



# TRANSFORMING CARE FOR MEDICALLY COMPLEX INFANTS: ACCOMPLISHMENTS & FUTURE DIRECTIONS OF THE CHNC AND CHND

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*Much of the work of the CHNC has been made possible through the support of our participating children's hospitals*

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The **Children's Hospitals Neonatal Consortium** ([www.thechnc.org](http://www.thechnc.org)), is a not-for-profit quality outcome organization for neonatology leaders based in regional, Level IV neonatal intensive care units (NICUs). The CHNC formed in 2006 and was established in 2011 as a 501(c)3 organization with the mission to improve care for infants in children's hospital NICUs. The CHNC partnered with the Child Health Corporation of America then The Children's Hospital Association (CHA) to develop the **Children's Hospitals Neonatal Database (CHND)**, launched in 2010 with 17 participating sites. In 2017, through continued participation of now 34 member institutions, the CHNC transitioned from its partnership with CHA to a new registry vendor, Velos, Inc, (Fremont, CA) to create the CHND 2.0, the second generation of the database platform and the CHNC took over management of all the other activities of the consortium.

CHND was developed to meet the data acquisition and analytics required for comparative quality and outcome measures for the unique population of medically complex neonates and infants treated in NICUs at children's hospitals (Level IV NICU patients). Many of these high acuity infants have surgical problems, congenital anomalies or serious acquired complications of preterm birth. With an average 25-day length of stay and the multiple services they require after discharge, these infants **represent one of the highest resource utilization groups of any pediatric population.**

**CHND is the largest clinically valid data set for this unique patient population.** In addition to clinical outcomes, CHND records have frequently been linked to PHIS (CHA's administrative dataset) to analyze cost variation for disease-specific patient populations. These linked analyses can provide patients, providers, and organizations with **comparative data on both clinical outcomes and resource utilization in these medically complex infants.**

In the current era, when the population health of medically complex infants is a focus for our hospitals, the **value** of delivered health care must be assessed as the US spends approximately 20% of its gross domestic product (GDP) on health care. NICU patients in Children's Hospitals represent only 7-8% of the patient population for these hospitals, but because of their complex care needs and long length of stay, with respect to resource utilization, this patient population represents approximately 1/4 of the patient days and over 20% of the total inpatient charges of a Children's Hospital. Therefore it is imperative that we invest in key clinical resources like CHND that marry pediatric outcomes to measures of resource utilization captured both with the CHND and in other datasets. Our goals are to both improve the quality of care as well as optimize expenditures in the care of medically complex infants.

*This document outlines the major milestones and accomplishments achieved through this collaboration and data analyses.*

## **ACCOMPLISHMENTS**

- **Engagement of an interdisciplinary group of neonatal experts**
  - CHNC established the vision and data elements to develop a robust clinical data set for this unique population
  - Neonatologists, pediatric surgeons, advanced practice nurses, neonatal nurses, infection control practitioners, anesthesiologists, epidemiologists, informaticists, quality improvement leaders and hospital administrators have volunteered to develop quality and research initiatives across participating institutions
  
- **Data design that focuses on this unique population of NICU infants**
  - Fills a gap in other existing databases by focusing on neonatal quaternary critical care
  - Captures the data elements, practices and outcomes needed to develop valid clinical predictions
  - Focused on disease-specific practices and outcomes
  - Designed to provide granularity and details on *clinical* diagnoses that are frequently inaccurately captured in administrative datasets based on billing codes
  - Allows linkage to PHIS and other administrative datasets for matching of clinical diagnoses with resource utilization data
  - Harmonized data elements with key national databases and registries (VON, CPQCC, ELSO, NICHD, CDH registry, NSQIP, NHSN)
  
- **Recognized by U.S. News & World Report (USNWR) Best Children's Hospital Survey: CHND participation and CHND measures were scoring criteria in the 2014 - 2017 surveys**
  - Based on CHND target benchmark data, five new objective patient-specific metrics were added to the Neonatology Survey over the past 4 years:
    - *Rate of breastfeeding at discharge*
    - *Rate of post-operative hypothermia*
    - *Rate of admission temperature in target range in infants receiving hypothermia treatment on transport*
    - *Rate of unintended extubation*
    - *Documentation of growth metrics at discharge*
  
  - In the 2018-19 **USNWR** results for best children's hospitals:
    - 9/10 top neonatology programs in the honor roll list of top children's hospitals are CHNC participating sites
  
- **Multi-center CHND QI Collaboratives are improving care and lowering costs**
  - *The CHNC SLUG BUG Project*, demonstrated a 20% decrease in central line associated bloodstream infections with \$69,000 of attributable cost savings per each averted infection
    - *Centers sustained low rates for 19 months across 17 level IV NICUs*
    - *Sterile tubing change was identified as an important factor in reducing central line infection rates*
  
  - *STEPP IN (Safe Transition and Euthermia in the Peri-operative Period In Neonates)*, demonstrated improvement in patient safety and coordination of care and patient safety in the perioperative period
    - 47% decrease in post-operative hypothermia; specific processes were identified to impact outcome
    - Decreased post-operative communication failures by 21% and

post-operative respiratory care failure by 64%

- o *The STEPP IN next STEPPs Collaborative addressing peri-operative safe patient practices and pain management began April 2017*
- o *ERASE-PAIN focusing on perioperative pain control in critically ill infants will kick off in 2019-2020.*
- o *See additional details in the CHND/CHNC CIQI White Paper*
- o **Representing the Consortium, CHNC leaders are invited participants on key national/international initiatives that are leading to the standardization and optimization of quaternary neonatal care**
  - o Representation on the Vermont Oxford Neonatal Database Advisory Board, the major worldwide benchmarking database for neonates with common neonatal diseases
  - o Representation on the "Optimal Resources for Children's Surgical Care" task force of the American College of Surgeons that developed new guidelines defining the resources hospitals need to deliver surgical care for children both safely and effectively
  - o Largest quaternary NICU in Canada a participant
  - o Participated in a joint pediatric surgery/quaternary neonatology symposium presentation at the Fall 2015 American Academy of Pediatrics (AAP) meeting, in collaboration with the Sections of Neonatal Medicine and Pediatric Surgery
  - o Representation on the Pediatric Terminology Governance Committee, an initiative of the National Institute of Child Health and Development (NICHD) and Pediatric EHR Data Sharing Network (PEDIStNet) supporting terminology harmonization
  - o Participation in the creation of the Neonatal Research Network Terminology, an initiative harmonizing the terminologies of the Vermont-Oxford Network, the NICHD, and the CHND
  - o Leadership (Co-Chair) on the Child Health Work Group of Health Level Seven International, which develops interoperability standards for Electronic Health Record Functional Profiles and Clinical Document Architecture (CDA) used in quality reporting and health information exchange
  - o Primary leadership in developing of the "*Essential Information for Children with Special Healthcare Needs CDA*," which enables electronic exchange of important information about the patient-centered clinical needs for **medically complex infants and children** and their primary and subspecialty providers, in order to support and facilitate **transitions of care** to new medical environments
  - o Invited to participate in a North American, international guideline development for the care of infants with diaphragmatic hernia
  - o AAP's Section of Neonatal Perinatal Medicine Metrics Initiative
- o **Promoting international, neonatal, interdisciplinary education focusing on quaternary care NICUs**
  - o The CHNC conducts the only educational symposium focusing on quality improvement, program development and research for the unique population of Level IV NICU patients. The size and scope of these meetings are growing rapidly each year, now with an attendance of over 350 professionals:
    - o *The Changing Face of Staffing, Education and Competency in Children's Hospitals' NICUs*, Kansas City, 2011
    - o *Optimizing Perioperative Care of the Neonate and Young Infant*, Philadelphia, 2012
    - o CHNC/CHND Quality & Research Symposium, Sept 2015
    - o CHNC/CHND Quality & Research Symposium, Sept 2016
    - o CHNC/CHND Quality & Research Symposium, Oct 2017, Columbus

- 10th Annual Quality & Research Symposium, Oct 2018 Columbus, OH
- 11th Annual Quality & Research Symposium, Nov, 2019, Atlanta, GA
- 12th Annual Symposium (Indianapolis, IN) Oct 23-25, 2020
- 13th Annual Symposium (Houston, TX) in 2021
  
- **Providing short-term outcome data, including survival to hospital discharge, in neonatal uncommon to rare diseases, to help inform clinicians in their patient care and counseling of families**
  
- **Providing the infrastructure to observe risk-adjusted outcomes for each disease of interest, to inform stakeholders in healthcare delivery for these populations**
  - Begins to quantify the **value of care** for medically complex infants when relating these outcomes with resource utilization
  
- **Disease-specific severity-of-illness risk adjustment tools under development**
  - Severe bronchopulmonary dysplasia (BPD) tools completed
  - Congenital diaphragmatic hernia (CDH) completed
  - CDH and Risk of Bloodstream (BSI) and Urinary Tract Infections
  
- **Identifying striking inter-center variation in resource utilization, costs, and outcomes**
  - Benchmarking data from CHND allowed one center to reduce length of stay by 33% among infants with gastroschisis
  - Use of Anti-epileptic medication usage in infants with hypoxic ischemic encephalopathy (HIE)
  - Length of inpatient stay among infants with gastroschisis > 34 weeks' gestation
  - Inter-center cost variations in infants with HIE
  - 5-fold risk-adjusted differences in death or tracheostomy in infants with severe bronchopulmonary dysplasia < 32 weeks' gestation.
  
- **Improving understanding of certain diseases and interventions specific to our population of patients: CHNC Focus Groups**
  - An important part of our work is done through CHNC Focus Groups, composed of CHNC members and invited multidisciplinary experts in the field. Some focus groups are using the CHND data on specific populations, with a growing number of peer reviewed publications to date (Appendix I), while other focus groups are currently more *focused* on education or quality improvement. The following groups are currently active:
    1. Severe bronchopulmonary dysplasia(sBPD)
    2. Cardiology
    3. Congenital diaphragmatic hernia (CDH)
    4. Extracorporeal Support (ECMO)
    5. Gastroschisis
    6. Hypoxic Ischemic encephalopathy (HIE)
    7. Infectious disease
    8. Micrognathia
    9. Necrotizing enterocolitis
    10. Neurosurgical Care and the Neuro-NICU
    11. Resuscitation (beyond the delivery room): research, QI and education sub-committees
    12. Transitioning home
    13. Telemedicine

#### **FUTURE DIRECTIONS and Return on Investment (ROI)**

*In a short period of time, the capital outlay by 34 participating hospitals, and the time commitment by clinicians, have rapidly generated new knowledge about these patients and*

successful quality improvement initiatives for them

### Reporting in CHND

In October 2018, CHND's reporting tool ([chndreports.veloseresearch.com](http://chndreports.veloseresearch.com)) was launched permitting comparative data on unit and patient characteristics, interventions and in-hospital patient outcomes with many filters to allow customizable reports. The following reports and their visualization have been developed to date and are displayed in the Tableau environment:

- Overview
- Discharge Characteristics
- Admission Characteristics
- Congenital Diaphragmatic Hernia (CDH)
- My Hospital Report: Detailed site specific reports with access to new filtering and more details of single site data
- US News and World Report: Site specific data on the USNWR survey questions being collected in the CHND (select diagnoses' volumes, breast milk at discharge Unintended extubation, etc)
- Site specific and consortium wide CIQI Outcomes
- \*2019-2020: comparative benchmarking across hospitals for a specific diagnosis and/or procedure

Disease-specific analyses are the power of the CHND. Unlike many other hospitalized children, infants in a quaternary NICU has a long inpatient length of stay, with varying disease processes that require in-depth analyses to determine best practices that will lead to improved care and outcomes. Therefore, future goals of the CHND include:

- Continue to provide key objective outcome metrics relevant specifically for this patient population for public and other reporting (eg US News and World Report, etc)
- Define disease specific treatment variability across sites, particularly related to LOS, resource utilization and outcomes
- Determine most effective treatment approaches within this variability, and make recommendations on best practice
- When new practices are implemented, measure outcome and success in improvement in clinically important areas, i.e., care, survival, length of stay. In addition, through data linkages with PHIS, determine best resource utilization for these key patient populations
- Provide data for resource utilization expectations and advocate for medically complex patients using the data-driven platform generated
- Simplify data access for both local and comparative data
- Develop quality dashboards with more contemporaneous access to data
- Identify and disseminate best practices and promote through QI implementation across sites

## Appendix I:

### Awarded Grants:

1. 2012: Abbott Nutrition, Abbott Laboratories Educational Grant
2. 2012: Covidien: Educational Grant
3. 2012: Draeger Medical: Educational Grant
4. 2012: Ikaria: Educational Grant
5. 2012: Thermo-Fisher Scientific Educational Grant
6. 2012: Friends of Prentice Research Grant: Prediction of Death or Tracheostomy in patients with severe BPD: Dr. Karna Murthy, Ann and Robert Lurie Children's Hospital, Chicago
7. 2014: Friends of Prentice Research Grant: Differentiating high-performing centers for infants suffering from severe BPD: Dr. Karna Murthy, Ann and Robert Lurie Children's Hospital, Chicago
8. 2015 Mead Johnson Nutrition, Educational Grant for 7th Annual Educational Symposium
9. 2016: Presidential Award: Home oxygen use in infants with BPD; Dr. Joanne Lagatta, University of Wisconsin Hospitals, Milwaukee
10. 2017: Mead Johnson Nutrition Educational Grant for 9th Annual Educational Symposium
11. 2017: K23 from NHLBI, Lagatta (PI) Mentored Career Development Award. Home Oxygen Use for Infants with Bronchopulmonary Dysplasia: Balancing Infant, Family and Health System Outcomes; Awarded 1/1/18-12/31/22
12. 2018: Fore Hadley CDH Foundation Grant to CHNC CDH Focus Group; PIs: Theresa Grover, MD Colorado Children's Hospital & Karna Murthy, MD MSc, Lurie Children's Hospital, Chicago, IL. "Sedation & Analgesic Medication Usage in Infants with Diaphragmatic Hernia."
13. 2018: Prolacta, Inc., Educational Grant Award for 10th Annual Educational Symposium
14. 2018: Mead Johnson Nutrition, Educational Grant for 10th Annual Educational Symposium
15. 2018: Abbott Nutrition, Educational Grant Award for 10th Annual Educational Symposium
16. 2018: Chiesi, Inc., Educational Grant Award for 10th Annual Educational Symposium
17. 2018: Food and Drug Administration: Contract: Oct 1, 2018: Route of Administration of Home feedings and its impact on Readmission.
18. 2019 Annual Symposium: Mead Johnson Nutrition Travel Awards for Trainees
19. 2019 Annual Symposium: Abbott Laboratories, Travel Awards for Trainees
20. 2019 Children's Hospital Orange County, Internal Research Award, "Chronic Respiratory Failure in Late-preterm and Term Infants."

### CHNC Publications

1. Slattery SM, Knight DC, Weese-Mayer DE, Grobman WA, Downey DC, Murthy K. "Machine Learning Mortality-Classification in Clinical Documentation with Increased Accuracy in Visual-Based Analyses." Accepted to *Acta Paediatrica*, 11-22-2019
2. Fry JT, Matoba N, Datta A, DiGeronimo R, Coghill CH, Natarajan G, Brozanski BS, Leuthner S, Niehaus JZ, Schlegel AB, Shah A, Zaniletti I, Bartman T, Murthy K, Sullivan KM. Center, Gestational Age, and Race Impact End-of-Life Care Practices at Regional NICUs; Accepted to *J Pediatr* Oct 14, 2019.
3. Rao R, Lee KS, Zaniletti I, Yanowitz T, DiGeronimo R, Dizon D, Natarajan G, Peebles E, Murthy K, Mathur A, Massaro A. "Anti-microbial therapy utilization in neonates with hypoxic-ischemic encephalopathy: A report from the Children's Hospital Neonatal Database." Accepted in *J Perinatol* 8/30/2019
4. Vyas-Read S, Wymore E, Zaniletti I, Murthy K, Padula M, Truog WE, Engle W, Savani RC, Yallapragada S, Logan J, Zhang H, Hysinger E, Grover TR, Natarajan G, Nelin LD, Porta NFM, Potoka K DiGeronimo R, Lagatta JM. "Utility of Echocardiography in Predicting Mortality in Infants with Severe Bronchopulmonary Dysplasia". Accepted in *J Perinatol* on 9/18/2019.
5. Falciglia GH, Murthy K, Holl JL, Palac H, Woods D, Robinson DT. "The Prevalence of Clinical Decision Support to Calculate Nutrition and Fluid Intake for Infants in the Neonatal Intensive Care Unit". I Acceptance in *J Perinatol* on 10/28/19.
6. Keene S, Grover TR, Murthy K, Palotto EK, Brozanski BS, Gien J, Zaniletti I, Johnson Y, Seabrook R, Porta NFM, Haberman B, DiGeronimo R, Rintoul N. "Extracorporeal Membrane

- Oxygenation and Bloodstream Infection in Congenital Diaphragmatic Hernia." *J Perinatol*. 2019 Oct; 39(10):1384-1391.
7. Machut KZ, Datta A, Stoller JZ, Rao R, Mathur A, Grover TR, Billimoria Z, Murthy K. 1. "Association of Neonatologist Continuity of Care and Short Term Patient Outcomes." *J Pediatr*. 2019 Sep; 212: 131-136.e1. PMID: [31201026](#)
  8. Dizon MLV, Rao R, Hamrick SE, Zaniletti I, DiGeronimo R, Natarajan G, Kaiser JR, Flibotte J, Lee KS, Smith D, Yanowitz T, Mathur A, Massaro A. Practice variation in anti-epileptic drug use for neonatal hypoxic-ischemic encephalopathy among regional NICUs. Accepted on 2/19/2019: *BMC Pediatrics*. PMID: [30813933](#)
  9. Yanowitz T, Piazza A, et al., on behalf of the CHNC Necrotizing Enterocolitis Focus Group., "Does the Initial Surgery for Necrotizing Enterocolitis Matter? Comparative Outcomes for Laparotomy vs. Peritoneal Drain as Initial Surgery for Necrotizing Enterocolitis in Infants <1000 gm Birth Weight." *In Press in J Ped Surg*, Jan 2019. PMID: [30765157](#)
  10. Bourque SL, Levek C, Melara DL, Grover TR, Hwang SS. Prevalence and Predictors of Back-Transport Closer to Maternal Residence After Acute Neonatal Care in a Regional NICU. *Matern Child Health J*. 2018 Sep 25. doi: 10.1007/s10995-018-2635-6. [Epub ahead of print]; PMID: [30255218](#)
  11. Natarajan G, Mathur A, Zaniletti I, DiGeronimo R, Lee KS, Rao R, Dizon M, Hamrick S, Rudine A, Cook N, Smith D, Flibotte J, Murthy K, Massaro A on behalf of the Children's Hospitals Neonatal Consortium (CHNC). "Withdrawal of Life-support in Neonatal Hypoxic-Ischemic Encephalopathy" Accepted to *Pediatric Neurology* 2018 Nov 23. pii: S0887-8994(18)30680-5. doi: 10.1016/j.pediatrneurol.2018.08.027; PMID: [30559002](#)
  12. Lagatta JL, Hysinger EB, Zaniletti I, Wymore EM, Vyas-Read S, Yallapragada SG, Nelin LD, Truog WE, Padula MA, Porta NFM, Savani RC, Potoka KP, Kawut SM, DiGeronimo R, Natarajan G, Zhang H, Grover TR, Engle WA, Murthy K on behalf of the Children's Hospitals Neonatal Consortium. "Impact of Pulmonary Hypertension in Preterm Infants with Severe BPD Through One Year." *J Pediatr* 2018. Dec; 203; 218-224.e3. PMID: [30172426](#)
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  14. Falciglia GH, Murthy K, Holl JL, Palac HL, Oumarbaeva, Y, Woods DM, Robinson DT. "Energy and Protein Intake During the Transition from Parenteral to Enteral Nutrition in Very Low Birth Weight Infants." *J Pediatr*. 2018 Nov; 202:38-43.e1. PMID: [30195557](#)
  15. Bhat R, Kumar R, Kwon S, Murthy K, Liem RI, "Risk Factors for Neonatal Venous and Arterial Thromboembolism in the NICU – A Case Control Study." *J Pediatr* 2018 Apr;195:28-32. PMID: [29398052](#)
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  17. Keene S, Murthy K, Pallotto E, Brozanski B, Gien J, Zaniletti I, Hulbert C, Seabrook R, Rintoul N, Chicoine L, Porta N, Grover TR. Acquired Infection & Antimicrobial Utilization During Initial NICU Hospitalization in Infants with Congenital Diaphragmatic Hernia; *Pediatr Infect Dis J*. 2018 May;37(5):469-474. PMID: [29189614](#)
  18. Sustaining SLUG Bug CLABSI Reduction: Does Sterile Tubing Change Technique Really Work? Pallotto EK, Piazza AJ, Smith JR, Grover TR, Chuo J, Provost L, Mingrone T, Holston M, Moran S; DNP, Morelli L; LNCC, Zaniletti I, Brozanski B. *Pediatrics*. 2017 Oct;140(4). pii: e20163178. doi: 10.1542/peds.2016-3178. PMID: [28951441](#)
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  20. Gien J, Murthy K, Pallotto EK, Brozanski B, Chicoine L, Zaniletti I, Seabrook R, Keene S, Alapati D, Porta N, Rintoul N, Grover TR. Short-term weight gain velocity in infants with congenital diaphragmatic hernia (CDH). *Early Hum Dev* 2017 Feb 5;106-107:7-12. doi: 10.1016/j.earlhumdev.2017.01.010. Epub 2017 Feb 6. PMID: [28178582](#)
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## **Presentations at Scientific Meetings**

### **PAS Presentations 2019 (Baltimore)**

1. Longer time to full enteral feeds following longer courses of antibiotics for medical necrotizing enterocolitis.
2. Short-Term Outcomes in the Newly Re-Defined BPD: Findings from The Children's Hospitals Neonatal Consortium; Session Title: Neonatal Pulmonology: Lung Disease - Clinical
3. Nasogastric versus Gastrostomy Tube Feedings in Regional NICU Graduates: Inter-Center Variation and 30-Day Readmission Risks (Platform)
4. Antecedents of neurological injury in neonates with mild hypoxic-ischemic encephalopathy
5. Inter-center Variation in Autopsy Practices Among Regional NICUs
6. Electronic Health Record Documentation to Predict Neonatal Short-Term Outcomes: A Pilot Study for Newborns with Hypoxic-Ischemic Encephalopathy
7. Implications of continuity of care on infant nutrition in the neonatal intensive care unit

### **PAS Presentations 2018 (Toronto)**

1. Using a Quality Improvement Tool to Identify Inter-center Variation in End of Life Care Across Regional Level IV NICUs. Poster Symposium presentation with Kevin Sullivan, MD as presenting author
2. Inter-center variation (ICV) in antimicrobial therapy (AMT) use in neonates with hypoxic-ischemic encephalopathy (HIE): A report from the Children's Hospitals Neonatal Database (CHND) Poster presentation with An Massaro, MD as presenting author
3. Exploring Potential Indications for Tracheostomy and Chronic Mechanical Ventilation in Patients with Severe Bronchopulmonary Dysplasia. Poster presentation with Sushmita Yallapragada, MD as presenting author
4. How to Reduce CLABSI's in the NICU? Invited Science Presenter: Beverly S. Brozanski, MD
5. Inter-center variation in pulmonary hypertension treatment for infants with Congenital Diaphragmatic Hernia (CDH) on behalf of the Children's Hospitals Neonatal Consortium CDH Focus Group. Poster presentation with Theresa Grover as presenting author
6. Identifying Gaps in the Electronic Health Record's (EHR) Support of Infant Nutrition Management Poster presentation with Gustave Falciglia, MD as presenting author
7. Utility of echocardiography in predicting mortality in infants with severe bronchopulmonary dysplasia: Findings from the Children's Hospitals Neonatal Consortium. Platform / Oral presentation with Shilpa Vyas-Read MD MS & Erica Wymore, MD as presenting authors
8. Electronic Health Record Documentation to Predict Neonatal Short-Term Outcomes: A Pilot Study for Newborns with HIE; Poster Presentation with Susan Slattery, MD as the

- presenting author
9. Electronic Data Elements for Neonatal Intensive Care Unit Discharge. Poster Presentation with Susan Slattery, MD as the presenting author
  10. ESPR: Do Neonatologist Transitions Matter for Patient Care? .Poster Session presentation by Kerri Machut, MD & Jason Stoller, MD at the Eastern Society for Pediatric Research Meeting 2018 .

## PAS Presentations 2017

1. End of Life Care in Regional Level IV Neonatal Intensive Care Units (NICUs): Infants of older gestational ages are more likely to die without CPR: A report from the Children's Hospitals Neonatal Consortium (CHNC). Poster presentation with Kevin Sullivan as presenting author
2. Declining Neonatal Mortality in Regional Level IV Neonatal Intensive Care Units (NICUs): An initial report from Children's Hospitals Neonatal Consortium (CHNC). poster presentation with Kevin Sullivan as presenting author
3. Intercenter variation (ICV) in anti-epileptic drug (AED) therapy in neonates with hypoxic-ischemic encephalopathy (HIE): A report from the Children's Hospitals Neonatal Consortium (CHNC). poster presentation with Maria Dizon as presenting author
4. The Impact of Pulmonary Hypertension in Preterm Infants with severe BPD: A Multi-Center Comparison of NICU and Readmission Outcomes. Poster presenting with Joanne Lagatta as presenting author
5. Withdrawal of Life-Sustaining Therapy (WLST) among Infants with Hypoxic-Ischemic Encephalopathy in the Era of Cooling: A report from the Children's Hospitals Neonatal Consortium. Platform presentation with Girija Natarajan as the presenting author

## Other Presentations 2017

1. Yanowitz TD; Walek, S; Zaniletti I; Sharma J; Brozanski B; Sullivan K; DiGeronimo R; Piazza AJ; Wadhawan R; Murthy K and Children's Hospital Neonatal Consortium Surgical NEC Focus Group: Does the Initial Procedure for Surgical Necrotizing Enterocolitis Really Matter? At the "Necrotizing Enterocolitis Symposium: A transdisciplinary approach to improving outcomes." Sponsored by the NEC Society and the UC Davis Health System Office of Continuing Medical Education and Division of Neonatology. April 2017
2. Brozanski B. "Perioperative Handoff for Neonates - Culture Clash or Team Collaboration?" Hot Topics of Neonatology in December 2017; Washington DC.
3. Brozanski B, Pallotto E, Piazza A. "How Can Orchestrated Testing be Applied and Effectively Impact Quality Outcome Projects?" Breakout - Hot Topics of Neonatology in December 2017; Washington DC.
4. Murthy K, "Nutritional Practices and Growth Outcomes after Surgical Necrotizing Enterocolitis." Hot Topics of Neonatology in December 2017; Washington DC.

## PAS Presentations 2016

1. Piazza AJ, Brozanski B, McClead R, Smith JR, Richardson T, Grover T, Mingrone T, Holston M, Chuo J, Moran S, Bellflower B, Rao R, Hulbert C, Rintoul N, Pallotto EK. STEPP-IN: A Multi-Center Collaborative Decreases Care Failure by Implementing Standard Communication Process for Post-Operative Handoff.
2. Pallotto EK, Brozanski B, Piazza AJ, Mingrone T, Smith JR. *Helping your Team with Handoff: Using Quality Improvement Methodology to Optimize Patient Safety and Team Communication.* Workshop.
3. Pallotto EK, Piazza AJ, McClead R, Smith JR, Richardson T, Grover T, Mingrone T, Holston M, Chuo J, Moran S, Bellflower B, Rao R, Hulbert C, Rintoul N, Brozanski B. STEPP-IN: A Multi-Center Collaborative Reduces Post-Operative Hypothermia and Identifies Key Strategies for Success.

4. Piazza AJ, Brozanski B, McClead R, Smith JR, Richardson T, Grover T, Mingrone T, Holston M, Chuo J, Moran S, Bellflower B, Rao R, Hulbert C, Rintoul N, Pallotto EK. *STEPP-IN: A Multi-Center Collaborative Decreases Care Failure by Implementing Standard Communication Process for Post-Operative Handoff.*
5. Murthy K; Gien, J; Pallotto EK; Brozanski BS; Chicoine L Zaniletti I; Seabrook R; Porta N; Keene S; Alapathi D; Rintoul N; Grover T and the Children's Hospital Neonatal Consortium Congenital Diaphragmatic Hernia Study: *In-Hospital Weight Gain and Survival in Infants with Congenital Diaphragmatic Hernia*
6. Yanowitz TD; Zaniletti I; Sharma J; Brozanski B; Sullivan K; DiGeronimo R; Piazza AJ; Wadhawan R; Murthy K and Children's Hospital Neonatal Consortium Surgical NEC Focus Group: *Does the Initial Procedure for Surgical Necrotizing Enterocolitis Really Matter?*

## PAS Presentations 2015

1. Grover TR, et al: On behalf of the Children's Hospitals Neonatal Consortium Congenital Diaphragmatic Hernia Study Group. *Predicting Death or Length of Stay  $\geq 90$  Days in Infants with Congenital Diaphragmatic Hernia*
2. Porta NFM, Lagatta JM, Troug WE, Zaniletti I, Savani RC, Nelin LD, Grover TR, Murthy K. *Inter-center Variation in Death or Tracheostomy Placement in Infants with Severe Bronchopulmonary Dysplasia*
3. Javier M, Murthy K, Gotteiner N, Porta NFM. *Right Ventricular Size Is Related To Death or Tracheostomy Placement in Infants With Severe Bronchopulmonary Dysplasia*
4. Massaro A, Murthy K, Zaniletti I, Cook N, DiGeronimo R, Dizon M, Hamrick SE, McKay V, Natarajan G, Rao R, Smith D, Telesco R, Wadhawan R, Evans JR, Short BL, Mathur AM. *Variability in Intercenter Cost of Care for Neonatal HIE in the Era of Therapeutic Hypothermia*
5. Lin GC, Robinson DT, DiGeronimo R, Mulroy C, Moallem M, Reber K, Olsen S, Datta A, Murthy K. *Parenteral Nutrition and Short-term Growth Outcomes in Preterm Infants with Surgical Necrotizing Enterocolitis (NEC)*
6. Pallotto EK, Piazza A, Grover TR, Smith J, Moran S, Mingrone T, Bellflower B, Holston M, Chuo J, Morelli L, Richardson T, Hulbert C, Rintoul N, Rao R, Soliman D, McClead R, Brozanski BS. *STEPP IN: A Multi-center Quality Collaborative Reducing Post-Operative Hypothermia in Neonates*
7. Piazza A, et al; On behalf of the Children's Hospitals Neonatal Consortium, Collaborative Initiatives and Quality Improvement Group. *The Benefits of Participation in a CLABSI Reduction Collaborative*
8. Riley MM, Goldbach M, Yanowitz TD, Morowitz, M, Vats K, Brozanski BS. *Interdisciplinary Collaboration To Reduce Hospital Stay for Neonates With Gastroschisis*

## Appendix II:

### The Children's Hospital Neonatal Database 2019 Membership

1. Alfred I. duPont Hospital for Children, Wilmington
2. All Children's Hospital Johns Hopkins Medicine, St. Petersburg
3. American Family Hospital, Madison
4. Advent Health for Children, Orlando
5. Ann & Robert H. Lurie Children's Hospital of Chicago
6. Arkansas Children's Hospital, Little Rock
7. Boston Children's Hospital
8. Cincinnati Children's Hospital
9. Children's Healthcare of Atlanta at Egleston
10. Children's Healthcare of Atlanta at Scottish Rite
11. Children's Hospital and Medical Center, Omaha
12. Children's Hospital Colorado, Denver
13. Children's Hospital of Orange County
14. Children's Hospital of Pittsburgh of UPMC
15. Children's Hospital of Wisconsin, Milwaukee
16. Children's Medical Center Dallas
17. Children's Mercy Hospitals and Clinics, Kansas City
18. Children's National Medical Center, Washington, DC
19. Children's of Alabama, Birmingham
20. Children's Hospital Los Angeles
21. Children's Hospital of Michigan, Detroit
22. Cook Children's Medical Center, Fort Worth
23. Hospital for Sick Children, Toronto, Ontario
24. Le Bonheur Children's Hospital, Memphis
25. Nationwide Children's Hospital, Columbus
26. Primary Children's Hospital, Salt Lake City
27. Rady Children's Hospital, San Diego
28. Riley Children's, Indianapolis
29. Seattle Children's Hospital
30. St Christopher's Hospital for Children, Philadelphia
31. St. Louis Children's Hospital
32. Texas Children's Hospital, Houston
33. The Children's Hospital of Philadelphia
34. UCSF Benioff Children's Hospital Oakland

### Sites In Process of Joining

1. Connecticut Children's Hospital, Hartford
2. Iowa Hospital for Children, Des Moines
3. Winnie Palmer Hospital Orlando Health, Orlando
4. Children's Hospital of Minnesota, Minneapolis
5. May Clinic Children's Center, Rochester
6. Nemours Children's Hospital, Orlando

## Appendix III:

### The Children's Hospital Neonatal Consortium Board of Directors 2019

**Karna Murthy, MD MSc** Chair

Associate Professor of Pediatrics Feinberg School of Medicine, Northwestern University Division of Neonatology Ann & Robert H. Lurie Children's Hospital of Chicago

**Anthony Piazza, MD** Secretary

Medical Director ICN and Neonatal ECMO Medical Director Children's Healthcare of Atlanta at Egleston Hospital, Associate Professor of Pediatrics Emory University School of Medicine Atlanta, GA Lead, CHNC CIQI Steering Committee

**Eugenia K Palloff, MD MSCE** Treasurer

Medical Director Intensive Care Nursery Neonatal, ECMO Medical Director Children's Mercy Hospital-Kansas City, Professor of Pediatrics University Missouri School of Medicine Kansas City, MO Lead, CHNC CIQI Steering Committee

**Jeanette Asselin MS, RRT-NPS, FAARC**

Manager, Neonatal/Pediatric Research IRB Chair, UCSF Benioff Children's Hospital Oakland, CA

**Beverly Brozanski, MD**

Medical Director, Neonatal Intensive Care Unit, UPMC Children's Hospital of Pittsburgh, Professor Dept of Pediatrics, University of Pittsburgh School of Medicine. Pittsburgh, PA Lead, CHNC CIQI Steering Committee

**Theresa Grover, MD**

Medical Director NICU, Children's Hospital Colorado  
Professor of Pediatrics University of Colorado School of Medicine, Aurora, CO

**Michael A. Padula, MD, MBI, FAAP**

Medical Director of Informatics, Division of Neonatology The Children's Hospital of Philadelphia  
Associate Professor of Clinical Pediatrics Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA

**Kristina Reber, MD**

Associate Division Chief Neonatology Fellowship Program, Director Division of Neonatology Nationwide Children's Hospital, Associate Professor of Pediatrics The Ohio State University Columbus, Ohio

**Billie Lou Short, MD**

Chief, Division of Neonatology Children's National Health System  
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Dec 2019

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