapeutic drug monitoring at our institution. Descriptive statistics and Chi-squared analyses were utilized to evaluate the data collected.

Results: A combined total of 434 interventions were made, 78% of which were deemed appropriate. Overall, the initial gentamicin regimens were appropriate 83% of the time. Over 900 gentamicin concentrations were obtained, 69.4% of which were appropriate. There was a significant difference in the appropriateness of interventions made by pharmacists in comparison to those made by the medical team. Overall, 97.2% of interventions made by pharmacists were appropriate compared to only 74.1% of interventions made by the medical team (P ≤ .01). Additionally, we noted 245 gentamicin concentrations that were obtained inappropriately. This resulted in a loss of more than $30,000 in patient costs.

Conclusions: Despite some limitations, this study demonstrated that clinical pharmacists made a significantly greater proportion of appropriate interventions when compared to the remainder of the medical team. Our institution is using this data to consider initiating a pharmacist-driven aminoglycoside protocol.

VANCOMYCIN POPULATION PHARMACOKINETIC PARAMETERS FOR PEDIATRIC PATIENTS UNDERGOING CONTINUOUS RENAL REPLACEMENT THERAPY. Stengone R, Capparelli E, Romanowski G, Benador N, Friece C. Rady Children's Hospital, 3020 Children's Way, San

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Objective: To investigate population vancomycin pharmacokinetic parameters for pediatric patients on continuous renal replacement therapy.
Methods: Retrospective chart review and pharmacokinetic modeling using the program NONMEM.
Results: The average clearance and volume of distribution during CRRT of the pediatric population was determined to be 0.8 ± 0.4 mL/min/kg and 1.27 ± 0.5 L/kg respectively.
Conclusions: A recommended initial starting dose of vancomycin and frequency of administration for pediatric patients undergoing CRRT is 15 mg/kg every 24 hours.
Critically ill patients in ICU settings are often prescribed vancomycin for treatment of gram positive infections. Some patients in renal failure require hemodialysis. Continuous renal replacement therapy (CRRT) is often preferred for patients due to the favorable hemodynamic stability profile compared to intermittent hemodialysis. Previous adult studies have shown that vancomycin is cleared during CRRT requiring dose modification. However, there is no pediatric information regarding CRRT clearance of vancomycin to allow for empiric dosing modifications. A retrospective chart review was performed on 21 pediatric ICU patients undergoing CRRT to assess the pharmacokinetic parameters of vancomycin, including clearance and volume of distribution. Two of the subjects were excluded from the analysis because vancomycin levels were not drawn during CRRT. Of the remaining 19 patients 3.5 ± 2.4 vancomycin levels were drawn during CRRT. The average age and weight of the group was 8.7 ± 6.7 years and 35.7 ± 27.5 kg. 13 of the subjects were male, 6 were female. Vancomycin levels were collected on 16 of the patients prior to CRRT and on all of the patients during CRRT. The average dose of the antibiotic on CRRT was 12.3 ± 1.8 mg/kg. Pharmacokinetic parameters (PPK) were analyzed for these patients prior to and during CRRT using the NONMEM program. The average clearance and volume of distribution during CRRT was 0.8 ± 0.4 mL/min/kg and 1.27 ± 0.5 L/kg. Based on the determined population pharmacokinetic parameters a recommended initial starting dose and frequency of administration for pediatric patients undergoing CRRT is 15 mg/kg every 24 hours.

DEVELOPMENT OF CRITERIA FOR GENTAMICIN MONITORING IN THE INTENSIVE CARE NURSERY (ICN) AT CHILDREN'S MERCY HOSPITAL. Stach L, Pallotto E, Sandritter T. Children's Mercy Hospital, 2401 Gillham Rd, Kansas City, Missouri 64108; email: lmstach@cmh.edu

Background: In our ICN, there are limited criteria for serum level monitoring of aminoglycosides. Typically, serum levels are obtained if the duration of therapy exceeds three days. Limiting antibiotic levels to a sub-group of patients with defined risk factors for abnormal levels would be beneficial in preventing unnecessary blood draws, laboratory time, pain, and possible blood transfusions in neonates.
Objective: To identify risk factors in the neonatal population associated with supratherapeutic or subtherapeutic gentamicin serum levels.
Methods: Single-center, retrospective, cohort study. IRB approval was obtained. A sample size of 225 patients was required to have adequate power for detecting risk factors having a large influence on the probability of drawing an abnormal serum concentration. Inclusion criteria: Patients receiving gentamicin with at least one serum level measurement. Exclusion criteria: Patients who did not have a serum level measurement during a course of therapy or levels drawn outside of the ICN. Repeat gentamicin levels due to a dosage adjustment based on the first set of levels were not included. Data collection started with the most recent patients working backwards in time until the sample size was met. Data collection included: demographic data, indication/diagnosis, dose, cultures, serum concentrations, time of sampling, dosage changes, acidosis, shock, urine output (UO), serum creatinine (SCr), and concomitant medications that might affect gentamicin levels.
Results: 414 charts were reviewed with 225 patients meeting the inclusion criteria from 1/1/05-6/30/06. Demographic data: mean GA: 35.3 weeks (23–41.3), mean GA @ start of

Gent: 36.6 wk (25.5–50). Gentamicin Dose: appropriate 175/225 (78%), appropriate for one variable (mg/kg/dose or interval) 9/225 (4%), inappropriate 41/225 (18%) [33 high doses, 8 low doses]. 31 courses were adjusted based on levels (1–3 adjustments). Risk factors for an elevated trough included: inappropriate dose RR 2.9 (95% CI; 1.18–6.9), abnormal SCr (>0.8 mg/dL) on the day of the level RR 25.6 (95% CI; 9.1–71.4), low UO (<1 mL/kg/hr) on the day of the level RR 7.8 (95% CI; 3.9-15.4), shock (need for pressors) RR 3.16 (95% CI; 1.32–7.57). Blood urea nitrogen, combined vancomycin and gentamicin therapy, and acidosis were not predictors of elevated troughs.

Conclusions: SCr, UO, and the use of pressors are the best predictors for an elevated trough. Due to unequal distribution of inappropriately high doses, we suggest inappropriate high doses lead to elevated troughs. These variables will help to define a prospective trial in order to develop criteria for when to draw gentamicin levels.

IMPACT OF NON-ADHERENCE AMONG ADOLESCENTS DIAGNOSED WITH EPILEPSY—PRELIMINARY RESULTS FROM A U.S. SURVEY. Phelps SJ, Hovinga C, Wheless J, Asato M, Sheth R, Manjunath R, Haskins Li, Pina-Garza E. GlaxoSmithKline, Five Moore Drive, RTP, North Carolina; email: ranjani.y.manjunath@gsk.com

Purpose: No published studies exist assessing the impact of non-adherence in adolescents with epilepsy. The purpose of this study is to assess the clinical and economic impact of non-adherence in adolescents diagnosed with epilepsy.

Methods: A cross-sectional survey will be conducted among adolescents, 12–17 years of age, diagnosed with epilepsy, and currently taking an AED (n = 220). A working group of 6 pediatric epilepsy specialists was convened and 3-day focus groups were conducted to gather information on seizures, ED visits/hospitalization, adherence to AEDs, quality of life, and productivity to inform the survey. Preliminary results from the focus groups are presented here with data from the cross-sectional survey available August 2007.

Results: Adolescents with epilepsy (n = 18) participated in the focus groups; mean age of 15 years. 75% experienced seizures in the past year with 29% having a seizure in the past week. Adolescents reported taking an average of 1.4 AEDs per day. The biggest motivator to taking medication is fear of seizure (63%), and the largest barrier is forgetfulness (33%). 42% cited seizure or re-initiation side effects due to non-adherence and 63% reported missing school. Seizures interfered with sports activities, delays in driving ability, sustaining injuries, and concentrating in school. Adolescents report that caregivers play a major role in tracking seizures and monitoring adherence with treatment.

Conclusions: These preliminary findings suggest that non-adherence may impact seizure activity which contributes to reduced productivity and quality of life. The full results in August 2007 may inform medication management interventions necessary in improving adherence.

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DEXMEDETOMIDINE USE FOR SEDATION OF CHILDREN IN THE ICU. Carroll C, Krieger D, Burke M, Fisher D, Comeau L, Zucker A. Connecticut Children's Medical Center, 282 Washington St., Hartford, Connecticut 06106; email: mmburke@ccmckids.org

Purpose: To describe our experience with the use of dexmedetomidine infusions for sedation of children in an ICU.

Methods: A retrospective chart review of all patients in the PICU receiving dexmedetomidine infusions for sedation between December 2003 and October 2005. Patients were identified from pharmacy dispensing records. Data collected included patient demographics, PRISM III score, reason for PICU admission, reason for dexmedetomidine use, amount and duration of dexmedetomidine received, complications and corresponding treatments required during dexmedetomidine infusion, reason for discontinuation of dexmedetomidine, and concominant sedatives used. We defined the optimal dose of dexmedetomidine a priori as the dose the patient received for the longest period of time.

Results: Dexmedetomidine was administered 74 times to 60 children with a median age of

1.5 years (range 0.1–17.2 years). Patients were intubated at the time dexmedetomidine was begun in 84% (n = 62) of cases. The reason for dexmedetomidine use was to supplement existing sedation deemed to be inadequate in 53% (n = 39); as a bridge to extubation in 41% (n = 30) of cases; and as planned short term sedation in the remainder. The median duration of therapy for all cases was 23 hours (range 3-451 hours). In thirty-six cases (49%) the duration exceeded 24 hours. No patient received a bolus dose at therapy initiation. The median optimal dose was 0.7 mcg/kg/hr (range 0.2-2.5 mcg/kg/hr). Patients were discontinued from the drug because sedation was no longer needed (74%), longer term sedation was determined to be needed (16%), inadequate sedation (7%), and adverse effects (3%). Most children (80%) experienced no adverse effects during the dexmedetomidine infusion. The most common adverse effects noted were hypotension (9% of all children), hypertension (8%), and bradycardia (3%). In 93% of children experiencing one of the adverse effects (n = 14 of 15), the event either resolved without treatment (n = 9) or by withholding or decreasing the dose of dexmedetomidine (n = 5). One patient received a fluid bolus for hypotension.

Conclusions: Dexmedetomidine infusion at doses similar to those used in adults is a potentially useful sedation agent for both intubated and spontaneously breathing children in the ICU setting. Minimal and reversible side effects were seen. A prospective study is needed to determine safety and efficacy.

DEVELOPMENT OF AN EVIDENCE BASED MEDICINE (EBM) TOOL FOR PEDIATRIC PHARMACISTS.

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Objective: There are limited resources at the fingertips of pediatric pharmacists on how to effectively search and critically appraise the pediatric literature. The desire to assist our pharmacists in their practice and their teaching of pharmacy trainees by providing them with an instrument that would house useful pediatric resources led us to the development of this tool. It was designed as a self-directed learning module that would allow the user to visit all components or only those relevant to their needs.

Methods: The first step in the development of the module involved defining and developing its content. A literature search was conducted for any existing similar pediatric EBM learning modules, and 32 pharmacists at our institution were surveyed. In collaboration with a librarian from our institution's pediatric library, criteria on content, accuracy, validity, and currency, criteria were developed to apply to the appraisal of existing pediatric websites. Help from an e-learning specialist was enlisted to define the look of the tool and understand possibilities on where to house the tool (CD Rom vs. hospital intranet, vs. other on-line systems). Once a draft of the tool was developed, a seminar was conducted to introduce the tool to our pharmacists and obtain their feedback.

Results: Based on the literature search and the responses from 14 pharmacists, it was decided that the tool would include: How to Effectively Search for Pediatric Literature (with pearls and tips on how to conduct a search using common indexes and databases such as PubMed), How to Appraise the Pediatric Literature (with a checklist for the systematic appraisal of a pediatric study); a Comprehensive Listing of Online Pediatric Journals available via our library and their respective impact factors; Online Pediatric Resources (useful online websites, their content and merits); and a listing of Pediatric List-serves identified as useful by the pharmacists. A section for user feedback was also included. At this time, and while users continue to become familiar with the tool and provide feedback, it was decided to house the tool within our Department, as an icon in all the pharmacy computers.

Conclusions: To date, the feedback received has been positive, and suggestions on how to further modify and improve the tool are continually being received. Next steps include: exploring options for extending its use to pediatric pharmacists outside our institution, and ensuring the content is updated on a regular basis.

PILOT ANALYSIS OF A NOVEL DUAL ANTIBIOTIC APPROACH ON RETURN TO BEST BASELINE PULMONARY

FUNCTION TEST IN PATIENTS WITH CYSTIC FIBROSIS (PANDAA – CF). Deady K, Ramsey EZ, Hayes, Jr D, Anstead M, Kanga J, Davis G, Lewis D, Kuhn R. University of Kentucky HealthCare, 800 Rose Street, Lexington, Kentucky 40536; email:kimberly.deady@gmail.com

Objective: Summative decline in forced expiratory volume in one second (FEV_1) from baseline associated with cystic fibrosis (CF) pulmonary exacerbation is a major cause of CF-related morbidity and mortality. The purpose of this study was to assess the effect of high dose extended interval aminoglycoside (HDEI AG) plus continuous infusion beta-lactam (CIBL) antimicrobial therapy on return to baseline FEV_1.
Methods: This was a single-center concurrent observational analysis with retrospective review at UK HealthCare, a 473-bed academic level I trauma center with an Adult and Pediatric Cystic Fibrosis Center. Fifteen pediatric and adult patients with cystic fibrosis hospitalized with an acute pulmonary exacerbation between November 1, 2005 and February 28, 2007 and were culture-positive for *Pseudomonas aeruginosa* in their sputum were included. Patients served as their own historic controls via conventional treatment (HDEI AG plus intermittent beta-lactam) versus HDEI AG plus CIBL (treatment group). The primary endpoint was percent of patient courses that allowed for a return to best FEV_1 at clinic follow-up visit from the previous 12 months after treatment with HDEI AG plus CIBL. Secondary endpoints included percent of patient courses that allowed for a return to mean FEV_1 at clinic follow-up visit from the previous 12 months after treatment with HDEI AG plus CIBL.
Results: Average overall percent change from best baseline FEV_1 was $-6.3 \pm 11.1\%$ at follow up with 24% patient courses returning to their best baseline. Average overall percent change from mean FEV_1 baseline was $1.4 \pm 10.5\%$ at follow up with 53% of patient courses returning to their mean baseline.
Conclusions: HDEI AG plus CIBL may be an alternative to HDEI AG plus intermittent beta-lactam therapy in patients with CF-related pulmonary exacerbation. Further investigation is warranted.

IMMUNIZATION RATES AND PHYSICIAN PREFERENCES REGARDING BIRTH DOSES OF HEPATITIS B AT A COMMUNITY HOSPITAL. Hrdy M, Christensen C, Davis E, Nystrom K, Foral P, Destache C. Creighton University School of Pharmacy and Health Professions, Hixon-Leid Science Bldg Rm 117, 2500 California Plaza Omaha, Nebraska 68178; email:cchristensen@creighton.edu

Objective: The purpose of this study is to evaluate newborn Hepatitis B immunization rates and compliance with ACIP guidelines at Alegent Health Bergan Mercy Medical Center (BMMC) and to determine physician perceptions regarding birth doses of HBV.
Methods: A retrospective chart review of 100 newborn records was completed to determine Hepatitis B immunization rates before and after the most recent ACIP guidelines. Fifty records each were randomly selected from November 2005 and September 2006. Demographic data and immunization rates were collected. Additionally, a ten-question physician survey was sent to 110 BMMC physicians to assess perceptions of this practice.
Results: Hepatitis B immunization rates increased from 22% in 2005 to 100% in 2006. In 2005, only 4/11 patients immunized received the vaccine within twelve hours of birth as recommended by ACIP. In contrast, 49/50 newborns received the vaccine within twelve hours in 2006. The response rate for the physician survey was 44%. A vast majority believe that birth doses of HBV are necessary, safe, reduce the transmission of the disease, have a greater cost in the hospital, and are compensated for by insurance companies. They also feel that it is difficult to determine if the vaccine was administered and do not believe that birth doses of HBV increase series completion. Parental resistance to vaccine administration was not perceived to be of great concern.
Conclusions: These results show that the immunization rates of birth doses on HBV have improved dramatically at BMMC since the implementation of the most recent ACIP guidelines. Methods to improve documentation of the infants vaccinations should be explored.

UTILIZATION OF OPIOID INFUSIONS IN THE NEONATAL INTENSIVE CARE

UNIT (NICU). Cherry A, Knoppert D, Lee D, Pletsch D, Seabrook J. London Health Sciences Centre, Department of Pharmacy, London, Ontario, Canada; email: Dave.Knoppert@sjhc.london.on.ca

Objective: To describe the utilization of opioid infusions, patterns of supplemental opioid and sedative use, and the use of pain assessment scoring in the NICU.
Methods: All neonates who received an opioid infusion between November 1, 2005 and November 30, 2006 were identified. Neonates born to opioid dependent mothers were excluded. Gestational age, birth weight, sex, length of stay, discharge status, and NPASS (a scoring system for neonatal pain/discomfort) were recorded. The reason, dose and duration of the opioid infusion were recorded. Supplemental opioid and sedative use were also recorded.
Results: Demographics: Sixty-six neonates were included for analysis. Gestational age was 31 ± 5 (SD) weeks, birth weight 1.65 ± 1.01 kg, and the length of stay was 65 ± 45.5 days. Number of infusions: Of the included patients, 64% received a single opioid infusion, 24% received 2, and 12% received 3 or more opioid infusions. Reasons for starting: Reasons for starting first infusions included sedation and/or analgesia (50%), post-operative pain (18%), and procedural pain (2%). No reason was documented in 30%. Reasons for starting second infusions were similar, except that post-operative pain accounted for 38% and sedation and/or analgesia accounted for 29%. Supplemental opioid and sedative use: Supplemental opioid doses were given to 53% of neonates during first infusions and 71% during second infusions. Use of supplemental sedative doses was similar. Pain assessment: At least one NPASS score was recorded for 80% of neonates while receiving an opioid infusion.
Conclusions: Documentation of reasons for starting opioid infusions and pain assessment scoring are inconsistent. A high proportion of neonates on opioid infusions receive supplemental doses of opioid and sedative.

COMMUNICATION OF MEDICATION-RELATED INFORMATION IN THE PEDIATRIC EMERGENCY DEPARTMENT: A PARENTAL KNOWLEDGE ASSESSMENT.

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Objective: This study was designed to assess the health literacy of parents and primary caregivers of children presenting to the pediatric Emergency Department. We examined the ability of parents to successfully communicate and improve upon the triage nurse's and physician's working knowledge of the Patient's medication history.
Methods: The study consisted of two phases, the ED based information collection and a telephone follow up interview following the ED visit. Parents were asked to independently complete the medication history form and the TOFHLA (Test of Functional Health Literacy in Adults) during the ED visit. As part of the gold standard confirmation, the research assistant attempted to verify the prescription information during the time of the ED visit with their community pharmacy. A scripted telephone follow up call one to three days following the
ED visit was placed, requesting the parent gather the current prescriptions and over-the-counter medications to complete the gold standard interview. We enrolled 92 parent-child dyads, 89 (97%) completed the ED based portion of the study, 71 (7%) completed the telephone follow up and community pharmacy records were successfully obtained for 85 (92%). Forty seven percent of children met the previously defined criteria for having a chronic illness.
Results: Primary outcomes included the percentage of parents able to accurately communicate the medication name on the medication history form (84%), with more than 50% of parents achieving 100% accuracy. Additionally we examined the triage nurses, documented history accuracy (65%), and the physicians, working knowledge of the patient's medications after completing the H&P (60%) to the gold standard interview. There was no direct correlation found between the parents, health literacy score and the ability to provide an accurate medication history for their child.
Conclusions: Direct parental information can improve upon the accuracy of ED caregivers working knowledge of patients' medication

history in the pediatric Emergency Department. Systems can be designed to incorporate the provision of relevant medication history information at the time of clinical decision making in the ED.

THE VALUE OF PHARMACIST-DRIVEN DISCHARGE COUNSELING FOR COMPLEX PEDIATRIC PATIENTS. Steffensen C. Advocate Hope Children's Hospital, 4440 West 95th Street, Department of Pharmacy, Oak Lawn, Illinois 60453; email: chris.steffensen@advocatehealth.com

Objective: Research has demonstrated that medication non-compliance and adverse drug events occur more frequently when patients do not fully understand their drug regimen.
This is especially true for pediatric patients. Pharmacists can help close this gap by providing patient education. It is hypothesized that a pharmacist-driven discharge service provided for complex pediatric patients will increase the parent's understanding of their child's medication.
Methods: This study was a one group, pretest-posttest design in which the patient's guardian was tested regarding discharge medication information, taught the information, and re-tested. The study population included pediatric patients that were considered to be "medically-complex" (defined as those receiving three or more medications.) A pharmacist performed all counseling functions. A pretest was taken by asking the guardian to list the patient's (1) medications, their (2) indications, (3) dose, (4) dose-preparation method, and (5) potential side effects. An education intervention was performed and the guardian was asked to reiterate drug information and demonstrate dose-preparation competency which served as a posttest. The pretests and posttests were graded by assigning 1 point for each piece of information recalled. In addition, the pharmacist reviewed discharge orders and performed medication reconciliation. Potential medication errors discovered during the discharge process were reviewed by a group of pediatricians to determine the seriousness of the error. A risk value was assigned to each error ranging from 1 to 5 (1 = no risk of patient harm, to 5 = certain patient harm if error occurred).
Results: The study assessed 56 patients for eligibility. Twenty-three cases were excluded because the guardian or the interpreter was not available for counseling. A total of thirty-one guardians were counseled. Patients received an average of 4.93 medications. Pharmacists spent an average of 29 minutes with each patient. The guardians' mean scores were (pretest/posttest): Drug Name 0.95/0.99; Dose 0.89/1.0; Administration 0.76/0.99; Side Effects 0.47/0.88; Indication 0.65/0.97. The cumulative mean score increased from 3.7 to 4.83 (out of 5). Eighteen medication errors were detected out of 148 medications reviewed (12%). Thirteen errors were ranked a risk value of 1, 2, or 3. However, 5 potentially life-threatening errors were discovered and averted (ranked 4 or 5).
Conclusions: In conclusion, it was found that pharmacists improved guardian knowledge of their child's medications and averted serious medication errors. Minimally, patients receiving three or more medications or one high-alert medication should receive pharmacist counseling. Medication reconciliation processes should be streamlined and consistently practiced to avoid medication errors.

IMPLEMENTING AUTOMATED DISPENSING MACHINE ALERTS TO PREVENT MEDICATION ERRORS IN A PEDIATRIC HOSPITAL. Steffensen C. Advocate Hope Children's Hospital, 4440 West 95th Street, Department of Pharmacy, Oak Lawn, Illinois 60453; email:chris.steffensen@advocatehealth.com

Objective: Hospital pharmacists must provide timely and safe medication delivery. However prospective order review is not always possible in emergency situations. Newer automated dispensing machines (ADMs) provide a tool which allows the pharmacy to provide drug information at the time of drug removal—an ADM alert. In some cases, the ADM alert can be used to prevent drug access if the patient does not have certain clinical conditions to justify utilization of the drug.
Background: Numerous drug errors occur when medications are used from floor stock. Patient harm occurs because: (1) the pharmacist is not involved with drug review or preparation, (2) many medications are considered to

be "high-alert" medications and pose a danger to the patient if they are used incorrectly, and (3) the nurse may be under considerable stress during emergency situations and prone to making errors. It is hypothesized that ADM alerts can decrease medication errors by providing the nurse with information when he/she needs it most.

Methods: A 2-year retrospective review of errors associated with floor stock medications was performed. Next, the pharmacist and nurse educator reviewed this information and alerts were developed based on medication error experience. Alerts were formulated with brevity, clarity and appropriateness to avoid alert fatigue. For example, the alert for KCl (IVPB) states "max dose 1 mEq/kg (equal to 2.5 mL/kg), infuse over 3-4 hours via central line." For neuromuscular blockers, the nurse must indicate that the patient is intubated or in the process of intubation in order to gain access to these drugs. The ADM alerts were activated and medication errors were tracked.

Conclusions: Prior to the implementation of the ADM alerts, we experienced 12 medication errors or near-misses associated with medications removed from the ADM. Overdoses of medications (KCl, lorazepam, albumin, acetaminophen, and heparin) accounted for 9 of the reported incidents. Inappropriate administration of KCl and calcium chloride occurred three times. After implementing the ADM alerts, only 1 error (acetaminophen dosing) occurred in the following 10-month period.

(Data through August, 2007 will be presented.) In conclusion, many "high-alert" medications are stocked in ADM machines and may cause serious patient harm if not dosed or administered correctly. Providing the nurse with ADM alerts decreases medication errors. Floor stock medications and errors should be periodically reviewed to perfect the drug delivery system. Lastly, medications made available to the nurse without a pharmacist prospective review should be limited to life-threatening situations.

PARENTERAL NUTRITION PRESCRIBING ERRORS IN NEONATAL INTENSIVE CARE UNITS: A LOCAL EXPERIENCE. Ismail N. King Faisal University, PO Box 40149, AL-khobar, AL-Khobar Saudi Arabia 31952; email:nadiai80@hotmail.com

Background: The effect of CPOE on total Parenteral nutrition (TPN) ordering has not been well reported in the literature, the only control study that evaluated the effect of CPOE's on intravenous admixture and drip medications was conducted by Bates et al, this four years study showed an 86% decline in the number of non-intercepted potential ADR¿s in both adult and pediatrics. In pediatrics especially neonates it is more difficult to recognized inappropriate medication orders since there is a smaller margin of safety. Data on medication errors and CPOE's in pediatric population are limited. One study in Ontario's children hospital showed that the introduction of CPOE's was associated with significant decrease in the rate of medication errors but not ADE. Currently data is lacking at national and local level on the impact of computerized physician order entry systems (CPOE's) on medication errors rates.

Objective: Since the introduction of the Misys CPR-Programto our institution in July, 1997, no quality improvement studies were performed to evaluate the impcat of the new system on patient safety and medication error rates. The aim of this project is to Identify the prevalence of CPOE related prescribing errors in neonatal intensive care units

Methods: Design: A prospective cohort study Setting: 11 bed neonatal intensive care units medication error rate before and after implementation of pharmacist order entry system for TPN orders. We daily screened all medication orders (electronic or paper) received by the pharmacy's admixture/TPN service. Pharmacists were instructed to document any drug errors using a standardized report form. At end of each month forms were collected and errors were classified by unit, type of error and clinical significant.

Results: A total of 257 medicating errors were identified, where 68% (175) were related to neonatal TPN errors. Before the introduction of the pharmacist order entry system, over 100 TPN related error were identified, of which 93% were CPOE related, then after the introduction of the pharmacist order entry system, CPOE accounted for only 4.2% of TPN related errors

Conclusions: Our study is the first of its kind to our knowledge in the Arab region, and can be

used as bases for further studies on the impact of CPOE's on medication errors rates in pediatric and neonatal intensive care units.

ESTABLISHMENT OF DECENTRALIZED SERVICES IN A REMOTE AREA OF A CHILDREN'S HOSPITAL: A PILOT PROJECT. Galloway W, Southers K. University of Kentucky, 800 Rose Street, Lexington, Kentucky 40536; email: wlgall0@email.uky.edu

Background: The Kentucky Children's Hospital is a pediatric facility located within a large academic medical teaching institution. The satellite pharmacy provides services to a 50 bed NICU, a 12 bed PICU as well as 66 general floor patients. Like most children's hospitals, pharmacy presence in the NICU and PICU areas has been well established. However, consistent pharmacy presence on the floor was lacking. The pharmacy satellite is located in close proximity to the critical care areas, but the floor areas are geographically remote. This presented a barrier to providing clinical pharmacy services to these areas utilizing satellite services alone.

Methods: To remedy this situation, a decentralized pharmacist pilot program was implemented in January 2007. This individual would primarily serve as a liaison between the pediatric pharmacy and the nursing staff, general pediatric teams as well as the nursing, medical and pharmacy students during the busy morning rounding time. They would also serve as a resource for patient/family counseling, medication history and reconciliation, and Pyxis med station education. We also hoped it would provide faster turnaround time on medication delivery to the pediatric ward floors, address drug administration questions in a convenient manner, provide direct input on drug decision making, identify causes of and reduce wastage, and help facilitate chemotherapy orders for the day.

A pharmacist is available during morning rounds at a centrally established location in Kentucky Children's Hospital on the ward floor. Orders can be processed from the floor, prepared in the Pediatric Pharmacy, and sent via pneumatic tube system where it is retrieved and delivered by the pharmacist. Communication between the pharmacist and the pharmacy is primarily done with a text pager when medications have been sent, clarifications are needed, or consults are requested. Medication errors have also been identified by having the patient chart readily available for reference. While this program has greatly improved turnaround time for medication delivery, perhaps the most important aspect was simply pharmacy presence to reinforce the idea of a multi-disciplinary approach to patient care.

Conclusions: We saw this as an opportunity not only as a benefit to nursing and physicians, but also as a staff development tool. Pharmacists who may be new to the world of pediatrics can gain knowledge and experience, simply by working one-on-one with doctors, nurses and, most of all, patients. The response from the nursing staff during a staff council meeting was so tremendously positive that this is no longer a pilot program at Kentucky Children's Hospital, but a continuing service that the Pediatric Satellite Pharmacy will provide. We are evaluating satisfaction with this program routinely with surveys directed toward the nursing staff as well as internal assessment of wastage and turnaround. Initial reviews were overwhelmingly positive and we will expand this service as necessary.

PHARMACIST MEDICATION RECONCILIATION ACTIVITIES IMPROVE PEDIATRIC PHARMACEUTICAL CARE. Biehle K. Children's Healthcare of Atlanta Scottish Rite, 1001 Johnson Ferry Rd, Atlanta, Georgia 30342; email: karen.biehle@choa.org

Introduction: This practice experience involved a retrospective chart review of patient home medications and admission orders before and after medication reconciliation**.** The project idea arose from technological and procedural changes in the pharmacy related to medication reconciliation. The project was designed in June 2005, with a plan to review 30 patient charts each in August 2005 and June 2006. Data collection focused on discrepancies in the patient's medication history and admission orders.

Background: Providing safe and effective pharmaceutical care to hospitalized patients begins with a complete and accurate record of the patient's current medications. Missing or inaccurate information causes unintended dis-

continuation of drugs, inappropriate treatment or incorrect decisions by physicians caring for the patient. Pharmacists must clarify erroneous or ambiguous orders, which often delays medical care to the patient. A recent study revealed that 67% of patients have medication errors in their hospital medication history. Medication reconciliation, a JCAHO patient safety goal, requires creation of an accurate list of the patient's home medications. A comparison (reconciliation) of this list is required for orders written on admission, transfers and at discharge.

Three new programs provided a framework for the project:

- JCAHO requirement for medication reconciliation activities by January 2006.
- Installation of a new hospital-wide computer program with electronic documentation.
- Pharmacy and Therapeutics Committee goal to improve physician order accuracy.

Methods: Phase I focused on home medications and admission orders prior to medication reconciliation. Thirty patient charts were reviewed in August 2005, by examining the patient's medication history and orders written in the first 48 hours. Variances were documented on the data collection form. If orders required physician clarification, then clarification time and delay in patient care was noted. A spread sheet detailing medication discrepancies summarized the findings. Approximately 32% of the orders contained discrepancies. Patient histories were still handwritten. Phase Two included thirty patients admitted in June 2006 with medication reconciliation and were reviewed in the same manner. Only 15% of orders and histories in Phase Two contained discrepancies. The electronic medical record provided much more detail in the patient medication history section.

Conclusions: Medication reconciliation improves patient care by ensuring that medications are not erroneously dropped or added during the patient's hospitalization. The pharmacy and nursing departments made medication reconciliation a priority and accuracy of admission database information improved. Medication reconciliation activities improved accuracy of home medications and admission orders by reducing discrepancies from 32% to 15%.

IMPLEMENTATION OF STANDARD CONCENTRATIONS IN THE EMERGENCY DEPARTMENT, OPERATING ROOM AND PEDIATRIC INTENSIVE CARE UNIT OF A CHILDREN'S HOSPITAL. Irwin D, Vaillancourt R, Dalgleish D, Thomas M, Doherty D, Wright M, Grenier S, Wong E, Sears M. The Children's Hospital of Eastern Ontario, 401 Smyth Road, K1H 8L1 Ottawa, Ontario, Canada. email:irwin@cheo.on.ca

Introduction: Standard concentration (SC) practice was implemented in the Emergency Department (ED), Operating Room (OR) and Pediatric Intensive Care Unit (PICU) at a children's hospital. Time from program development to implementation was 18 months.

Background: The Institute for Safe Medication Practices and the Joint Commission on Accreditation of Healthcare Organizations recommend using Standard Concentrations (SC) as one strategy to reduce the risk of infusion related errors of high-alert medications. Within the critical care population a need was identified to increase medication safety and to improve continuity of care.

Methods: Stakeholder meetings were conducted with medical, nursing and pharmacy staff in the ED, OR and PICU in 2005/06 to discuss implementation process and identify barriers. A SC computer program was developed. Staff education and training was conducted. The SC program was implemented in the ED, OR and PICU in July 2006. Ongoing program evaluation.

Results: A possible negative impact of SC on fluid volumes was identified as a potential barrier to implementation. A study comparing actual volumes delivered using Variable Concentrations (VC) with projected volumes using SC's was conducted in 41 patients with 91 drug infusions. No significant difference was observed between the VC and SC volumes. (difference 1.74 mL/kg/day, 95% CI –1.75, 5.23 mL/kg/day, P = .324.) An Excel based SC computer program with numerous safety features was developed and made available on the CHEO Intranet. PICU and ED nurses received SC training, completed a training package and test. On the go-live date 76% of ED nurses and 82% of PICU nurses had fulfilled training requirements. PICU and ED physicians received

training and handouts on the SC program, as did Anaesthesiologists and Anaesthesia Assistants.

Phase 1 of the SC program was implemented July 2006 with the following drugs: dopamine, epinephrine, norepinephrine, milrinone, morphine, fentanyl, midazolam and dobutamine.

A May 2007 user survey reported that 95% of users felt that SC improved patient safety, 95% felt SC improved continuity of care and 77% felt that SC decreased drug delivery time. Medication error rate analysis reported a pre implementation error rate of 2.4 errors/year and a post implementation rate of 1error/10 months.

Conclusion: A SC program was successfully implemented in the ED, OR and PICU at a children's hospital. The program has been identified to enhance medication safety and to improve continuity of care for critically ill patients throughout the hospital. The program has been well accepted by staff in these areas.

HOW TO DEVELOP AND GROW A PEDIATRIC PHARMACY ELECTIVE. Worthington M, Benner K. Samford University, 800 Lakeshore Dr, Birmingham, Alabama 35229; email: maworthi@samfored.edu

Introduction: In 2000, in conjunction with a problem-based learning initiative at the university level, a pediatric elective pharmacy course was redesigned to prepare students for the unique aspects of pediatric pharmacy and to be problem-solvers for pediatric issues. A case-based approach is utilized in the course; and growth and development are emphasized by having cases relate to the same patient at different ages.

Background: The elective is a two credit hour course for third year Doctor of Pharmacy students. It meets weekly for two hours, and the enrollment averages 20-30 students. Prior to 2000, the format consisted of lectures and student presentations on therapeutic controversies. With redesign, the goals for improvement were to: 1) provide students experience in identifying and solving pediatric pharmacy problems; 2) expose students to the changing nature of the pediatric patient, unique disease states, dosage calculations, extemporaneous compounding and medication error risk; 3) increase utilization of pediatric specific drug information resources; 4) increase opportunity for communication of pediatric information.

Methods: Based on desired goals, the course was organized into three periods: 1) neonatal; 2) infancy/early childhood; and 3) older childhood/adolescence. Each period includes two sessions of case-based learning followed by a session of student presentations. Students are divided into groups with half of the groups working on a male neonate case and the remainder a female neonate case. Each group maintains the same patient in all course periods, simulating the "growing-up" of the patient. Parallel pharmacy issues are woven into both cases. However, the main disease state is different in each period. and this material is the subject for student presentations. Since its first offering, the course continues to change. Based on student feedback, it now includes a group presentation on a practical problem that could be encountered in the community setting, e.g., diaper rash. Fourth year students are also now involved as facilitators allowing them to teach and consider academic careers. Finally, a portfolio is now the major assessment to allow for student self-reflection.

Conclusions: The outcomes of the course have been positive and improvement goals met. Students repeatedly identify and solve pediatric problems in the cases utilizing pediatric resources. Their presentations and portfolios communicate information thoroughly and creatively. A breakdown of the learning issues in the cases demonstrates exposure to unique aspects of pediatrics and an example of how to meet recommendations for pediatric pharmacotherapeutic education. Finally, student evaluations and feedback are consistently affirmative.

INDIVIDUALIZED COMPATIBILITY CHARTS IN THE NICU. Luedtke S. Texas Tech University HSC School of Pharmacy 1300 S. Coulter, Amarillo, Texas 79106; email:sherry.luedtke@ttuhsc.edu

Introduction: An individualized compatibility chart program was developed for use in the neonatal intensive care unit (NICU) to provide nursing personnel drug compatibility information which is patient specific patient based upon his/her medication profile. Over a

3 month time-period, the medications for inclusion were selected, drug information resources reviewed, and data entered into the program. The program and process was reviewed and approved by the Department of Neonatology after which it was implemented by the pediatric satellite pharmacists for all neonates on parenteral medications.

Background: Information on medication compatibility is vital for the administration of medications in the NICU. Limitations in intravenous access, fluid volumes, and the need for multiple continuous infusions often complicate therapy, particularly for the micro-premie. Compatibility frequently varies depending upon the concentrations of the medications involved. The lack of nursing time, drug information resources, and expertise in medication compatibility issues make it difficult to determine optimal medication administration methods and can lead to negative consequences. A y-site compatibility program was developed to allow for quick and easy generation of patient specific compatibility charts. The goals of the program are to optimize drug delivery to neonates, assist nursing and pharmacy personnel, and reduce the potential for medication errors due to administration errors.

Methods: Thirty commonly employed parenteral medications were reviewed individually to determine their y-site compatibility based upon the standard concentrations adopted by the unit. This data was entered into a compatibility spreadsheet (Microsoft Excel). The neonatal specialist and/or pediatric satellite pharmacists utilize the program to generate a patient-specific compatibility chart by selecting the medications from the standard spreadsheet to print a preformatted compatibility chart which include the patient name, IV access, and medications. Additional recommendations or comments may be added to the chart. The compatibility charts are attached to the medication administration records (MARs) and new charts generated when medications changes occur or upon nursing request.

Conclusions: The program has been embraced by nursing and pharmacy personnel. Nursing staff report reduced time searching for information and/or calling pharmacy to inquire about medication compatibility. Pharmacists are able to efficiently provide compatibility information, avoiding time consuming searches for concentration specific compatibility data. The charts have assisted staff in making informed decisions regarding optimal medication administration methods.

INFLUENZA VACCINATION INITIATIVE IN A PEDIATRIC HOSPITAL. Durham S, Eiland L. Children's Health System, 1600 7th Avenue South Birmingham, Alabama 35233; email: durhash@auburn.edu

Introduction: This influenza vaccination initiative conducted at a pediatric hospital is a novel approach to ensuring that as many children as possible become vaccinated. The initiative was developed over approximately one month, and implemented over a two-month period during peak influenza season.

Background: Influenza is a common respiratory illness, and infants and children are particularly susceptible to its complications. Vaccination against the influenza virus is widely considered the optimal defense against infection. The primary purpose of this initiative was to develop and implement a program to vaccinate hospitalized children who met criteria to receive the influenza vaccine. Secondary analysis evaluated whether academic pediatricians or private pediatricians were more likely to accept the recommendations of the pharmacist and student pharmacist.

Methods: During October and November 2006, all patients admitted to the general pediatric floor were screened to evaluate if they met criteria to receive the influenza vaccine. If a patient who met criteria was admitted to the service of the academic pediatricians, the student pharmacist informed the medical team while on rounds, where it was then determined if the vaccine should be ordered for the patient. If a patient who met criteria was admitted under the care of a private pediatrician, the student pharmacist placed a Pharmacist/Physician Communication Form¿ in the Progress Notes section of the patient's medical chart, alerting the pediatrician that influenza vaccination criteria was met. The dose and route for the patient was provided to the pediatrician in the note.

Conclusions: A total of 243 patients were screened during the program; 116 (47.7%)

patients met criteria. At the end of the study period, 79% of the patients who met criteria received the vaccine. Academic pediatricians accepted the recommendation of the pharmacist or student 100% of the time, compared to 53.2% for the private pediatricians. Based on the results of this program, implementation of an influenza vaccine initiative in a pediatric hospital appears to be an effective way for children to receive the vaccine prior to hospital discharge. The low acceptance rate for private pediatricians may be due to physician preference to vaccinate in their office, or these patients had already received the vaccine. It may be beneficial for pharmacists to make a conscious effort to work more with private physicians to demonstrate the value to patient care that a pharmacist can provide.

MULTIDISCIPLINARY SOLUTIONS FOR IMPLEMENTING ASTHMA CORE MEASURES. Maish W, Smith-Hoopingarner H. Arnold Palmer Hospital for Children & Arnold Palmer Medical Center, 92 W Miller St, MP 349, Orlando, Florida 32806; email: william.maish@orhs.org

Introduction: A Core Measure for Children's Asthma Care was announced in 2006 by the Joint Commission, CHCA, NACHRI, and MMP.

Background: The limited information indicated that patients need to receive rescue medication and systemic corticosteroids in the hospital, and a Home Management (Action) Plan of Care (HMOC). We hypothesized that there are opportunities for improvement at Arnold Palmer Medical Center.

Methods and Results: *Phase 1 Methods:* A group of pediatric pulmonologists, hospitalists, respiratory therapists, nurse clinicians, and pharmacists met to decide which criteria to select since the HMOC "requirements" were vague. Data was collected on weekdays October 2006 on all inpatients with a diagnosis of asthma; patients with bronchiolitis were excluded. *Phase 1 Results:* Fourteen patients were admitted for asthma. All had rescue medication and 93% had systemic corticosteroids for inpatient use. The majority, 79%, had a HMPC. Only experienced clinical pharmacist specialists provided and documented specific verbal and written education. The Pediatric Medication SubCommittee of the Pharmacotherapy (P&T) Committee recommended that a uniform HMPC be more readily available. A multidisciplinary committee was charged with creating a consistent and uniform process for providing care. Discussions continued on which providers would provide care. *Phase 2: Methods:* In 2007, the requirements for HMPC were released and included 1) appointment for follow-up care, 2) environmental control and trigger control, 3) method and timing of rescue ctions, 4) use of controllers, and 5) use of relievers. *Phase 2 Results:* From the previously collected data, no patient met both HMPC criteria 1 & 2. Therefore the multidisciplinary team proposed a stepwise plan and timeline to better achieve compliance in this area. The timeline was then accelerated by hospital administration. Inpatient and outpatient HMPC's were incorporated into a single document to expedite the implementation of a unified HMPC. An environmental control and trigger control guide was developed, and a general information booklet on asthma was selected for use. A computer assisted education program was developed for respiratory therapists, nurses and pharmacists and is scheduled for completion in June 2007. Medical residents and attending physicians were notified of the need for completed HMPCs well in advance of hospital discharge. Care responsibilities were identified for providers. Specific plans to use hospital technology to identify eligible patients, coordinate care, and measure quality were requested.

Conclusions: Follow-up assessments of compliance with Core Measures after education completion will be presented. Current and future success of this program relies exclusively on teamwork among pediatric inpatient healthcare providers.

USE OF A NOVEL, COMPREHENSIVE WEB-BASED ANTIMICROBIAL APPROVAL PROGRAM IMPROVES EFFICIENCY, COMMUNICATION, USER SATISFACTION, AND RESULTING IN COST-SAVINGs. Agwu A, Lee C, Jain S, Murray K, Topolski J, Miller R, Townsend T, Lehmann C. The Johns Hopkins Hospital, 600 North Wolfe Street, Carnegie 180, Baltimore, Maryland 21287-6180; email:cleea@jhmi.edu

Introduction: To improve the efficiency, communication, and user satisfaction, and to reduce costs, a novel web-based antimicrobial approval program was developed at a tertiary children's hospital. It took six months to build, test and implement in June 2005.
Background: Hospital antimicrobial stewardship programs have been developed to foster appropriate antimicrobial use. Our institution's program faced challenges of inefficiency, miscommunication, increasing numbers of restricted antimicrobials (RAs), prescriber and pharmacist dissatisfaction and missed or delayed doses. To address these issues, we developed and implemented a web-based antimicrobial approval system providing basic clinical decision support; tracking of approval status and duration of approval; notification for missing requests and expiring approvals; and centralizing of all actions performed in the system.
Methods: The web-based system was developed using cold fusion programming and the institution's existing text-paging system. This system is contained within the institution's secured intranet and can be accessed remotely through a virtual private network. Pre and post implementation surveys of (1) prescribers on system satisfaction, and perceptions of missed and delayed doses; and (2) pharmacists on system satisfaction, and perceptions of RA related phone calls and delayed RA approvals (>24 hours) were completed. Two week assessments of antibiotic dispensing times (RAs vs. non-RAs) and equivalent six month RA and all antimicrobial agent costs were also evaluated pre and post implementation.
Results: The web-based antimicrobial program increased the approval system satisfaction from 22% to 68% in prescribers (N=121 and 78, respectively) and from 13% to 69% in pharmacists (N=15, both). There were 21% and 32% reductions in prescriber perception in missed and delayed doses; and 40% and 37% reductions in pharmacist perception in RA related phone calls and delayed RA approvals, respectively. There was no difference in pre vs. post RA dispensing times (P=.24, Wilcoxon Rank Sum). Despite similar acuity scores (mean 3.42 vs. 3.41), average length of stay (6.8 vs. 6.3 patient days), there was a $22,000 and $16,198 reduction in RA and all antimicrobial agent costs over a similar six month period, respectively.
Conclusions: A novel web-based antimicrobial approval system was well received and lead to more efficient administration, improved communication, user satisfaction, and cost-savings to the institution.

PHARMACY NOTIFICATION OF ADMISSION IMPROVES CARE FOR KETOGENIC DIET PATIENTS. Heidrich E. Cincinnati Children's Hospital Medical Center, 3333 Burnet Ave Cincinnati, Ohio 45229; email: cleea@jhmi.edu

Introduction: The ketogenic diet can be useful in controlling intractable seizures when medications are ineffective. Carbohydrates are very restricted, and inactive ingredients in medications can contain a high amount. When pharmacy does not receive timely notification of admissions of ketogenic diet patients, inappropriate medication formulations may be sent that interfere with the diet. New methods of communication and education of multidisciplinary team members were developed during the first year of this project to optimize patient care.
Background: The ketogenic diet is an old method for controlling intractable seizures. The diet is designed to provide 90% of calories from fat, a moderate amount of protein, and minimal carbohydrates. Only 1500mg of carbohydrates per day are permitted in medications without diet adjustments. Inactive ingredients in tablets, sugar based suspensions, and parenteral dextrose solutions can easily exceed this limit. Ketogenic diet patient admissions were tracked, with physicians prescribing and pharmacists dispensing monitored for notification of diet and accuracy of medication formulations.
Methods: A computerized list of carbohydrate content in medications was prepared, and individual patient profiles developed for these frequently admitted patients. In CPOE, a diet order which sends notification to Pharmacy and Nutrition upon admission, and two order sets with appropriate medication formulations and labs, including diet notification, were initiated. A pop-up alert in pharmacy computers on ketogenic diet patient profiles provides a continuing reminder. Pharmacists were edu-

cated about medication issues, carbohydrate limits, supplements needed and ketogenic diet information available on-line. Pharmacy communication with physicians, dieticians and nursing staff has been an important part in optimizing ketogenic diet patient care.

Conclusion: Accuracy in prescribing and dispensing has increased from 75 to 93% during the second year of monitoring. Basic knowledge of the ketogenic diet was lacking in both medical and pharmacy staff. Providing this information has increased awareness, and accuracy of medications. Access to information online and order sets has increased the ease and accuracy of prescribing. Diet notification to the pharmacy upon admission has been the most important key to early identification of patients. Communication and multidisciplinary care will continue to improve care for ketogenic diet patients. Continuous reinforcement to medical and pharmacy staff will be necessary to maintain a high level of accuracy. Admissions through the emergency department and ICU have a lower rate of diet notification and correct medication formulations which still needs to be addressed.

DOSE STANDARDIZATION OF SELECT ORAL MEDICATIONS IN THE NEONATAL INTENSIVE CARE UNIT (NICU). Mrsan M, Maxwell P, Green K. University Health System, Christus Santa Rosa Health Care, Pharmacy Department, 333 N. Santa Rosa St., San Antonio,Texas 78207; email: melinda.mrsan@christushealth.org

Introduction: The pharmacy department at University Hospital elected to assess the value of standardizing doses of select oral medications for the NICU in an effort to decrease wastage and preparation time. The project was successfully developed and implemented over a 5 month period. Although very limited literature documenting the impact of oral medication standardization exists, some institutions have utilized such strategies for their neonatal populations.

Background: Previously, the pharmacy extemporaneously prepared all oral medications for this population in patient-specific, unit-dose syringes, resulting in wastage due to frequent dosage adjustments and changes in therapy. The objective of this pilot project was to implement standard doses of oral medications in the NICU allowing pre-batched syringes to be stocked in automated dispensing machines. The primary endpoints for this study were to reduce wastage of oral medications and decrease associated pharmacy costs. The secondary endpoints included prescriber compliance and staff satisfaction.

Methods: Wasted oral syringes were counted from October through December 2005. From this data, a total of six drugs with a wide therapeutic range and high wastage were chosen for standardization. The medications were added as stock in the automated dispensing machines. After implementation, wastage was recorded for a one month period. Prescriber compliance was determined from the number of non-standard doses ordered. Staff satisfaction was evaluated by a subjective survey. Cost avoidance was calculated from decreased technician preparation time, pharmacist check time, and wasted medication and supplies.

Conclusions: During the 3 month data collection period, 5,735 syringes were made, 800 of which were wasted (14%). The six medications chosen for standardization accounted for 73% of all syringes made and 87% of those wasted. During the one month follow-up period, no wastage of the standardized doses occurred. Prescriber compliance was high with only 2 non-standard doses ordered, both of which were changed to standard doses upon request. Based on survey results, both nursing and pharmacy staff strongly supported the new process. Implementation of this project resulted in an estimated annual cost avoidance of approximately $16,800 (medications $888, supplies $828, tech salary $5,621, pharmacist salary $9,526). This pilot study demonstrated a reduction in wastage and resultant cost savings by creating standard doses for selected oral medications in the NICU.

PEDIATRIC WEIGHT-BASED EMERGENCY MEDICATION SHEETS. Hurford G. Lancaster General Hospital, 555 North Duke Street, Lancaster, Pennsylvania 17604; email: glhurfor@lancastergeneral.org

Introduction: Lancaster General Hospital (LGH) is a 638-bed non-profit, community-

based medical-surgical teaching hospital and level II trauma center located in Lancaster, PA. LGH's state-of-the-art facility includes a 19-bed general pediatric unit. Depending on the patient's status and bed availability in the pediatric unit, pediatric patients (defined as any patient less than 18 years old) may be found in various areas of the hospital, which may not be readily equipped with all the medications and supplies necessary for a pediatric code. At present, the pediatric nursing staff and on-call residents are responsible for responding to all pediatric codes, as well as transporting the pediatric unit's code cart to the code location.

Background: The Pediatric Medication Safety Committee (PMSC) began to address this issue in January 2006. The committee standardized a pediatric-specific code cart and established permanent locations to house the carts throughout the organization. The standardized medication trays contain medication consistent with the Pediatric Advanced Life Support (PALS) recommendations. In addition, the committee developed weight-based emergency medication sheets that would be patient-specific and accessible on all pediatric patients charts. The PMSC reviewed multiple electronic pediatric emergency dosing calculators and found that many dosing calculators did not include a weight-based volume for the medications, likely due to variations in supplied concentrations. Therefore, in this potentially life-threatening situation, additional calculations would still need to be performed in order to administer the correct dose. By developing our own emergency calculator, we would be able to provide the practitioners with precise doses and volumes that directly correlate with the medications in our code cart. Therefore, the PMSC believed a hospital-specific program to be the safest and most practical option. This decision was fully supported by our Medical Executive Committee and hospital administration.

Methods: The proposed emergency medication sheets are broken down into 19 standard weights ranging from 2.5 kg to 40 kg. Every child weighing 40 kg or less will have a weight-based medication sheet (closest to their actual weight) placed in their chart. Each sheet contains all of the medications available in the newly standardized code cart medication trays, their corresponding concentrations, their mg/kg doses (established in accordance with the 2005 PALS Guidelines), calculated doses based on the selected weights, administration route, the volume to be administered, and significant medication notes. Each sheet also has weight-based defibrillation (joules/kg), synchronized cardioversion (joules/kg), and equipment (laryngoscope blade, tracheal tube, and endotracheal tube) resource information. They are color-coded to correspond to the colors on the Broselow Tape and to highlight vital information (medication name, concentration, and volume to be administered).

Conclusions: The proposed pediatric emergency resuscitation plan is being finalized and will be implemented later this year.

OPTIMIZATION OF RSV PROPHYLAXIS: A COST-EFFECTIVE APPROACH. Pham K. St Joseph's Hospital and Medical Center, 703 Main St, Paterson, New York NY; 07503; email:phamer79@yahoo.com

Introduction: The use of palivuzimab (Synagis) for respiratory syncytial virus (RSV) prophylaxis during the 2006-2007 RSV season was evaluated. A retrospective review of patients receiving Synagis between September 28, 2006 and February 15, 2007 was conducted to assess consistency with recommendations from the American Academy of Pediatrics for patient selection of RSV prophylaxis. Results of this review prompted a more cost-effective approach defining appropriate selection criteria. In an effort to reduce cost, weekly batching of Synagis was encouraged after this retrospective review. The process of pre-authorization prior to administration as an outpatient on the day of discharge is currently being investigated.

Background: Of the 89 patients receiving Synagis for RSV prophylaxis from September 2006 to February 2007, 85 were inpatients in the NICU or Intermediate Nursery. Of these 85 patients, 49 patients were of gestational age ≤ 32 weeks. The other 34 patients of gestational age >32 weeks amounted to a cost of $45,000. The goal was to limit Synagis use to appropriate candidates and adequately document the risk factors in patients of 32-35 weeks gestational age that prompt consideration for Synagis administration. Patients were ordered

Synagis throughout the week and wastage of open partially used vials was costly.
Methods: Our current hospital policy set general guidelines but left patient selection to the discretion of the neonatologist. This policy was revised to follow recommendations from the American Academy of Pediatrics and a Synagis order form was designed to match the selection criteria defined in this policy. Batching was done every Thursday by encouraging physicians and advanced practice nurses to evaluate eligibility for RSV prophylaxis as early as possible based on gestational age and presence of risk factors. Synagis was ordered on the Thursday before anticipated discharge. Multiple doses could be drawn from the same vial if drawn within 6 hours of opening the vial. The potential for Synagis administration as an outpatient on the day of discharge is being explored, with the use of personnel to pursue pre-authorization from the insurance company to assure reimbursement for doses throughout the season for each patient. The position of a clinical pharmacy technician in pediatrics is being proposed to support this function.
Conclusions: Weekly batching from the start of the season to the time of review could have resulted in an anticipated savings of $22,000. Outpatient administration would not only take away from inpatient costs but would provide financial reimbursement to the institution's ambulatory care center.

VENTILATION ASSOCIATED PNEUMONIA & INFECTION IN A PICU: CHALLENGE OF PREVENTION & REDUCTION. Martinez-Montano R, Shannon M,Flint K, Johnson A. Presbyterian Healthcare Services 1100 Central Ave SE, Albuquerque, New Mexico, 87106; email:rimartin@phs.org

Introduction: A pediatric ventilator protocol and order set was designed and implemented over a 12 month period in our Pediatric Intensive Care Unit (PICU). The objective of this study was to evaluate the impact of this protocol and order set on ventilator associated pneumonia (VAP) and ventilator associated infection (VAI)
Background: Mechanical ventilation is one of the major risk factors for nosocomial pneumonia and the second most frequent infection in the PICU. A survey of the adult literature revealed an extensive body of information on prevention and reduction of VAP and VAI; however, no published data was found in pediatrics.
Methods: An interdisciplinary committee consisting of nursing, pharmacy, respiratory therapy and physicians reviewed the available literature as a basis for our design and development of a pediatric VAP/VAI prevention order set in 2005. A retrospective medical chart review was used to collect baseline data in our PICU for a 12 month period, from January through December 2004. We followed CDC guidelines to confirm the diagnosis of pneumonia. Primary outcomes included calculation of VAP & VAI events with subsequent rates per 1000 events determined. Staff education to ensure compliance with the protocol consisted of medication, nursing and respiratory care orders: chlorhexidine 0.12% solution to rinse mouth and suction residual after intubation, and for teeth/gum brushing every 12 hours rinse with hydrogen peroxide, elevate head of bed 30-45˚, bronchial alveolar lavage for gram stain and culture.
Conclusions: Using a quasi experimental study design, baseline data from January 2004 through December 2004 was analyzed and resulted in 6.75 VAI and 11.81 VAP events per 1000 ventilator days respectively. From September 2005 through December 2006 the protocol was implemented and evaluated. Data collected during implementation of the order set using VAI and VAP rates will be used to evaluate the impact of the protocol and order set. We plan on presenting results before and after the VAP/VAI protocol was implemented for comparison. Decrease in ventilator days with subsequent decrease in hospital days and ultimately hospital cost are potential secondary outcomes. We will continue data collection and staff education with strategies in place to evaluate our process and make any necessary changes to improve our VAP/VAI rates.

A CONTINUOUS APPROACH TO IMPROVING PEDIATRIC OUTCOMES THROUGH INTRAVENOUS AND ORAL MEDICATION STANDARDIZATION. Cash, J, Mackay M, Boehme S, Farr F, Holley M, Jones K. Primary Children's Medical Center/Inter-

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Introduction: Our pharmacy has been actively engaged for a decade in the development, implementation, and successive modification of standardizations in parenteral nutrition (12,000 solutions/year), intravenous solutions (50,370 solutions/year), continuous medication administration (24,500 drips/year), and oral liquid doses (233,604 doses/year).

Background: Standardization is an invaluable tool to promote safety, improve care, and decrease costs, which ultimately improves outcomes. However, a pediatric setting presents unique challenges with its wide variety of weights, medications, and needs that are distinctly different. Our goal was to develop and implement standards in complex high risk areas that demonstrate improved outcomes and safety.

Mehods: A pharmacist directed multidiciplinary team developed the first computerized prescriber order entry program with decision support for pediatric specific TPNs over ten years ago. Program modifications over the years included automated calcium phosphate compatibility checks, seemless order to automated compounder interface (after including pharmacist verification), osmolarity and route calculation, end product testing verification, aluminum exposure, and many other continuous quality improvement projects. This same electronic order program, interface to sterile compounders, and end product testing was used in 2006 to standardize and make common non-manufacturer available intravenous solutions. In 2003, the drip compounding and administration process was reengineered to include standard concentrations, label changes, and beta-testing of a smart syringe pump with dosing ranges for pediatrics. In addition, common standard oral doses were developed in 2004-5 and standard oral formulations in 2007. Multiple successive modifications to these programs continue to date.

Conclusions: Upon review, all four areas of standardization showed evidence of improved safety and outcomes. TPN error rates dropped from 7% to less than 1% and compatibility issues dropped from 36 to 2 per year. Neonatal osteopenia rates decreased from 15% to 2% as a result of standard improved calcium phosphate ratios and supplementation. End product testing of TPN solutions with USP standards showed extremely high correlation ($P < 0.001$) and led to improved laboratory standards for testing. Statistical improvement was shown in osmolarity, trace mineral and vitamin monitoring and dosing, along with iron stability in PN. The adaptation of the TPN process to intravenous solutions allowed standard safety strategies to be applied to most of the pharmacy compounded solutions. These strategies include reduced calculations, compatibility checking, barcode scanning of base ingredients, and electronic order transmission to compounders. This reduced our error rates by 15% and compounding time by 12 minutes (64%). Success was also seen with standard concentrations and smart pumps in decreasing drip errors by 73% from 3.1 to 0.8 per 1000 doses. Compounding errors decreased from 0.66 to 0.16 per 1000 doses and ten fold errors from 0.41 to 0.08 per 1000 doses. Oral medication doses were standardized for 80% of oral liquids dispensed within our institution. Eleven medications comprising 329 different doses were decreased to 59 standard doses (83% reduction). This also decreased workload 15%, wastage 90%, improved turn around time 32%, and saved $15,000/year. In addition, 100 literature documented standard oral formulations were developed and used in 22 different hospitals.

COMPUTER-ASSISTED MEDICATION RECONCILIATION. Gardner B, Graner K, Oyen L, O'Meara J, Cunningham J. Mayo Eugenio Litta Children's Hospital Mayo Clinic, 200 First Street SW, Rochester, Massachusetts 55905; email: gardner.brian@mayo.edu

Introduction: For six years, pharmacists at Mayo Children's Hospital have utilized a computer-based pharmaceutical care (P-CARE) clinical monitoring system. P-CARE is a web-based program that integrates data from disparate systems, including pharmacy, admissions, laboratory, and microbiology. In 2005, hospital leadership requested functionality be added to efficiently manage the workflow and documentation of medication reconciliation activities.

Planning and development took twelve months, with implementation in 4/06.

Background: The Institute for Healthcare Improvement estimates 46% of medication errors occur at transition points in a patient's care. Medication reconciliation, a process to consciously continue, discontinue, or modify medication orders, insures patients receive all intended medications during hospitalization. The P-CARE medication reconciliation functionality was created to make an efficient process for staff to prevent medication errors and comply with JCAHO's 2005 National Patient Safety Goal.

Methods: In response to JCAHO's mandated medication reconciliation safety goal, a multidisciplinary Medication Reconciliation Task Force was formed to develop procedures to assure that this goal was being met. After reviewing potential electronic and paper options, it was decided that developing a medication reconciliation tool within P-CARE would be the best option. The task force worked with Pharmacy Leadership and the P-CARE Development Team to design the appropriate functionality. Since implementation, these groups continue to work together to monitor and adjust the P-CARE tool for optimization.

Conclusions: Pharmacists are responsible for assuring reconciliation of patient's medications during admission and upon transfer to a different service/level of care. The tool automatically alerts pharmacists when a patient's admit medication history, admit medication reconciliation and transfer medication reconciliation needs to be completed. P-CARE allows documenting each step after completion. During the first two months, pharmacists changed 24% of admission medication lists completed by physicians and nurses. This confirmed to hospital leadership that pharmacists conducted more thorough medication histories, and it was necessary for pharmacists to interview each patient to assure appropriate medications are prescribed during hospitalization. Current statistics report that pharmacists interview approximately 85% of admitted patients.

As a result of the dedicated effort to perform medication reconciliation and ensure patient safety, pharmacists have more opportunities to intervene and correctly adjust medication orders. Pharmacists have documented nearly 500 interventions secondary to medication reconciliation. 10% have been categorized as making a "significant" impact upon patient care, with the remaining 90% "moderate". As evident by the efficient process and important interventions, P-CARE has further improved patient care aiding pharmacists to complete more thorough medication reconciliation.