

Abstracts from the California Association of Neonatologists Cool Topics in Neonatology 26th Annual Conference

John Cleary, MD



Cool Topics in Neonatology

26th Annual Conference

Friday, Saturday & Sunday
March 6-8, 2020
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Coronado, California



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California Association of Neonatologists (CAN) and
AAP District IX Section on Neonatal-Perinatal Medicine

Cool Topics in Neonatology

27th Annual Conference
A Virtual Educational Conference

Friday, Saturday & Sunday
March 5 - 7, 2021



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Abstract # 2

Abstract Title: Growth outcomes and biochemical differences in preterm infants less than 1250 grams at birth fed human milk with human milk-based fortifier versus bovine milk-based fortifier

Name: Millie Chang, MD

PGY-5

Co-Authors: Lorayne Barton, MD; Ting-Yi Lin, MD; Rangasamy Ramanathan, MD; Rowena Cayabyab, MD

Organization: LAC-USC

Abstract Overview: TITLE: Growth outcomes and biochemical differences in preterm infants less than 1250 grams at birth fed human milk with human milk-based fortifier versus bovine milk-based fortifier. Authors: Millie Chang, Lorayne Barton, Ting-Yi Lin, Rangasamy Ramanathan, Rowena Cayabyab Background: Exclusive human milk (EHM) feeding has been shown to improve feeding tolerance, decreased rate of necrotizing enterocolitis, late onset sepsis, retinopathy of prematurity, bronchopulmonary dysplasia and length of hospital stay in very low birth weight infants. However, there is insufficient evidence on growth outcomes and nutrition indices in preterm infants fed EHM. Purpose of Study: Comparison of growth outcomes and laboratory values in preterm infants less than 1250 grams at birth fed human milk with human milk-based fortifier (EHM) versus bovine milk-based fortifier (HMF). Methods Used: Retrospective data collection on preterm infants less than 1250g at birth admitted to NICU from January 2016 to November 2019 who were fed with human milk with human milk-based fortifier (EHM-26cal/oz, protein: 0.025g/ml) or bovine milk-based fortifier (HMF-24cal/oz, protein: 0.025g/ml). Demographics, clinical outcomes, anthropometric measurements (at birth, achievement of full feeds and at discharge); and laboratory values (achievement of full feeds and tolerated feeds for 3 consecutive days and off parenteral nutrition) were collected. Data was compared using chi square test or Wilcoxon rank sum test as appropriate. Infants with congenital anomalies/genetic syndromes were excluded. Summary of Results: Seventy four preterm infants were included in the study. Birth anthropometrics were similar in both groups. Preterm infants fed EHM were of significantly lower gestational age (GA) at birth and achieved full feeds at an earlier postmenstrual age (PMA). However, the time to full enteral feeding was not significantly different between the type of fortification of human milk. Infants fed EHM had similar PMA at discharge, higher discharge weight and weight percentiles; discharge head circumference and length compared to infants fed human milk fortified with bovine based HMF. Extrauterine growth restriction (EUGR) was significantly lower in preterm infants fed EHM. Serum albumin and BUN levels were significantly higher in preterm infants fed EHM at achievement of full feeds (Table 1). Clinical outcomes were not significantly different between the

two groups. Conclusions: Preterm infants fed EHM with higher caloric density had improved nutritional indices after achieving full enteral feeding resulting in fewer infants with EUGR. Despite lower GA in infants fed EHM, PMA at discharge was not significantly different from infants fed human milk with bovine milk based HMF.

Abstract # 3

Abstract Title: NEC PREVENTION CARE BUNDLE LED TO SUSTAINED LOW INCIDENCE OF NECROTISING ENTEROCOLITIS IN VERY LOW BIRTH WEIGHT INFANTS: 10-YEAR QUALITY IMPROVEMENT PROJECT

Name: Maria Fe Villosis, MD

Neonatologist, NICU Director-KFH PC

Co-Authors: Ma. Teresa C. Ambat, MD., Kambiz K. Rezaie, MD., Karine Barseghyan, MD

Organization: Kaiser Permanente

Abstract Overview: BACKGROUND: Necrotizing enterocolitis (NEC) is the most common gastrointestinal emergencies in preterm newborns and remains a serious complication associated with significant morbidity and mortality in this population. Over the past two decades, multicenter groups have reported reductions in the incidence of NEC among preterm infants. Although highly variable, an average rate exceeding 5% was reported by the majority. This coincided with reports of modifications in practice using continuous quality improvement (CQI) initiatives aimed specifically at reducing NEC risk or reducing risk of mortality and many morbidities associated with extreme prematurity. OBJECTIVE: To evaluate the result of NEC prevention CQI on the incidence of NEC among very low birth weight (VLBW) infants admitted to Kaiser Foundation Hospital Panorama City (KFH-PC) NICU from 2009-2018 METHODS: A cohort of 439 VLBW infants admitted to KFH-PC NICU from 2009-2018 was included in this retrospective study utilizing VON database. RESULTS: NEC incidence at KFH-PC NICU decreased from baseline of 6.7% in 2009 to an average incidence of 1.5% with a range of 0-4.9% during the years 2010-2018. The VON observed: expected ratio in the most recent epoch (2016-2018) was 0.5 (5th and 95th confidence limits 0.2 and 0.9, respectively). At KFH-PC NICU, the average rate of discharge on breastmilk was 91% during the study period. The practice modifications we implemented focusing on feeding strategies included: standardized feeding protocol, exclusive human milk diet, human milk-based fortifiers, and recent addition of probiotics. Infection prevention, controlling use of antibiotics and antacids were also integral to our bundle of care. CONCLUSION: Practice modifications based on evidence from clinical trials targeting reduction in NEC which were executed through CQI initiatives at KFH-PC NICU led to sustained reduction in its NEC rate lower than most reports in recent publications.

Abstract # 4

Abstract Title: Correlation between Total Serum Bilirubin and Transcutaneous bilirubin levels in extremely preterm infants less than 30 weeks gestation.

Name: Meera Sankar, MD

Clinical Associate Professor

Co-Authors: 1.Meera Sankar MD, Neonatology/Pediatrics, Stanford University, Stanford, CA 2.Dilip Bhatt MD, Neonatology/Pediatrics, Neonatology/Pediatrics,Kaiser Permanente,Fontana,CA 3.Anup Katheria MD, Neonatal Research Institute, Sharp Mary Birch Hospital, San Diego, CA, 4.Priscilla Joe, MD Neonatology, UCSF Benioff Children's Hospital Oakland, Oakland, CA, 5.Maria Cortes, NNP, Neonatology, Santa Clara Valley Medical Center, San Jose, CA, 6.Virna Paje MD,Neonatology/Pediatrics, Kaiser Permanente, Fontana CA 7.Manoj Biniwale MD & 8.Ram Ramanathan MD Division of Neonatal Medicine, Keck School of medicine of USC, LAC+USC Medical Center, Los Angeles, CA

Organization: Stanford University

Abstract Overview: Title: Correlation between Total Serum Bilirubin and Transcutaneous bilirubin levels in extremely preterm infants less than 30 weeks gestation Background: Measurement of Transcutaneous bilirubin (TCB) level is a safe, noninvasive, cost effective and widely used method for screening term and late preterm infants with hyperbilirubinemia. Limited data exists regarding the validity of TCB use in extremely preterm (EP) infants. Objective: The primary objective was to evaluate the correlation and agreement between total serum bilirubin (TSB) and TCB levels in EP infants. Design/Methods: This was a prospective multicenter study conducted at tertiary and regional NICUs in California. EP infants between 23.0-29.6 weeks of gestation admitted to the NICU without congenital anomalies were included. TCB measurements were performed within 30-60 minutes of TSB measurements during the first 3 weeks of life. Trained NICU staff measured TCB levels by using Drager Jaundice meter (JM-103) or the BiliChek transcutaneous bilirubinometer. Neonates with TSB readings in the phototherapy range received phototherapy as per the standard protocol. We examined the difference between TCB and TSB values, gestational age, maternal race, ethnicity and neonatal morbidities. Descriptive statistics were generated for entire group using IBM SPSS statistical software version 26. Correlation between TSB and TCB levels was assessed with Pearson's correlation analyses. Bland-Altman analysis was used to show the differences against the mean of the two methods. Results: 299 paired TCB and TSB measurements (58 infants) were analyzed. Median gestational age was 27.2 weeks (IQR 25.5-28.3) and postnatal age ranged from 1 to 18 days of life. TSB values ranged from 0.41 to 14.7 where as TCB values ranged from 0 to 15.5. Mean difference between TCB and TSB was 0.37

(SD +/-2.56). Pearson bivariate correlation testing revealed moderate level of correlation between TCB and TSB with a coefficient of 0.625 (p<0.001). Proportionate bias was noted in infants with higher bilirubin values. Bland Altman analysis of log transformed data (Figure 1) showed a good agreement at 95 percent limits with mean of 0.0074 (SD 0.267). Regression equation predicted TSB= 2.68+0.42(TCB) with r squared of 0.39 suggesting weak to moderate correlation (Figure 2). Conclusions: TCB levels correlated moderately with TSB levels in this ethnically diverse population of EP babies in California NICUs. TCB may be a useful screening tool for monitoring jaundice in EP newborns. Larger studies are needed to validate these findings.

Abstract # 5

Abstract Title: Barriers to optimal breast milk provision in the Neonatal Intensive Care Unit (NICU)

Name: Meera Sankar, MD

Clinical Associate Professor

Co-Authors: 1. Meera N. Sankar MD, Neonatology/Pediatrics, Stanford University, CA, 2. Ya'el E Weiner, Stanford University, CA 3. Peiyi Kan, Stanford University, CA 4. Sharon Rea, BA, IBCLC, Stanford University, CA 5. Henry Lee MD, Neonatology/Pediatrics, Stanford University, CA

Organization: Stanford University

Abstract Overview: TITLE: Barriers to optimal breast milk provision in the Neonatal Intensive Care Unit (NICU) AUTHORS: Meera N. Sankar MD*, Ya'el Weiner, Peiyi Kan, Sharon Rea & Henry Lee MD Neonatology/Department of Pediatrics, Stanford University, Stanford, CA,United States. INTRODUCTION: In the high risk NICU setting, breast milk use is associated with decreased morbidity and improved neurodevelopmental outcomes. This retrospective study aimed to identify patient and systems barriers to optimal breast milk use in infants admitted to a regional NICU in California. METHODS: 699 babies born at 23-41 weeks of gestation with no congenital anomalies admitted to the NICU within 3 days of birth from 9/2015 to 6/2018 were included. We examined: maternal factors and demographics; neonatal data, need for resuscitation and morbidity; length of stay; frequency of lactation support in first week, during NICU stay, and at discharge; age at first lactation consult; and breastfeeding in the NICU. Bivariate analysis and logistic regression were used to examine patient and lactation consultant service factors associated with breast milk use at discharge. RESULTS: Breast milk use at discharge for all infants was 89.7%: for extremely preterm (EP) 80.3%, moderate preterm 94.2%, late preterm (LP) 86.3%, and term 92.3%. Low birth weight, morbidities, length of stay, public insurance and lack of lactation support at discharge (OR 0.19 [0.09-0.38]) were associated with significantly no breast milk use at discharge (Table

1). In EP infants, need for resuscitation, morbidities, black race, singleton births, lack of lactation support during NICU stay and at discharge along with lack of breastfeeding in the NICU decreased breast milk use (Table 2). In term infants, sepsis, home on gavage feeds, lack of lactation support at discharge, and lack of breastfeeding in the NICU significantly decreased breast milk use (Table 3). In LP infants, inborn, C-section, older maternal age, frequency of lactation support in first week (OR 1.77[1.15-2.74]), and during NICU stay (OR 1.32[1.03-1.68]) increased breast milk use. Older age at first lactation consult (OR 0.88[0.78-1.00]), lack of lactation support at discharge, and lack of breastfeeding in the NICU (OR 0.17[0.04- 0.66]) decreased breast milk use (Table 4). LP infants benefitted from lactation support from admission through discharge. Black race and lack of lactation support at discharge were associated with decreased breast milk use in EP infants. CONCLUSION(S): Compared to term infants, LP and EP infants had lower rates of breast milk use at discharge, particularly with decreased use of lactation services. Lactation support should be targeted to increase breast milk use in these high-risk populations.

Abstract # 7

Abstract Title: Decreasing the number of unnecessary X-ray retakes in a Tertiary Level Neonatal Intensive Care Unit (NICU).

Name: Sheila Kalyanam, MD
Neonatology Fellow

Co-Authors: Guadalupe Padilla, MD Virender Rehan, MD

Organization: Harbor- UCLA Medical Center

Abstract Overview: Background: Depending on the diagnosis, birth weight, gestational age (GA), and length of stay of an infant admitted to a NICU, it is often necessary to perform a large number of radiographic examinations. In our NICU it was perceived that an excessive number of repeat X-ray examination were performed due to improper positioning or foreign objects obstructing the view of the intended field. Due to the potential harmful effects of radiation exposure, particularly on the developing organs, it is necessary to keep neonatal X-ray examinations to a minimum. Objective: Our goal was to decrease the number of X-ray retakes by 50% by applying the PDSA (Plan-Do-Study-Act) model, education on proper positioning, and a “two-person hold” approach. Design/ Methods: We initially performed a telephonic survey of 20 regional NICUs and queried their practice of positioning babies during X-ray examinations; 19/20 units had a policy of two persons, i.e., a registered nurse (RN) and a respiratory therapist (RT), holding the infant during X-ray examination. Using the PDSA model, baseline data was collected from Aug-Dec 2018 which included GA, type of X-ray, presence of a central line/ ETT, or positioning aid. We documented the numbers and reasons for retak-

ing the images. An educational video was created to demonstrate holding the infant in the correct position. All NICU RNs and RTs completed this education module. Staff champions were identified to provide ongoing hands-on support. Post intervention data was obtained from Aug-Dec 2019. Setting/Patients: Patients admitted to the NICU at Harbor- UCLA Medical Center Results: The pre-intervention retake rate was 56% (35/62), which, post intervention, decreased to 17% (18/105) (Image. 1). Image. 2 displays post-intervention decreases in retakes in specific sub-categories identified for most retakes. Conclusion: Education and assistance from RN and RT champions decreased the rate of unnecessary retakes from 56% to 17% exceeding our primary goal. Limitations: Many challenges and opportunities have been identified, e.g., un-reliable data collection if it is not collected immediately and is relied upon re-call, false perception that extremely low birth weight infants do not move much during X-ray examination and therefore, do not require two-person hold, etc., which will be the focus of our next PDSA cycle.

Abstract # 8

Abstract Title: Standardized Algorithm for Non-Invasive Pressure Based Weaning Strategy for Infants Less Than 32weeks and/or 1500gm: Lung Protective Strategies

Name: James Fritzell Jr, MD
Clinical Director Small Baby Program Miller Children's Hospital

Co-Authors: Irma Reyburn RRT Ching Tay, MS

Organization: Mednax

Abstract Overview: Background: The concept of less invasive forms of respiratory support in premature infant populations is well established in its role in reducing lung injury and the co-morbidities associated with chronic lung disease (CLD) and bronchopulmonary dysplasia (BPD). A reproducible evidence based approach to weaning or removing this form of support for the continued uninhibited respiratory and neurodevelopmental progression has not been established in this population. In our 95 bed level III unit, we have adopted an algorithmic reproducible pathway based on established evidence based practices to remove infants from less invasive pressure based respiratory support to minimize and protect their ongoing development. Objective: Create a weaning algorithm strategy for less invasive pressure based respiratory support in infants < 32 weeks and <1500gm. Educate staff (respiratory therapist and nursing staff of Small Baby Program) to the clinical pathway established in the algorithm. Demonstrate application and retention of algorithm based practice. Methods: An algorithm, based upon evidence based literature, was created for infants less than 32 weeks gestation and/or less than 1500gm that required pressure based less invasive respiratory support

(CPAP/HFNC) and are now at 21% FiO₂ requirements. Education sessions, visual bedside algorithm charts and PDSA cycle timetable were established for the support care teams (nursing, respiratory therapists and physician). Ongoing data collection for clinical outcome measures (BPD, home oxygen requirements and in-hospital days) were collected for all eligible infants. Results: Bedside auditing demonstrated 100% compliance in bedside visual education tools, >95% appropriate level of respiratory less invasive support as per algorithm delineation and early demonstration of reduction in un-necessary oxygen exposure. Conclusion: The standardization and reproducibility of a pressure based weaning algorithm in a level III NICU is possible through education and ongoing clinical visual cues and super-user monitoring/auditing for eligible premature infants. This quality intervention can provide a standardization in respiratory support to maximize consistency in care and reduce unintended complications of over or under exposure to inappropriate respiratory support. We believe that this standardization in respiratory care will lead to a reduction in BPD rates, decrease home oxygen requirements and shorten overall in-hospital days.

Abstract # 9

Abstract Title: A Case Series of Neonatal Aspergillosis: An Emerging Fungal Infection in the Extremely Low Gestational Age Neonates

Name: Alexandra Iacob, MD
Neonatology Fellow

Co-Authors: Cherry Uy, MD, University of California Irvine Neonatal/Perinatal Division Chief and Professor of Pediatrics Fayez Bany-Mohammed, MD, University of California Irvine Professor of Pediatrics Antoine Soliman, MD, Miller Women's and Children's Long Beach Neonatal Intensive Care Unit Medical Director Muhammad Aslam, MD, University of California Irvine Professor of Pediatrics

Organization: University of California Irvine

Abstract Overview: Title: A Case Series of Neonatal Aspergillosis: An Emerging Fungal Infection in the Extremely Low Gestational Age Neonates Authors: Alexandra Iacob, MD^{1,2*}, Cherry Uy, MD¹, Fayez Bany-Mohammed, MD¹, Antoine Soliman, MD², Muhammad Aslam, MD¹ 1 University of California – Irvine, Department of Pediatrics, Orange, CA 2 Miller Children's & Women's Hospital, Long Beach, CA Introduction: Aspergillosis is a fungal infection that can manifest through pulmonary, abdominal, cerebral, cutaneous or endovascular symptoms. Primary cutaneous aspergillosis is emerging as a new infection predominantly in the extremely low gestational age neonates (ELGAN), likely due to very thin epidermal layer and immaturity of the immune system. Very few case reports detail the presentation and management

of these infants. The objective of this study was to assess the presentation, management, and overall outcomes of neonatal aspergillosis in a series of ELGANs. Methods: Data from neonates with confirmed aspergillosis in the last 6 years at two affiliated academic institutions was retrospectively collected. Chart notes and laboratory values were reviewed to assess mode of presentation, images of lesions, choice of antifungal medication, duration of treatment, and overall outcome of each patient. Results: The series included 7 patients (4 males) with mean birth gestational age of 23w5d and mean birth weight of 570 grams. The mean age at the first presenting symptom was 9±4 days of life. All 7 infants manifested with a skin lesion on the back. All cases were confirmed primary cutaneous aspergillosis as only the skin scraping culture was positive with negative blood and urine cultures. All infants were managed with liposomal amphotericin B, the standard first line antifungal. Micafungin was added as dual therapy for three infants due to ongoing new lesions presenting while on liposomal amphotericin B. Six of 7 patients have completed treatment, as evidenced through resolution of the skin lesions. The mean duration of therapy was 47±9 days. All 6 infants survived and were discharged from the hospital. The seventh patient is under active treatment. Conclusion: High index of suspicion and early recognition is critical for neonatal aspergillosis in ELGANs. All cases in the series were limited to primary cutaneous aspergillosis without evidence of invasive aspergillosis. Prolonged course of liposomal amphotericin B was well tolerated and associated with overall good outcome.

Abstract # 10

Abstract Title: A MULTIDISCIPLINARY APPROACH TO NICU ANTIBIOTIC STEWARDSHIP

Name: Harjinder Singh, A4638333
Neonatologist

Co-Authors: Harjinder Singh MD – Neonatologist Pankaj Mistry MD – Neonatologist Shahid Kamran MD - Neonatologist, Medical director Susan Wilkinson. RN , NICU Quality Supervisor Sheri Landazuri, BSN,RN (Clinical IV NICU)

Organization: Pomona Valley Hospital Medical Center

Abstract Overview: TITLE: Multidisciplinary Antibiotic Stewardship reduced the NICU Antibiotic Use Rate (AUR) Authors: Harjinder Singh MD*, Susan Wilkinson RN BACKGROUND: Broad spectrum antimicrobial use in the NICU has been associated with emergence of multi-drug resistant gram negative bacilli and development of invasive candidiasis. Prolonged use of empiric antibiotics for early onset sepsis (EOS) in ELBW infants has been associated with increased risk of mortality, NEC and late onset sepsis. After observing a modest decrease in AUR from 22%-19.99% in 2018 related to increased awareness , in January 2019 we ini-

tiated a multidisciplinary NICU antibiotic stewardship. SMART AIM: To reduce the AUR in NICU from 22% to 17% by January 2020 DRIVERS OF CHANGE: Addressed variations in physician practices by standardizing approach to management of suspected sepsis in NICU. Guidelines were developed for management of EOS in infants less than 35 weeks, greater than 35 weeks and the late onset sepsis in NICU SETTING: 53 bed Level 3B Community NICU METHODS: We assembled a Multidisciplinary Antibiotic Stewardship Team (Nov 2018) that included Neonatologists, Pharmacists, NICU Quality Supervisor, Infection Prevention Nurse, Clinical IV RN NICU and Medical Directors of NICU and the hospital Infection Control. The team defined member roles and responsibilities, reviewed current literature, benchmarked community NICUs practices, developed standardized guidelines for sepsis management(March 2019), implemented daily antibiotic rounds(April 2019) and educated staff and pharmacists. MEASUREMENTS: AUR data was collected monthly using the electronic medical record. Hospital readmission rate was monitored as a balancing measure to detect possible under treatment. RESULTS: Interventions were implemented as indicated above and the AUR declined over a 12 month period from 19.99% at the beginning of the stewardship program to 13.52% by January 2020. Compliance with the established guidelines exceeded 95% DISCUSSION: Gradual but significant reduction in AUR was observed when evidence based standardized approach was adopted for management of suspected sepsis in a large NICU. AUR for ampicillin and gentamicin also demonstrated similar decline. Ongoing challenges include improving compliance with established guidelines and avoiding administration of unintended doses of antibiotics. FUTURE STEPS: Incorporate elements of stewardship program into standard NICU practice, dissemination of stewardship practices to include night shift staff and expansion of the stewardship program to all well newborns at our facility Acknowledgement: Antibiotic Stewardship Team and NICU Staff Members

Abstract # 11

Abstract Title: Outcomes of neonates with severe hypoxic-ischemic encephalopathy receiving cooled blood hypothermia.

Name: Eiji Hirakawa, MD
Neonatologist

Co-Authors: Itaru Hayasaka, MD, PhD. neonatologist Satoshi Ibara, MD, PhD. neonatologist

Organization: Nagasaki Harbor Medical Center, Nagasaki, JAPAN

Abstract Overview: Introduction Therapeutic hypothermia (TH) has improved outcome in Hypoxic Ischemic Encephalopathy

(HIE), however ,especially in severe HIE group, their outcomes are not enough. In terms of head MRI image, 48% neonates who received TH has some abnormal signal 1). Therefore, deep brain hypothermia, long term hypothermia, Xe, Epo and stem cell transfusion have been studied as an adjunctive therapy. None of them are a promising therapy for improving outcomes in severe encephalopathy. Hypothermia on ECMO have been reported at 2003 2). Neonatal ECMO study of temperature have reported no difference between hypothermia and normal temperature group who received ECMO 3). However, hypothermia on ECMO in the high-risk population with moderate or severe HIE have been reported as safe and efficacious at 2019 4). Our team has introduced cooled blood hypothermia on ECMO for severe encephalopathy since 2014. We report the outcome of cooled blood hypothermia in neonates. Methods HIE patients have been divided two groups, surface cooling and blood cooling, according to severity at admission. On blood cooling group, ECMO have been introduced for cooling within 6 hours. ECMO pump works at 10 ml/kg/min, and blood temperature is set at 33.5 degree. Cooling protocol is same in both group, 33.5 degree for 72 hours. Fentanyl is used as sedative drug. Respiratory support on ECMO is used for the patients who developed PPHN as needed. Results 38 HIE patients have been admitted from Jan,1 2014 to May, 31 2018. 29 of them have been treated on surface cooling, 8 cases have received cooled blood hypothermia. One case has dropped off follow-up program. Background in cooled blood hypothermia are birth weight is 2908±423g, Gestational Age is 38±2.1week, Cord blood; pH 6.87±0.15, CO₂ 94.7±27.1mmHg, BE -18.6±-6.7mmol/L, Apgar Score; 1 min 1.1±1.2, 5min 2±2.2, 10min 1.4±2.2. In terms of head MRI at discharge, 3 of them have abnormal signal at basal ganglion. Developmental score at 1.5 years old is normal in four patients, one is in border line. Conclusion We introduced cooled blood hypothermia for severe encephalopathy who supposed to have poor prognosis. 57% (4/7) of them are normal development at 1.5years old. Cooled blood hypothermia for severe HIE might be effective.

Abstract # 12

Abstract Title: Use of Point-of-Care Ultrasound to Serially Assess Umbilical Venous Catheter Tip Location

Name: Caroline Noh, MD
Fellow

Co-Authors: Pai VV, Vallandingham S, Manipon C, Dasani R, Houghteling PD, Balasundaram M, Davis AS, Bhombal S

Organization: Stanford University

Abstract Overview: TITLE Use of Point-of-Care Ultrasound to Serially Assess Umbilical Venous Catheter Tip Location AU-THORS Noh CY*, Pai VV, Vallandingham S, Manipon C, Dasani

R, Houghteling PD, Balasundaram M, Davis AS, Bhombal S. **BACKGROUND** Umbilical catheter placement is a routine neonatal procedure, and radiographs are often used to confirm tip location. Recent studies have shown that ultrasound can readily identify umbilical venous catheters (UVC) tip location with greater accuracy than radiographs and that ultrasound-guided UVC placement is a faster method to place catheters requiring fewer manipulations and radiographs. Studies have demonstrated the propensity of UVCs to migrate over time, and inappropriately positioned catheters can pose significant risk. The impact of using ultrasound to survey UVC tip location over time is unknown. **OBJECTIVE** To evaluate the use of point-of-care ultrasound (POCUS) for UVC placement and surveillance, and its impact on patient management. **DESIGN/METHODS** At a large academic neonatal intensive care unit (NICU), POCUS was utilized at the time of UVC placement as able, and surveillance POCUS of UVCs was performed 2-3 times a week as quality improvement endeavor. POCUS scans were used as an adjunct and did not replace radiographs obtained as part of standard care. If the tip was identified to be in unfavorable position, the primary physician was notified, and a confirmatory radiograph was obtained at their discretion. Patient demographic data, ultrasound findings, interpretation, and subsequent clinical interventions were documented in a standardized database. **RESULTS** A total of 179 scans were performed to evaluate UVC tip location on 97 patients from January through December 2019. Among 15 scans performed at the time of placement, 4 UVCs (27%) were adjusted prior to obtaining confirmatory radiographs, which then confirmed optimal placement. Out of 164 scans performed after placement, 35 scans (21%) identified UVCs to be in an unfavorable position, which prompted manipulation or removal of 28 UVCs (80%). The average time spent to identify UVC tip location by POCUS was 6.1 minutes. **CONCLUSION** Utilizing POCUS to survey UVC tip location can be done quickly, without radiation, and can identify unfavorably positioned catheters with potential to improve the management and safety of patients with UVCs.

Abstract # 14

Abstract Title: The Relationship between Gestational Age, Fetal Sex, and Immunologic Age: Deep Profiling of the Newborn Immune System using CyTOF

Name: Laura Peterson, MD
Clinical Fellow

Co-Authors: Xiaoyuan Han, PhD; Kazuo Ando, MD, PhD; Amy Tsai, BS; Edward Ganio, PhD; Natalie Stanley, PhD; Nima Aghaeepour, PhD; Brice Gaduilliere, MD, PhD

Organization: Stanford University, Department of Pediatrics, Division of Neonatology

Abstract Overview: Background Dysregulated immunity lies at the heart of the most severe morbidities of prematurity: sepsis, bronchopulmonary dysplasia, retinopathy of prematurity, and periventricular leukomalacia. For unknown reasons, male infants are at increased risk. A comprehensive understanding of the newborn immune system may shed light on the pathophysiology underlying these important diseases. High-dimensional mass cytometry (CyTOF) is a novel technology that allows for the characterization of dozens of immune cell types and their signaling behaviors, providing the opportunity to create an unprecedentedly detailed map of the newborn immune system. Methods Cord blood was collected at delivery. Samples were stimulated with immunologically active compounds, including lipopolysaccharide (LPS), interferon alpha (IFN α), and interleukins (IL) 2, 4, and 6. The samples were stained with antibodies to 24 phenotypic markers and 15 phosphorylated (i.e. activated) signaling proteins and run on CyTOF. Analysis was performed using multivariate machine learning (CITRUS) and traditional univariate statistics. Results Eighteen cord blood samples have been analyzed, including from nine term babies (GA \geq 37 weeks), four GA <34 weeks (preterm group), and five GA 34-36/6 weeks (late preterm group). There were no demographic differences between groups. Differences were seen in rates of preeclampsia, c-section delivery, and antenatal steroids (Table 1). Analysis revealed numerous immune system-wide differences. As an example, there was a linear relationship between increasing GA and NF κ B signaling in T cells, as evidenced by increased levels of I κ B, an NF κ B inhibitor, at earlier GA (Fig 1A-C). NF κ B is required for T cell activation, which is the basis for adaptive immunity. Another example is the relationship between increasing GA and response of STAT-6 to IL in innate immune cells (Fig 1D-F). STAT-6 is a mediator of the anti-inflammatory cytokine IL-4. Male fetuses had decreased numbers of all subsets of T cells and increased numbers of innate inflammatory cells, including Dendritic Cells (DCs) and Natural Killer (NK) cells (Fig 2). A larger sample size is anticipated prior to abstract presentation. Conclusions This study is the first to use CyTOF to comprehensively map the cellular composition and signaling behavior of the newborn immune system. Results suggest that premature newborns suffer from a combination of an impaired adaptive immune system and a dysregulated innate immune system that has diminished response to counter-regulatory cytokines such as IL-4. The increased vulnerability of males to morbidities of prematurity could be partially explained by decreased numbers of T cells and increased numbers of dysregulated innate immune cells.

Abstract # 15

Abstract Title: Critical congenital heart disease screening modification to decrease the gap in diagnosis: QI project

Name: Priya Jegatheesan, MD
NICU Director

Co-Authors: Angela Huang, RNC, Weifen Den, NNP, SudhaRani Narasimhan, MD, IBCLC, YT Lan, MD, Dongli Song, MD, PhD, Balaji Govindaswami, MBBS, MPH

Organization: Santa Clara Valley medical center

Abstract Overview: Background: Oxygen saturation screen in newborns decreases mortality by early diagnosis of critical congenital heart disease (CCHD), however misses up to 25% of CCHDs, especially those with left ventricular outflow tract obstructions. To decrease the gap in the sensitivity of CCHD screening we modified our screen to include perfusion index (PI). Objective: To implement a modified CCHD screen universally in order to increase the sensitivity of identifying CCHD. Method: The CCHD screening criteria was revised to include the 2 new criteria: PI <0.7 and saturation <95% to repeat the screen. Modified criteria were implemented in December 2018 in well baby nursery and in April 2019 in NICU following nursing and provider education and electronic health record update. Failed CCHD cases were reviewed during weekly clinical meetings. Electronic reports were obtained monthly. Failed and repeated screens were reviewed and summarized in SPS control charts. Baseline data was collected from January to November 2018. Results: Of 5,105 newborns screened, 8 (0.2%) failed the screen which included 2 CCHD cases during the baseline period, 1 pulmonary hypertension (PPHN) that required respiratory support, 5 mild PPHN or transitional circulation not requiring treatment. The number infants who required repeat screening increased from baseline 0.5% to 1.6%, while failed screen remained the same at 0.2%. Conclusion: Broadening CCHD screening criteria increased number of repeat screens but not failed screens. Large number of screens are needed to evaluate the sensitivity of the modified CCHD screening in asymptomatic newborns.

Abstract # 16

Abstract Title: Neonatal Resuscitation in the Emergency Room: Testing Knowledge and Confidence of Residents

Name: Shannon Liu, MD

Neonatal Perinatal Medicine Fellow

Co-Authors: Shannon Liu, MD*, Loren Yaeger, DO, Evan Sander, MD, Priya Shastry, DO, Nicole Flores-Fenlon, MD, Aarti Jain, MD, Yvette Liza Kearl, MD, Rangasamy Ramanathan, MD, Fiona Wertheimer, DO, Manoj Biniwale, MD

Organization: LAC+USC Medical Center

Abstract Overview: Emergency Medicine (EM) residency training is a diverse discipline, encompassing many facets of adult and pediatric medicine. Currently, neonatal resuscitation program (NRP) training is not a required ACGME milestone. As neonatal

cardiopulmonary compromise in the emergency department is rare, it is difficult for EM residents to learn and master the necessary skills to stabilize critically ill infants. Little is known about EM residents' knowledge and confidence in these skills. We conducted a survey of EM residents from a four-year academic residency program assessing their confidence in implementing NRP guidelines. We also tested their knowledge of conducting neonatal resuscitation with a quiz on NRP guidelines. A 5-point Likert scale was used on confidence questions. A total of 48 (65%) residents represented all postgraduate years participated (Figure 1). Perceived importance of NRP skills scored highly, with majority of participants expecting to resuscitate newborn infants in their future career (95.6%) and eager for structured training (97.9%) within their existing curriculum. Residents reported discomfort leading a neonatal resuscitation and were not confident in their knowledge of aspects of NRP such as targeted saturations, initiating positive pressure ventilation and intubation (Figure 2). The mean score on the quiz was 16 out of 29 (mean 55%, SD 4.4; range 0-89%). Figure 3 shows quiz questions in which majority of residents were not able to identify the correct response (marked with asterisk). Although two thirds of residents reported prior NRP training, there was no difference in mean quiz scores among participants with prior training ($p=0.19$). Residents with prior training did have increased self-reported confidence in their knowledge of the indications for intubation ($p=0.005$), and chest compressions ($p=0.005$). Prior NRP training was associated with knowledge of the correct depth of chest compressions ($p=0.03$) but did not correlate with coordination of ventilation with chest compressions ($p=0.52$). EM residents desire structured training in neonatal resuscitation. They report discomfort in leading a resuscitation but moderate confidence with skills required to resuscitate a newborn; however, when tested on content they scored poorly. Prior training did help with building some confidence but did not improve the content knowledge. A structured simulation curriculum specifically geared towards EM residents to learn NRP skills needs to be implemented.

Abstract # 17

Abstract Title: Factors Affecting Infants of Unexpected Deliveries Presenting to the Emergency Department

Name: Shannon Liu, MD

Neonatal Perinatal Medicine Fellow

Co-Authors: Shannon Liu, MD*, Loren Yaeger, DO, Evan Sander, MD, Priya Shastry, DO, Nicole Flores-Fenlon, MD, Maria Martes Gomez, DO, Bret Nolan, MD, Rangasamy Ramanathan, MD, Fiona Wertheimer, DO, Manoj Biniwale, MD

Organization: LAC+USC Medical Center

Abstract Overview: Perinatal mortality is high in unexpected de-

liveries. The objective was to analyze unplanned out of hospital deliveries and threatened deliveries presenting to a single center Emergency Department (ED) and compare maternal and infant characteristics. This is a retrospective chart review of pregnant women who were admitted to the Labor and Delivery Unit from the ED between June 2015 and December 2019 at LAC+USC Medical Center. Electronic records of women who delivered infants or presented with threatened deliveries to the ED and went into labor within 24 hours of admission were included. Those with an intrauterine fetal demise were excluded. A total of 107 live births met inclusion criteria. The median maternal age was 28 years (IQR20-36 yrs), and median gravida 3 and parity 1. Infants born before hospital arrival comprised 45% of the population. Only 8% of women presented after trauma or motor vehicle accident, while the remaining were in labor. Illicit substance use was confirmed in 45% of mothers and 20% had a psychiatric diagnosis. Limited prenatal care was seen in 58% of women. None of these factors were statistically significant for delivery before ED arrival. Maternal drug use at any point during pregnancy was significantly higher in infants delivering before ED arrival ($p=0.02$). Substance use was noted to be higher in women receiving limited prenatal care ($p=0.018$). Median infant gestational age was 38 weeks (IQR 34-42wks) with mean birth weight of 2787g (SD 720g). Significantly more infants born before hospital arrival were classified as small for gestation age ($p=0.04$) and had first measured temperature less than 36.5 degrees Celsius ($p=0.004$). Advanced resuscitation, including positive pressure ventilation, intubation or chest compressions was required in 35% of infants and 44% required NICU admission. Infants of substance abusing mothers were more likely to require advanced resuscitation ($p=0.008$). Mortality rate for all neonates was 7.5%. Infants who died had a lower mean maternal age of 23 years ($p=0.029$) and lower mean gestation age of 31 weeks ($p=0.046$). Our results highlight the significant mortality associated with unexpected deliveries presenting to the ED with increased morbidities in the infants requiring resuscitation and higher NICU admission rates. Substance use and limited prenatal care appear to be significant factors to before hospital delivery. Special care should be given at maintaining temperature in infants born before hospital arrival.

Abstract # 18

Abstract Title: Analysis of Non-Human Proteins/Peptides in Human Breast Milk by Mass Spectrometry

Name: Shiyu Bai-Tong, MD

Fellow

Co-Authors: Kathleen Luskin MD, Sandra Leibel MD, Majid Ghassemian PhD, Jessica Kitsen BS, Diba Motazavi BS, Kerri Bertrand MPH, Tina Chambers PhD, MPH, Sydney Leibel MD, MPH, Bob Geng MD

Organization: UCSD Medical Center and Rady Children's Hospital, Division of Neonatology

Abstract Overview: Background: Human breast milk is shown to decrease the risk of atopic diseases in full term babies. But its allergenic effects on preterm babies and the etiology of its protective effect have not been established. We aim to perform a broad analysis of non-human proteins and peptides in human breast milk using mass spectrometry. Methods: Four breast milk samples were obtained from Mommy's Milk, a human milk research biorepository in San Diego for mass spectrometry analysis. Two samples were from preterm infant's mothers and two were from term infants' mothers. Mothers filled out food and environmental exposure surveys when donating their breast milk. We utilized the University of Nebraska Allergen Protein Database and The Universal Protein Resource (UniProt) protein sequence database to identify a total of 2211 protein/peptide sequences. Results: Each sample had between 806 and 1007 proteins/peptides, with 37 to 44 non-human proteins/sample encompassing 26 plant and animal species. Bovine proteins/peptides were the most numerous; seven unique *Bos taurus* proteins/peptides were found in all samples. Cat, dog, mosquito, salmon, and crab were detected in all four samples. All maternal donors ingested fish, shellfish and tree nuts. Aeroallergen proteins/peptides, including dust mite and mold were identified in all samples. Two almond proteins were detected in three samples. Two samples contained latex and chicken. One sample contained several unique proteins/peptides, including carrot, two molds (including *Penicillium citrinum*) and American house dust mite-like protein. Conclusions: These findings represent the first breast milk mass spectrometry analysis with identification of known allergenic proteins from food and the environment. The correlation between the exposure of allergenic protein in human milk and the development of atopic disease is unclear. This raises the question of whether breast milk can serve to induce sensitization or tolerance in infants. We are currently conducting a prospective study aiming to analyze allergenic peptides in preterm infants' milk feeding and their risk of atopic disease later on in life.

Abstract # 19

Abstract Title: Delayed cord clamping for 2-3 minutes further reduces RBC transfusion in very preterm infants

Name: Priya Jegatheesan, MD

NICU Director

Co-Authors: Dongli Song, MD, PhD, Priya Jegatheesan, MD, Angela Huang, RNC, SudhaRani Narasimhan, MD, Matthew Nudelman, MD, Claudia Flores, Sonya Misra, MD, Christina Anderson, MD, James Byrne, MD, Balaji Govindaswami, MBBS, MPH

Organization: Santa Clara Valley Medical Center

Abstract Overview: Background: Delayed cord clamping (DCC) increases blood transfusion from placenta to the newborn at birth. DCC >30-60 seconds reduces risk of transfusion, morbidity, and mortality in preterm infants. We increased the duration of DCC from 1 minute to 2 minutes in 2016 and 3 minutes in 2018 in order to further decrease the risk of red blood cell (RBC) transfusion. Objective: To evaluate the risk of RBC transfusion in preterm infants < 33 weeks of gestation after increasing the duration of DCC to at least 2-3 minutes. Methods: DCC for 30 seconds was included in the standardized delivery room management bundle for preterm infants in 2008. DCC duration was increased to 1 minute in March 2011, 2 minutes in July 2016 and 3 minutes in January 2018. Use of erythropoietin for prevention of anemia was standardized in 2016. Demographics, delivery room and neonatal interventions, early (<72 hours) transfusion and any transfusion during NICU stay were obtained from the prospectively maintained NICU database. Transfusion data were summarized as SPC control charts. Demographics and outcomes were compared between infants who received at least 60 seconds: 1-minute DCC from January 2014-June 2016 and those who received at least 120 seconds: 2-3 minutes DCC from July 2016-December 2019. Results: During the study period, 192 preterm infants were born and 75% received the intended duration of DCC. The half-yearly control charts show the trend to lower rate of early and any RBC transfusion (Figure 1, 2). There was no difference in neonatal demographics between the DCC groups (Table 1). There was an increase in use of erythropoietin in the 2-3minutes DCC group. There was a significant reduction in any RBC transfusion from 17% in 1-minute DCC group to 8% in 2-3minutes DCC group. This reduction remained significant even after adjusting for the increase in erythropoietin use. There was no difference in hematocrit values. There is no difference in death, but there is a significant increase survival without major morbidities from 77% to 88% in the 2-3minutes DCC group even after adjusting for GA. Conclusion: Extending the duration of DCC to 2-3 minutes further reduces RBC transfusion in very preterm infants and improves their survival without major morbidities.

Abstract # 20

Abstract Title: Improving Postoperative Management Scores (POMS)

Name: Irfan Ahmad, MD

Professor of Clinical Pediatrics

Co-Authors: Melissa Powell MSN, CRNP, NNP-BC, Michel Mikhael MD, Megan Norton RN, BSN, Joe Kim, MD and Mustafa Kabeer MD

Organization: CHOC Children's Hospital and UCI

Abstract Overview: Background: Anesthesia and surgery place

significant stress on neonatal physiology. Lack of timely recognition and management may contribute to adverse outcomes. Aim: Increase the percentage of infants returning from operating room (OR) with all POMS within target range from baseline median of 33.3% to 85% by December 2018 and sustain this improvement for 12 months (December 2019). Interventions: We enrolled in CHNC STEPP IN Next STEPPs project in April 2017. Baseline data were collected from March to June 2017. Credit was given if all four measurements were within target range (temperature 36.1-38 C, pH 7.2-7.5, pCO₂ 31-75mm Hg, glucose 46-200mg/dl). Multi-disciplinary team and key driver diagram helped organize efforts and interventions were tested in multiple PDSA cycles beginning in July 2017. The first PDSA cycle (P1) focused on structured perioperative handoffs (POH). Intraoperative IV fluids guideline (IFG) was implemented in P2. Focus of P3 was real time POMS feedback to anesthesiologists. IFG was modified in P4 focus was to sustain gains in P5 and 6. Results: P1 interventions resulted in median shift to 57% with decreased post-op hypothermia and acidosis contributing to gains. This gain was sustained during P2 with decreased postop hyperglycemia. Median shifted to 77.8%, following P3 interventions. Gains were stabilized and sustained during P4-6. Lessons Learned: Addressing four physiologic variables simultaneously was challenging. Understanding the importance of postop stability was key in aligning multiple disciplines in NICU and OR. POH tool provided structured multidisciplinary communication. Multi-center collaboration on glucose management resulted in modified intraoperative IFG, leading to improved glucose control. Barriers to change included struggle with audit sheets completions and returns. Educating nurses, seeking help from unit secretary and process mapping led to improvement. While our median has not reached our goal of 85%, we have reached goal values in last 2 months. Next steps: Continue emphasizing importance of perioperative physiologic stability during PHO. Refine newly developed perioperative improvement bundle in a variety of surgical conditions in infants with different levels of maturity with appropriate guideline modifications. Our next focus will include optimizing postoperative pain control in infants.

Abstract # 21

Abstract Title: Decreasing Length of Stay in Very Low Birth Weight (VLBW) Infants

Name: Irfan Ahmad, MD

Professor of Clinical Pediatrics

Co-Authors: Kristine Golder, Karen Mitchel, Diana Hurtado, Sarah Lauridson, Su Freck, Kushal Bhakta and Jack Sills

Organization: CHOC Children's Hospital and UCI

Abstract Overview: Background: Preterm infants born weighing less than 1500g have prolonged length of stay (LOS) in the NICU

which places significant social and economic stress on families and healthcare system. Aim: Decrease mean LOS for inborn VLBW infants from postmenstrual age (PMA) of 40 to 37 weeks from July 2018 to June of 2019 and then sustain this till June 2020. Interventions: This project was part of Intermediate Improvement Science Series (I2S2) course (Cincinnati Children's Hospital). Multidisciplinary team addressed key drivers of change, which were tested in multiple incremental small change Plan-Do-Study-Act cycles (PDSA). New guidelines were developed for feeding advancement, nipple progression, management of apnea/bradycardia (A/B) and parent discharge education. Reminders were placed for timely completion of prescriptions and screening tests. Weekly multidisciplinary discharge rounds were initiated. Results: Baseline mean PMA at discharge (DC) was determined from previous 6 months. Cyclic implementation of improvement processes resulted in shift in DC PMA mean from 40 to 37.6 weeks and narrowing of control limits (decreased variability). Lessons Learned: Improvements in several processes were achieved resulting in DC of VLBW infants at a lower PMA. Simultaneous work from three improvement teams (with focus on single drivers of change) improved efficiency but created difficulties with coordination of meeting times and some complaints of "QI fatigue" amongst staff. Participation of hospital chief operating officer in meetings helped maintain enthusiasm. Faster advancement in feeds led to decrease in time to full feeds without changing NEC incidence (balancing measure). Nipple advancement guideline decreased variability in practice and a A/B guideline led to improved charting and less DC delays. Parents were able to complete all DC teachings a day prior to discharge using the Parents DC education sheet. Parent representation was instrumental in providing key perspectives. Achieving full nipple feeds and getting off nasal cannula remain important barriers to early discharge. Next steps: Continue to refine nipple progression guideline and reach consensus when to discharge some infants on nasal cannula or partial gavage feeds.

Abstract # 22

Abstract Title: Simulating Success through Multidisciplinary Team Training Exercises

Name: Irfan Ahmad, MD

Professor of Clinical Pediatrics

Co-Authors: Nandini Arul MD, Christina Clay RN, Maria Thrasher RT, Justin Cain SS

Organization: CHOC Children's Hospital and UCI

Abstract Overview: Background: Simulation training has been shown to improve team performance. Latent safety threats (LST) are identified improvement goals that impact delivery of optimal care to the patient. Simulations help identify these LST and help

reinforce positive team behaviors. Aim: Simulation training has been shown to improve team performance. Latent safety threats (LST) are identified improvement goals that impact delivery of optimal care to the patient. Simulations help identify these LST and help reinforce positive team behaviors. Setting: Level IV NICU within a freestanding Children's hospital with Pediatric Residency and Neonatal Fellowship Programs. 104 Bed NICU with surgical NICU, Small Baby Unit, Neuro NICU and Cardiac NICU. Methods: We joined California Perinatal Quality Care Collaborative (CPQCC) Simulating Success quality improvement project in March of 2018. Team members received simulation instructor training at Center for Advanced Pediatric & Perinatal Education (CAPE). Video recorded simulations and debriefings were started in July 2018 with first 10 serving as baseline. An improvement bundle was implemented in January 2019 with modifications during multiple PDSA cycles. Results: A total of 22 simulation exercises were done InSitu in labor and delivery, NICU and in a simulation lab. After implementation of the change bundle, LSTs decreased and there was a shift in the median to 2 LST per simulation. On further categorizing the LST's we found 58.7% of them were technical and 36.2% were behavioral issues. We focused our learning objectives in improving those weaknesses during subsequent simulation exercises. We were able to find solutions for some of the system errors identified. Discussion: Through these exercises, all respiratory therapists, 46% of nurses and 73% of physicians attended ≥ 1 simulation session. Barriers included finding suitable storage space for equipment and time commitment from facilitators. These were in-situ simulations which are inherently challenging. These issues were discussed during team meetings with CPQCC faculty/other centers and solutions were implemented. The hospital was able to provide a simulation lab and a dedicated sim specialist which made subsequent simulations more efficient. Significant improvements have been made in team performance as evidenced by decline in median LSTs getting us closer to our goal of 1 LST per simulation. Next steps: Achieve all staff participation of ≥ 1 simulation per year. Enhance simulation training to include procedural skills like chest tube placements/paracentesis. Implement a solution based tracking of system errors identified.

Abstract # 23

Abstract Title: Symptomatic Treatment Approach Versus Nonintervention for Patent Ductus Arteriosus in Very Low Birth Weight Infants

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Name: * Ma Teresa Ambat, MD

Neonatologist

Co-Authors: Maria Fe Villosis MD, Karine Barseghyan MD, Kevin Rezaie MD (all are Neonatologists)

Organization: Kaiser Foundation Hospital - Panorama City

Abstract Overview: Background: Reports on clinical experience with less aggressive strategies for patent ductus arteriosus (PDA) management are continuing to emerge and suggest that a more permissive approach does not result in worse outcomes. Some studies have reported that nonintervention that allows spontaneous PDA closure did not increase the risk of mortality, bronchopulmonary dysplasia (BPD), retinopathy of prematurity (ROP), intraventricular hemorrhage (IVH) and necrotizing enterocolitis (NEC). A more recent publication also showed that it was not associated with increased risk of long-term neurodevelopmental impairment. Currently, wide variation in practice continues to exist and the effect of active treatment compared with nonintervention remains unclear. Objective: To evaluate and compare outcomes of two management approaches for PDA in very low birth weight infants (VLBWI) admitted to Kaiser Foundation Hospital-Panorama City (KFH-PC) NICU Design/Methods: This is a single-center, retrospective study of VLBWI admitted to KFH-PC NICU. Outcomes of symptomatic treatment used in period I (January 2010-June 2015) were compared with nonintervention or conservative treatment approach used in period II (July 2015-September 2018). Results: We retrospectively analyzed data from the medical charts in 315 VLBWI (184 in period I, 131 in period II). In period I, there were 77 VLBWI who had PDA of which 67 (87%) were treated with indomethacin, 2 (2.5%) had both indomethacin treatment and PDA ligation and 10 (13%) had spontaneous closure prior to discharge. In period II, there were 69 VLBWI who had PDA of which 3 (4.3%) were treated with indomethacin and 3 (4.3%) had PDA ligation without prior indomethacin treatment. Those who had PDA ligation in period II were transferred to another facility where they had PDA ligation following the facility's treatment protocol for PDA. In period II, spontaneous closure was observed prior to discharge in 51 (74%) and after discharge in 7 (10%) VLBWI. Late onset sepsis, IVH and death prior to hospital discharge did not differ significantly between the 2 time periods. In period II, BPD was significantly lower ($p=.003$) as well as the time to reach full feeds ($p<.001$). Trends for oxygen use at discharge, NEC and ROP were also lower in period II but not statistically significant. Conclusion(s): In this study, we found that conservative approach compared to symptomatic treatment resulted in high spontaneous closure of PDA without increasing the risks of death and major morbidities in VLBWI.

Abstract # 25

Abstract Title: Impact of a Parent Video Viewing Program in the Neonatal Intensive Care Unit

Name: Jennifer Weber, MD

Neonatal-Perinatal Medicine Fellow

Co-Authors: Jennifer Weber, MD* Hadley Sauers-Ford, MPH, CCRP Kristin Sohn, MD Ashley Hanhauser James Marcin, MD Daniel Tancredi, PhD Kristin Hoffman, MD

Organization: University of California, Davis

Abstract Overview: Introduction: The NICU is a unique health-care setting, where given the complexities of caring for a critically ill baby, the parent population is at high risk for emotional distress and disrupted parental bonding. To address this, many NICUs have begun using bedside video cameras to facilitate virtual visits by parents and other family members. We examined parents' self-reported perceptions regarding the NICU experience in relation to these video visits. Responses from families that voluntarily utilized the video cameras for virtual visits were compared to those from families that did not use the cameras. Methods: Using a prospective study design, families were enrolled following informed consent and were asked to complete a series of two surveys, one at time of enrollment and the second at time of discharge from the NICU. Responses from families that voluntarily utilized the video cameras for virtual visits were compared to those from families that did not use the cameras. In addition to parent surveys, additional data were collected on each subject, including demographics, breastmilk feedings at discharge, and use of video visits. One hundred respondents who completed both surveys were included for analysis. Student's T-test was used to compare subjects using the video cameras to those who did not use video visits for each survey response variable. Results: 30% of parents ($N = 30$) utilized video visits. Characteristics such as gestational age (GA) and breastmilk feedings at enrollment were similar between groups. Length of stay was significantly extended in the video visits group (Table 1). Families who used video visits experienced a more sustained intention to breastfeed or pump breastmilk compared to nonusers with a mean over time difference between groups of -0.95 points (95% CI: -1.76, -0.14). The percentage of babies receiving breastmilk at discharge was likewise higher in the video visits group (83% vs. 66%, $p = 0.03$). Additionally, there was a trend toward improved parental involvement in the babies' care in the video visit group (Tables 2-3). Conclusion: The extension of technology to allow parents to view their babies remotely may be one way of mitigating some of the stressors related to NICU hospitalization. Participation by parents in video viewing of their infant in the NICU was associated with sustained intention to breastfeed over the duration of the NICU stay and a trend toward improved self-perception of involvement in care. These findings justify further study of video viewing in this high-risk population.

Abstract # 26

Abstract Title: Implementation of Eat, Sleep, Console as Pri-

Primary Treatment for Neonatal Abstinence Syndrome in a Level IV NICU

Name: Charles Egesdal, MD
Resident (PGY-3)

Co-Authors: Charles Egesdal*, MD Priscilla Joe, MD Joanne Kuller, RN, CNS Bette Flushman, MA Kathryn Ponder, MD

Organization: UCSF Benioff Children's Hospital Oakland

Abstract Overview: Title: Implementation of Eat, Sleep, Console as primary treatment for Neonatal Abstinence Syndrome in a level IV NICU Authors: Charles Egesdal*, MD, Priscilla Joe, MD, Joanne Kuller RN, CNS, Bette Flushman MA, Kathryn Ponder MD Background: The incidence of NAS has increased nationwide with the opioid epidemic across our country. Traditionally, treatment has focused on the use of pharmacologic opiate agents which are associated with long hospital stays and prolonged drug exposures. The ESC model has shown that interventions focused on non-pharmacologic therapies for infants with NAS can dramatically reduce hospital length of stay (LOS), morphine exposure, and costs. The approach focuses on the use of physiologic determinants to dictate the need for interventions as opposed to symptoms of withdrawal. This approach is not regularly implemented in neonatal ICUs. Objective: The aim of our project was to implement the ESC approach for infants admitted with NAS to our level IV NICU, and improve outcomes defined as a reduction of average LOS by at least 50% and a reduction in morphine exposure by 50%. Design/Methods: ESC nursing training was provided. NAS babies were assessed for their ability to feed, sleep for > than 1 hour, and be consoled within 10 minutes. Infants' abilities to accomplish these physiologic outcomes guided pharmacologic and non-pharmacologic interventions with non-pharmacologic interventions being prioritized. Medical records for NAS babies admitted to our NICU in 2019 were reviewed and compared to our NICU baseline retrospective data from 2015-2018. Infants who were premature (<33w GA), on iNO, or on HFOV were excluded. Results: A total of 12 infants were enrolled in our study from January to August of 2019. A total of 29 infants were used for comparison using our retrospective data. The mean length of stay at our institution for babies admitted with a primary diagnosis of NAS decreased from 29.8 days to 10.3 days, a reduction of 65%, with a p value of 0.002. Our mean morphine exposure days, defined as a 24 hour period during which an infant received morphine, decreased from a mean of 24.2 days to 0.42 days, a reduction of 98%. Volunteer hours were recorded with an average of 27.7 hours per infant of volunteer cuddling. 91.67% (11/12) of our infants were placed in foster care following discharge. Conclusion(s): Our project displays that the ESC approach is an effective option even for patients admitted to a high acuity level IV NICU without a mother present to provide care. With the use of ESC in addition to adjunctive approaches such as volunteer cuddlers, we were able to significantly decrease the length of stay and morphine exposure of patients in our unit admitted with NAS.

Abstract # 27

Abstract Title: Direct Umbilical Vein Injection of Epinephrine with Cut Umbilical Cord Milking

Name: Peggy Chen, MD
Clinical Fellow

Co-Authors: Peggy Chen, MD*; Payam Vali, MD; Amy Lesneski, BS; Morgan Hardie, BS; Ziad Alhassen, MD; Houssam Joudi; Deepika Sankaran, MD; Satyan Lakshminrusimha, MD

Organization: University of California, Davis

Abstract Overview: Background: Acute perinatal asphyxia remains a significant cause of morbidity and mortality. Early return of spontaneous circulation (ROSC) in asphyxial arrest is associated with better outcomes. In severe bradycardia/asystole, NRP recommends administering epinephrine (EPI) by a low umbilical venous catheter (UVC). Umbilical access with a low UVC is time-consuming and requires advanced skills and specialized equipment. Direct umbilical vein (UV) injection offers the potential for quick administration of IV EPI with milking of the cut umbilical cord to flush EPI into the circulation (Figure 1). Objective: To show feasibility and effectiveness of direct injection of EPI into the UV followed by cord milking as a quick method of IV EPI administration. Methods: Ten near-term fetal lambs were exteriorized, intubated, and instrumented. The umbilical cord was occluded to induce asphyxia, then tied and cut at the placental end to leave a long 15-20 cm segment. After 5 minutes (min) of asystole, resuscitation following current NRP guidelines was initiated. Upon initiation of chest compressions, preparation to administer EPI began. IV EPI of 0.03 mg/kg/dose was administered into the UV at the base of the umbilicus with a syringe attached to a 23G needle, followed by 3 quick successive cord milkings to flush EPI. If ROSC was not achieved, a UVC was placed and UVC EPI was given and repeated every 3 min until ROSC with a max of 4 doses or 15 min of CPR. Plasma samples were collected to analyze pharmacokinetics. Results: The average weight of the lambs was 3.65

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± 0.71 kg. The male:female ratio was 6:4. 90% of lambs achieved ROSC; 70% following direct UV EPI injection alone. Average time of UV EPI administration was 2.28 ± 2.13 min and average time to ROSC was 5.82 ± 2.81 min. Plasma EPI assay concentration for two lambs showed an average concentration of 562 ± 471 ng/mL, similar to historical values following UVC injection of 0.03 mg/kg EPI (450 ± 190 ng/ml, Vali et al. JAHA 2017). Conclusion: In an asphyxia cardiac arrest lamb model, direct UV EPI administration followed by cord milking is quick and efficacious with a good success rate of ROSC. Preliminary data suggest adequate epinephrine plasma concentration following direct UV EPI administration. Experiments are underway to compare success and time to ROSC between direct UV and UVC EPI administration. Further evaluation of direct UV EPI followed by cord milking may have high relevance in resource-limited settings.

Abstract # 28

Abstract Title: Piezo1 in the Biomechanical Stretch of the Small Bowel Muscularis

Name: Geoanna Bautista, MD

Fellow

Co-Authors: Yingjie Du BS, Nicolle Martin, Nam Phuong Nguyen, Mutian Hua BS, Elmira Tokhtaeva PhD, RS Solorzano-Vargas, Michael S. Lewis MD, Ximin He PhD, Matthias Stelzner MD, James Dunn MD, PhD, Martin G. Martin MD

Organization: University of California, Los Angeles

Abstract Overview: Introduction: Biomechanical stretching of the small bowel has clinical and therapeutic implications for pediatric and neonatal patients with small bowel obstruction (SBO) and intestinal failure. Little is understood of the mechanism by which biomechanical stretching results in the thickening of the muscularis and expansion of crypts and intestinal stem cells (ISC) of the epithelium. Piezo1 is a stretch-induced ion channel involved in the modulation of trophic effects in mechanosensitive tissues and is expressed in the gut. Methods: In vivo and in vitro methods were used to determine whether Piezo1 in smooth muscle cells (SMC) is necessary in mediating stretch-induced intestinal growth. Using the Piezo1/Myh11-ERT2/Cre-LoxP system, we generated a mouse model with a tamoxifen (Tam) inducible-Piezo1 knockout (Piezo1 Δ SMC) in the SMC of small bowel muscularis (SBM). In vivo, mice received Tam and had distal SBO surgery to induce biaxial stretch. In vitro, SBM was isolated from mouse pups and plated on 2D monolayers on a soft tissue scaffold composed of a thermo-responsive hydrogel to induce ~50% stretch by cooling from 37°C to 33°C. Confocal microscopy was used to record SBM contraction/Ca²⁺flux using a GCaMP indicator. The rhythmicity, frequency and magnitude were quantified with MATLAB. Results: In vivo: Mortality rates were similar between control (Piezo1WT)

and Piezo1 Δ SMC. Obstructed Piezo1WT and Piezo1 Δ SMC mice had a significant increase in crypt size and SBM compared to non-obstructed mice. Although, there was significant attenuation in crypt elongation in Piezo1 Δ SMC mice compared to Piezo1WT. There were no statistical differences between both groups in obstructed SBM width. In vitro: At 37°C, Piezo1WT SBM cells have spontaneous and rhythmic contractions associated with Ca²⁺flux. At 33°C, Piezo1WT cells seeded on hydrogels doubled in frequency of contractility/Ca²⁺flux, compared to Piezo1WT cells seeded on plastic, which had decreased contractility/Ca²⁺flux. When Yoda1, a Piezo1 agonist was added to Piezo1WT cells on plastic at 33°C, contractility/Ca²⁺flux resumed. In contrast, Piezo1 Δ SMC cells displayed decreased frequency and disorganized pattern of contractions/Ca²⁺flux, which diminished further on stretching at 33°C. When treated with Piezo1 shRNA, Piezo1WT cells had decreased contractions/Ca²⁺influx. Conclusion: Our data suggests that Piezo1 in the SMC of the SBM partly mediates crypt expansion associated with SBO, and is required for the maintenance of regular, rhythmic SBM contractions/Ca²⁺flux with and without biomechanical stretch.

Abstract # 29

Abstract Title: Implementation of a Bedside Point-of-Care Ultrasound Program in a Large Academic Neonatal Intensive Care Unit

Name: Caroline Noh, MD

Fellow

Co-Authors: Pai VV*, Dasani R, Noh CY, Vallandingham S, Manipon C, Houghteling PD, Balasundaram M, Davis AS, and Bhombal S.

Organization: Stanford University

Abstract Overview: TITLE Implementation of a Bedside Point-of-Care Ultrasound Program in a Large Academic Neonatal Intensive Care Unit BACKGROUND In the adult and pediatric critical care population, bedside clinician performed ultrasound has been shown to provide rapid diagnostic capability, affect patient management and improve procedural accuracy. For neonatal providers, training in ultrasound and the use of ultrasound for diagnosis and management is increasing, but overall the use of ultrasound in the Neonatal Intensive Care Unit (NICU) is still uncommon compared to other critical care fields. OBJECTIVE To describe the process of implementing a Point-of-Care Ultrasound (POCUS) program in a large academic NICU and evaluate the role of ultrasound in neonatal care during early adaption of this program. DESIGN/METHODS Two faculty, 1 fellow and 2 neonatal nurse practitioners (NNP) attended a regional 2-day immersive course in POCUS in November 2018 and subsequently began performing regular scans in their NICU. For all fellows, attendings and

nurse practitioners in the NICU, a 2-day POCUS course was organized by the core team in June 2019 to expand the number of NICU providers with knowledge of ultrasound basics and skills in POCUS. Team meetings occurred monthly and included internal quality assurance review. Additional multidisciplinary QI sessions were held with radiology. Joint conferences, teaching, and bedside scanning sessions were held monthly in conjunction with pediatric critical care faculty and fellows. The NICU POCUS team established guidelines for performing POCUS in the NICU, created an image bank and procedure log, with the goal of eventually achieving individual credentialing. **RESULTS** In addition to the core team of 5 providers initially trained in POCUS, an additional 22 providers attended a local 2-day POCUS course in June 2019. A total of 233 POCUS scans were performed on 123 patients from 12/2018 to 12/2019 by 7 fellows, 4 attendings, and 5 NNPs or neonatal hospitalists in 6 diagnostic and procedural applications: central line (PICC/UVC), bladder, lung, cardiac assessment, lumbar puncture/spinal fluid assessment and vascular access (Table 1). Utilization of bedside clinician performed ultrasound resulted in 20.2% (47/233) cases of diagnostic or error prevention (Table 2). **CONCLUSION** Implementation of a bedside POCUS program is labor intensive and benefits from a team approach in a large academic NICU. Bedside clinician performed ultrasound findings can provide valuable information in the NICU and impact clinical management.

Abstract # 30

Abstract Title: Fetal Central Nervous System Anomalies- How to Prognosticate

Name: Monika Bawa, M.S, M.Ch

Additional Professor

Co-Authors: Nilesh tank- Senior Resident Ravi P Kanojia- Professor Ram Samujh- Professor

Organization: Postgraduate Institute of Medical Education and Research

Abstract Overview: Aim: To assess the prevalence and outcome of antenatally diagnosed central nervous system malformations (CNS). Method: Prospective study conducted on antenatal mothers who were diagnosed with fetal central nervous system anomalies (brain and spine) on ultrasound over a period of two years. Detailed data was recorded in terms of gestational age at diagnosis, comorbidity, TORCH infection, triple screening, ultrasound, associated anomalies. Outcome was analyzed as need for MTP, fetal and neonatal demise, need of surgery and overall outcome. Results: Out of 521 antenatally detected congenital malformations, 163 patients (31.28%) had CNS malformation with isolated choroid plexus cyst (CPC) being the commonest (39.26%). Average size of CPC was 7.8mm (3-15mm) and it disappeared in

all. Isolated corpus callosum agenesis (CCA) was seen in 6.74%, prominent cisterna magna (PCM) in 7.36 %, CPC with ventriculomegaly in 4.9%. Isolated ventriculomegaly was found in 44 patients (26.99%), while 11 patients had ventriculomegaly with associated malformations. 16 patients with >15mm ventricular size had a poor outcome postnatally. 12.88% had isolated NTD. MTP was advised in 9.81% and 3.06% died after birth. 11% patients underwent surgery. Conclusion: Isolated CPC, isolated ventriculomegaly of < 15 mm, isolated CCA, isolated PCM carry a good prognosis hence the parents should be counselled positively.

Abstract # 32

Abstract Title: Neonatal Normothermia in the Golden Hour, Kaiser Southern California Region

Name: Sandra Short-Bartlett, MD

Partner Neonatologist, Kaiser Orange County

Co-Authors: Mandhir Gupta, MD (NICU Director, Kaiser Downey), David Braun, MD (Regional Neonatology Quality Initiatives, Past Regional Physician in Charge for Neonatology, (1999-2019), Marielle Nguyen, MD (NICU Director, Kaiser Orange County, Regional Physician in Charge for Neonatology 2019-), Dilip Bhatt, MD (Partner Emeritus, Past NICU Director, Kaiser Fontana), Nirupa Beckham, MD (Partner Neonatologist Kaiser Fontana/Ontario) and the Kaiser Southern California Regional Neonatal Normothermia Practice Improvement Committee

Organization: SCPMG

Abstract Overview: Introduction: Numerous studies have demonstrated that neonatal outcomes are improved if normothermia is maintained. In 2016 VON's Roger Soll clarified the care gap: "Despite decreases, nearly 4 in 10 babies are cold..." At Kaiser Southern California, we had improved our <32 weeks or <=1500g NICU admission temperatures from 72% normothermic in 2012-14 to just 77% in 2016. While we overall had better results than the VON VLBW average, our Fontana facility regularly attained over a 90% normothermia rate. In 2017 we established perfor-

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mance goals, and we undertook an even more ambitious Quality Improvement project to achieve the Fontana benchmark throughout our Region. Methods: Each center formed a multidisciplinary Normothermia team lead by OB/NICU Physician, Nursing and Respiratory Therapy champions. Local teams worked on their own quarterly PDSA cycles - utilizing checklists, audit tools, EHR/CPQCC data, and provider/staff feedback. We conducted periodic Regional teleconferences and posted regularly on a Microsoft teams site – a format for ongoing discussion, emphasizing our AIM Statement, Key Driver Diagram, literature/education, successful and unsuccessful strategies, buy in, team roles, optimization of new and existing equipment, documentation, results, and plans for future improvement. We focused on several Key Drivers: keeping patients warm in the delivery room with a bundle of techniques, careful temperature monitoring, and maintaining a stable temperature during transport to the NICU. Results: Neonatal Normothermia improved from 77% to 92% over the two year study period. 93% of our centers were at or above our 90% Normothermia goal for 2nd Quarter 2019. Only 0.3% of the babies were admitted in the moderate hypothermia range. 5.3% of babies were hyperthermic early in the project, but this dropped to 3.6% which was below our baseline 2016 rate of 3.8%, but above our goal of <3%. Conclusions: We observed drastic improvement in our small baby NICU admission temperatures over the duration of the project. We had challenges with hyperthermia, which improved over time. Our future goals will be to sustain or surpass our success, to improve uniformity of data collection, documentation, and checklists, and to determine which interventions are most important and cost effective.

Abstract # 33

Abstract Title: Impact of a Small Baby Program on Infants of Periviable Births

Name: Ting-Yi Lin, MD

Neonatologist

Co-Authors: Ching Ching Tay, MS, CNS, RNC-NIC; James Fritzell, MD; Antoine Soliman, MD.

Organization: MemorialCare Miller Children's & Women's Hospital

Abstract Overview: Background Survival of extremely low birth weight (ELBW) infants has improved significantly in the last decade. Clinical programs instituted in many neonatal intensive care units (NICU) targeted at the ELBW population have demonstrated their value by improving outcomes and survival without major morbidities. Yet, little is known if such clinical programs, usually implemented through a quality improvement approach, have any impact on the outcomes of extremely low gestational age neonates (ELGAN) between 22 to 24 completed weeks. Method The aim of our project is to improve survival and reduce major morbidities of ELGAN between 22 and 24 completed gestational weeks. In the first phase of our project, we sought to understand the current outcomes for ELGAN after 1 year of implementing a small baby program in our level III NICU. The Small Baby Program at Miller Children's & Women's Hospital Long Beach began in late 2016. The program brought a significant culture change in our approach to care of very preterm infants using age-specific guidelines and checklists. Development and adherence to established guidelines and checklists are overseen by a multidisciplinary leadership team, who is also responsible for monitoring process and outcome measures. Some of the key practices introduced focused on care during the golden hour such as delayed cord clamping, thermoregulation, early parenteral nutrition, and timely surfactant administration. Results All infants delivered between 22 and 24 gestational weeks at our facility were included in the data analysis. Infants delivered at outside centers or with known congenital anomalies were excluded. Between 2018 and 2019, there was a total of 27 inborn periviable infants; 22 weeks (n=1), 23 weeks (n=8) and 24 weeks (n=18). Overall survival rate was 78%; 100% at 22 weeks, 75% at 23 weeks, and 78% at 24 weeks. Of the infants who were discharged home, 13% had no major morbidity, 17% had 1 major morbidity, 25% had 2 major morbidities, and 17% had 3 or more major morbidities. Conclusion This preliminary assessment suggests that survival rate of periviable infants at our institution is comparable to recently published multi-national data. More encouragingly, a third of survived infants were discharged home with only one or no major morbidity. Consequently, we have determined that our Small Baby Program has the potential to further increase survival of these periviable infants with excellent outcomes. The program steering team will focus next on tailoring care to this specific population through additional guidelines and checklists.

Abstract # 34

Abstract Title: Improving Newborn Early Onset Sepsis (EOS) Screening at Cottage Health

Name: Katherine Chung, MD
Neonatologist

Co-Authors: Katherine Chung MD*, Lori Brown MD, Barbara Donnelly MD, Theresa Lueck MD, Adrienne Macdonald MD, and Jeanne (Jing) Li MA.

Organization: Cottage Santa Barbara Hospital

Abstract Overview: **BACKGROUND:** Existing protocol at our institution was to automatically initiate antibiotics for babies born to mothers with maternal chorioamnionitis, resulting in NICU admissions and antibiotic usage for asymptomatic infants. Furthermore, CBCs and CRP levels were frequently drawn in the newborn nursery, despite having questionable utility in predicting early onset sepsis (EOS). We sought to improve our neonatal sepsis screening practice by aiming for a 20% reduction in unnecessary NICU admissions, lab draws, and antibiotic use, without missing a case of EOS. **METHODS:** The Plan Do Study Act method of quality improvement was used for this project. Pre-intervention baseline data was collected for the 6 month time period February-July 2018. Post-intervention data was collected for the time period February-July 2019. The following measures were analyzed: antibiotic usage out of total live births, antibiotic usage out of inborn NICU admissions (greater than or equal to 35 weeks), asymptomatic NICU admissions, nursery patients with CBC or blood culture drawn, positive blood cultures, and readmissions for EOS. **INTERVENTIONS:** We instituted universal EOS screening on all newborns \geq 35 weeks gestational age using the Kaiser Sepsis Calculator. We worked to build the sepsis calculator into the hospital's electronic medical record system and provided education to the nursing staff and physicians. We updated hospital policies to reflect sepsis calculator implementation, and developed an algorithm for nursing workflow. **RESULTS** Since implementation of the EOS calculator, antibiotic usage out of total live births dropped from 3.31% (32/967) to 2.41% (24/997) over the course of 6 months, a 27% drop from baseline ($p=0.29$). During the same time period, antibiotic usage for infants \geq 35wks gestation in the NICU dropped from 42.67% (32/75) to 26.97% (24/89), representing a drop of 37% ($p=0.052$). There was a significant drop in laboratory draws from 15.22% (142/933) to 8.35% (81/970), a percentage decrease of 45% ($p<0.001$). There were 7 asymptomatic NICU admissions for antibiotic administration due to maternal risk factors during the baseline period; this number dropped to 0 after calculator implementation and was sustained over the six month period. There were 0 positive blood cultures in both the baseline year and after calculator implementation, and there were 0 re-admissions for missed early onset sepsis. **CONCLUSIONS** Implementation of a sepsis risk calculator has produced a reduction in antibiotic usage, asymptomatic NICU admissions, and laboratory draws. Long term data must be analyzed to demonstrate sustained improvement and statistical significance.

Abstract # 35

Abstract Title: Impact of probiotic Bifidobacterium longum subsp. infantis EVC001 on patient outcomes in neonatal intensive care units

Name: Marielle Nguyen, MD
Regional Physician in Charge, Neonatology

Co-Authors: M Nguyen, MD; Heaven Holdbrooks, RN; Prasanthi K Mishra, MD; Maria A Abrantes, MD; Carrie McGuckin, RN; Cindi Hein, RD; Steven A Frese, PhD

Organization: Kaiser Permanente Southern California-Orange County

Abstract Overview: **Introduction:** Dysbiosis in the gut microbiome affects the health of preterm neonates and increases the risk for diminished growth and infection. Probiotics have been considered to correct this in preterm infants, but there are a variety of organism, strain combinations, and differing levels of quality which complicate interpretation of meta-analyses. The objective of this pilot study was to evaluate the use of a single strain probiotic containing activated Bifidobacterium longum subsp. infantis EVC001 (EVC001) in medium chain triglyceride oil, compared to the previous protocol using L. reuteri DSM17938, in neonatal intensive care units. We hypothesized that the known ability of EVC001 to utilize human milk oligosaccharides, colonize the infant gut, and resolve dysbiosis would be associated with improved clinical outcomes. **Methods:** Deidentified medical health records were collected from patients born in NICUs within a single health care system in California. Two time periods were examined; the period where L. reuteri DSM17938 was used and patient data from the first year of EVC001 use. Total nutrition (TPN hours), length of stay, antibiotic use, and infection (incidences of late onset sepsis, NEC, intestinal perforation, and urinary tract infections) were compared. Data were analyzed by Wilcoxon rank sum test with continuity correction. **Results:** Data from 141 individuals was collected in this pilot study. Only 90 infants remained in these hospitals for the duration of their NICU stay. In this population, infants fed EVC001 had a shorter duration of stay (by 5 days, 95% CI: 61-84 days vs. 64-90 days) and fewer hours on total parenteral nutrition (by 105 hours, 95% CI: 218-299 hours vs. 292-435 hours), in an otherwise similar population in terms of gestational age (95% CI: 27-29 weeks). Other monitored outcomes were not significantly different between the groups given the small sample size, but directional trends to lower rates of NEC and infections were observed as well. **Conclusion:** This pilot analysis of patient outcomes shows promising trends toward a medically relevant decrease in the duration of stay and TPN usage in a preterm population fed EVC001 (an estimated savings of \$23,800 per patient, relative to DSM17938). Future analysis using additional hospitals matched for feeding protocols, with a larger sample set, as well

as prior to any probiotic use will provide additional insight into the impact EVC001 has on preterm infants.

Abstract # 36

Abstract Title: Elimination of hypothermia (<36.5C) in Extremely Low Birth Weight (ELBW) Infants for Last Six Years (2014-2019). Best in all California NICUs. Experience of Single Level III NICU

Name: Dilip Bhatt, MD
Neonatologist

Co-Authors: Nirupa Reddy, MD, NICU Hospitalist Reinaldo Ruiz, MD, Obstetrician Darla Bustos, RN, NICU Toria Peacock, RN, OB Roman-Angelo Dizon RCP Sunjeeve Weerasinghe, NNP Rangasamy Ramanathan, MD

Organization: Kaiser Hospital, Fontana

Abstract Overview: Background: Perinatal care practices, including initial stabilization and resuscitation of newborn infants have improved dramatically over the past 5 decades. Yet thermal management around the time of birth continues to be a major problem with many newborns admitted with hypothermia. Objective: Our Hospital Perinatal Quality Improvement Committee developed a quality improvement bundle to decrease hypothermia in all preterm babies. Staff education including nurses of L&D and NICU, Obstetricians, Neonatologists, NNP, and Respiratory Care

Practitioners is critical. Stabilize the temperature in normothermia range (36.5-37.5C) in DR/OR prior to transport to NICU. Take axillary temperature in DR/OR q5 minutes. No umbilical vessel catheterization in DR/OR except for resuscitation. No surfactant administration in the DR/OR. Axillary temperature of infant was taken within minutes of NICU admission. This is a prospective study from 2014-December 31, 2019. Results: We studied 200 consecutive cases. Nine out of 200 were <500 grams, 25/200 were <24 weeks gestational age, 5/200 (2.5%) among ELBW infants had hypothermia. Hyperthermia (>37.5C) was 6.5% 13/200. Overall normothermia (36.5C-37.5C) rate for this 200 ELBW was 90% (18/200). Overall mortality in ELBW was 14.5% (29/200). We tried to keep the OR and DR temperature 74F. Conclusion: Our NICU has eliminated hypothermia (<36.5C) for last six consecutive years in more than 90% of ELBW. There was not a single case of moderate hypothermia (32-36C) in last six years. Our NICU has the best result in all NICUs of California to eliminate hypothermia in ELBW infants.

Abstract # 37

Abstract Title: Zooming Into the Future of Neonatal Transport with Telemedicine and TeamSTEPPS

Name: Casandra Boylan, BSN, RN, RNC-NIC
Clinical Nurse

Co-Authors: Casandra Boylan, BSN, RN, RNC-NIC*; Albert O. Antonio, DO

Organization: Miller Children's and Women's Hospital Long Beach

Abstract Overview: Background: Telemedicine is becoming an important component of the modern health care system as a multi-purpose intervention. As a consultation tool, telemedicine provides timely access to subspecialty care that result from provider shortages. As high reliability organizations, regional and tertiary hospitals who extend their neonatal services to birthing centers and level I/II nurseries rely on patient-centered, outcome-optimizing high fidelity communication systems. TeamSTEPPS is an evidence-based teamwork system developed to improve patient safety and reduce medical error, built upon a framework to enhance team performance centered on 4 principles: Communication, Leading Teams, Situation Monitoring, and Mutual Support. Methods: This is quality improvement project collaboration between the NICU and Neonatal transport team. Our aim in this initial phase since implementing telemedicine is to understand outcomes of patients consulted through this technology. The neonatal/pediatric critical care transport team transports +190 neonatal patients per year with 35 patients referred by telemedicine. Mechanisms include TeamSTEPPS concepts consisting of: SBAR, Closed-loop communication, Mutual support, Handoff, Brief, Debrief, and Utiliza-

tion of checklists. In-house staff, outside facility feedback along with transport case reviews reflecting a need for enhancing team performance and communication during telemedicine consults were the main drivers of change. Results: A six month chart review revealed that not all telemedicine consults resulted in NICU admission, reducing maternal-infant separation. Change in Transport Risk Index of Physiologic Stability (TRIPS) score favored improved patient outcomes. Time to dispatch after telemedicine consults was reduced compared to transports without telemedicine. Discussion: Currently there are no TeamSTEPPS applications in practice during neonatal telemedicine consultation to ensure that our service performs as a high reliability organization. Ongoing review of feedback from the referring facility and accuracy in TRIPS score documentation would be helpful to ameliorate inter and intra-facility practice variance through several PDSA cycles. This understanding would help drive high fidelity simulation and didactic sessions to target interventions and improve patient outcomes.

Abstract # 38

Abstract Title: Functional differences among *B. infantis* strains in infant probiotic products

Name: Rebbeca Duar, PhD

Sr. Microbiology Scientist

Co-Authors: Giorgio Casaburi, PhD, Sr. Bioinformatics Scientist; Lindsey N.C Scofield, Research Assistant; Ryan D. Mitchell Sr. Research Associate; Camila Ortega, PhD, Scientist, Analytical Chemistry; Steven A. Frese, PhD, Director Microbiology and Bioinformatics.

Organization: Evolve Biosystems, Inc,

Abstract Overview: Background: Human milk oligosaccharides (HMO) in breastmilk influence the composition of the intestinal microbiome by serving as growth substrates to select strains of bifidobacteria. Over 200 individual HMO structures have been identified. However, lacto-N-tetraose (LNT), lacto-N-neotetraose (LNnT), and 2'-Fucosyllactose (2'FL) in FUT2+ mothers, are disproportionately abundant. The biological role for their abundance in the context of colonization of *Bifidobacterium longum infantis* in the infant gut has not been determined. Objective: *B. infantis* EVC001 durably and stably colonizes the gut when fed to breastfed infants. In this study, we use a trait-matching approach to determine if the ability of *B. infantis* EVC001 to utilize these highly abundant HMO plays a role in the colonization success of this strain. Further, we explore the ecological consequences of the inability to ability to access these HMO. Methods: The genomes of EVC001, and 11 other strains of *B. infantis* isolated from infant probiotics were sequenced and compared to the type strain ATCCC 15697. Genomes were examined for the presence

utilization genes and the ability to grow on LNT, LNnT, 2'FL and free HMO from breast milk. Colonization dynamics of *B. infantis* EVC001 and a strain exhibiting an impaired HMO-utilization profile were determined by quantitative PCR using bacterial DNA extracted from stools samples of a breastfed infants supplemented with equivalent amounts of each strain. Results: Strains fell into two distinct groups. *B. infantis* EVC001 and strains in group I conserved all HMO-utilization genes. Whereas strains in group II lacked three genes located in the H5 cluster and involved in the active transport of HMO. Growth data and glycoprofiling after HMO fermentation revealed that the absence of these genes impairs the ability to utilize LNT and LNnT as well as pooled HMO, but not 2'FL. Further, competition experiments between EVC001 and a strain in group II revealed that EVC001 reaches higher numbers, demonstrating that to access these HMO has an associated fitness advantage when it comes to colonization of the breastfed infant gut. Conclusions: This work provides evidence of the genetic and functional adaptation of *B. infantis* to the breastfed infant gut, supporting the notion that human milk and *B. infantis* have a co-evolutionary relationship. Results also show that genotype and HMO-utilization profiles are highly predictive of colonization success and should be considered when selecting strains for use in probiotic applications for infants.

Abstract # 39

Abstract Title: Artificial intelligence reveals key biomarkers of necrotizing enterocolitis in the preterm infant gut microbiome

Name: Giorgio Casaburi, PhD

Sr. Bioinformatics Scientist

Co-Authors: G. Casaburi, PhD, S. Kazi BS, R. Duar, PhD, B. Ling, PhD, S. Frese, PhD, K. Sylvester, MD

Organization: Evolve BioSystems

Abstract Overview: Artificial intelligence reveals key biomarkers of necrotizing enterocolitis in the preterm infant gut microbiome. G. Casaburi*, PhD1, S. Kazi BS1, R. Duar, PhD1, B. Ling, PhD2, S. Frese, PhD1,2, K. Sylvester, MD3, 1. Evolve Biosystems, Inc, Davis, CA, United States. 2. Department of Surgery, Stanford University, Stanford, California, United States of America 3. Department of Food Science and Technology, University of Nebraska, Lincoln, NE, United States. Introduction: Necrotizing enterocolitis (NEC) is an intestinal disease that primarily affects premature infants, causing an inflammatory process that can lead to intestinal tissue damage and death. NEC is a leading cause of overall infant mortality in the United States, affecting 0.1% of newborns per year in North America while reaching treatment costs of up to \$200,000 per patient. Although outcomes related to prematurity illness have remarkably improved, the mortality rate for NEC

has remained constant at up to 50% or more depending on severity. Objective: The major limitation in NEC prevention dwells in the inability to predict which subset of premature infants is at risk for developing NEC. Recently, gut dysbiosis has emerged as a major trigger in NEC, particularly supported by the fact that NEC cannot be produced in germ-free animals. Here, we present a new, non-invasive approach that combines functional and taxonomical data from infant gut microbiomes to develop an algorithm capable to predict metagenomics biomarkers of NEC among a preterm infant population. Methods: A total of 1,712 raw publicly available shotgun metagenomic datasets were collected, (NEC=253; and healthy preterms=1,459). Taxonomic and functional analyses were carried out and dataset was divided based on corrected gestational age (cGA). Several machine learning models were tested to identify functional core biomarkers able to distinguish NEC from healthy preterm microbiomes. Results: The 29-32 weeks cGA population reported a significant level of prediction accuracy among models (up to 99.8%). Intersection of models led to the identification of top proteins and super pathways, which were then coupled with taxonomic classification to establish a collection of biomarkers able to discriminate NEC from healthy preterms. The most discriminatory bacterial species was *Enterobacter cloacae*. In vitro assay confirmed biomarkers role potentially responsible for NEC onset. Conclusions: This is the first computer model capable to identify causative NEC biomarkers from microbial signatures. Future efforts to minimize the frequency and severity of NEC should focus on reducing exposure to risk factors, including bacterial biomarkers by using safe and stable interventions such as systemic microbial gut modulation.

Abstract # 40

Abstract Title: Maternal Antenatal Marijuana Use Lowers the Biologic Potential of Umbilical Cord Mesenchymal Stem Cells

Name: Adnan Ismail, MD
Fellow Physician

Co-Authors: Adnan Ismail MD1*; Yona Nicolau MD1; Cherry Uy MD1; Fayez Bany-Mohammed1; Muhammad Aslam MD1 1. Pediatrics-Neonatology, UC Irvine School of Medicine, Orange, CA, United States

Organization: UC Irvine Medical Center

Abstract Overview: Background: Human umbilical cord derived mesenchymal stem cells (MSCs) have been extensively studied with therapeutic efficacy in several injury models. Our work has shown therapeutic efficacy of MSCs and their secreted factors in experimental neonatal chronic lung disease and pulmonary hypertension models. Maternal antenatal drugs and disease states can affect the efficacy of MSCs. At present, very limited data are available on maternal marijuana use during pregnancy affecting

the MSC biologic potential. Objective: We hypothesized that human umbilical cord Wharton's jelly MSCs harvested from marijuana exposed cords will lack biologic potential compared with non-exposed cords. Our aims were: 1. To generate human umbilical cord MSCs from marijuana exposed and non-exposed cords. 2. To determine in vitro properties and secreted factors between the two groups. Design/Methods: Human umbilical cord Wharton's jelly MSCs from marijuana exposed and non-exposed umbilical cords were isolated and cultured according to our modified protocols. Marijuana exposure was considered positive if mothers have smoked marijuana within the prior two weeks before delivery with a positive urine drug test. In vitro growth, differentiation, and secreted factors were analyzed utilizing duplication time, Western immunoblot, and proteomics analysis. Results: MSCs were harvested from 3 pooled marijuana exposed cords with 3 non-exposed cords as control. Marijuana exposed MSCs had much shorter duplication and differentiation time compared to non-exposed MSCs. Interestingly, although the marijuana exposed MSCs grew faster, they had lower concentration of cardiopulmonary protective secreted factors compared to non-exposed MSCs. Conclusion(s): Marijuana exposure during pregnancy leads to a reduction in biologic potential of human umbilical cord MSCs. Further in vitro and in vivo studies are underway to determine the extent of this relationship.

Abstract # 41

Abstract Title: Association between blood carboxyhemoglobin level and bronchopulmonary dysplasia in extremely low birth weight infants

Name: Thea Tagliaferro, MD, MPH
Neonatology Fellow

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Organization: USC, Keck School of Medicine, LAC-USC Medical Center, Division of Neonatology

Abstract Overview: Background Carboxyhemoglobin (CO-Hb) can be endogenously formed in the presence of oxidative stress and may be elevated in inflammatory lung disease. There is lack of evidence of its relationship with development of bronchopulmonary dysplasia (BPD) in extremely low birth weight infants (ELBW). Objective: To evaluate the relationship between blood CO-Hb levels in the first 14 days of life in ELBW infants and development of BPD at 36 weeks postmenstrual age (PMA). Methods: Retrospective study of 58 ELBW infants born at LAC-USC Medical Center between June 2015- and June 2019, that survived to 36 weeks PMA. CO-Hb values were collected daily from day of life (DOL) 1 to DOL 14. BPD definition per 2001 NICHD criteria

was used. Wilcoxon Rank sum test was used to compare the differences in continuous variables. Logistic regression was used to adjust for the confounding variable GA in the association between blood CO-Hb levels and BPD. Results: 53/58 ELBW infants with BPD at 36 weeks PMA had a median GA in weeks of (25 (2) vs 29 (2) in non-BPD infants ($p=0.012$), and median BW of (730 (220) vs. 920 (160) grams, $p=0.0003$) respectively. Blood CO-Hb levels were significantly higher in BPD patients compared to non-BPD infants (Table 1). 40% of patients had severe BPD at 36 weeks PMA. However, severity of BPD was not significantly correlated with CO-Hb levels. Logistic regression analysis showed invasive mechanical ventilation to predict development of BPD but not CO-Hb levels. Table 1. Combined CO-Hb at different DOL and BPD

	BPD	Non-BPD
CO-Hb at DOL 1 to 5	2.54 (0.42)	1.78 (0.58)
CO-Hb at DOL 6 to 10	2.40 (0.60)	1.81 (0.31)
CO-Hb at DOL 11 to 14	2.21 (0.39)	1.65 (0.33)

Data reported as: Median (IQR) Conclusions: BPD patients had significantly lower gestational age and birth weight at 36 weeks PMA. While CO-Hb levels within the first 14 DOL are higher in BPD patients compared to non-BPD, they did not predict later development of BPD. Fetal hemoglobin (HbF) may have falsely elevated CO-Hb values in our population. This needs to be further studied in a larger sample size correcting for HbF.

Abstract # 42

Abstract Title: Pulmonary hemorrhage in extremely low birth-weight infants: Significance of the size of left to right shunting through a valve incompetent patent foramen ovale

Name: Jaclyn Kappico, MD

Neonatal Perinatal Medicine Fellow

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Organization: USC/LAC+USC Medical Center, Keck School of Medicine

Abstract Overview: Background: Pulmonary hemorrhage (PH) in extremely low birthweight (ELBW) infants is usually attributed to the presence of a large patent ductus arteriosus (PDA). However,

most neonates with a large PDA do not develop PH. Therefore, there may be other factors contributing to the development of PH. Objectives: We investigated whether there was any difference in the echocardiographic findings of ELBW infants with PH and control infants without PH. Methods: This was a retrospective cohort study of live born infants with birthweight of less than 1000gm, who lived for at least 24 hours. Clinical and echocardiographic data were analyzed for infants with PH and a control group of infants matched for gestational age (GA) and birth weight. Results: Over an eleven-year period, 214 neonates were born weighing less than 1000 grams who lived for more than 24 hours at LAC+USC Medical Center. Twenty had PH with an incidence of 9.3%. Of 20 infants with PH, four were not included in the study (3 infants had either necrotizing enterocolitis, sepsis or were post-PDA ligation and one did not have an echocardiogram). The other 16 infants with PH all had a PDA, yielding a PH incidence of 7.9% potentially related to having a PDA. Sixteen infants with PDA and similar GA and birthweight were randomly selected as controls. There was no significant difference in Apgar scores, birth weight classification, surfactant administration, ventilator days, bronchopulmonary dysplasia, length of stay, size of PDA, LA/Ao ratio, or shortening fraction between the two groups. However, there was a significant difference in the presence and the size of left to right shunt through the foramen ovale between the groups. All control infants had a L-R shunt through the PFO with average size of 2.27mm (range 1.4 to 3.4), whereas 5 of 16 infants with PH had no L-R shunt and average PFO measurement was 0.85mm (range 0 to 1.53, $p\text{-value} < 0.0001$). Conclusion: In addition to a large left to right shunt through the PDA, pulmonary venous congestion as a result of blocked or restricted left to right shunting through the foramen ovale may predispose ELBW infants to PH.

Abstract # 43

Abstract Title: Effect of temperature and brain injury on apparent diffusion coefficient changes in newborns undergoing therapeutic hypothermia

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Neonatal-Perinatal Medicine Fellow

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Organization: USC Keck School of Medicine, LAC+USC Medical Center/Children's Hospital Los Angeles

Abstract Overview: Background: Apparent diffusion coefficient (ADC) changes are useful in detecting ischemic brain injury by the principle that cytotoxic edema restricts Brownian motion of water molecules. Other than pathology, tissue temperature may also affect the kinetic movement and diffusion of water. We hypothesize that ADC values are more restricted when regional tissue temperature is reduced, such as during therapeutic hypothermia (TH). Objective: To determine the effect of temperature on diffusion restriction or ADC values in infants without radiographic evidence of brain injury. To compare magnitude of ADC changes during and after TH in infants with and without injury. Design/Methods: MR spectroscopy measures local tissue temperatures non-invasively by quantifying chemical shift difference. In this study, we compared ADC values with brain temperatures during and after TH in infants with hypoxic-ischemic encephalopathy. We excluded data if duration between scans was >5 days to minimize the effects of injury evolution on ADC. Injury severity (normal-mild vs. moderate-severe) was scored by a pediatric neuroradiologist based on previously published methods. Corresponding ADC values and tissue temperatures in thalamus (Thal), basal ganglia (BG), parietal gray matter (GM) and white matter (WM) were compared. Paired comparison of temperatures and ADC were performed. Comparison of ADC changes between the two injury severity groups were performed. Results: Overall, data from 34 suspected HIE newborns (22 normal-mild and 12 moderate-severe) were analyzed. Mean gestational age was 38±2 weeks and birthweight 3231±641g. Mean duration between MR scans (during/after TH) was 3.7±1.1 days. In all patients, mean ADC and brain temperature significantly increased during and after TH, Table 1. In normal-mild group, whereby ADC changes due to evolution of injury is minimal, ADC increased after TH (838±86 vs. 910±84×10⁻⁶ mm²/s, p<0.0001), with ADC value increasing ~25×10⁻⁶mm²/s per degree Celsius change (ΔADC/ΔBrain Temp). In moderate-severe group, there was a significant increase and more variable change in ADC (867±171 vs. 1057±240, p<0.0001), Figure 1. When comparing regions, the GM and WM had the greatest increase in ADC values for both injury groups. Notably, patients with the most severe injuries had worsening diffusion restriction (decrease in ADC) even after rewarming. Conclusion(s): Aside from brain injury, low tissue temperature may be another factor contributing to diffusion restriction in infants with HIE during TH.

Abstract # 46

Abstract Title: *B. infantis* EVC001 metabolites improve enterocyte proliferation in vitro

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Director Immunology & Diagnostics

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Organization: Evolve Biosystems

Abstract Overview: Introduction: Short chain fatty acids (SCFA) are an important energy source for host cells to maintain homeostasis. Indeed, SCFAs account for 50-70% of the energy used by intestinal epithelial cells (IECs) and provides nearly 10% of our daily caloric requirements. Given previous findings that showed exclusively breastfed infants colonized with *B. infantis* EVC001 have significantly increased fecal SCFA concentrations compared to infants not colonized with *B. infantis*, we investigated the effect of fecal water (FW) from these two distinct populations on enterocyte proliferation and morphology in vitro. Methods: FW were derived from fecal samples collected from infants colonized with *B. infantis* EVC001 (EVC001) and infants not colonized with *B. infantis* (controls). FW were added to adult and premature enterocyte cell lines to assess growth, proliferation and cytotoxicity. Microscopic images were taken to observe morphological differences. Results: Intestinal epithelial cells (IECs; Caco-2 and HIEC-6 cells) exposed to EVC001 FW showed significantly increased proliferation, as shown by cell count and real-time ATP expression, compared to medium alone and control FW (P < 0.0001). Conversely, enterocytes exposed to EVC001 FW showed significantly decreased lactate dehydrogenase activity, an indicator of compromised membrane integrity, compared to controls FW (P < 0.01). Specific bacterial metabolites, lactate and acetate, at median physiological concentrations found in EVC001 infant FW significantly increased Caco-2 cell proliferation compared to medium alone (P < 0.01, P < 0.05, respectively), while control FW levels did not significantly increase proliferation. Physiological concentrations of butyrate or formate from EVC001 or controls did not increase proliferation rates of IECs. Furthermore, control FW negatively altered the morphology of enterocytes compared to cells exposed to EVC001 FW or medium alone. Conclusions: EVC001 FW and specific bacterial metabolites, lactate and acetate, significantly increased enterocyte proliferation compared to control FW and medium alone, while control FW negative affected cell growth, membrane integrity and cell morphology. These data suggest that metabolites produced by *B. infantis* EVC001 promote enterocyte growth and improve intestinal integrity in both adult and premature infants.

Abstract # 47

Abstract Title: Progress Towards Screening for Hyperammonemia in Oregon

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Abstract Overview: Background: Neonatal hyperammonemia (NH), with an aggregate incidence of ~1/10000 births, is frequently due to a metabolic disorder, namely a urea cycle disorder (UCD) or an organic acidemia. NH can be lethal, causing an estimated hundreds of deaths per year, and if survived, causes significant neurologic impairment. Early intervention for younger siblings born with the same genetic condition have demonstrated that intravenous calories, ammonia scavengers, dietary management, and eventual liver transplant can lead to good outcomes. NH can be difficult to diagnose in the newborn period because symptoms overlap with those for neonatal sepsis, delaying diagnosis and treatment. Some states screen for distal UCDs, but proximal UCDs, in particular ornithine transcarbamylase (OTC) deficiency, are symptomatic long before newborn screening results return. Efforts to improve NH diagnosis have thus far been unsuccessful, due to rarity and misconception that the disease is essentially lethal and without a cure. We describe the development and ongoing efforts to obtain ammonia levels for neonates less than 30 days old in Oregon who present with sepsis. Objective: To improve the diagnosis of NH in Oregon, prior to the onset of irreversible neurologic damage, multiorgan failure, and death. Methods: The key elements of this effort are 1. Formulation of a care pathway for NH detection that specifies an ammonia level with initial sepsis evaluations in neonates \geq 36 weeks from dol 2 (one day old) to dol 30. The guideline includes an ammonia drawn from any source (arterial, venous, capillary) and a clinical algorithm based on ammonia level, including emergency treatment; 2. Education regarding NH and the pathway at all institutions with NICUs in Oregon, with wider efforts for adoption in well-baby, pediatrics, family medicine, and emergency medicine services across the state in process; 3. Support for institutions to adopt the practice; 4. Support for data collection at interested institutions; 5. Close collaboration with the National Urea Cycle Disorders Foundation to refine methodology and for support. Results: Of the 12 NICUs in Oregon, 9 have adopted or are in process of adopting the guideline and 4 are working on data collection involving Epic. This represents well over half of the NICU beds, and hospitals with over half of the in-hospital births in Oregon. Conclusion: It is feasible to institute a state-wide practice guideline to improve early NH diagnosis and treatment before neurologic damage, multiorgan failure, and death. We are working to collect data to track outcome.

Abstract # 48

Abstract Title: Preterm infants fed B. infantis EVC001 Demonstrate Significant Changes to the Gut Microbiome Composition and Reduction of Intestinal Inflammation

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Regional Physician in Charge

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Organization: Division of Neonatology, Kaiser Permanente Southern California

Abstract Overview: Background: Gut microbiome dysbiosis negatively affects the health of premature infants and increases risk for infection and diminished growth. Additionally, microbial dysbiosis has been linked with increased enteric inflammation, which is a major driver of many adverse clinical outcomes in premature infants, including necrotizing enterocolitis. In this study, we hypothesized that gut microbiome composition has a beneficial effect on enteric inflammation in preterm infants, similar to findings in term infants. We compared fecal samples from infants at similar corrected gestational age to evaluate the cytokine profile and gut microbiome of infants fed *Bifidobacterium longum* subsp. *infantis* EVC001 compared to those that were not fed *B. infantis* EVC001. Methods: Prospective fecal collection was performed at Kaiser Permanente Southern California (Anaheim and Irvine, CA). All infants in the hospital born at less than 32 weeks gestational age OR less than 1500 g received 8 x 10⁹ CFU activated *B. infantis* EVC001 suspended in MCT oil daily as standard of care. Fecal samples (n = 298) were collected during routine diaper changes and were subjected to shotgun metagenomics and cytokine profiling. Results: The gut microbiome of preterm infants fed human milk was depleted in Bifidobacteriaceae, relative to term infants, but could be restored in infants fed *B. infantis* EVC001. Proinflammatory markers were significantly correlated with signatures of dysbiosis. Proteobacteria correlated with the pro-inflammatory cytokine IFN- γ (P=0.01), and Enterobacteriaceae, specifically, correlated with IL-1b (P = 0.014) and IL-2 (P = 0.017). Peptostreptococcaceae correlated with IL-2 (P=0.0002), IL-4 (P = 0.005), and IL-8 (P = 0.002). Fecal calprotectin levels were also positively correlated with Staphylococcaceae (P = 0.005). Interestingly, antibiotic resistance genes were significantly reduced as *Bifidobacterium* levels increased (R = -0.60; P < 0.001), in agreement with our previous findings in term infants. Conclusion: Our findings indicate gut dysbiosis (i.e. the absence of *Bifidobacterium*) is associated with increased intestinal inflammation and antibiotic resistance gene carriage in preterm infants. Early addition of *B. infantis* EVC001 to the diet represents a novel strategy for controlling the composition of the premature infant gut microbiome, as well as preventing dysbiosis-driven enteric inflammation and the dissemination of antibiotic resistant bacteria.

Abstract # 49

Abstract Title: Neonatal Resuscitation Education in a Community Hospital: Simulation vs Video-based?

Name: Linda Truong*, DO

Clinical Assistant Professor

Co-Authors: Melinda Porter, RN, CNS, NNP-BC, Christine Johnson, MD

Organization: Stanford University

Abstract Overview: Background: Simulation-based education has been shown to be a superior method of maintaining and improving neonatal resuscitation skills by healthcare providers. However, current programs can be resource intensive and financially prohibitive, particularly in community hospital settings. With electronic devices becoming commonplace, access to video-based education can be used to supplement or replace simulation-based education. Objective: To determine if simulation or video-based education results in higher retention of neonatal resuscitation knowledge among neonatal nurses (RN) and respiratory therapists (RT) in a community neonatal intensive care unit (NICU) Methods: A prospective comparison of simulation vs. video-based neonatal resuscitation education was conducted at a community level III NICU July-Aug 2019. 63 RNs and 28 RTs participated in educational sessions consisting of 2 simulations followed by video debriefing and teaching. Learners also watched internally created videos on topics ranging from equipment review to proper resuscitation technique according to the Neonatal Resuscitation Program. Learners were divided into 2 groups: the simulation group (SG), who attended the simulations first then watched the videos, and the video group (VG) who watched the videos first then attended the simulations. SG completed an in-person pre-assessment quiz (PRE) prior to their session and an electronic post-assessment quiz (POST) after their session, prior to viewing the videos. VG completed PRE electronically prior to their session, watched the videos, and then completed an in-person POST at their session. The PRE and POST were identical, internally generated, and consisted of 10 NRP based questions designed to test retention of knowledge and skills. Results: 56 learners (39 RNs+17 RTs) from SG and 35 (24 RNs+11 RTs) from VG completed PRE. 3 learners were lost to follow up: 2 from SG and 1 from VG. The improvement in average scores of all learners was statistically significant ($p<0.01$). In subgroup analysis, learners from both SG and VG had significantly improved scores ($p<0.01$), but there was no statistically significant difference between the POST scores of the 2 groups (Table 1). While those in VG had higher overall POST scores, the largest improvement in scores was seen in SG. Conclusion: In conclusion, simulation-based neonatal resuscitation education showed a trend towards higher retention compared to video-based education. In community hospital settings, video-based resuscitation education may be

a suitable substitute.

Abstract # 50

Abstract Title: Effect of diuretic exposure on the growth and body composition of very preterm infants

Name: Sonya Misra, MD MPH

Attending Neonatologist

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Organization: Sant Clara Valley Medical Center

Abstract Overview: Background: Appropriate infant growth is essential to optimize neonatal outcomes. Diuretics have been suggested to interfere with growth and their effect on body composition (BC) of infants is unknown. Objective: To evaluate the effect of diuretic exposure on the growth and BC of preterm infants born less than 33 weeks of gestation (GA). Design/Methods: We included all 285 preterm infants of <33 weeks GA born from 2014 to 2019 who survived to discharge. Standardized enteral and parenteral nutrition were followed. Individualized nutrition was provided with a focus on catch-up growth. BC was measured by air displacement plethysmography (ADP) within 1 week of discharge. Growth anthropometrics, weight, length and occipitofrontal circumference (OFC) at birth and discharge, were collected prospectively. Z-scores were obtained using growth charts (Fenton 2013/WHO). Growth velocity was calculated using the exponential model (Patel 2005). Diuretic exposure was obtained from NICU database and was grouped as <4, 4-14, and >14 days of exposure. Chronic lung disease (CLD) was defined as oxygen need <36 weeks post menstrual age. Growth measures and BC were compared between diuretic exposure groups in infants of <33 weeks and <30 weeks. Kruskal Wallis, Fisher exact test and Multivariable linear regression were performed. Results: Demographics are described in Table 1 and 2. Nineteen percent of <33 weeks and 43% of <30 weeks were exposed to diuretics, respectively. Lasix and Diamox were used for intermittent dosing and Aldactazide was used for chronic use. Infants exposed to diuretics had lower GA, birth weight, length, OFC, were older at discharge and had higher CLD. The weight and length velocity, fat % were higher and fat free mass % was lower in diuretic exposed infants (Table 1, 3). In <30 weeks GA, diuretic exposed infants were discharged later, and had more CLD but their growth measures were similar to unexposed (Table 2). There was no dose effect of diuretics. After adjusting for birth length and GA at discharge the BC measures were not significant (Table 3, 4). Conclusions: Growth measures and BC were not adversely affected by diuretics in preterm Infants who received individualized nutritional support. The growth differences between infants <33 weeks that were

exposed and non-exposed may be secondary to the unexposed older infants having a shorter NICU stay with less time for catch up growth.

Abstract # 51

Abstract Title: The First Sixty Minutes: Implementation of Golden Hour Guidelines in a Level III NICU

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Director of Neonatal Transport

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Organization: VALLEY CHILDREN'S HEALTHCARE

Abstract Overview: Background: The unique characteristics of preterm infants put them at risk for hypothermia, hypoglycemia and respiratory distress. Best outcomes for pre-term infants are contingent on effective communication, teamwork, and clinical skills. Objective: The project started in May 2018 to implement a standardized multidisciplinary approach to the resuscitation and stabilization processes for infants born <32.6 weeks GA and/or < 1500 grams. Design: 2017 admissions to the satellite NICU were reviewed to gather baseline data. The records revealed that 79% of VLBW infants were within range for the recommended admission temperature (36.4C to 37.5C) and 60% of VLBW infants were within range for admit glucose level (>40 mg/dl). There was great variability in time to surfactant but 80% of the qualified VLBW infant received surfactant within 120 minutes of life. Patients: All infants 32.6 weeks GA and/or < 1500 grams admitted to the Valley Children's Satellite NICU at St. Agnes Medical Center SMART AIMS: By October 15, 2020, 80% of infant's meeting criteria will demonstrate: ¥ Admission temperature > 36.5°C ¥ Within 60 minutes: Initiate IV fluid & obtain an initial point of care glucose ¥ Admission glucose > 40 mg/dL ¥ Administer surfactant within 120 minutes (if indicated) Interventions: We established key drivers for advancing each objective • Delivery room(DR) checklist: Increase DR temperature, hypothermia prevention bundle • Protocols for automatic umbilical line placement and for starting fluids and obtaining labs • Guidelines to standardize surfactant administration • Simulation based training for all providers, nursing and respiratory staff Results: Total number of patients = 124 Admission Temperature > 36.5°C = 62% Initial Glucose > 40 mg/dl = 66% IV Fluids Initiated within 60 minutes = 53% Glucose Obtained within 60 minutes = 61% Surfactant Administered within 120 min = 93% Discussion: The satellite NICU is uniquely placed within another hospital system. The influx of new nurses/RCPs training at any given time creates a significant challenge in meeting our goals. We were able to successfully standardize and improve the rate

of surfactant administration. We were not able to meet our target for admission temperature and hypoglycemia. Through sequential PDSA cycles, we have identified gaps that contributed to this. Our focus includes collaboration with host facility to educate their staff to adjust DR temperature specially with the implementation of delayed cord clamping. And continue simulation based training for our staff to appropriately utilize the newly acquired temperature probes and plastic bags for resuscitation and to follow the umbilical lines protocol.

Abstract # 52

Abstract Title: Moms in the NICU: A Pilot to Empower Moms, Lower Health Care Barriers, and Reduce Preterm Birth

Name: Kimber Padua, CRC

Clinical Research Coordinator

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Organization: CPQCC

Abstract Overview: Objective: Moms often spend hours and days at the bedside with their premature infants. As women care

for their infants in the Neonatal Intensive Care Unit (NICU), their own health needs often become secondary. Despite spending time in a healthcare setting, clinicians often miss an opportunity to engage moms to care for their own health. Our objective was to develop and pilot a NICU-based intervention to reduce the risk of recurrent preterm births by engaging and empowering moms to improve their own health in between and during future pregnancies by creating: a maternal birth story, including accurate information on potential factors associated with preterm birth to help manage future pregnancies, and a health plan for mom to help support actions aimed at improving her own health. **Method:** A toolkit for Moms in the NICU was developed by a multidisciplinary team of Maternal Fetal Medicine (MFM) physicians, Obstetricians, Neonatologists, neonatal nurses, and parents. Moms participated in a one-on-one consultation with the MFM clinician to share their birth story, clarify any concerns or issues related to their pregnancy and delivery, and discuss relevant interventions to improve their health and to reduce the risk of preterm birth during future pregnancies. Moms developed an individualized post-partum health plan and were provided with a personalized health record with suggested interventions to enable effective communication with obstetric providers during subsequent pregnancies. A 6-week follow-up phone interview was conducted to identify successes and barriers to implementing their health plan. **Results:** Participants reported experiencing reassurance, understanding, and in some cases, revelation and relief. Maternal Fetal Medicine providers offered a balance of compassion and medical knowledge to support moms who felt distress from their birth experience. By promoting maternal engagement and empowering moms during their one on one consultation, we were able to provide clarification from a clinical standpoint, encourage a prolonged interpregnancy interval, and support moms in their development of a postpartum health plan. **Conclusion:** By developing and implementing the "Moms in the NICU" program, clinicians will utilize the time that a mother spends in the NICU as an opportunity to empower them to care for their health. Topics addressed include but are not limited to: getting treatment for any acute and chronic health care issues, understanding the importance of their inter pregnancy interval, providing enhanced access to family planning that would enable optimizing future prenatal care. The 6-week follow-up will allow the identification of barriers to carrying out their postpartum health plan, and provide guidance for future interventions.

Abstract # 53

Abstract Title: Are prenatally opiate and/or polysubstances exposed male neonates at higher risk for Neonatal Abstinence Syndrome?

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Quality Coordinator

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Organization: Santa Clara Valley Medical Center

Abstract Overview: Background: A recent large statewide study using payor data has shown increased neonatal abstinence syndrome (NAS) in male neonates exposed to perinatal opiate and polysubstance use. Sex distribution variation in the hospitalized neonates may be due to biology, population sociocultural characteristics or the healthcare delivery system. Objective: To examine if prenatally opiate exposed inborn males were more likely to require pharmacological treatment for NAS, at 2 regional perinatal centers in different states, using different screening strategies. Design/Methods: Available data was collected in inborn neonates 2014-2019 in two regional perinatal centers: Center 1 (San Jose, CA) and Center 2 (Huntington, WV). Data was examined retrospectively to determine prevalence of perinatal substance exposure at birth, and frequency of NAS treatment in substance/opiate-exposed neonate. Chi square was used to compare the percentages of males and females in the exposed neonates and NAS treated neonates. Results: 34818 consecutive livebirths between 2014 and 2019 at 2 regional perinatal centers included 19,133 in Center 1 and 15685 in Center 2 (Table 1). Prenatal substance exposure was documented in 3% and 10.5% neonates in Centers 1 and 2 and opiate exposure was 0.6% in Center 1 and 9.3% in Center 2 (2017-2019). Of the substance exposed, 22% were opiate exposed and 2% were treated for NAS in Center 1 and 80% were opiates exposed and 71% were treated for NAS in Center 2. Of the substance exposed neonates at both centers, there was no difference in male and female proportion in the opiate exposed neonates or those who were treated for NAS (Table 2). Conclusion: Centers differed significantly in perinatal substances exposure, opiate exposure, and NAS treatment. There was no difference in sex in opiate exposure or NAS treated neonates in our study. We did not observe difference in sex distribution despite regional variations in population characteristics and/or exposure to different perinatal substances and/or differences in healthcare delivery. Prospective data collection is critical to characterize both infant and discrete prenatal substance exposure.

Abstract # 54

Abstract Title: Improving oral colostrum administration within first hour of life in Neonatal Intensive Care Unit infants

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Quality Coordinator

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Organization: Santa Clara Valley Medical Center

Abstract Overview: Background: Despite studies demonstrating accurate correlation and clinical utility of transcutaneous bilirubin (TcB) screening in preterm and term infants, TcB technology is underutilized in the NICU setting. Purpose/Aim: To evaluate the effect of a TcB screening for hyperbilirubinemia on the number of serum bilirubin levels obtained per infant who were born at > 30 weeks' gestational age (GA). Methods/Interventions: This is a single-center quality improvement project conducted from January 2019 to September 2019 at Santa Clara Valley Medical Center (SCVMC), a California regional NICU. A TcB screening protocol using Philips Bilichek TcB meter was implemented in May 2019 (Figure 1) in all infants born at > 30 weeks gestation and admitted to NICU. Threshold for obtaining serum bilirubin was established as greater or within 2mg/dl of phototherapy threshold for each gestation. The protocol was disseminated via group education to providers and individualized hands on demonstration on use of TcB meter to nursing staff. GA, birth weight (BW), number of serum bilirubin, peak bilirubin, phototherapy exposure, and number of phototherapy days were compared between baseline pre-protocol (Jan-April 2019) and post-protocol period (May-September 2019) using t test, ranksum test, chi square as appropriate. Results: A total of 108 infants with median GA of 35weeks (30w-41w3d) and BW of 2346g (970-4786g) were included: 52 infants in pre-protocol and 56 infants in post protocol period. TcB was obtained at least once in 98% of post-protocol study infants. Compared to pre-protocol, post-protocol period had a significant reduction in number of serum bilirubin obtained per infant (4 vs 2.4, p<0.001) and phototherapy exposure (50% vs. 21%, p=0.004) (Table 1). In the >35 weeks GA subgroup, 34% never had a serum bilirubin test done in the post-protocol in contrast to 100% in the pre-protocol period. In the 30-34 weeks GA subgroup post-protocol period had a significant reduction in phototherapy exposure (88% vs. 38%, p<0.001). There was no difference in the GA, BW, peak bilirubin, or phototherapy days between pre and post-protocol periods. Implications for Practice: This single center study shows implementation of TcB screening protocol in the NICU reduced serum bilirubin sampling. Education and implementation of TcB protocol improved clinician's adherence of phototherapy guidelines thresholds and reduced phototherapy exposure in neonates > 30 weeks GA. Sharing our experience regarding the effect of TcB screening protocols in the NICU will facilitate best practice in evaluation and management of hyperbilirubinemia in NICU.

Abstract Overview: Background Early colostrum administration provides optimum colonization and immune benefits to NICU infants. Early expression of colostrum in the first hour has been linked to improved mother's milk supply and breastfeeding. Setting AAP level 4 Regional NICU within a public hospital. Staff from NICU and Labor and delivery units, including nurses, neonatal nurse practitioners, neonatologists, and infants' families participated in this project. Aim To increase percentage of NICU infants who receive colostrum within the first hour of life from a baseline of 16% in 2017 to 50% by 2018. Design/Methods We used Plan Do Study Act rapid cycle quality improvement method. Patient demographics, delivery method, time to colostrum administration were collected retrospectively from October 2017 to February 2018 as baseline. Changes were implemented in March 2018 to July 2018, and sustainability was monitored monthly until December 2019. Patients Infants born and admitted to our unit within one hour of life are included. Exclusion criteria included maternal contraindication for breastfeeding including exposure to illicit substances, or critical maternal medical conditions. Results During study period, 327 eligible infants were admitted to our center, 79 (24 %) of whom were born <33 weeks GA. The percentage of eligible infants receiving colostrum in the first hour improved from 16% to 53% (p<0.001) (Table 1). Time to first colostrum administration improved from median of 113 minutes (IQR 76, 274) to 60 minutes (IQR 36.5, 113) (p<0.001). The percentage of infants <33 weeks GA receiving colostrum in the first hour improved from 24% to 69% (p=0.001), and time to first colostrum administration improved from median of 116 minutes (IQR 76, 527) to 49 minutes (IQR 30, 76) (p=0.006) (Table 2). Vaginally born infants were more likely to receive colostrum within 1 hour than infants born via C-section (64% vs 54%, p=0.04). Conclusion We increased the percentage of infants receiving colostrum within the first hour of life through a multidisciplinary approach and have sustained our improvement. We observed lower rate of early colostrum in c/section-born infants which highlights challenges and is an area for further improvement efforts.

Abstract # 55

Abstract Title: Implementing transcutaneous bilirubin screening in infants >30 weeks gestation in NICU

Name: Maria Cortes, DNP, NNP-BC
Neonatal Nurse Practitioner

Co-Authors: Priya Jegatheesan MD, Dongli Song MD, PHD,

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Abstract # 57

Abstract Title: Mapping inflammatory markers in non-invasively ventilated very low birth weight infants at risk for bronchopulmonary dysplasia: a comparison between bubble continuous positive airway pressure and nasal intermittent mandatory ventilation

Name: Anupama Chundu, MD

Neonatal-Perinatal Medicine Fellow

Co-Authors: Chundu, Anupama; Uy, Cherry; Bany-Mohammed, Fayeze; Nicolau, Yona; Aslam, Muhammad

Organization: University of California Irvine

Abstract Overview: Background: Bronchopulmonary dysplasia (BPD) is a chronic debilitating disease of extremely premature infants leading to high morbidity and mortality. Respiratory distress syndrome requiring oxygen, mechanical ventilation, and surfactant treatment in early life leads to lung inflammation with later development of BPD. At present, very limited data exist on the protective role of non-invasive ventilation in early life lung inflammation and later development of BPD. Objective: This study analyzed the relationship between two types of non-invasive respiratory support methods that are used routinely in neonatal intensive care units: bubble continuous positive airway pressure (bCPAP) and nasal intermittent mandatory ventilation (NIMV). We enrolled a cohort of preterm infants born at < 32 weeks gestational age and/or birth weight < 1500g with randomization into bCPAP vs. NIMV groups at birth and analyzed the lung inflammation in the first week of life. Design/Methods: Babies < 32 weeks gestational age and/or birth weight < 1500g were enrolled into an institutional IRB approved study. Card randomization into bCPAP vs. NIMV groups was performed at enrollment with no cross over between groups. The nasopharyngeal aspirates were collected at the time of placement on noninvasive ventilation, at 4 days of life, and at 7 days of life. Luminex assays were performed on samples to determine lung inflammation at baseline and evolution over time between the two groups. Maternal and neonatal clinical data were collected. Results: A total of 28 babies have been enrolled into the study. At present, 8 babies (3 in bCPAP group and 5 in NIMV group) have data and sample analysis completed. The baseline maternal and neonatal data were similar between bCPAP and NIMV groups. The average gestational age in bCPAP group was 30.4 weeks compared with 29.5 weeks in NIMV group. Average birth weight in bCPAP group was 1327g compared to 1175g in NIMV group. Luminex assay revealed that several of the proinflammatory cytokine levels were higher in the bCPAP group compared to the NIMV group. Levels of IL-6, IL-1 β , MCP-1 α , IP-10, and IL-8 were similar at baseline samples, but higher in second and third samples in bCPAP group compared to NIMV group. Conclusion(s): Our study showed that bCPAP leads to more lung inflammation compared to NIMV in first week of life. Further pa-

tient enrollment and data collection is underway to reach study power.

Abstract # 58

Abstract Title: Potential Role of FOX Family Transcription Factors in the Pathogenesis of Bronchopulmonary Dysplasia

Name: Avidesh Rashed, MD

Doctor of Medicine

Co-Authors: Saverio Bellusci, PhD; Cho-Ming Chao, MD PhD; Feng Gao, PhD; Rangasamy Ramanathan, MBBS MD; Parviz Minoo, PhD

Organization: LAC+USC Medical Center and Children's Hospital Los Angeles

Abstract Overview: Bronchopulmonary dysplasia (BPD) is a chronic lung disease most commonly seen in preterm infants as a result of long-term mechanical ventilation and oxygen exposure. The pathogenesis resulting in BPD is not completely understood. Studies using postmortem BPD lung tissue have shown that there is altered expression of a number of developmentally important genes. Our aim was to identify the genes that play a role in the pathogenesis of BPD. We generated three independent genetic models of BPD-like phenotype by disrupting the signaling pathways of TGF β , PDGF α , and IGF-1 in neonatal lung in mice. The mutations to disrupt the pathways were induced in secondary crest myofibroblasts (SCMF) whose role is critical for normal alveologenesis. RNAseq analysis was performed which identified a cluster of differentially expressed genes that were common amongst the three BPD-like phenotypes. To assess the physiologic relevance of a specific subset of the identified genes, we examined their expression in a well-established hyperoxia-induced hypoalveolization mouse model. We analyzed gene expression using a total of ten mice exposed to hyperoxia compared to eight combined controls at three different points during neonatal life. mRNA expression was assessed by quantitative RT-PCR. Expression of Foxq1, Foxd1, Foxc2 were decreased in the mouse BPD lungs suggesting a role for the selected genes in the pathogenesis of BPD. We further demonstrate that Foxd1 is expressed in SCMF and ablation of SCMF during alveologenesis via Foxd1-cre arrests alveolar formation leading to a BPD-like phenotype. To validate our findings in the mouse model, we show that Foxd1 is also reduced in human BPD lung tissue. Collectively, these observations support the notion that disruption of Foxd1 and FOX family transcription factors may play a major role in the pathogenesis of BPD in preterm infants.

Abstract # 59

Abstract Title: Improving Growth in the Very Low Birthweight Infant: A Quality Improvement Project

Name: Robin Koepfel, RN, CNS

Neonatal Clinical Nurse Specialist

Co-Authors: Rebecca Coleman, MD Janice Pianalto, RD Jennifer Jones, IBCLC Pam Aron-Johnson, RN

Organization: UCI Medical Center

Abstract Overview: Background: adequate nutrition is vital to the health and welfare of very low birthweight infants; unfortunately, the incidence of extra-uterine growth restriction is high in many NICU's, especially in those infants less than 1000 grams. As part of our participation in the CPQCC nutrition collaborative, we identified our incidence of infants discharged as growth restricted (discharged with weight below the 10th percentile) to be 23%. Objective: Improve nutrition in VLBW infants by reducing the number of infants discharged with a fall in z-score greater than 0.8 by 20% by March 31, 2020. Design: this is a Quality Improvement (QI) project using evidence-based interventions; no experimental practices or equipment were involved. Setting: 30-bed NICU with a high-risk perinatal delivery service, neonatal surgery, and specializing in care of the very low birth weight infants. Patients: infants <1500 grams and/or less than 32 weeks admitted and discharged from UCI are included in the QI project. Interventions: multiple interventions have been implemented including conduction twice-weekly Nutrition Time Out, modified TPN guidelines and feeding protocols. Nutritional goals were also modified, including re-gaining birthweight by day of life 10 and initiating TPN and intralipids within two hours of life. Measurement: the primary outcome is the difference between birthweight and discharge z-score. Other measurements are time to first feeding, time to initiating TPN, intralipids and first enteral feeds, days to regain birthweight. Results: for those infants 1000-1500 grams, we have reduced the number of infants discharged with fall in z-score greater than 0.8 by 20%. Limitations: results represent a QI project conducted at a single center. Conclusions: QI activities focused on nutrition can result in improved growth in VLBW infants.

Abstract # 60

Abstract Title: Measuring Infant Body Composition with Free-Breathing MRI

Name: Daniel Cho, MD

Resident Physician

Co-Authors: Sevgi Gokce Kafali, MSc - Graduate Student Re-

searcher Shu-Fu Shih, MSc - Graduate Student Researcher Tess Armstrong, PhD - Associate Professor Shahnaz Ghahremani, MD - Associate Professor Holden H. Wu, PhD - Associate Professor Kara Calkins, MD, MS - Principal Investigator

Organization: UCLA Mattel Children's Hospital

Abstract Overview: Background: Childhood obesity is a major problem. Preterm and low birth weight infants are at risk for future metabolic syndrome. In adults and older children, increased visceral adiposity and hepatic fat, and decreased lean body mass, are associated with metabolic syndrome. We have developed a novel research tool, free-breathing magnetic resonance imaging (MRI), to quantify body composition, including visceral and subcutaneous adipose tissue and hepatic fat (using proton-density fat fraction, PDFF). However, there is a lack of research studying these body composition biomarkers in infants. Objectives/Hypothesis: The goal of this project was to expand our profile of body composition biomarkers and determine if free-breathing MRI can measure lean body mass in infants. We hypothesized that birth weight would positively correlate with lean body mass and adiposity. Methods: This was a single site, prospective pilot study. Our inclusion criteria included infants < 12 months of age. Exclusion criteria included contraindications to MRI and infants whose parents did not provide consent. Infants were fed, rocked to sleep, and swaddled in a vacuum immobilizer prior to placement in the MRI scanner for a 20-30 minute research study. Lean body mass indices were measured in terms of area of the paraspinal muscles in the lumbar region and area of the gluteal muscle on a selected slice using medical image analysis software (Figure 1). These measurements were correlated to birth weight, gestational age, subcutaneous and visceral adipose tissue volumes, and hepatic PDFF using Pearson coefficients (r). Results: 9 subjects (55% male) completed the study. The mean (\pm SD) gestational age and age at the time of the study was 36+/-4 weeks and 4+/-2 months, respectively (Table 1). Body composition profiles for each subject are also depicted in Table 1. There was a non-significant correlation between birth weight and gluteal muscles ($r=0.6$, $p=0.07$), and between gluteal muscles and subcutaneous adipose tissue ($r=0.6$, $p=0.06$). Conclusion: In this study, we successfully measured lean body mass indices in infants. We noted that lower birth weights are associated with decreased lean body mass and subcutaneous adipose tissue. Free-breathing MRI is a non-invasive tool that can be used in longitudinal studies to help uncover the early origins of obesity and associated metabolic complications in preterm and growth restricted infants.

Abstract # 61

Abstract Title: Reducing Environment-Associated Temperature Instability During Transports to Nursery

Name: Daniel Cho, MD

Resident Physician

Abstract Overview: see attached

Co-Authors: Esther Kim, MD - Resident Physician Neema Pithia, MD - Resident Physician Jyotirbala Ruparel, MD - Attending Physician Jimmy Nguyen, MD - Principal Investigator

Organization: UCLA Mattel Children's Hospital

Abstract Overview: **PURPOSE** Newborns transferred from Labor & Delivery (L&D) to Nursery units in open cribs are at risk of hypothermia secondary to convection loss during transport, possibly leading to unnecessary sepsis evaluations and antibiotic therapies. We aimed to reduce environment-associated temperature instability via a practical low-cost intervention. **METHODS** We conducted a prospective observational study. Nurses conducting newborn transfers from L&D to Nursery were trained in a "double hat double blanket swaddle" protocol instead of the usual single layer clothing cover. The protocol was implemented on April 12, 2018. Data such as birth weight, gestational age, pre- and post-transfer temperatures, hospital length of stay, and sepsis work-ups were collected on newborns four months leading up to and four months after protocol initiation. **RESULTS** Compared to the pre-intervention cohort (n=1796), the post-intervention cohort (n=1830) showed a lower proportion of hypothermic babies upon arrival to Nursery (5.5% vs 3.8%; p=0.02) and smaller temperature variation between leaving L&D and arrival to Nursery (-0.23°F vs -0.19°F; p=0.03). Small for gestational age (SGA) term newborns showed the greatest reduction in hypothermia (5.4% vs 3.3%; p=0.005) as well as newborns with birth weights 2800-3200g (7.2% vs 3.0%; p=0.004). The post-intervention cohort overall received fewer sepsis workups (6.0% vs 6.8%; p=0.31) and trended toward fewer antibiotic courses (2% vs 2.9%; p=0.72). **CONCLUSION:** A practical and relatively low cost "double hat double blanket swaddle" intervention led to a decrease in environment-associated temperature instability during transport, especially for SGA term newborns and BW 2800-3200g.

Abstract # 64

Abstract Title: a QI initiative to establish infant driven feeding with >90% compliance in infants born at 32 weeks or less in a level III NICU

Name: Sneha Taylor, MD
Attending neonatologist

Co-Authors: Cheryl McElwain MSN, RNC-NIC

Organization: Children hospital of Orange county

Abstract # 65

Abstract Title: **Bifidobacterium longum subspecies infantis EVC001 decreases inflammation and mortality in a murine NEC model**

Name: Steven McElroy, MD
Associate Professor

Co-Authors: Shiloh R. Lueschow; Steven A. Frese, PhD; Bethany M. Henrick, PhD; Steven J. McElroy, MD

Organization: Stead Family Department of Pediatrics, University of Iowa

Abstract Overview: Purpose: Historically, *Bifidobacterium longum subspecies infantis* (*B. infantis*) has been an important component of the gut microbiome of infants. *B. infantis* is uniquely able to break down and utilize human milk oligosaccharides (HMOs) completely, which gives some strains a competitive advantage in the infant gut. However, HMOs are not in most formulas, thus formula fed infants do not have as many bifidobacteria in their microbiome. Parallel, Necrotizing Enterocolitis (NEC) is an intestinal disease affecting mainly preterm infants with a 30-50% mortality rate and a higher incidence in formula fed infants. Treatment strategies for NEC are limited and have not improved in the last few decades, prompting research into prevention strategies. One potential prevention strategy is probiotics, though there are wide variations in strain composition, product quality and potential mechanisms of action. Recent work with *B. infantis* EVC001 suggests that colonization with this organism may result in a more appropriate microbiome for preterm infants who generally have inappropriate gut colonization and inflammation, both of which are risk factors for NEC. Methods: Experimental NEC was induced in 14 day old C57Bl/6 mice by Paneth cell depletion (IP injection with 75ug/gbw dithizone) followed seven hours later by induction of bacterial dysbiosis (gavage of *Klebsiella pneumoniae* 1x10¹¹ CFU/kgbw). In addition, mice were gavaged twice with 100 ul *B. infantis* or MCT oil as a vehicle control with or without gavage of the HMO lacto-N-tetraose (LNT) at 250 ul/dose or water as a vehicle control. Sixteen hours after dithizone delivery we harvested serum to look at inflammatory cytokines, then sacrificed the mice and harvested intestinal tissue for injury scoring and the cecum for microbiome analysis. Results: Analysis of NEC model survival showed improved survival in mice with *B. infantis* exposure (82% compared to 70%, n ≥ 8). Additionally, mice given *B. infantis* EVC001 in our NEC model had significant 2-fold decrease in the inflammatory cytokine IL-6 (p = 0.046, n ≥ 7) to approximate sham levels compared to NEC mice not given *B. infantis*. Finally, there was a trending decrease in the inflammatory murine cytokine KC-GRO when mice were given *B. infantis* in our NEC model

compared to those not given the probiotic. Conclusion: This finding supports the beneficial properties of *B. infantis* EVC001 and drives further research looking into NEC-like injury prevention.

Abstract # 66

Abstract Title: Anti-inflammatory effects of vagus nerve stimulation in a newborn rat model of acute inflammation

Name: Bradley Cacho, MD

Fellow of Neonatology

Co-Authors: Jonathan Abdala, BS, Christopher G. Wilson, PhD, Vadim Gospodarev, MD, Douglas Deming, MD, Lianne Pak, MS

Organization: Loma Linda University Children's Hospital, Division of Neonatology

Abstract Overview: Neonatal sepsis and inflammation pose a potential source of morbidity and mortality in newborns. We have previously shown that vagus nerve stimulation (VNS) modulates pro-inflammatory cytokine expression in the central nervous system (CNS). The optimal VNS parameters to reduce inflammation are not known. In this randomized control trial, we tested the hypothesis that VNS reduces the expression of pro-inflammatory cytokines in a lipopolysaccharide (LPS) model of airway inflammation. We used intratracheal injections of LPS (0.5 mg/kg in 10 μ L of saline) in neonatal Sprague Dawley rats (postnatal days 10 to 12) to induce pro-inflammatory cytokine expression. The pups were anesthetized with isoflurane, and then underwent midline incision and dissection to expose the trachea. LPS was injected into the trachea to mimic airway inflammation, and the vagus nerve was then isolated via blunt dissection. The experimental group received VNS at pre-selected frequencies (ranging logarithmically from 10 to 10000 Hz) continuously for 30 minutes directly after LPS injection. Stimulation current was titrated down as needed to account for apnea (typically about 0.5 mA). After recovery, each brainstem was processed for cryosectioning and immunohistochemistry. We stained for and measured the expression of cytokines IL-1 β , TNF- α , and HMGB1 in subjects with or without VNS (the control group received LPS without VNS). We then used ImageJ software and the particle analysis plug-in to quantify the number of cells in the nucleus tractus solitarius that expressed these cytokines. Using one-way ANOVA, we showed a significant decrease ($p < 0.05$) in the expression of IL-1 β , TNF- α , and HMGB1 in LPS-injected rats that underwent VNS compared to those who received LPS alone. IL-1 β was significantly decreased at frequencies of 10, 100, 1000, and 10000 Hz, TNF- α was significantly decreased at frequencies of 10 and 1000 Hz, and HMGB1 was significantly decreased at frequencies of 1000 Hz and 10000 Hz. Cytokine expression in the LPS + VNS group was similar when compared to sham rats (no LPS injection and no VNS). Our study showed that VNS at various frequencies significantly

decreased the expression of early inflammatory cytokines in LPS-injected neonatal rats. Blocking the early cytokine cascade may be associated with decreased inflammation and a concomitant reduction in associated symptoms in patients with sepsis. VNS used either alone or in conjunction with antibiotics may lead to improved outcomes in neonates suspected to have an infection.

Abstract # 68

Abstract Title: It is possible! Reducing Central Line Usage and CLABSI using a Multidisciplinary Process

Name: Shaina Lodhi, MD

Neonatology Fellow (PGY-6)

Co-Authors: Elba Fayard, MD (Professor of Pediatrics; Division Chief, Neonatal-Perinatal Medicine)

Organization: Loma Linda University

Abstract Overview: Introduction: Central lines in the NICU are a common source for hospital-acquired infections. Central line-associated blood stream infections (CLABSIs) contribute greatly to neonatal morbidity and mortality. Attributable mortality with CLABSI is estimated to be 4% to 20%. CLABSI can increase length of stay by up to 7 days. The cost per infection can be up to \$69,000. Success in decreasing central line usage and CLABSI rates has been demonstrated in other units with a collaborative approach targeting line care bundles, monitoring compliance, and rigorous reporting. Hypothesis: Reducing line use is the most effective way to reduce CLABSI. Multidisciplinary approach to regulate insertion, maintenance and discontinuation of central lines will decrease CLABSI. Objective: To reduce central line usage and the CLABSI rate by 20% from 2017 to 2019. Methods: We created a NICU CLABSI taskforce, which included nurses, physicians, and administrative representatives. The taskforce: 1) Developed clear indications for the placement and continuation of central lines. 2) Updated bundle practices for insertion and maintenance of central line hubs and dressings. 3) Created a nursing team that inserted lines, changed dressings and checked line position on a regular bases. 4) Provided formal education on indications and maintenance of central lines to nurses and physicians. Nurses were required to discuss the reasons for keeping the central line with the medical team daily. Physicians were asked to document the location, duration and indication for central lines in daily progress notes. 5) Audited physicians compliance and sent weekly reminders to remove central lines if they no longer met criteria. Central line days/patient days, CLABSI events/1000 line days, Standardized Utilization Ratio (SUR; observed line days/ predicted line days) and Standardized Infection Ratio (SIR; observed infections/predicted infections) were tracked from Jan 2017 to Sept 2019. Results: The ratio of central line to patient days was reduced by 23% and the rate of CLABSI/1000 line days was reduced by 40%

from 2017 to 2019. The table shows the ratio of central line to patient days, rate of CLABSI/1000 line days, SIR and SUR from 2017 to 2019. This reduction represents 28 less hospital days, and cost savings of up to \$276,000 in 2019. Conclusion: We were able to reduce central line usage and CLABSI rates in our NICU by using a multidisciplinary approach including educating the staff, mandating strict reporting, and updating and monitoring hub and dressing practices.

Abstract # 69

Abstract Title: Maternal Hepatitis C viral (HCV) seroprevalence at birth in women with perinatal polysubstance and/or opiate exposure.

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NICU Clinical Research Nurse Educator

Co-Authors: Haas JE1, Huang, A2, Stemmler, M 2 ; Davies, T 4, Jegatheesan, P2 ; Maddox, T4 ; Werthammer, J1,3 ; Govindaswami, B1,2,3

Organization: Hoops Family Children's Hospital/ Cabell Huntington Hospital

Abstract Overview: Background: Guidance for HCV in pregnancy (hcvguidelines.org) by the American Association for the study of Liver diseases and Infectious Disease Society of America are not yet widely known and screening for HCV varies, particularly in high-risk populations. Maternal HCV may indicate high-risk behavior including prior maternal substance and/or perinatal opiate exposure. We have noted at our institution (center 2) that 55% of Neonatal abstinence syndrome (NAS) treated infants > 35 weeks gestation in 2017 were born to mothers who were HCV+ at the time of their birth. Objective: To determine maternal Hepatitis C prevalence in women delivering at 2 different regional perinatal safety-net centers at a University affiliated government hospital in San Jose, CA (Center 1) and Marshall University affiliated Children's hospital in Huntington, WV (Center 2). We examined maternal HCV in all liveborns including those prenatally exposed to polysubstances and/or opiates. Design/Methods: Data collected prospectively 2014-2019 in 2 regional perinatal centers were examined retrospectively to determine prevalence HCV seropositivity at delivery of all liveborn infant(s) including those subsequently managed with Neonatal Abstinence Syndrome (NAS). Methodological variation and incomplete/missing data are limitations at the time of this submission, but data examination is ongoing. Results: 35018 consecutive livebirths at 2 regional perinatal centers 2014-2019 (some data collection ongoing) are included ~19133 in center 1 and ~15885 in Center 2. Substance exposure at birth occurred in 544 (2.8% of livebirths) inborn infants in center 1 and 1600 (10%) in Center 2. Opiate exposure occurred prenatally in 120 (0.6% of livebirths) infants in Center 1 and 698 in

Center 2. Hepatitis C positive status was noted prior to or at birth in 0.5% (2014-2018) and 7.5% (2017-2019) of livebirths in Center 1 and Center 2 respectively, a fifteen fold variation in maternal seroprevalence at Substance exposed infants had 5.3% HCV seroprevalence in center 1 and a 39.8% seroprevalence in center 2. Opiate exposed infants had maternal HCV seroprevalence of 1% in Center 1 (2014-2018) and 9.2% for centers 2 (2017-2019). Conclusion(s): Maternal Hepatitis C seroprevalence is 7-10 x higher in polysubstance exposed infants compared to all live-borns in our study population. An urgent public health crisis in chronic liver injury could be averted by standardized universal screening and early treatment approaches to HCV as recommended by hcvguidelines.org

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