AAP Section on Critical Care
Scientific & Educational Program
Abstract & Poster Presentations

AAP National Conference & Exhibition
October 21-22, 2012
New Orleans, LA
Section on Critical Care Program & Reception - Day 1  
*Scientific Abstract Presentations and Treatment of Respiratory Failure*

**Session Description/Objectives:**
This session will enable physicians, physician trainees, nurses, and other healthcare professionals to present original research in both oral/platform and poster presentation formats. The attendee will become conversant in new research in the field of pediatric critical care.

8:00 – 8:15 am  
*Introduction:* Brad Poss, MD, MMM, FAAP

8:15 – 9:30 am  
**Oral Abstract Session I**  
*Moderators: Mary Lieh-Lai, MD, FAAP & Donald Vernon, MD, FAAP*

1. 8:15 am  
   #16945 **Christopher L. Carroll**  
   Location of Intubation & Duration of Ventilation in Children with Acute Asthma

2. 8:30 am  
   #17317 **Joana Anjeh Tala**  
   Hyperglycemia Increases the Risk of Deep Venous Thrombosis in Non-Diabetic Critically Ill Children

3. 8:45 am  
   #18284 **Katherine Slain**  
   Predicting Mortality in Pediatric Respiratory Failure: Feasibility of the Oxygenation Index Area under the Curve

4. 9:00 am  
   #17065 **Jonathan W. Byrnes**  
   Effect of Antithrombin Supplementation in Pediatric Cardiac Extracorporeal Membrane Oxygenation

5. 9:15 am  
   #18442 **Antonio G. Cabrera**  
   Effect of Dexmedetomidine in Children with Trisomy 21 Undergoing Congenital Heart Surgery

9:30 – 10:30 am  
**Poster Walk Rounds & Coffee Break**

**Group I**  
*Moderators: Alice Ackerman, MD, MBA, FAAP & John Straumanis, MD, FAAP*

- #15923 **Ingrid Anderson**  
  Epidemiology of Hospital Based Emergency Department Visits Due to Central Venous Catheter Related Blood Stream Infection among Children in the U.S.

- #17830 **Alicia DeMarco**  
  Pediatric Mortality Risk Scores and Initiation of End-of-Life Discussions in a Tertiary Pediatric Intensive Care Unit

- #18288 **Kristen Nelson-McMillan**  
  Vitamin D Deficiency in a Pediatric Intensive Care Unit
• #18361  **Kristen Nelson-McMillan**  
Isoflurane Use in Children with Severe Status Asthmaticus

• #18638  **Venessa L. Pinto**  
Clostridium Difficile Associated Disease among Children in a Pediatric Intensive Care Unit

**Group 2**
*Moderators: Carley Riley, MD, MPP, FAAP & Edward Conway Jr, MD, MS, FAAP*

• #17063  **Pooja A. Nawathe**  
Severe Hemorrhagic Coagulopathy with Hemophagocytic Lymphohistiocytosis Secondary to Epstein - Barr Virus Associated T-Cell Lymphoproliferative Disorder

• #17372  **Jeffrey E. Vergales**  
Face-to-Face Handoff: Improving Transfer to the Pediatric Intensive Care Unit after Cardiac Surgery

• #17808  **James L. Laham**  
Clinical Parameters to Predict Extubation Outcome in the Pediatric Intensive Care Unit

• #18216  **Geetha Challapudi**  
Outcomes of Tracheostomies in Children with Congenital Heart Disease

• #18624  **Brittany K. Potts**  
The Myth of Preventable PICU Readmissions: A Review Using a Local Clinical Database

10:30 – 12:00 pm  **Oral Abstract Session II**
*Moderators: Alice Ackerman, MD, MBA, FAAP & Richard Mink, MD, MACM, FAAP*

1. 10:30 am  #16153  **Marek J. Grzeszczak**  
Effect of Clinical Practice Variation on the Outcomes of Diabetic Ketoacidosis in Children

2. 10:45 am  #18730  **Paul M. Jeziorczak**  
Glycyrrhizic Acid Does Not Reverse Micro particle-Induced Pulmonary Endothelial Permeability

3. 11:00 am  #15759  **Eliyahu C. Rosman**  
What Are We Missing? Arrhythmia Detection and Alarm Fatigue in the PICU

4. 11:15 am  #17347  **Matthew Pinto**  
RSV Related Apnea – A Multicenter Regional Review of Incidence, Risk Factors and Outcomes

5. 11:30 am  #16363  **Brent Whittaker**  
Predicting Outcomes in Pediatric Blunt Trauma

11:45 – 1:00 pm  **Lunch**
Session Description/Objectives:
This session will update attendees on several of the newly developed means to provide respiratory support to critically ill children including the use of non-invasive ventilation techniques such as BiPAP and high flow nasal cannula. Participants will also receive education on one of the newer ventilatory modes being used in children, applied pressure release ventilation (APRV). The final session will discuss how to provide respiratory support in resource limited areas of the world.

Treatment of Respiratory Failure: So Many Options

1:00 – 1:10 pm  Introduction:
Brad Poss, MD, MMM, FAAP

1:10 – 2:00 pm  Non-Invasive Ventilation: Who Needs an Endotracheal Tube?
Gerhard Wolf, MD

2:00 – 2:50 pm  Airway Pressure Release Ventilation: Take a Deep Breath and Hold!
Ellie Hirshberg, MD

2:50 – 3:10 pm  Coffee Break

3:10 – 4:00 pm  Respiratory Failure Around the World: Ventilation with Limited Resources
Niranjan “Tex” Kissoon, MD, FAAP

4:00 – 4:15 pm  Panel Discussion

4:15 – 4:30 pm  SOCC Business Meeting
Donald Vernon, MD, FAAP, Chair

4:30 – 5:00 pm  Presentation of SOCC Distinguished Career Award
Recipient: Niranjan Kissoon, MD, FAAP
Presented by: Timothy Yeh, MD, FAAP

5:00 – 6:00 pm  Reception, Viewing of Posters, Abstract Awards (ROOM 346-347)
Section on Critical Care Program - Day 2
Trauma in the ER, the ICU and Beyond

JOINT PROGRAM WITH SECTION ON EMERGENCY MEDICINE

Session Description/Objectives:
The traumatic brain injury session will discuss the evidence based therapy for children who suffer traumatic brain injury as well as the challenges, controversies, and cutting edge therapies. The multi-trauma discussion will center on stabilization and treatment of this condition and include discussions on the transition from emergency department to the OR and the ICU. The pediatric war injury discussion will be led by a practitioner with experience in recent military action and will include an overview of the types of injuries encountered and the challenges of treating these children. The session objectives are: 1) To understand and apply the most recent evidence based care for children with traumatic brain injury; 2) To understand the challenges in caring for children with multiple traumatic injuries; and 3) To have an overview of the types of traumatic injuries children experience in war and the challenges to the military trauma system.

Trauma in the ER, the ICU and Beyond

8:30 – 8:45 am  Introduction
Brad Poss, MD, MMM, FAAP

8:45 – 9:40 am  Traumatic Brain Injury
Courtney Robertson, MD, FAAP

9:40 – 10:35 am  Multi-Trauma Injuries
Adam Silverman, MD, FAAP

10:35 – 11:30 am  Pediatric War Injuries
CAPT Jon Woods, MD, MC, USN

Note:  Dr Silverman and CAPT Woods will participate in a Meet the Faculty session for all conference attendees on Sunday, October 21 – AAP Resource Center, Booth 1443, Convention Center. Dr Silverman is scheduled from 12:30-1:15pm and CAPT Woods from 5:30-6:15pm.
LOCATION OF INTUBATION & DURATION OF VENTILATION IN CHILDREN WITH ACUTE ASTHMA
Richard Uluski, MD, Ranjini Srinivasan, MD, Kathleen A. Sala, MPH, Laurie Karamessinis, CRT, RPFT, CCRC, Sharon R. Smith, MD and Christopher L. Carroll, MD, MS, Connecticut Children's Medical Center, Hartford, CT

Purpose: Respiratory failure, although a relatively rare occurrence, carries a high burden of morbidity in children with asthma. Additionally, there is a considerable lack of research suggesting which children with acute asthma require intubation for respiratory failure. Location of intubation has been linked to duration of intubation previously, but only in a small cohort single center study. Our objective was to examine the impact of location of intubation in a large multi-center cohort.

Methods: We conducted a retrospective review of children intubated for acute asthma using the international, multi-institutional VPS database. Clinical characteristics and outcomes were compared between children intubated in the ICU setting and in the non-ICU setting. Children less than 2 years of age and with chronic conditions were excluded.

Results: Between 2009-2011, there were 2,746 children included in the VPS database who were intubated for acute asthma and met study criteria; 1,984 of these were intubated in the non-ICU setting and 762 were intubated in the ICU. There were no significant differences in the ages (71 ± 67 vs. 68 ± 66 months, p=0.36) or race/ethnicities of children intubated in the non-ICU setting and those intubated in the ICU. However, children intubated in the non-ICU setting were significantly less acutely ill (PRISM3 5.8 ± 6.0 vs. 6.6 ± 5.8, p=0.0006) and had significantly shorter durations of mechanical ventilation (3.2 ± 5.5 vs. 7.6 ± 9.3 days, p<0.0001) and ICU lengths of stay (5.5 ± 9.3 vs. 12.9 ± 15.7 days, p<0.0001) than children intubated in the ICU setting.

Conclusion: Children intubated in a non-ICU setting were less acutely ill, and intubated for shorter durations of time than children intubated in the ICU. These children intubated outside the ICU who require short durations of intubation may represent either an acute asphyxial asthma sub-type or a lower threshold for intubation in providers outside of the ICU setting.

HYPERGLYCEMIA INCREASES THE RISK OF DEEP VENOUS THROMBOSIS IN NON-DIABETIC CRITICALLY ILL CHILDREN
Joana Anjeh Tala, MD, Pediatric Intensive Care Unit, Yale New Haven Hospital, New Haven, CT, Sree Pemira, MD, Pediatrics, Yale University School of Medicine, New Haven, CT, Cicero T. Silva, MD, Diagnostic
**Purpose/Background:** Deep venous thrombosis (DVT) is common in diabetic children admitted to the intensive care unit (ICU) with ketoacidosis. It is unclear whether hyperglycemia, in the absence of diabetes mellitus, increases the risk of DVT in critically ill children.

**Objective:** To determine the incidence, association and acute outcomes of DVT in non-diabetic critically ill children with hyperglycemia

**Methods:** We performed a retrospective cohort study using data from critically ill children admitted to a tertiary ICU from 1/1/2007 to 12/31/2010. We included non-diabetic children ≤18 years on invasive mechanical ventilation (MV) or vasopressor support with blood glucose ≥150mg/dl. From each subject’s medical records, we collected data on the presence of radiologically confirmed DVT, maximum blood glucose prior to the diagnosis of DVT and patient characteristics. We calculated ventilator (VFD), ICU (ICUFD) and hospital free days (HFD) (defined as the number of days within 28 days after study inclusion that the subject is alive and off MV, ICU and hospital, respectively). We presented the incidence of DVT as proportion of subjects with DVT. Logistic regression was used to determine the association between DVT and hyperglycemia. We compared the VFD, ICUFD and HFD between subjects with and without DVT using t-test and linear regression

**Results:** Of the 475 subjects included in the study, 27 developed DVT for an incidence of 5.7 per 100 subjects. This was significantly higher than the DVT rate for all ICU admissions during the study period (0.9 per 100 subjects, \( P < .001 \)). Maximum blood glucose was significantly higher in those with DVT (309±170 mg/dl vs. 232±89 mg/dl, \( P = .03 \)). After adjusting for age, diagnosis, presence of central venous catheter and vasopressor support, maximum blood glucose was independently associated with DVT with an adjusted odds ratio of 1.04 (95% confidence interval: 1.01-1.06, \( P = .01 \)) for every 10 mg/dl increase in maximum blood glucose. Subjects with DVT had worse acute outcomes with less VFD, ICUFD and HFD. After adjusting for age, severity of illness score and maximum blood glucose, subjects with DVT had 2.9 less VFD (\( P = .11 \)), 4.8 less ICUFD (\( P = .007 \)) and 3.7 less HFD (\( P = .06 \)) compared to those with no DVT.

**Conclusion:** In this cohort of critically ill non-diabetic children, hyperglycemia increases the risk of DVT. The incidence of DVT is higher than the general ICU population and children with DVT have worse acute outcomes. The increased risk of DVT in this cohort of critically ill children suggests that in the appropriate setting, clinicians should have a low index of suspicion for working up these children for DVT. The data also suggest that these children may be targeted for future studies on thromboprophylaxis.

8:45 AM – 18284
**PREDICTING MORTALITY IN PEDIATRIC RESPIRATORY FAILURE: FEASIBILITY OF THE OXYGENATION INDEX AREA UNDER THE CURVE**

*Katherine Slain, DO¹, Michael L. Forbes, MD, FAAP² and Richard Wendorf, MD², (1) Graduate Medical Education, Akron Children's Hospital, Akron, OH, (2) Critical Care, Akron Children's Hospital, Akron, OH*

**Purpose:** Multiple multicenter, retrospective studies have consistently identified the oxygenation index (OI) as a potential prognostic indicator in pediatric respiratory failure. It has also been recommended as a possible predictor of success for extracorporeal membrane oxygenation (ECMO). Numerous models have suggested that maximum OI or sustained elevations of OI over time are associated with poor outcomes in cases of severe pediatric respiratory failure. We hypothesized that the cumulative area under the OI curve (OI-AUC) in the 24h transition from conventional (CMV) to high frequency oscillating ventilation (HFOV) would predict mortality in cases of pediatric respiratory failure.

**Methods:** Using a local PICU database (VPS, https://www.portal.myvps.org) we identified patients with acute respiratory failure who eventually were treated with HFOV. Point-of-care hourly ABGs and clinical information from the electronic health record were used to calculate the OI (Mean Airway Pressure (MAP) x FiO2 x 100)/PaO2 starting at 24h prior to the transition from CMV to HFOV. OI was then calculated for each hour
until 48h after HFOV cessation or death. The OI-AUC is the integrated sum of all OI values. A receiver operator characteristics (ROC) curve was derived using the OI-AUC (minimum > 300) with survival/non-survival as outcomes. Data are presented as median (range).

**Results:** 28 patients (68% male) were eligible for analysis with an average age of 112.6 months. The median OI-AUC was higher in non-survivors (n=6), 2920.7 (836-5293) vs 1931.7(372.2-9568.7), p>0.05, Mann-Whitney U test. The ROC AUC was 0.65 (0.386-0.914) using 2663.6 as threshold.

**Conclusion:** The OI-AUC appears to be a satisfactory metric for predicting death in pediatric respiratory failure. While the small sample size limits generalizability, the feasibility of the model is encouraging as bedside OI calculations are simple, are easily automated, and, in aggregate, may have predictive value. Mathematically modeling the decision to provide ECMO support and its timing may facilitate further standardization of practice and improve outcomes. Further investigation is warranted.

**EFFECT OF ANTITHROMBIN SUPPLEMENTATION IN PEDIATRIC CARDIAC EXTRACORPOREAL MEMBRANE OXYGENATION**

Jonathan W. Byrnes, Pediatrics, University of Arkansas for Medical Sciences, Little Rock, AR, Christopher J. Swearingen, PhD, Pediatrics--Biostatistics, University of Arkansas for Medical Sciences, Arkansas Children's Hospital, Little Rock, AR, Parthak Prodhan, MBBS, Pediatrics, University of Arkansas for Medical Sciences, Arkansas Children's Hospital, Little Rock, AR, Richard Fiser, MD, Pediatric Critical Care, Arkansas Children's Hospital, Little Rock, AR and Umesh Dyamenahalli, Pediatric Cardiology and Cardiac Critical Care, University of Arkansas for Medical Sciences, Arkansas Children's Hospital, Little Rock, AR

**Purpose:** Recombinant antithrombin III (rATIII) is used as an adjunct to heparin in anticoagulation during extracorporeal membrane oxygenation (ECMO) based on physiologic rationale and studies in patients on cardiopulmonary bypass. In February 2008 our institution began using rATIII as replacement for low antithrombin III (ATIII) levels (<70%) in patients supported with ECMO. We hypothesize that rATIII administration will result in reductions in heparin infusion rates, increases in unfractionated heparin anti-Xa (UF anti-Xa) levels, and longer effective life of the extracorporeal circuit.

**Methods:** We collected clinically pertinent data on 40 consecutive cardiac patients who represented 46 ECMO deployments; each was supported more than 72 hours with venoarterial ECMO from January 1, 2007 through December 31, 2008. While on ECMO patients are monitored by measuring activated clotting time (ACT) and heparin levels along with platelet count, prothrombin time and fibrinogen. Blood concentration of ATIII was measured at least once daily as part of routine clinical care, and rATIII concentrate was supplemented for concentrations < 70%. We questioned what effect rATIII supplementation had upon anticoagulation and circuit survival. A reduction of greater than 10% in the heparin infusion rate with stable ACT range after ATIII supplementation within the treatment group was a primary outcome. Secondary outcomes were response of UF anti-Xa level in response to rATIII administration within the supplementation group and duration of circuit life in supplemented versus unsupplemented controls.

**Results:** No difference in heparin infusion rates was observed regardless whether rATIII was administered (p=0.245) (Table 1). Unfractionated heparin anti-Xa levels were lower at the time of administration and were increased following rATIII supplementation (p < 0.001) within the supplemented group. There was however increased incidence of circuit failure in rATIII-supplemented group compared to the unsupplemented controls (p=0.018) (Figure 1).

**Conclusion:** Heparin responsiveness is not altered by daily rATIII supplementation in our study population, although there was a statistically significant if not a clinically significant effect increase in UF anti-Xa levels. The supplementation of rATIII did not prolong ECMO circuit life. Further prospective studies are necessary to determine whether the routine administration of rATIII is warranted in patients supported on ECMO.
Table 1. Estimated Differences in Measures of Coagulation Based on Routine rATIII Replacement.

<table>
<thead>
<tr>
<th>AT-III Treatment</th>
<th>No</th>
<th>Yes</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heparin Dose</td>
<td>31.0 (1.2)</td>
<td>30.4 (1.1)</td>
<td>0.665</td>
</tr>
<tr>
<td>10% Heparin Reduction</td>
<td>32.9%</td>
<td>38.4%</td>
<td>0.5215</td>
</tr>
<tr>
<td>20% Heparin Reduction</td>
<td>17.8%</td>
<td>29.3%</td>
<td>0.1061</td>
</tr>
<tr>
<td>Anti-Xa*</td>
<td>0.25 (0.02)</td>
<td>0.19 (0.02)</td>
<td><strong>0.001</strong></td>
</tr>
</tbody>
</table>

*Treatment effect modeled using Generalized Estimating Equation (GEE). Estimated in 21 Patients over 221 Observations using Repeated Measures Linear Regression Adjusting for Age at ECMO Cannulation

Figure 1. Estimated Cumulative Incidence of Circuit Change by AT III Administration by Cox Regression Adjusting for Disease Group and Day of Life ECMO Started in 40 Patients with 74 Circuit Changes

---

EFFECT OF DEXMEDETOMIDINE IN CHILDREN WITH TRISOMY 21 UNDERGOING CONGENITAL HEART SURGERY

Antonio G. Cabrera, MD, David Morales, MD, Gerald Adams, PhD, Emad Mossad, MD and Brady Moffett, PhD, Section of Pediatric Cardiology, Department of Pediatrics, Baylor College of Medicine/Texas Children's Hospital, Houston, TX

9:15 AM – 18442
Purpose: Dexmedetomidine (DEX) is a novel sedative agent with minimal respiratory depressive effects. The use of DEX in post-operative pediatric cardiac surgical patients may improve outcomes. Patients with Trisomy 21 that have undergone cardiac surgery can be difficult to sedate and extubate. DEX may be a useful agent to improve post-operative outcomes. The purpose of our study was to assess the outcomes of children with Down syndrome treated with DEX as adjunct sedation after congenital heart surgery.

Methods: A retrospective case matched study was conducted using the Pediatric Health Information System (PHIS) database from 2009-2010 for all patients with Trisomy 21 (ICD-9 code 758.0) who underwent a cardiac surgical procedure. Patients who received DEX were matched to patients who did not receive DEX by propensity score matching by age, gender, and RACHS-1 score. Patients were excluded if they did not have a match, received extracorporeal membrane oxygenation or ventricular assist device, had an open sternum in the ICU, or had missing data. A sample of approximately 500 patients per group was estimated to detect approximately a 20% difference in the primary outcome of ventilator days.

Results: 1,434 patients met study criteria and propensity score matching resulted in 356 matched pairs (712 patients). Baseline characteristics were similar between the two groups with the exceptions of increased dopamine use in the non-DEX group and increased vasopressin use in the DEX group (p<0.05). Patients in the DEX group received DEX for a median of 8 days (Range 3-166 days). Proportionally more patients in the DEX group received morphine, lorazepam and ketorolac and fewer patients received fentanyl or midazolam (p<0.05). There was no difference in ventilator days (6.5 (1-535) vs. 7 (1-165), p =0.07) in DEX and non-DEX groups, and no difference in ICU length of stay (4 (0-127) vs. 4 (0-166), p=0.94), hospital length of stay (6 (2-534) vs.7 (2-165), p=0.33), mortality (0.28% vs. 0.84%, p=0.32) or incidence of bradyarrhythmias (11.2% vs. 10.7%, p=0.81).

Conclusion: Use of DEX does not improve outcomes in patients with Trisomy 21 who have undergone surgery for congenital heart disease
EFFECT OF CLINICAL PRACTICE VARIATION ON THE OUTCOMES OF DIABETIC KETOACIDOSIS IN CHILDREN

Marek J. Grzeszczak, MD, Pediatric Intensive Care, Huntsville Hospital for Women and Children, Huntsville, AL

Purpose: Diabetic ketoacidosis (DKA) accounts for the majority of hospital admissions in pediatric patients with insulin dependent diabetes mellitus. DKA management is based on organizational consensus statements and institutional protocols and guidelines. Management of DKA is mostly based on level E evidence (expert consensus or clinical experience) rather than level A evidence. Consequently recommendation is to repeat laboratory tests every 2-4 hours or more often. In our institution two clinical management strategies are in use: one with frequent laboratory tests (lab intense-LI) and the second with less frequent tests usually 6 to 12 hours intervals or additional testing when there is a deviation from the anticipated clinical course (lab restrictive-LR). This study was set to compare the clinical outcomes in DKA using these two different managements. We specifically evaluated: 1. duration of insulin infusion, 2. Incidence of insulin infusion restart, 3. Incidence of readmission within 48 hours after discharge, 4. Laboratory utilization and cost of hospitalization.

Methods: Medical records of patients admitted with diagnosis of DKA between March 2010-April 2011 were reviewed. 16 patients in the LI group and 14 in the LR group were identified. The demographics, clinical attributes and the outcomes are listed in Tables 1 and 2. Student t test was used.

Table 1. Mean and (SD)

<table>
<thead>
<tr>
<th></th>
<th>Age yr</th>
<th>Sex</th>
<th>New IDDM</th>
<th>pH</th>
<th>BE Neg</th>
<th>CO2</th>
<th>AG</th>
<th>Na</th>
<th>BG</th>
</tr>
</thead>
<tbody>
<tr>
<td>LI</td>
<td>11.2</td>
<td>F-8</td>
<td>3</td>
<td>7.14</td>
<td>19.3</td>
<td>8.3</td>
<td>29.5</td>
<td>132</td>
<td>612</td>
</tr>
<tr>
<td></td>
<td>(3.9)</td>
<td>M-8</td>
<td></td>
<td>(0.1)</td>
<td>(5.8)</td>
<td>(3)</td>
<td>(5.8)</td>
<td>(6)</td>
<td>(418)</td>
</tr>
<tr>
<td>LR</td>
<td>10.6</td>
<td>F-7</td>
<td>3</td>
<td>7.14</td>
<td>18.5</td>
<td>9.4</td>
<td>30.1</td>
<td>133</td>
<td>601</td>
</tr>
<tr>
<td></td>
<td>(4.9)</td>
<td>M-7</td>
<td></td>
<td>(0.2)</td>
<td>(6)</td>
<td>(4)</td>
<td>(7.6)</td>
<td>(5.8)</td>
<td>(214)</td>
</tr>
</tbody>
</table>

Table 2. Mean (SD) and p-value

<table>
<thead>
<tr>
<th></th>
<th># of VBG</th>
<th># of Mg</th>
<th># of Phos</th>
<th># of BMP</th>
<th>Insulin hr</th>
<th>Cost $</th>
</tr>
</thead>
<tbody>
<tr>
<td>LI</td>
<td>12.3</td>
<td>5.6</td>
<td>5.5</td>
<td>7</td>
<td>30.2</td>
<td>27,39</td>
</tr>
<tr>
<td></td>
<td>(10)</td>
<td>(4.5)</td>
<td>(4.6)</td>
<td>(4.7)</td>
<td>(31.5)</td>
<td>(32,996)</td>
</tr>
<tr>
<td>LR</td>
<td>3.7</td>
<td>0</td>
<td>0</td>
<td>2.5</td>
<td>17.6</td>
<td>11,235</td>
</tr>
<tr>
<td></td>
<td>(1.3)</td>
<td></td>
<td></td>
<td>(0.8)</td>
<td>(7.3)</td>
<td>(5273)</td>
</tr>
</tbody>
</table>
P value 0.001 0.0008 0.06 0.03

Results: There was no statistical difference between the two groups at the time of admission in regard to age, gender, values of pH, base deficit (BE), CO2, anion gap-AG, sodium and blood glucose (BG). None of the patient had to be placed back on insulin infusion or readmitted to the hospital. Insulin infusion was shorter in the LR group. There was a significant difference in laboratory usage (VBG, BMP, Mg and Phos, # of samples). There was a significant difference in cost of hospitalization with mean cost of $11.235 in the LR group and $27.392 in the LI group. This represents a mean difference of $ 16.163 per patient per hospitalization.

Conclusion: This small study demonstrates that clinically comparable outcomes are achievable using restrictive laboratory tests in the management of the pediatric patients with DKA. This strategy results in significant cost and resource utilization reduction without affecting outcomes.

10:45 AM – 18730
GLYCYRRHIZIC ACID DOES NOT REVERSE MICROPARTICLE-INDUCED PULMONARY ENDOTHELIAL PERMEABILITY
Paul M. Jeziorczak, MD, MPH1, James A. Rydlewicz, MD1, Sushma Kaul, MS2, Christopher J. Kuckleburg, DPhil and John C. Densmore, MD3, (1) Pediatric Surgery, Medical College of Wisconsin/Children’s Hospital of Wisconsin, Milwaukee, WI, (2) Blood Research Institute, Blood Center of Wisconsin, Milwaukee, WI

Purpose: Respiratory complications are major causes of patient morbidity and mortality. Amongst these, Acute Lung Injury (ALI) and the Acute Respiratory Distress Syndrome (ARDS) remain challenging clinical entities with only supportive therapeutic options. Our previous work with Endothelium-derived micro particles (EMPs) has shown their ability to induce oxidative injury, inflammation, and increase pulmonary capillary permeability with granulocyte cotreatment. High mobility group box 1 (HMGB-1) is a major histone protein with cytokine-like effects capable of inducing further inflammation. Previous studies have shown that HMGB-1 release leads to increased pulmonary endothelial permeability. The early onset of these changes closely matches those seen in EMP-induced ALI. In this study we hypothesize that a functional inhibitor of extracellular HMGB-1, Glycyrrhizic acid, will protect against EMP-induced pulmonary endothelium permeability changes.

Methods: 60,000 human pulmonary artery endothelial cells (HPAEC, Lonza, Switzerland) were seeded in an 8 chambered slide coated with 1% gelatin and cultured to confluence in 4% FBS medium. EMPs were generated from plasminogen activator inhibitor-1 (PAI-1; 10ng/ml) stimulated human umbilical vein endothelial cells (HUVECs). HL-60 cells (Human Promyelocytic Leukemia) were transformed into mature granulocytes by incubating them with 1.2% dimethyl sulfoxide (DMSO) for 5-7 days. Resistance measurements were made in the presence and absence of EMPs (500,000/ml) and HL-60 cells (200,000/mL). Cells were either treated with HMGB-1 (20ug/ml), or Glycyrrhizic acid (1mM) or both in the presence or abscess of EMPs and HL-60s. 2.5U/ml Thrombin (Sigma) was used as positive control. Individual well impedance was measured using Applied Biophysics ECIS Z Theta (electric cell substrate impedance sensing) equipment. Statistical analysis was performed using a two way ANOVA.

Results: Repeated resistance measurements show increased HPAEC permeability in cells co-treated with EMPs and HL-60 cells or with HMGB-1 respectively at 3-4 hours with subsequent plateau (p<.0001). Cells treated with the combination of HMGB-1 and Glycyrrhizic acid show a partial reversal of the permeability changes (p<.001). However, this same reversal was not seen in the EMP/HL-60 treated HPAECs.

Conclusions: Previous studies have shown the important role of HMGB-1 in the inflammatory cascade and its prominent role in human ALI/ARDS. While HMGB-1 induced permeability changes occur in three to four hours after endothelial cell treatment with subsequent plateau and match the pattern of EMP/granulocyte injury, attempts to abrogate this effect using glycyrrhizic acid were unsuccessful. This lack of effect could be due to inadequacy if glycyrrhizic acid to block other B box binding domains (e.g. RAGE) or HMGB1-independent mechanism. Glycyrrhizic acid, a commercially available direct HMGB-1 inhibitor, only partially protects against HMGB1-induced permeability changes at high doses (1mM). Identifying a more complete inhibitor or
receptor blocker is an important next step. EMP-induced granulocyte activation and the role of additional cytokine activation are ongoing areas investigation.

11:00 AM – 15759
WHAT ARE WE MISSING? ARRHYTHMIA DETECTION AND ALARM FATIGUE IN THE PICU
Eliyahu C. Rosman, MD1, Amanda Menco, MD2, Andrew D. Blaufax, MD1, Randi Trope, MD1 and Howard S. Seiden, MD1, (1) Pediatric Cardiology, Steven and Alexandra Cohen Children's Medical Center of NY, New Hyde Park, NY, (2) Pediatrics, Steven and Alexandra Cohen Children's Medical Center of NY, New Hyde Park, NY, (3) Pediatric Critical Care, Steven and Alexandra Cohen Children's Medical Center of NY, New Hyde Park, NY

Purpose: The utility of routine daily review of rhythm alarms in non-cardiac pediatric intensive care unit (PICU) patients has not been reported. We hypothesized that instituting a process of daily review of all recorded rhythm alarms in a PICU would improve detection of clinically relevant rhythm disturbances. We also sought to determine if daily review of heart rate (HR) trends and rhythm alarms could provide insight into alarm setting adjustments that could be made in an attempt to reduce clinically irrelevant alarms, thereby reducing the risk of alarm fatigue.

Methods: All non-cardiac patients admitted to the PICU during a consecutive 28 day study period were evaluated prospectively. Daily HR trends, total monitor alarms, and rhythm alarms were recorded. Rhythm alarm recordings were independently reviewed by two members of the study team. Critical arrhythmia alarms include asystole, ventricular tachycardia/fibrillation (VT), and extreme bradycardia or tachycardia, defined as 20 bpm above or below the upper or lower HR limits, respectively. Medical records were reviewed for patients who had critical arrhythmia alarms demonstrating asystole or VT.

Results: 86 patients (343 patient-days) were evaluated. There were 54,656 total alarms (1.35 alarms/minute), 34,686 (63%) non-rhythm alarms and 19,970 (37%) rhythm alarms (1 alarm every 2 minutes). There were 15,938 (80%) non-critical rhythm alarms and 4,032 (20%) critical rhythm alarms. Of the non-critical alarms, at least 40% were artifactual. Of the 6,239 true non-critical alarms reviewed, 5,172 (83%) were HR alarms, 198 (3%) ventricular ectopy or pause alarms, and 869 (14%) other. Of the critical alarms, at least 56% were artifactual. Of the 883 true critical alarms reviewed, 865 (98%) were for extreme tachycardia or bradycardia. Of 1,786 VT alarms, 17 were true episodes of VT that occurred in 5 patients, none of which were detected by the clinical staff at the time of occurrence. Management of 2 of these patients was altered by virtue of detection of these rhythm disturbances, including 1 with a PICC line that migrated into the right ventricle and 1 with sepsis syndrome who was subsequently diagnosed with myocardial dysfunction and was ultimately initiated on beta-blocker therapy. Analysis of HR trends and alarms indicate that raising and lowering the default upper and lower HR alarm limits, respectively, by 20 bpm and turning off specific non-critical alarms (irregular rhythm, missed beat, multiform PVC) would have reduced the number of total monitor alarms by 16% and the rhythm alarms by 44% without missing clinically relevant events.

Conclusion: Daily review of rhythm alarms improves detection of clinically relevant rhythm disturbances in non-cardiac PICU patients. Adjustment of alarm parameters and default settings would reduce the total number of alarms and rhythm alarms which may improve detection of clinically relevant alarms and decrease the risk of alarm fatigue.

11:15 AM – 17347
RSV RELATED APNEA - A MULTICENTER REGIONAL REVIEW OF INCIDENCE, RISK FACTORS AND OUTCOMES
Simon Li, MD, MPH1, Michael F. Canarie, MD2, Christopher L. Carroll, MD3, E. Vincent S. Faustino, MD4, John S. Giuliano Jr., MD5, Aalok R. Singh, MD1 and Matthew G. Pinto, MD1, (1) Pediatric Critical Care, New York Medical College, Valhalla, NY, (2) Pediatric Critical Care, Tufts School of Medicine, Springfield, MA, (3) Pediatric Critical Care, Connecticut Children’s Medical Center, Hartford, CT, (4) Pediatric Critical Care,
Purpose: Respiratory syncytial virus (RSV) is the leading infectious agent for young children who are admitted to the hospital with respiratory illnesses. RSV is known to cause apnea in these children with a wide-ranging incidence of 1.7-23.8%. Infants are the predominant group to manifest apnea secondary to RSV. Development of apnea in RSV is thought to lead to increased healthcare utilization. We conducted this study to determine the incidence, risk factors and outcomes of children admitted in the pediatric intensive care unit (PICU) with RSV related apnea.

Methods: We conducted a retrospective cohort study of 312 children admitted to the PICU of four children's hospitals in the northeast United States with RSV bronchiolitis between July 2009 and July 2011. Children were classified as having apnea according to a priori established definition including both historical and witnessed apnea. Univariate and multivariate analytic methods were used to determine the association of risk factors for apnea and for the association of apnea with outcomes. Collinearity was assessed and those with high correlation were eliminated from the multivariate models.

Results: In this cohort, 18.27% had RSV related apnea. The age ranged from newborn to 2 years old. In the univariate analysis, patients who developed apnea were significantly younger, weighed less, had history of prematurity and were more likely to have received palivizumab. Ninety-five percent of apneic patients were <6 months old and weighed <6 kg. In the multivariate analysis, apnea was more likely to occur in children who weighed less (OR 0.56, 95% CI 0.44-0.72). Both prematurity and RSV seasonality trended towards significance in positive association with apnea. Children with apnea were more likely to be invasively mechanically ventilated in the univariate analysis (OR 1.97, 95% CI 1.06-3.66). However, after factoring in PIM 2 score, race/ethnicity, and site there was no association between apnea and invasive or noninvasive ventilation. There was also no association between apnea and length of mechanical ventilation, ICU stay, or overall hospital stay.

Conclusion: Nearly 1 in 5 children admitted to the PICU with RSV had apnea. RSV patients with apnea seem to have outcomes similar to those without apnea. Younger children who weighed less were more likely to present with apnea due to RSV infection. Interestingly, there was a trend of association between apnea with different RSV seasons and history of prematurity. Further research is needed to explore these possibly important relationships.

Table: Multivariate adjusted risk for apnea\(^a\)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>% Apnea Cases</th>
<th>Adjusted OR (95% CI)</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td></td>
<td>0.56 (0.44-0.72)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Gestational Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full term</td>
<td>14.74%</td>
<td>Reference</td>
<td>---</td>
</tr>
<tr>
<td>Preterm (&lt;36 weeks)</td>
<td>32.79%</td>
<td>1.94 (0.88-4.30)</td>
<td>0.101</td>
</tr>
<tr>
<td>RSV Season</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009-2010</td>
<td>20.56%</td>
<td>Reference</td>
<td>---</td>
</tr>
<tr>
<td>2010-2011</td>
<td>15.15%</td>
<td>0.47 (0.22-1.01)</td>
<td>0.053</td>
</tr>
</tbody>
</table>

\(^a\) Adjusted factors were weight, history of prematurity (<36 weeks gestation), RSV season

11:30 AM – 16363

PREDICTING OUTCOMES IN PEDIATRIC BLUNT TRAUMA

Brent Whittaker, MD\(^1\), Jeffrey Kerby, MD\(^2\), Mike K. Chen\(^3\), Jessica Altice, MaEd\(^4\) and Jean-Francois Pittet, MD\(^5\), (1)Pediatric Critical Care, University of Alabama-Birmingham, Birmingham, AL, (2)Surgery, University of Alabama-Birmingham, Birmingham, AL, (3)Pediatric Surgery, Children's Hospital of Alabama, University of Alabama at Birmingham, Birmingham, AL, (4)Anesthesiology, University of Alabama-Birmingham, Birmingham, AL
**Purpose:** Trauma is the leading cause of death after the first year of life in pediatrics, but the tools for outcome prediction are complicated and non-specific. We hypothesized that by using 3 simple markers: Cardiac Arrest, Head injury and Coagulopathy, we can improve prediction of mortality for pediatric blunt trauma.

**Methods:** Retrospective chart review of all severe pediatric blunt trauma patients, seen over a 10 year period in the level 1 trauma center of a free standing Children’s Hospital. We evaluated all these patients for 1) Cardiac Arrest prior to PICU admission (A=arrest, a=no arrest), 2) Head injury, defined as skull fracture, intracranial bleed, or evidence of elevated ICP or cerebral edema on head CT (H=Head Injury, h=no head injury), and 3) Coagulopathy, defined as an INR of >=1.2 (C=coagulopathy, c=no coagulopathy). Patients were identified from the National Pediatric Trauma Registry and then individual charts were reviewed.

**Results:** 952 patients were included, of which 61 had a cardiac arrest, 505 patients had a head injury, and 386 had neither. Mean age was 8.6±5.1 years, and 61% of patients were male. Mechanism of injury was predominantly motor vehicle collisions (76%), but also included Non-Accidental Trauma (3.5%), falls and low speed collisions (20%). Of patients with head injury, 67% had a skull fracture, 72% had evidence of intracranial bleed, and 7.5% showed evidence of cerebral edema or increased ICP. Almost half (46%) of the patients had an INR >=1.2. Mortality of patients with traumatic cardiac arrest (group A) is 93.4% (57/61). In patients without cardiac arrest and without head injury, mortality is 0% in both those with (ahC) and without (ahc) coagulopathy, 0/150 and 0/236 respectively. For patients with a head injury and without cardiac arrest, those without coagulopathy (aHC) had lower mortality than those with coagulopathy (aHC). [1% (2/193) vs. 25.2% (61/242), p <0.0001] Mortality increases as INR increases. Although the elevation of INR is associated with a higher Injury Severity Score, the risk of mortality is also increased within groups of similar severity.

**Conclusion:** Mortality from pediatric trauma is strongly associated with cardiac arrest. For patients who have not suffered cardiac arrest, head injury with coagulopathy is strongly associated with mortality even at levels of INR that are only mildly increased. Stratifying patients based on AHC is a simple tool for predicting mortality of pediatric blunt trauma patients and requires only history, head CT, and coagulation studies. The AHC tool should next be used as a prospective predictor, then as support to evaluate outcomes after correction of coagulopathy in Head Injury.
(15923) Epidemiology of Hospital Based Emergency Department Visits Due to Central Venous Catheter Related Blood Stream Infection among Children in United States

Veerajalandhar Allareddy, MD, MBA¹, Ingrid M. Anderson, MD¹, Veerasathpurush Allareddy, BDS, MBA, PhD² and Min Kyeong Lee, DMD³, (1)Pediatric Critical Care and Pharmacology, University Hospitals, Rainbow Babies Children's Hospital, Cleveland, OH, (2)Dental Medicine, Harvard University, Boston, MA, (3)Department of Developmental Biology, Harvard School of Dental Medicine, Boston, MA

**Purpose:** Central line associated blood stream infections (CLABSI’s) are a major cause of morbidity and mortality in hospitalized patients. The objective of this study is to provide nationwide estimates and outcomes of pediatric emergency department (ED) visits for central venous catheter related blood stream infection among children.

**Methods:** The Nationwide Emergency Department Sample dataset for the years 2008 of the patients between ages 0-17 were included. The ICD-9-CM diagnostic codes for Central Venous Catheter Related Blood Stream Infection (999.31) were selected for analysis.

**Results:** A total of 4,212 pediatric ED visits occurred in 2008. Mean age at admission was 5.6 years among this cohort. Males comprised 60.5% of the ED visits. Payers were Medicare and Medicaid (60%), private insurance (34%), uninsured (1%), and other government plans (4%). Most ED visits (93%) were admitted to the same hospital. The mean ED charge per visit was $1,226, and the total US hospitalization ED charges was $2.8 million. Among those were admitted to the same hospital, the mean hospitalization charge was $123,297, and the total US charge was $481 million. The mean length of stay after admission into hospital was 17.6 days, and the total hospitalization days was 68,975.

**Conclusion:** In children, CLABSI’s as the primary cause of ED visit accounts for significant resource utilization.

(17830) Pediatric Mortality Risk Scores and Initiation of End-of-Life Discussions in a Tertiary Pediatric Intensive Care Unit

Alicia DeMarco, MD¹, Katherine Kruse, MD¹, Surender Rajasekaran² and Michael Stoiko, MD³, (1)Pediatrics, Grand Rapids Medical Education Partners, Helen DeVos Children's Hospital, Michigan State University-College of Human Medicine, Grand Rapids, MI, (2)Pediatric Critical Care, Helen DeVos Children's Hospital, Grand Rapids, MI, (3)Pediatric Critical Care, Helen DeVos Children's Hospital, Grand Rapids, MI
**Purpose:** The relationship between physiologic status and mortality risk has been investigated using tools such as the Pediatric Risk of Mortality III (PRISM III) score, Pediatric Logistic Organ Dysfunction (PELOD) score, and Pediatric Index of Mortality 2 (PIM 2) score. To date, the utility of these scores in predicting time to withdrawal or limitation of life sustaining therapies has not been investigated. We evaluated the PRISM III, PELOD, and PIM 2 scores as tools to predict time to critical conversations with families regarding end of life care in the pediatric critical care unit (PCCU).

**Methods:** Data were abstracted retrospectively from Virtual PICU Systems (VPS) and chart review. The study included 62 patients aged 0-18 years treated at a 30-bed PCCU between January 2009 and July 2011. Descriptive statistics were generated and expressed as mean +/- SD. T-test was used to compare the means of all continuous variables between groups. Pearson Chi-squared test was used to determine any relationship between categorical variables. Data analysis was done using SPSS software (V.17, 2008).

The mean age of the cohort was 7.6 +/- 5.9 years. Patients had an average ICU stay of 6.1 days (median 2). End of life discussions were initiated at 3.9 days (median 1), and withdrawal occurred 3.6 days (median 1) after discussions were initiated. Death occurred in 5.1 hours (range 0 – 3 days) after withdrawal. The mean PRISM III score of the cohort was 24.0 compared to 3.1 for all PCCU admissions over the same period; mean PELOD score was 28.9 versus 8.8.

**Results:** The sickest patients (PRISM III score > 10) had shorter PCCU stays (5.9 versus 14.9 days, P=0.002) and were less likely to have documentation of end of life discussions (25.2% versus 14.2%, P=0.043). Sicker children were significantly more likely to die within 48 hours of admission to the PCCU (58.3% versus 28.2%, P=0.03). Patients whose charts had no documentation of end of life discussions spent less time in the PCCU (1.7 versus 7.3 days, P=0.003), but were not necessarily sicker (PRISM III 23.8 versus 24.1, P=0.66).

**Conclusion:** End of life discussions are vital to helping families accept limitation or withdrawal of aggressive support, yet these discussions are often not documented in the medical record in our PCCU. Patients with the highest severity of illness scores die sooner and are less likely to have end of life discussions documented. The decision to withdraw support is extremely difficult for caregivers and families, on average requiring 3.6 days of discussion before this decision is made. Most children in our cohort passed away quickly after the parents’ decision to withdraw support. Further studies are needed to better define a best practice for end of life discussions with families and improve documentation of those discussions.

**Vitamin D Deficiency in a Pediatric Intensive Care Unit**

**Kristen Nelson-McMillan, MD, Pediatrics and Pediatric Anesthesiology and Critical Care Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, David Procaccini, PharmD, BCPS, Pediatric Pharmacy, Johns Hopkins Hospital, Baltimore, MD and Laura Davis, MS, RD, LD, CNSC, Pediatric Nutrition, Johns Hopkins Hospital, Baltimore, MD**

**Purpose:** Vitamin D is essential for calcium metabolism and bone health, but is also necessary for normal function of the immune and cardiovascular systems. Data from the National Health and Nutrition Examination Survey (NHANES) 2001-2004 revealed 70% of the U.S. pediatric population is either vitamin D deficient or insufficient. We conducted a pilot study in our combined medical-surgical pediatric intensive care unit (PICU) to delineate the prevalence of vitamin D deficiency, as well as the conditions leading to admission and dietary intake prior to admission.

**Methods:** Over a three month period, 25-OH-vitamin D (25OH) levels were obtained from 30 patients admitted to our PICU. Demographics, admitting diagnosis, underlying medical conditions, route of feeding and type of diet were obtained for each patient. Vitamin D deficiency was defined as a 25OHD level less than 20 ng/mL and insufficiency was defined as a level less than 30 ng/mL.
Results: Of the 30 patients in our pilot study, 37% were African-American, 30% Caucasian, 17% Hispanic and 13% other races. Overall, 50% were female and 50% were male. 73% (22/30) of patients were either vitamin D deficient or insufficient, with 100% of African Americans, 70% of Caucasians, 40% of Hispanics and 75% of other races being so classified. 50% (5/10) of the patients with respiratory insufficiency or failure as their admitting diagnosis were vitamin D deficient or insufficient, while 100% (8/8) of the patients with heart disease as their admitting diagnosis were either deficient or insufficient (including congenital heart disease patients admitted post-operatively and patients with acquired heart disease admitted for management of heart failure). Of the patients in this study with normal vitamin D levels, 88% (7/8) were fed either vitamin-D fortified formula by mouth or enteral tube prior to admission. Of the patients in this study with vitamin D deficiency or insufficiency, 95% (21/22) were either breast fed infants or patients consuming regular diets. Only 7% (2/30) of patients were supplemented with vitamin D as part of a daily regimen prior to admission, with one of these patients being vitamin D deficient despite receiving the recommended daily intake.

Conclusions: Inadequate vitamin D levels were prevalent in this pilot study in our multidisciplinary PICU, particularly in patients with cardiovascular and respiratory disease. Patients consuming regular US diets and/or breast milk without vitamin D supplementation were much more likely to have vitamin D deficiency than those fed with vitamin-D fortified formulas. We have begun enrolling all patients in our PICU with respiratory and/or cardiovascular disease in a prospective, observational study to further address the prevalence of this deficiency and further define associated risk factors.

(18361) Isoflurane Use in Children with Severe Status Asthmaticus

Kristen Nelson-McMillan, MD and Ivor Berkowitz, MD, MBA, Pediatrics and Pediatric Anesthesiology and Critical Care Medicine, Johns Hopkins University School of Medicine, Baltimore, MD

Purpose: Status asthmaticus is a potentially life threatening condition in spite of therapy with conventional bronchodilator therapy. Asthma exacerbations can result in respiratory failure and may be fatal. Although several medical therapies exist for asthma treatment, patients requiring mechanical ventilation have higher mortality rates. Mechanical ventilation with isoflurane, which has bronchodilator properties, has been used in asthma-induced respiratory failure. This anesthetic gas has been reported to be used in severe cases due to its’ bronchodilatory effects. We performed a retrospective review of patients admitted to the pediatric intensive care unit (PICU) with a diagnosis of status asthmaticus who required mechanical ventilation and isoflurane use.

Methods: We conducted a retrospective medical chart review, evaluating patients 0-21 years of age admitted to the PICU of a tertiary-care children's hospital over an 8-year period with a diagnosis of status asthmaticus who were refractory to traditional medical therapy and required mechanical ventilation and initiation of isoflurane.

Results: 18/268 (6.7%) of patients admitted with status asthmaticus required mechanical ventilation, with 7/18 (39%) requiring isoflurane. Isoflurane was administered by vaporizer through a Servo 300 ventilator under the direction of pediatric intensivists. The mean age of patients receiving isoflurane was 11.9 years with a M:F ratio of 7:1. All of the patients requiring isoflurane were non-Hispanic blacks. The mean duration of isoflurane use was 14 hours. 3/7 (43%) of patients required vasopressor therapy for hypotension following initiation of isoflurane. All patients who received isoflurane had an increase in arterial pH and decrease in partial pressure of CO2 and 5/7 (71%) were extubated within 24 hours of isoflurane initiation. One child died from severe anoxic brain injury sustained prior to arrival to the PICU.

Conclusion: Isoflurane can be used to successfully treat refractory asthma and may prevent need for ECMO in some cases. Slightly over 40% of the patients in this study did require pressors while they were receiving isoflurane, but these pressors were discontinued once isoflurane was discontinued.

(18638) Clostridium Difficile Associated Disease among Children in a Pediatric Intensive Care Unit
**Purpose:** To evaluate the prevalence, risk factors and course of Clostridium difficile associated disease (CDAD) among children admitted to a Pediatric Intensive Care Unit (PICU) and compare to children with diarrhea who were tested negative for C.diff. C. diff infections are becoming more common among hospitalized patients and they affect patient safety and quality of care outcomes in ICU settings. There is a limited recent data especially among critically ill children.

**Methods:** After IRB approval, a retrospective chart review was conducted on all children (aged 1 mo to 21 years) admitted to a PICU that had been tested for C. diff during a 15-month period. Demographic and predisposing factors and outcomes were compared between two groups of patients with and without positive PCR test for C. difficile. Data that was recorded and analyzed from medical records included: age, sex, ethnicity, pre-existing medical conditions, medications (antibiotics and gastric acid suppressants) received within 4 weeks prior to the onset of diarrhea, use of probiotics, duration of diarrhea, recurrence and complications of C. difficile infection etc. Descriptive data is presented as mean for parametric continuous data or median for non-parametric data and as percentages for categorical data. Chi square tests and Mann-Whitney U/ Wilcoxon tests were used for statistical analyses.

**Results:** During the study period, there were 2,131 admissions to the PICU. Of these, 116 patients (5.4%) were tested for C. difficile; a total of 32 patients (1.5%) were C. diff PCR positive (Cd+) and developed CDAD, while the other 84 tested negative (Cd-). Age of patients, gender distribution, median duration of hospitalization and duration of diarrhea before C. diff testing and total duration of diarrhea were not significantly different between two groups. PIM2Score (-3.26 vs. -4.48) and PIM2 risk of mortality (3.71% vs. 1.14%) were significantly higher among Cd+ (P<0.05). Gender and racial distribution and rates of immunosuppression, malignancy, sepsis, co-infections, malnutrition, GER, and chronic lung disease and the rate of use of gastric acid suppression were similar between two groups. Prior antibiotic use was lower (75% vs. 92%) and past history of C.diff infection (18.6% vs. 4.8%), rates of mechanical ventilation (47% vs. 27%), and septic shock (9% vs. 2%) were higher among Cd+ patients (p<0.05). Mortality rate was similar in both groups.

**Conclusion:** The incidence of C. difficile associated disease in a PICU is 1.5% with a case fatality rate of 3.1%. CDAD is common among children with prior history of C. diff infection, sicker patients, and who are on mechanical ventilation. Use of antibiotics or gastric acid suppressants was not found to be associated with a higher incidence of CDAD.

(17063) **Severe Hemorrhagic Coagulopathy with Hemophagocytic Lymphohistiocytosis Secondary to Epstein - Barr virus Associated T-Cell Lymphoproliferative Disorder**

**Objective:** We describe the coagulopathy and hemorrhagic complications associated with fulminant, secondary hemophagocytic lymphohistiocytosis (HLH) in a cohort of patients with Epstein-Barr virus (EBV)-associated T-cell lymphoproliferative disorder (LPD).

**Patients and Methods:** IRB-approved retrospective review of all patients at our children's hospital over 3 years (2008-10) with HLH secondary to acute EBV-associated T-cell LPD.

**Discussion:** Four males (ages: 2, 3, 17, and 20 years) presented with fever, hepatosplenomegaly, and pancytopenia with elevated serum ferritin, and all met clinical and laboratory criteria for secondary hemophagocytic lymphohistiocytosis (table 1). D-dimer on admission was elevated in all patients, and remained extremely elevated during hospitalization, while the median prothrombin and activated partial thromboplastin
times as well as fibrinogen were all in the normal range (table 2). Three out of the four patients who survived more than one month of hospitalization had episodes of life threatening hemorrhage with an elevation of D-dimer and a drop in fibrinogen without reaching a nadir of platelet count during those episodes. Within a few weeks to months following admission, all patients developed multiorgan system failure with episodes of severe, life-threatening hemorrhage; there were no survivors beyond 4 months from diagnosis.

**Conclusions:** A novel non-consumptive coagulopathy characterized by persistent, extreme elevations in plasma D-dimer and severe, life-threatening hemorrhage was noted in association with HLH secondary to EBV-associated T-cell LPD. We speculate that this coagulopathy is a marker of severe HLH in this setting.

**Table 1: Patients with EBV-associated T-cell LPD.**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (years), gender</th>
<th>Clinical presentation, time to diagnosis, duration of hospital stay</th>
<th>Life-threatening hemorrhage, hospital day of life threatening hemorrhage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17, male</td>
<td>Fever, jaundice, pancreatitis, hepatosplenomegaly, 28 days, 50 days</td>
<td>Right forearm compartment syndrome secondary to radial arterial line placement needing fasciotomy, day 26</td>
</tr>
<tr>
<td>2</td>
<td>2, male</td>
<td>Fever, cervical lymphadenopathy, massive hepatosplenomegaly, petechiae, epistaxis, 13 days, 15 days</td>
<td>Pulmonary hemorrhage, day 1</td>
</tr>
<tr>
<td>3</td>
<td>3, male</td>
<td>Fever, hepatosplenomegaly and hypertension, 7 days, 44 days</td>
<td>Abdominal compartment syndrome after hemorrhage from liver biopsy needing paracentesis, day 36</td>
</tr>
<tr>
<td>4</td>
<td>20, male</td>
<td>Fever, hepatosplenomegaly, epistaxis, hypoxemic respiratory failure, renal failure, 10 days, 110 days</td>
<td>Mediastinal hemorrhage following placement of an internal jugular vein central venous catheter, day 6</td>
</tr>
</tbody>
</table>

**Table 2 Coagulation testing for patients with EBV-associated T-cell LPD (n=4).**

<table>
<thead>
<tr>
<th>Prothrombin time (normal 12.1-15.3 seconds)/INR (normal: 0.87-1.16)</th>
<th>Activated partial thromboplastin time (normal 24.4-37.9 seconds)</th>
<th>Fibrinogen (normal 203-447 mg/dL)</th>
<th>D-dimer (normal &lt;0.55 μg/mL)</th>
<th>Platelets (normal 165-415 X10⁹/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission values for all patients 13-20/0.97-1.64</td>
<td>24.9-69</td>
<td>90-460</td>
<td>7.77-&gt;20</td>
<td>32-125 X10⁹/L</td>
</tr>
<tr>
<td>Median value (range of median values) for all 15-16/1.03-1.19</td>
<td>29-56</td>
<td>223-396</td>
<td>5-&gt;20</td>
<td>32-130 X10⁹/L</td>
</tr>
<tr>
<td>patients during hospitalization</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(17372) Face-to-Face Handoff: Improving Transfer to the Pediatric Intensive Care Unit after Cardiac Surgery

Jeffrey E. Vergales, MD\textsuperscript{1}, Nancy G. Addison, RN\textsuperscript{1}, Evelyn A. Nicholson, RN\textsuperscript{1}, D. Jeannean Carver, MD\textsuperscript{1}, Victor C. Baum, MD\textsuperscript{1} and James J. Gangemi, MD\textsuperscript{3}. (1)Pediatrics, University of Virginia, Charlottesville, VA, (2)Anesthesiology, University of Virginia, Charlottesville, VA, (3)Thoracic and Cardiovascular Surgery, University of Virginia, Charlottesville, VA

**Purpose:** The transfer of children after cardiac surgery to the intensive care unit (ICU) is a critical step in ensuring smooth post-operative management. This requires excellent communication and coordination among a variety of providers to make certain details are not overlooked and the handoff process is accurate, complete and efficient.

**Methods:** We sought to develop a comprehensive, primarily face-to-face, handoff process that begins initially in the operating room and concludes at the bedside in the ICU. The system involves formalized process steps, utilizing a variety of essential providers across multiple disciplines, with the goal of improving overall accuracy and efficiency. After an initial trial period to accommodate unforeseen problems, the final process was evaluated by the use of observer checklists to evaluate quality metrics and timing in all subsequent patients admitted to the ICU following cardiac surgery.

**Results:** Prior to initiation of the new system, only 73% of providers at our institution believed that information transfer was smooth from one unit to another. Similarly, only 41% believed the process to be standard among all providers, and just 58% believed there was good interdisciplinary communication and efficiency at the time of transfer. 30 cases were observed after the new system was finalized. The admitting nurse travelled to the operating room near the completion of the case to receive face-to-face handoff prior to assisting in the transport to the ICU. The total time to stabilize, secure and transport the patient was not prolonged (mean of 26.0 minutes ± 8.5) and was not statistically significant when stratified across RACHS-1 categories (p=0.82), meaning that even the most complex patients were able to be transported efficiently. Similarly, the time from patient arrival in the ICU to completion of handoff was rapid (mean of 7.8 minutes ± 4.2) and also did not differ when stratified to complexity of the surgery (p=0.30). This step included the stabilization of lines, drains and airways, drawing necessary labs, reporting of an initial arterial blood gas, obtaining a chest radiograph and initiation of face-to-face handoff among all providers caring for the child. Accuracy of information was assured by the use of a standardized electronic post-operative note completed during the case by the anesthesiologist, with 100% compliance, and available prior to the patient’s arrival in the ICU. Further, all subspecialties and ancillary services involved were able to be present 90% of the time for the final steps of the handoff.

**Conclusion:** A standardized process-driven system, that emphasizes face-to-face communication, can be implemented for transferring patients to the ICU after cardiac surgery. It can improve efficiency and accuracy of the information in addition to improving overall communication between the many providers caring for these critical patients.

(17808) Clinical Parameters to Predict Extubation Outcome in the Pediatric Intensive Care Unit

James L. Laham, D.O., Pediatrics, University of Kentucky Children's Hospital, Lexington, KY, Patrick Breheny, Assistant, Professor, Biostatistics, University of Kentucky, Lexington, KY, Amanda Rush, Research, Assistant, Department of Pediatrics, University of Kentucky, Lexington, KY and Henrietta Bada, M.D., M.P.H., Pediatrics, University of Kentucky, Lexington, KY

**Purpose:** To evaluate our extubation practice in a multidisciplinary Pediatric Intensive Care Unit (PICU). The decision to extubate is based on review of pre-extubation clinical parameters (blood gas analysis, ventilator settings and other factors potentially affecting extubation outcome) by the attending PICU physician ultimately responsible for care of the patient. We present a review of 326 consecutive PICU patients with complete documentation associated with first planned extubation.
Methods: This study was approved and waiver of consent obtained through the IRB. Extubation outcome and clinical parameters were recorded following first planned extubation attempts from August 20, 2010 through March 31, 2012. Clinical parameters reviewed consisted of pre-extubation arterial or venous pH, P02, PC02, Sa/v02; and ventilator rate, set tidal volume, peak inspiratory pressure, pressure support, positive end expiratory pressure and inspired fraction of oxygen. Other variables evaluated included age, sex, days of mechanical ventilation (MV), intensivist, admitting service, diagnosis, surgery performed, pre-extubation steroids, post-extubation stridor and use of a spontaneous breathing trial. Associations between extubation failure and categorical variables were tested by Fisher's exact test and confidence intervals constructed by hypergeometric distribution. Associations between extubation failure and continuous factors were modeled using logistic regression, with likelihood ratio methods used for both testing and construction of confidence intervals.

Results: During the study period 326 first planned extubations took place. The overall success rate was 91% (296/326 attempts) regardless of sex, intensivist, admitting service, diagnosis or surgery performed. In evaluation of all 326 patients, prolonged mechanical ventilation ($p<0.0001$; OR for difference of 4 days=$1.9$), age ($p=0.01$; OR for difference of 5 years=$1.9$) and pre-extubation steroid use (OR $2.6$; $p=0.02$) were associated with extubation failure. A subgroup analysis was also conducted, separating patients into two groups based on duration of MV. For patients with 1 day or less of MV, stridor (OR $10$; $p=0.01$) and set ventilator rate ($p<0.01$; OR for difference of 6 breaths=$4.8$) were associated with extubation failure. For patients requiring > 1 day of MV, venous pH (OR $1.9$; $p=0.05$) and Pa02 (OR $2.1$; $p=0.06$) were borderline significant.

Conclusion: Physician judgment utilizing clinical parameters resulted in a 91% success rate for first planned extubations, a process applicable to all patients, intensivists and admitting services. We found that prolonged mechanical ventilation and young age continue to be risk factors for failed extubation. The role of steroids requires further evaluation. Weaning to low ventilator rates may not be justified in short term ventilation, as we found low ventilator rates to be associated with increased failure rates. Latitude in blood gas expectations may be warranted in cases of prolonged ventilation.

(18216) Outcomes of Tracheostomies in Children with Congenital Heart Disease

Geetha Challapudi, MD, Carman and Ann Adams Department of Pediatrics, Children's Hospital of Michigan, Wayne State University School of Medicine, Detroit, MI, Girija Natarajan, MD, The Carman and Ann Adams Department of Pediatrics, Division of Neonatal-Perinatal Medicine, Children's Hospital of Michigan, Detroit, MI and Sanjeev Aggarwal, MD, Division of Cardiology, Carman and Ann Adams Department of Pediatrics, Children's Hospital of Michigan, Wayne State University School of Medicine, Detroit, MI

Purpose: A subset of children with repaired congenital heart disease (CHD) may require tracheotomy for ongoing ventilatory support. Data on outcomes in this population are scarce. Our objectives were to describe indications for and short-term outcomes related to tracheotomy in children with repaired CHD.

Methods: A retrospective chart review of children with repaired CHD who underwent tracheotomy at a single center over a 10 year period. Exclusion criteria were prematurity, isolated PDA ligation and neuromuscular conditions. Follow-up outcomes and all readmissions after the initial discharge were reviewed.

Results: A total of 21 subjects with CHD underwent tracheotomy at a median (range) age of 4 months (1 month-7 years) and mean (SD) weight of 7.2 (5.9) kg. Table 1 describes the demographics and clinical data of the subjects. The most common indication for tracheotomy was tracheomalacia or ventilator-dependence in 19 (90.5%) subjects, followed by vocal cord palsy and thoracic insufficiency in 1 (4.7%) each. The mean post-tracheotomy length of stay was 55 (35) days. Of the 19 infants who survived to discharge, 17 (81%) were on home ventilation. A total of 11 (52%) subjects died, all were mechanically ventilated. Table 2 describes follow-up data after tracheotomy. Three children underwent successful decannulation of tracheotomy. The number of readmissions decreased from 2.4 /year in the 1st year to 1.6 /year in the 2nd year to 1.7/year in the 3rd year. The
total duration of hospitalization after first discharge decreased from 15.5 days/patient-year in the first year to 7 days/patient-year in the 2nd yr. after discharge following tracheotomy.

### Table 1: Demographic and clinical data

<table>
<thead>
<tr>
<th>Tracheostomy</th>
<th>N(%) or mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at cardiac surgery</td>
<td>3 weeks (1 week to 7 yrs.)</td>
</tr>
<tr>
<td>Male Gender</td>
<td>11 (52.4)</td>
</tr>
<tr>
<td>Primary cardiac lesion</td>
<td></td>
</tr>
<tr>
<td>VSD/COA</td>
<td>2</td>
</tr>
<tr>
<td>AV canal</td>
<td>4</td>
</tr>
<tr>
<td>VSD/ASD</td>
<td>2</td>
</tr>
<tr>
<td>AP window and interrupted aortic arch</td>
<td>1</td>
</tr>
<tr>
<td>DORV</td>
<td>2</td>
</tr>
<tr>
<td>PA/VSD/TOF</td>
<td>3</td>
</tr>
<tr>
<td>Truncus</td>
<td>3</td>
</tr>
<tr>
<td>Ebstein</td>
<td>1</td>
</tr>
<tr>
<td>OHT</td>
<td>3</td>
</tr>
<tr>
<td>Syndromes</td>
<td></td>
</tr>
<tr>
<td>Down syndrome</td>
<td>4</td>
</tr>
<tr>
<td>Charge syndrome</td>
<td>2</td>
</tr>
<tr>
<td>Digeorge syndrome</td>
<td>3</td>
</tr>
<tr>
<td>Myopathies</td>
<td>1</td>
</tr>
<tr>
<td>Other genetic</td>
<td>4</td>
</tr>
<tr>
<td>Ellis Van Crevald syndrome</td>
<td>1</td>
</tr>
</tbody>
</table>

### Table 2: Follow up Data

<table>
<thead>
<tr>
<th>Reasons for readmissions (n=51) in first year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory/Pneumonia</td>
<td>27</td>
</tr>
<tr>
<td>Tracheostomy obstruction/dislodge</td>
<td>8</td>
</tr>
<tr>
<td>Tracheostomy bleed</td>
<td>2</td>
</tr>
<tr>
<td>sepsis</td>
<td>1</td>
</tr>
<tr>
<td>Infective/ other</td>
<td>13</td>
</tr>
<tr>
<td>Number of admission (pts.)</td>
<td></td>
</tr>
<tr>
<td>No readmission</td>
<td>5</td>
</tr>
<tr>
<td>&lt;5 first year</td>
<td>10</td>
</tr>
<tr>
<td>&gt;5 first year</td>
<td>4</td>
</tr>
<tr>
<td>Died</td>
<td>11</td>
</tr>
<tr>
<td>Died within first hospitalization</td>
<td>2</td>
</tr>
<tr>
<td>Died within 6 months</td>
<td>5</td>
</tr>
<tr>
<td>Died after 6 months</td>
<td>4</td>
</tr>
<tr>
<td>Cause of death</td>
<td></td>
</tr>
<tr>
<td>Sepsis</td>
<td>2</td>
</tr>
<tr>
<td>Respiratory Failure</td>
<td>6</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusions:** The overwhelming majority of children with CHD who needed tracheotomy did so for ventilator dependence and tracheomalacia and had coexisting genetic syndromes. About half the cohort died; among survivors, readmissions were common but decreased after the first year. These results underscore the ongoing
mortality and morbidity risks faced by this vulnerable population.
(18624) The Myth of Preventable PICU Readmissions: A Review Using a Local Clinical Database

Brittany K. Potts, MD, Akron Children's Hospital, Akron, OH and Michael L. Forbes, MD, FAAP, Critical Care, Akron Children's Hospital, Akron, OH

**Purpose:** Increased morbidity and mortality as well as increased utilization of healthcare resources are associated with unplanned ICU readmissions. There is a current void in the literature revealing modifiable, therefore preventable, risk factors for unplanned readmissions to ICUs.

**Objectives:** The specific aims of this study were to determine (a) the temporal relationship between ICU discharge to readmission and (b) the patient characteristics and systemic elements of preventability of each event.

**Methods:** We reviewed a local PICU clinical database (VPS [http://www.myvps.org], paper charts, and electronic medical records of all patients with unplanned readmissions to Akron Children’s Hospital PICU from June 2009-October 2011. Data elements included all demographics, clinical course and diagnostic testing as well as severity of illness indices. Reviewers determined preventability of readmissions, change in care plan after transfer from PICU, and failure to communicate care plan to acute care providers. All readmissions with indeterminate preventability were analyzed as preventable. Data analysis included descriptive statistics and Chi-squared comparisons of proportions. Significance was defined as p≤0.05.

**Results:** Data from 55 patients, representing 61 readmissions were analyzed. One chart was excluded due to unavailability of paper charting. Most readmissions occurred after 24 hours (78.6%) and were due to either acute respiratory (47.5%) or neurologic (21.3%) failure. There were 7 (11%) preventable and 6 (10%) indeterminate readmissions. One (2%) had insufficient documentation, and 47 (77%) were not preventable. Readmissions occurring within 24 hours of transfer were almost 4 times more likely to be preventable than those occurring after 24 hours. (Positive LR 3.92, 95%CI 1.35-10.58, p=0.003). There was a difference in the proportion of readmissions among nursing units (range 9.8%-27.9%).

**Conclusion:** There is a difference between early (within 24 hours) and late (after 24 hours) unscheduled readmissions. Acute respiratory and brain failure account for nearly 80% of all readmissions. While the majority are late, preventability is more likely with early readmissions. Additionally, there is a disparity in likelihood of readmission as a function of the nursing unit. Our study suggests that multiple, complex systematic elements and patient characteristics conspire to facilitate each readmission event. The premise that all PICU readmissions are preventable is based, in part, on the assumption that a unifying systemic process failure drives all readmissions. Presently, all PICU readmissions are reviewed with a standardized format. Our study suggests that early and late readmissions may represent separate processes requiring unique review strategies. Further studies are necessary to clarify systematic and patient-level drivers of PICU readmission with the goal of prevention.