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Leveraging Telemedicine to Eliminate Outcome Disparities for Rural-born Newborns

March 16, 2023

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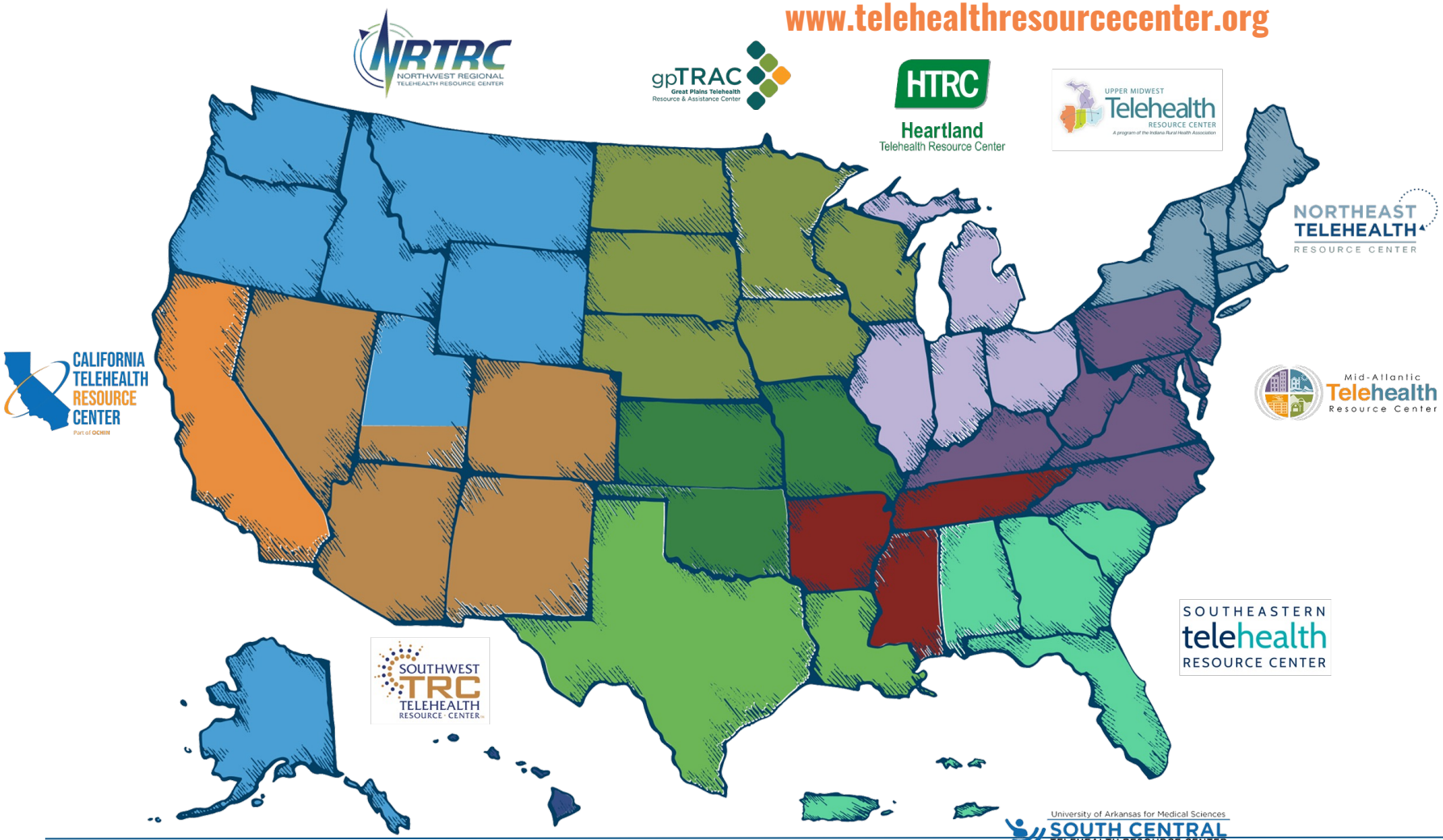

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Leveraging Telemedicine to Eliminate Outcome Disparities for Rural-born Newborns

Alexa Craig, MD, MS, MSc

Assistant Professor of Pediatrics

Tufts University of School of Medicine

Disclosures

- Grant funding: Northern New England Clinical and Translational Research Network (NNE-CTR) (NIH U54GM115516)

- Grant funding: Center of Biomedical Research Excellence in Acute Care Research and Rural Disparities (NIH 1P20GM139745-01)

- This research would not be possible without the families, who have been generous with their time and insights

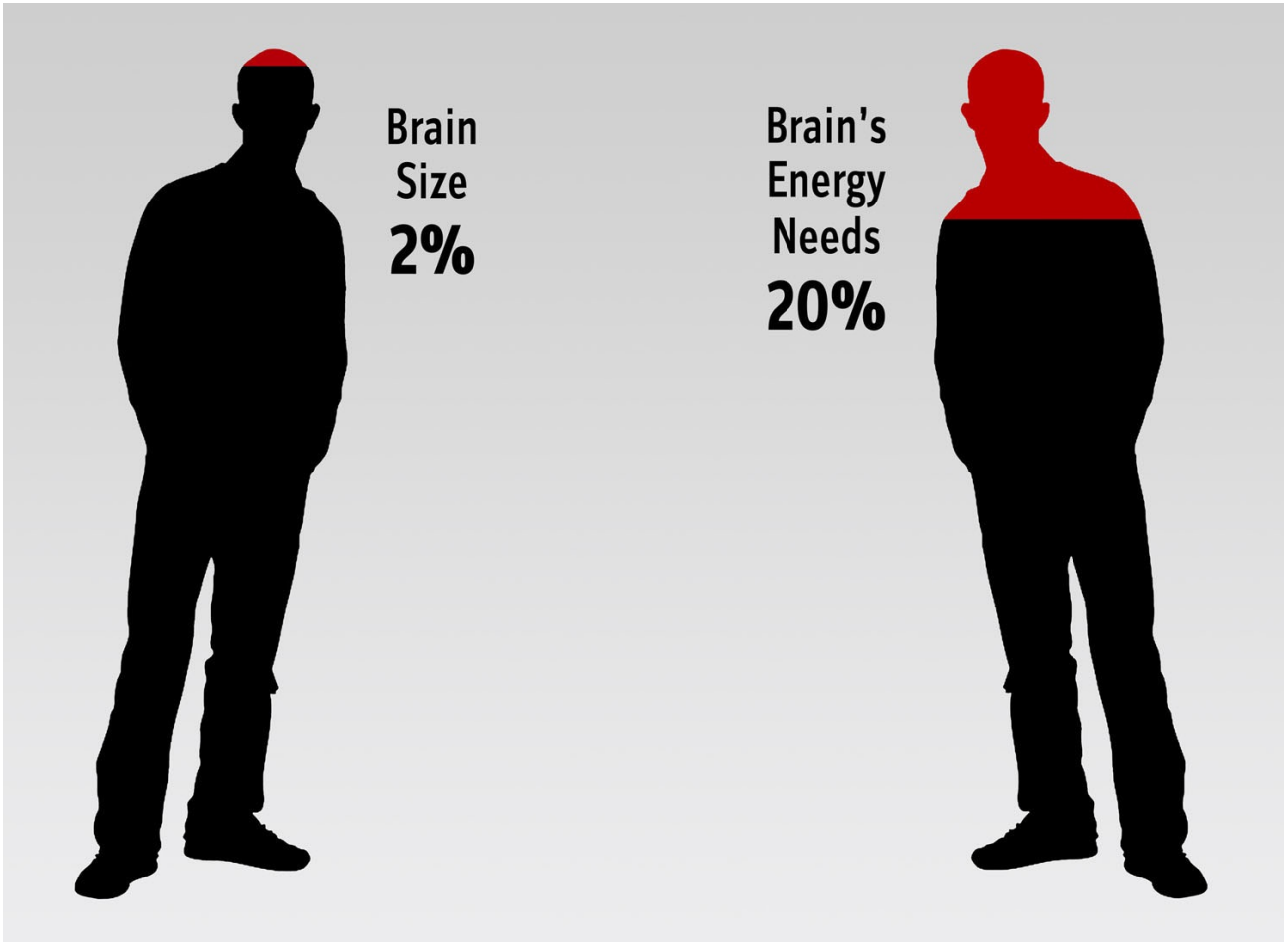
Objectives

- Identify barriers to optimal care for neonatal encephalopathy in rural areas
- Learn about strategies being implemented such as telemedicine to evaluate neonatal encephalopathy and improve the parent experience
- Learn about ways in which we are expanding telemedicine application to other types of care in newborns and in children

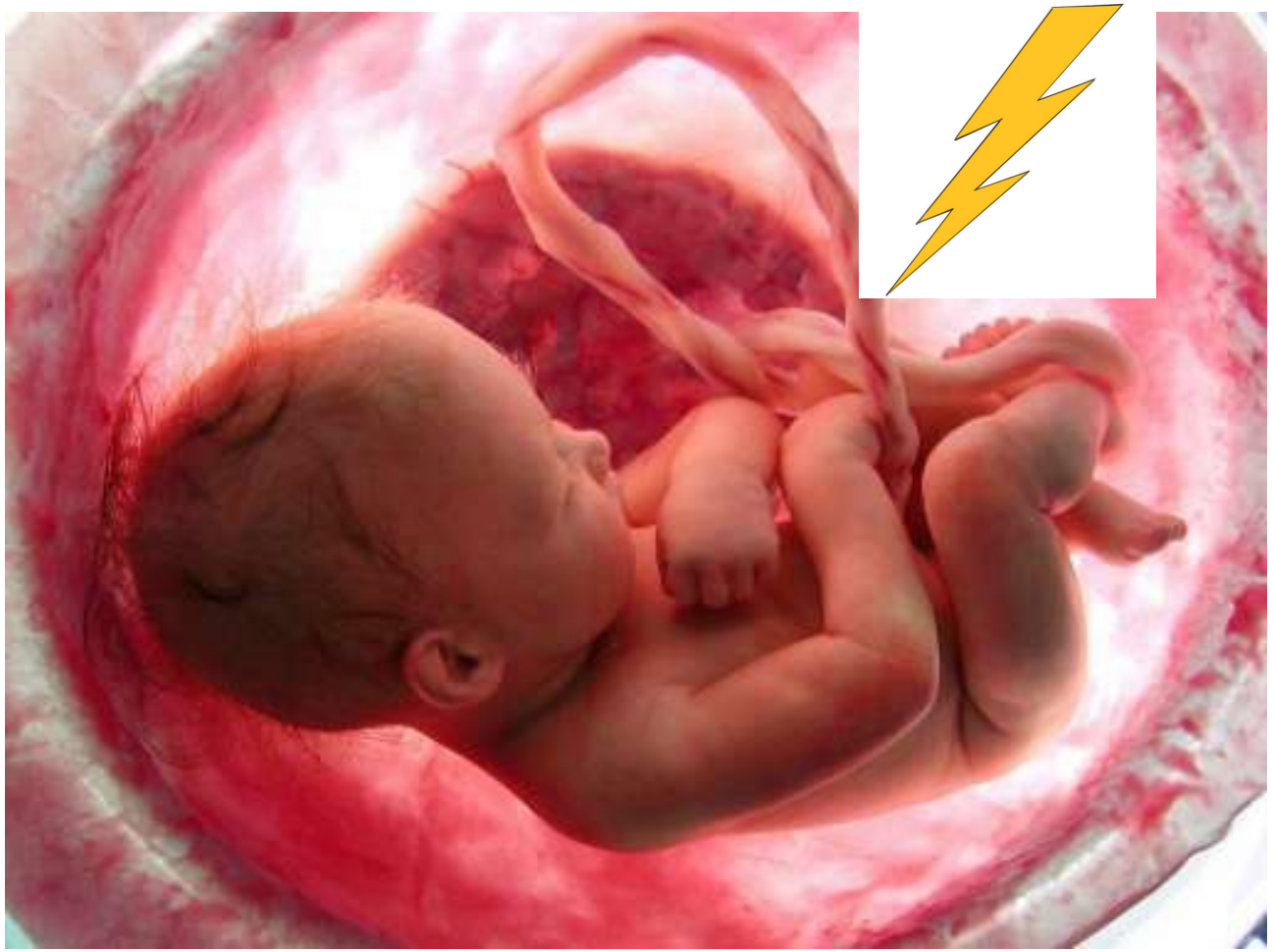
The Human Brain

- Did you know that the human brain is the only organ that studies itself?

The Brain is an Energy Hog



Hypoxic Ischemic Encephalopathy (HIE)



Hypoxic Ischemic Encephalopathy (HIE)

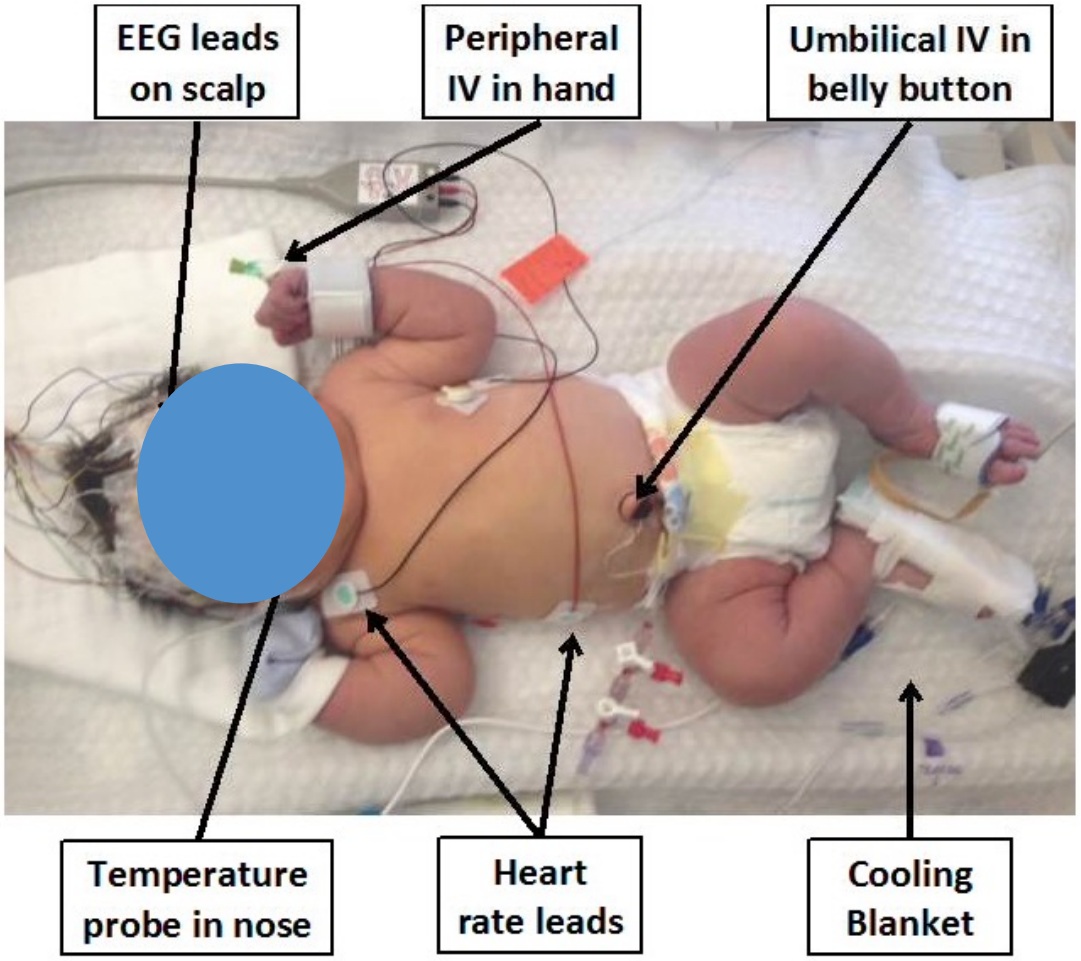
- Estimated incidence rate of 1-3 per 1,000 live births (in developed countries)
- Maine has an annual birth rate of ~12,000
  - Potentially 36 (or more) incidences of Hypoxic Ischemic Encephalopathy per year in Maine
- HIE is associated with cerebral palsy, hearing and vision loss and seizure disorders among other sequelae
  - The lifetime costs of children with functional or intellectual disabilities such as cerebral palsy, hearing and vision loss in the United States is estimated at $16.1 billion (Honeycutt, Grosse, Dunlap 2003)

A case: part 1

- Term birth
- Umbilical cord prolapse ->stat C-section with general anesthesia
- Chest compressions
- Intubated after 4 attempts
- Arterial cord gas 6.8/-15
- TREATMENT: Therapeutic hypothermia

*Signed consent from Aaron's parents to share photos for the purpose of education

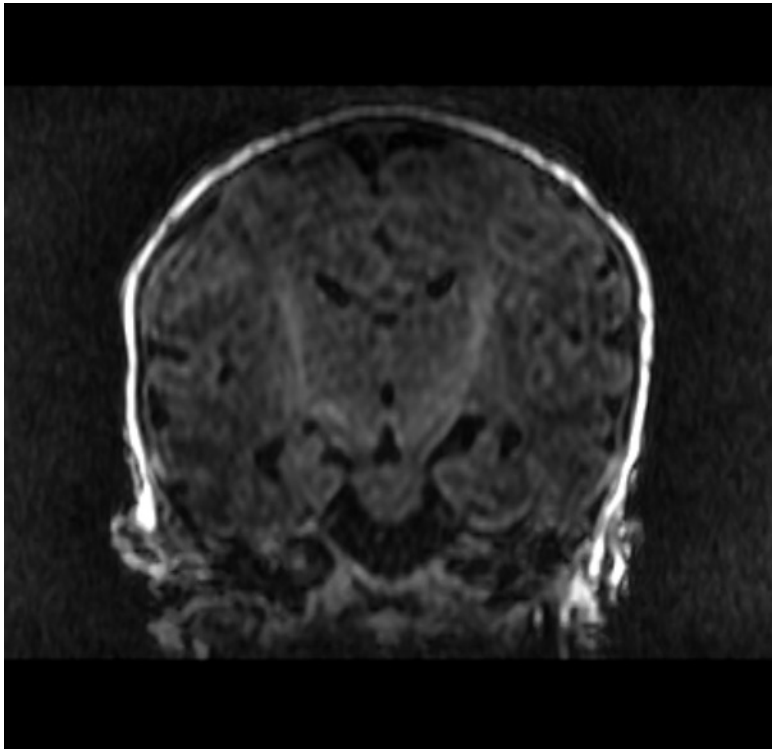
Therapeutic Hypothermia



*Signed consent from David's parents to share photos for the purpose of education

A case: part 2

- Aaron had no seizures on EEG for 72 hrs of cooling and 12 hours rewarming
- MRI of the brain was normal at completion of hypothermia
- Discharged home on day of life 11 on full oral feeds



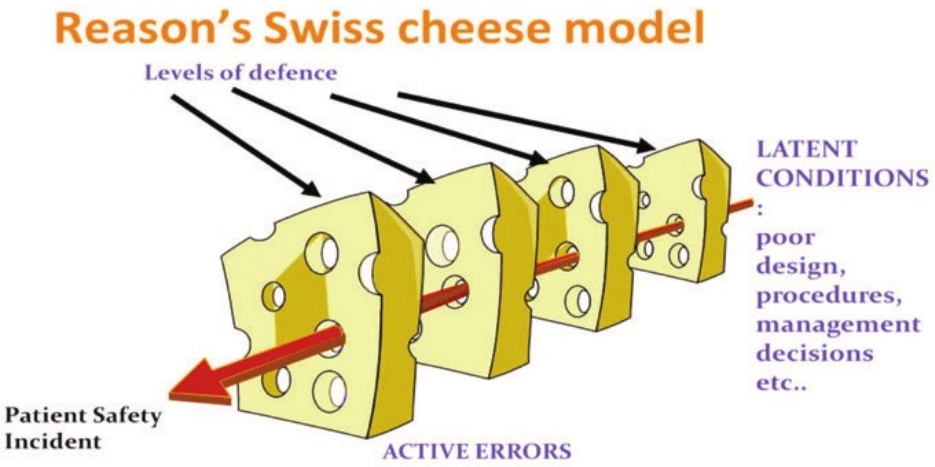
A case: part 3

*Signed consent from parents of Aaron to share photos for the purpose of education

What was the role of chance in this good outcome??

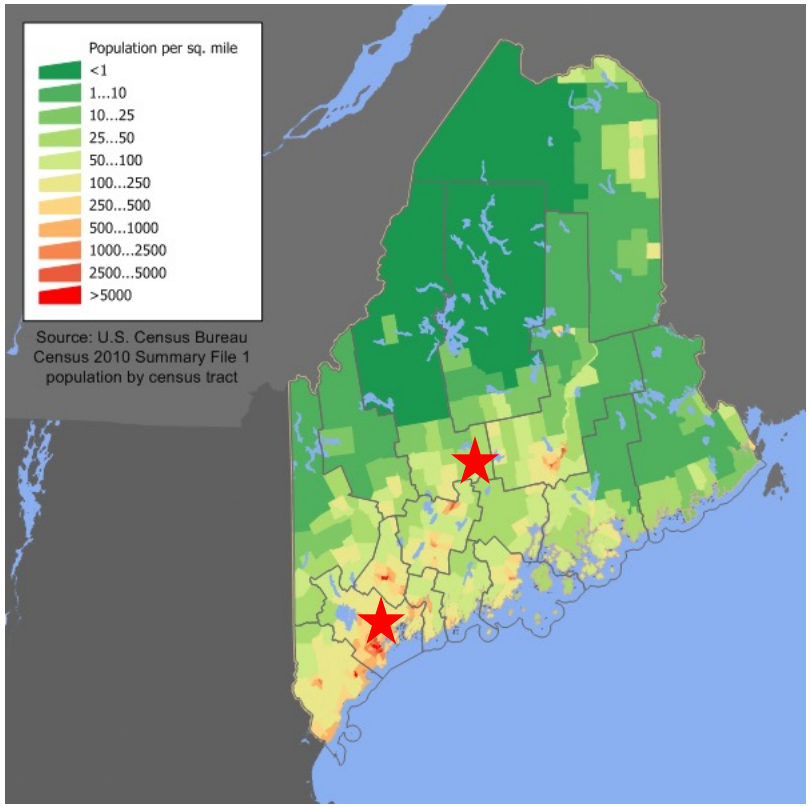
Reasons for Success

- His pediatrician got to the bedside in 10 minutes
- She was ultimately successful at securing his airway after 4 attempts
- She new about therapeutic hypothermia and called us at the tertiary care center quickly



The Swiss Cheese Model of Organizational Accidents: https://www.researchgate.net/figure/Swiss-Cheese-model-of-organizational-accidents_fig1_265177684

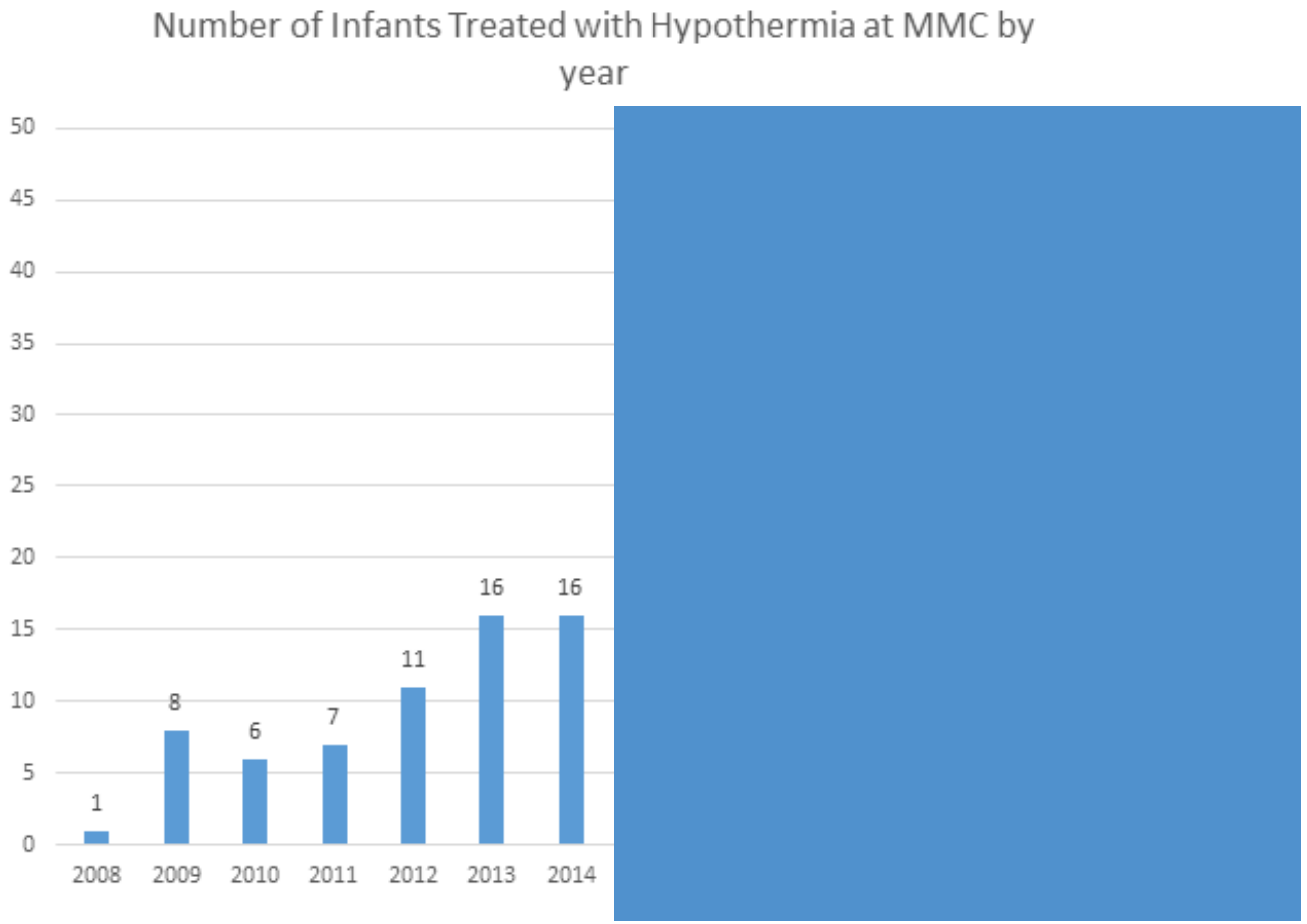
Maine is a very rural state



- 2/3rd of babies born in Maine are delivered in small community hospitals (<1 baby born per day)

Transport Team-Cooled Aaron in the Rig

Where we started with cooling…



Retrospective Study of Infants Treated with Hypothermia

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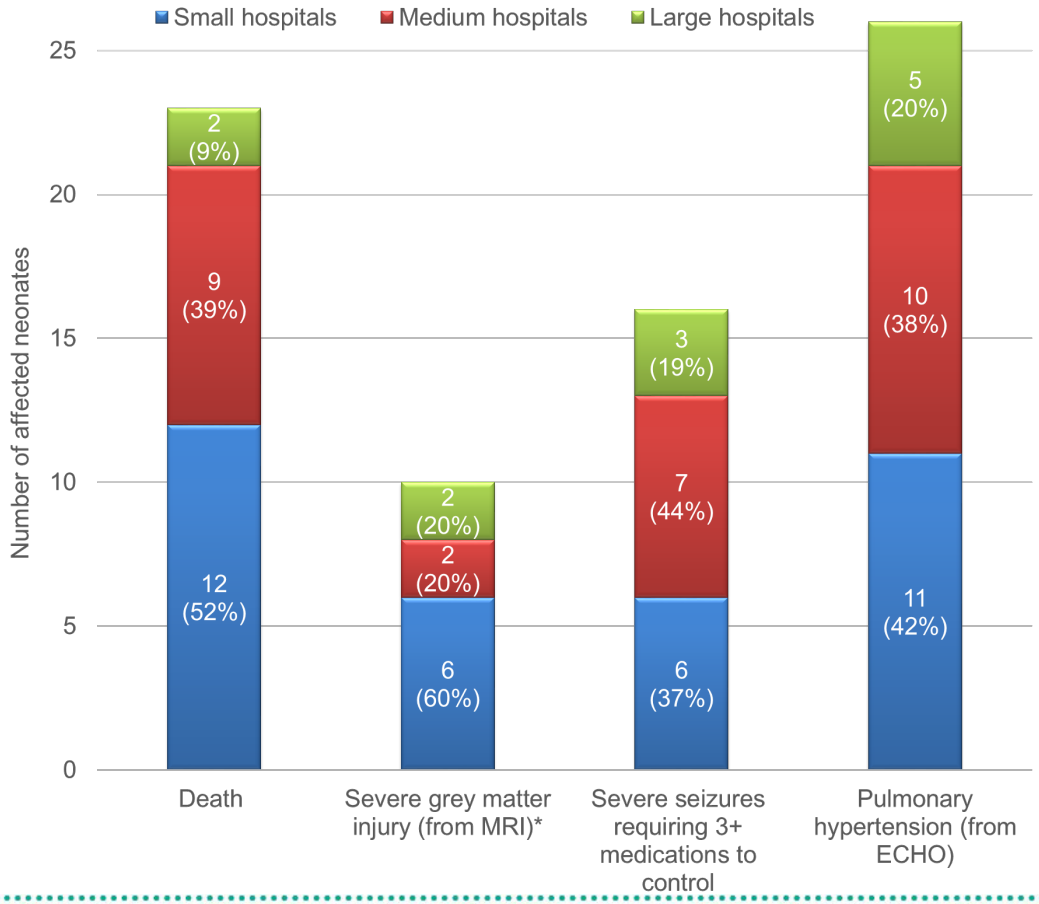
FIGURE I: SHORT TERM OUTCOMES BY HOSPITAL BIRTH VOLUME



Even though there were few differences in the mothers and babies, there are obvious differences in outcomes

Small Volume Hospital Associated with Increased Risk

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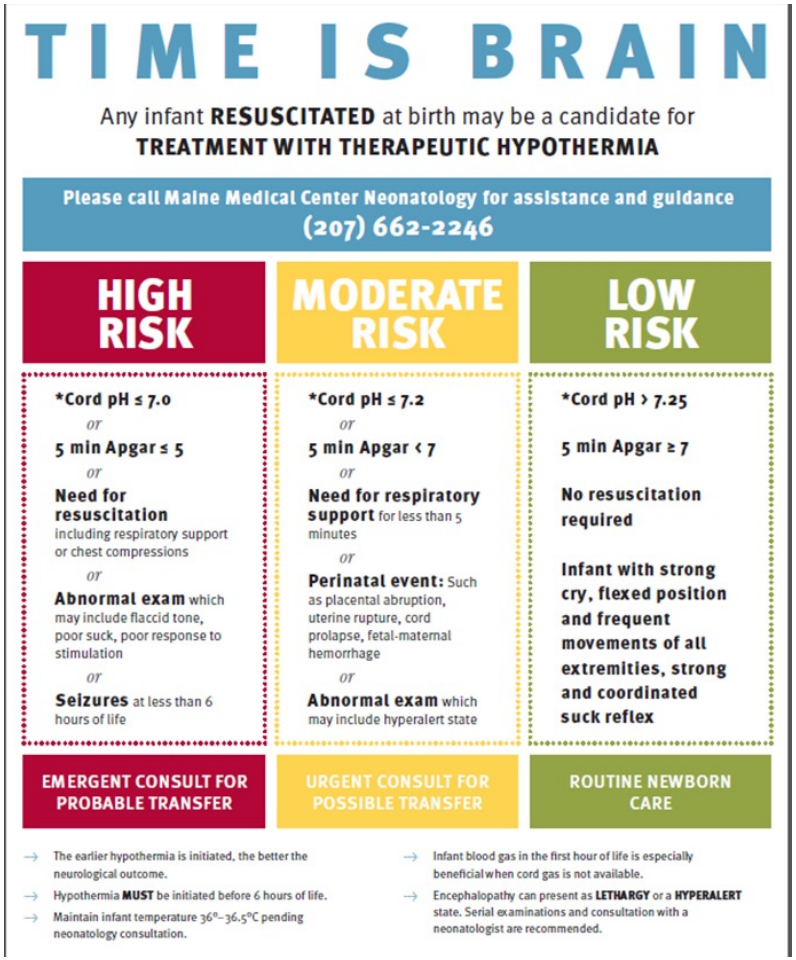
Model	Odds Ratio	CI
Unadjusted model for death/severe brain injury		
• Medium volume vs Large volume	2.5	0.8, 9.4
• Small volume vs Large volume	5.9	2.0, 21.8
Adjusted for maternal age and gestational age		
• Medium volume vs Large volume	2.7	0.8, 11.3
• Small volume vs Large volume	7.5	2.3, 30.0

Poster presented at PAS 2021: Prathusha Yerramilli[1], Nabeel Hashmi[1], Jay Kerecman MD[2], Misty Melendi[3] MD, Alexa Craig[3] MD; Tufts University School of Medicine[1], Northern Light Eastern Maine Medical Center[2], Maine Medical Center[3]

Educational Outreach Intervention



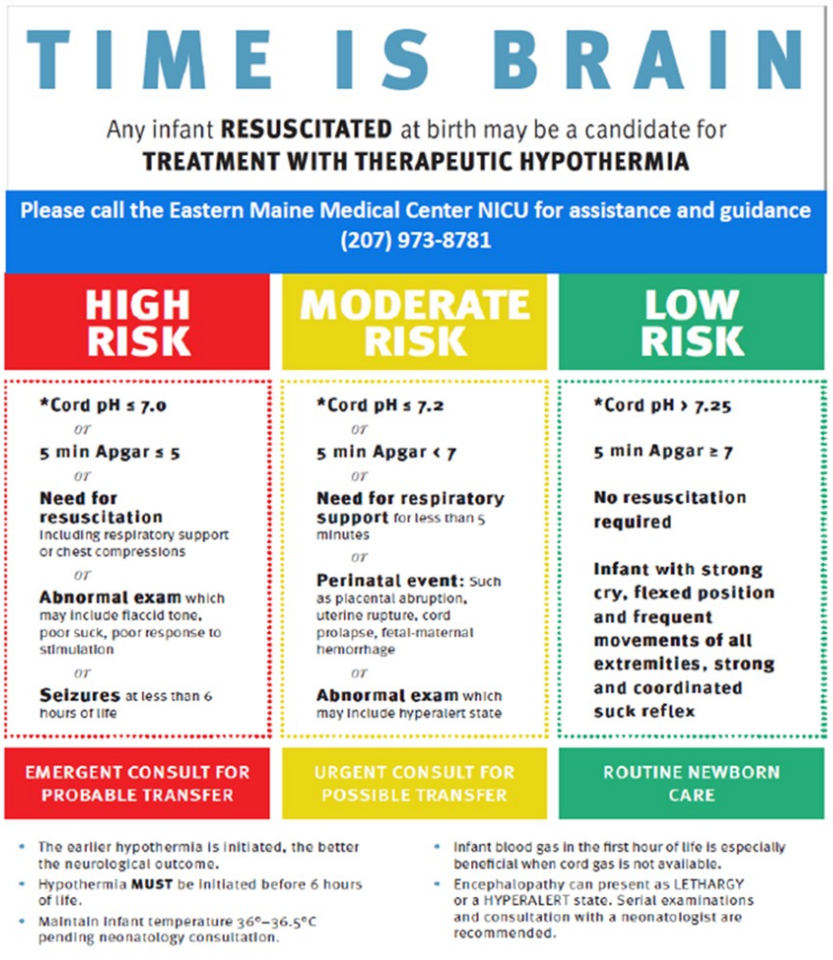
TIME IS BRAIN

Any infant **RESUSCITATED** at birth may be a candidate for **TREATMENT WITH THERAPEUTIC HYPOTHERMIA**

Please call Maine Medical Center Neonatology for assistance and guidance
(207) 662-2246

HIGH RISK	MODERATE RISK	LOW RISK
***Cord pH ≤ 7.0** *or* **5 min Apgar ≤ 5** *or* **Need for resuscitation** including respiratory support or chest compressions *or* **Abnormal exam** which may include flaccid tone, poor suck, poor response to stimulation *or* **Seizures** at less than 6 hours of life	***Cord pH ≤ 7.2** *or* **5 min Apgar < 7** *or* **Need for respiratory support** for less than 5 minutes *or* **Perinatal event:** Such as placental abruption, uterine rupture, cord prolapse, fetal-maternal hemorrhage *or* **Abnormal exam** which may include hyperalert state	***Cord pH > 7.25** **5 min Apgar ≥ 7** **No resuscitation required** **Infant with strong cry, flexed position and frequent movements of all extremities, strong and coordinated suck reflex**
EMERGENT CONSULT FOR PROBABLE TRANSFER	**URGENT CONSULT FOR POSSIBLE TRANSFER**	**ROUTINE NEWBORN CARE**

→ The earlier hypothermia is initiated, the better the neurological outcome.
→ Hypothermia **MUST** be initiated before 6 hours of life.
→ Maintain infant temperature 36°–36.5°C pending neonatology consultation.
→ Infant blood gas in the first hour of life is especially beneficial when cord gas is not available.
→ Encephalopathy can present as **LETHARGY** or a **HYPERALERT** state. Serial examinations and consultation with a neonatologist are recommended.



TIME IS BRAIN

Any infant **RESUSCITATED** at birth may be a candidate for **TREATMENT WITH THERAPEUTIC HYPOTHERMIA**

Please call the Eastern Maine Medical Center NICU for assistance and guidance
(207) 973-8781

HIGH RISK	MODERATE RISK	LOW RISK
***Cord pH ≤ 7.0** *or* **5 min Apgar ≤ 5** *or* **Need for resuscitation** including respiratory support or chest compressions *or* **Abnormal exam** which may include flaccid tone, poor suck, poor response to stimulation *or* **Seizures** at less than 6 hours of life	***Cord pH ≤ 7.2** *or* **5 min Apgar < 7** *or* **Need for respiratory support** for less than 5 minutes *or* **Perinatal event:** Such as placental abruption, uterine rupture, cord prolapse, fetal-maternal hemorrhage *or* **Abnormal exam** which may include hyperalert state	***Cord pH > 7.25** **5 min Apgar ≥ 7** **No resuscitation required** **Infant with strong cry, flexed position and frequent movements of all extremities, strong and coordinated suck reflex**
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After Education Outreach Numbers Triple

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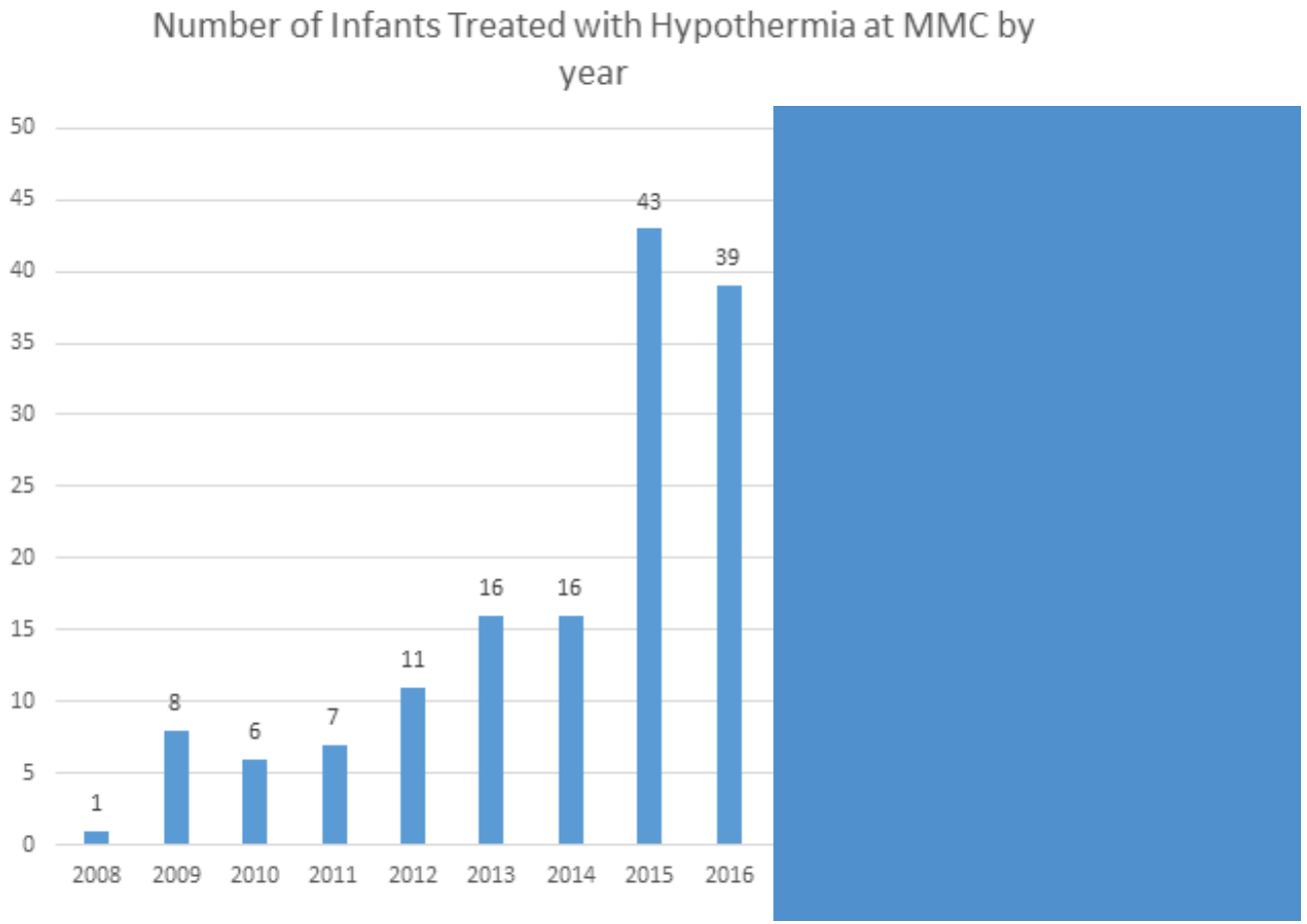


Rural Community Hospital

- Family medicine doctor or pediatrician stabilizes the baby
- Phone call to MMC NICU for advice-provide verbal description of infant's exam

Knowledge of Neonatal Encephalopathy

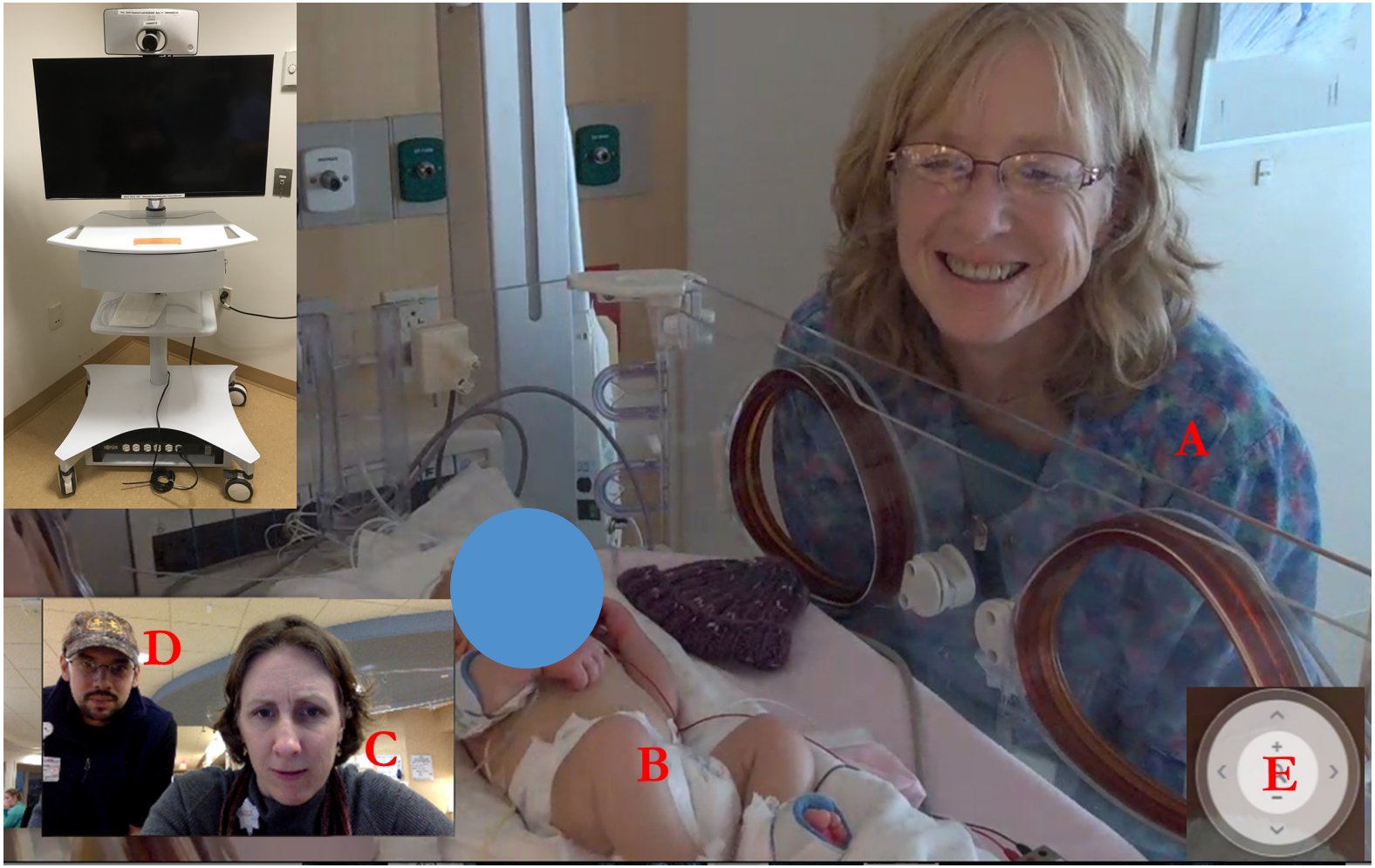
NORMAL

MILD

MODERATE

SEVERE

Telemedicine 2017-2018-1st Platform



Telemedicine 2017-2018

Journal of Perinatology
https://doi.org/10.1038/s41372-020-00828-3

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CORRESPONDENCE

Telemedicine consults to assess neonatal encephalopathy are feasible in the neonatal intensive care unit

Alexa K. Craig[1] · Lauren M. McAllister[2] · Scott Evans[3] · Misty E. Melendi[3]

Received: 18 June 2020 / Revised: 14 August 2020 / Accepted: 10 September 2020
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Lauren McAllister, MD

Misty Melendi, MD

Scott Evans, RN-NIC

Inborn vs Outborn

	Tertiary Care Center ($n=15$)	Community Hospital ($n=11$)	p value
Gestational age (weeks)	38.5 (1.5)	39.6 (1.4)	0.054
Birth via C-section (n, %)	7 (47%)	5 (46%)	1.0
Delivery complications:			
Nuchal or body cord	6	6	
Fetal bradycardia or decelerations	4	6	
Meconium stained amniotic fluid	1	5	
Shoulder dystocia	2	3	
Placental abruption	2	1	
Intrauterine growth restriction	0	1	
Home birth	0	1	
Footling breech delivery	1	1	
Maternal general anesthetic	1	1	
Twin gestation	1	0	
Hypermagnesemia	1	1	
Birthweight (kg)	3.3 (0.7)	3.1 (0.7)	0.61
Apgar 1 min (median, IQR)	2.0 (2.0, 3.5)	2.0 (1.5, 2.0)	0.28
Apgar 5 min (median, IQR)	7.0 (5.0, 7.5)	5.0 (4.0, 6.5)	0.24
Apgar 10 min (median, IQR)	8.0 (8.0, 9.0)	6.0[#] (6.0, 8.0)	0.004
Arterial cord pH	7.12* (0.13)	7.08[$] (0.10)	0.56
Arterial cord base deficit	10.4* (5.6)	11.1[&] (5.0)	0.77
Venous Cord pH	7.18 (0.10)	7.13[&] (0.16)	0.36
Venous cord base deficit	9.7 (4.4)	9.8[%] (5.0)	0.96
Required positive pressure ventilation in the delivery room	9 (60%)	6 (55%)	1.0
Intubated in the delivery room	3 (20%)	0 (0%)	0.34
Duration of first NE consult, minutes	[illegible]	[illegible]	0.90
Treated with therapeutic hypothermia	4 (27%)	4 (36%)	0.92
Hour of life of first teleconsult	2.1 (1.4)	4.7 (2.2)	0.001
Hour of life of second teleconsult	3.1 (1.1)	5.1 (0.63)	0.007

kg kilograms, *NE* neonatal encephalopathy.
*$n=13$, [#]$n=10$ [$]$n=8$, [&]$n=7$, [^]$n=6$, [%] $=5$.

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Disparity identified for Outborn babies :

1. Time to consult
   2.1 vs 4.7 hrs
2. Treated with TH
   27% vs 36%

Fewer babies treated with hypothermia

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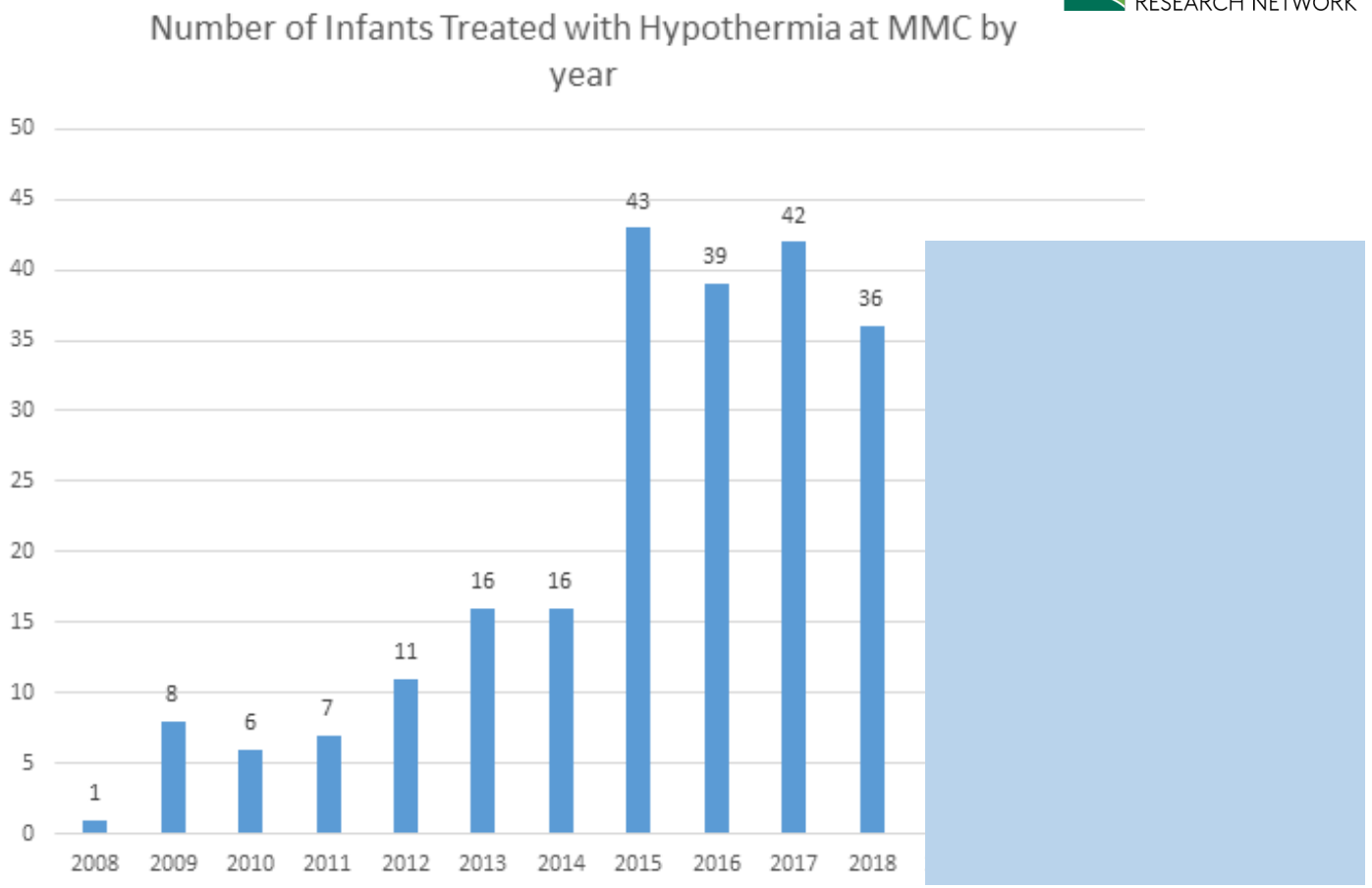

Telemedicine 2018-2020-2nd Platform

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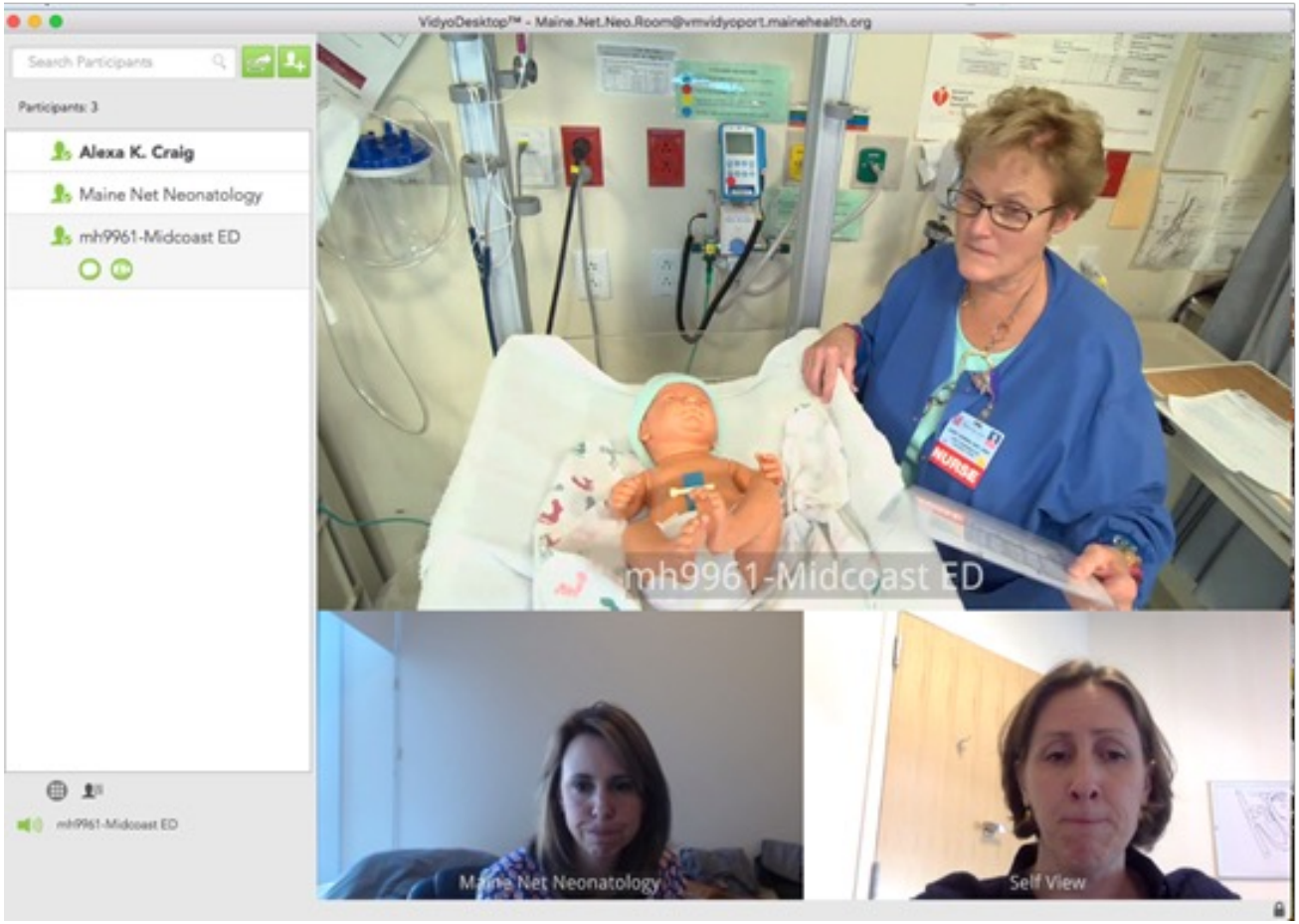
RESEARCH NETWORK



Time to Consult: 2018-2020

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Table 2: Encephalopathy scores and timing of scores

Characteristic	Tertiary Care Center, N = 19	Community Hospitals, N = 34	p-value[1]
First Encephalopathy Score			0.4
N	19	34	
Median (IQR)	4 (2, 6)	6 (1, 9)	
Time from birth to first consult (min)	66 (43, 91) (was 2.1 hours)	98 (76, 127) (was 4.7 hours)	**0.004**
Second Encephalopathy Score			0.5
N	14	12	
Median (IQR)	2 (0, 4)	4 (0, 8)	
Time from first to second consult (min)	106 (94, 132)	151 (103, 194)	0.3
Third Encephalopathy Score			0.10
N	4	2	
Median (IQR)	0 (0, 2)	9 (8, 10)	
Time from second to third consult (min)	130 (116, 146)	108 (99, 116)	0.5

[1]Wilcoxon rank sum test

Inborn: 7 (37%) treated

Outborn: 17 (50%) treated; 9 (26%) not transferred; 8 were transferred and not treated

New question-are we missing anyone?

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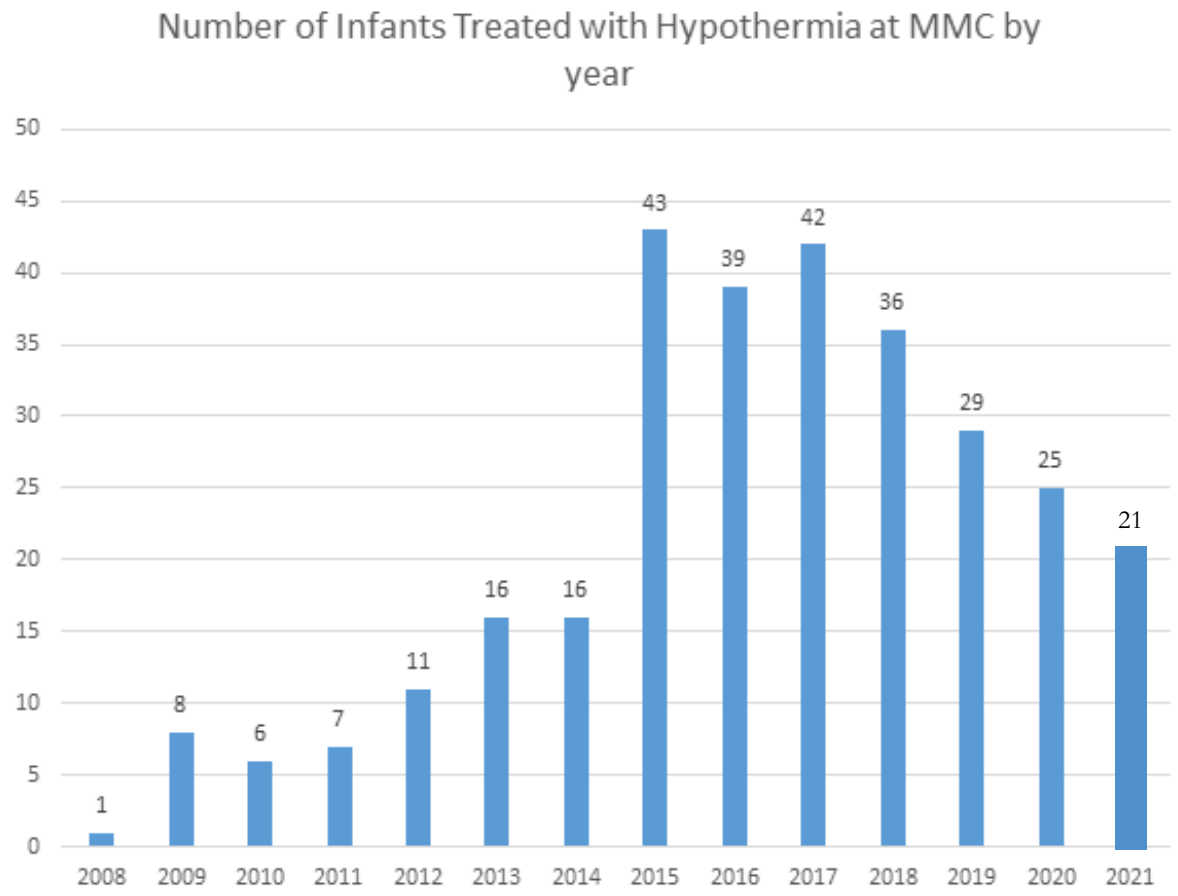
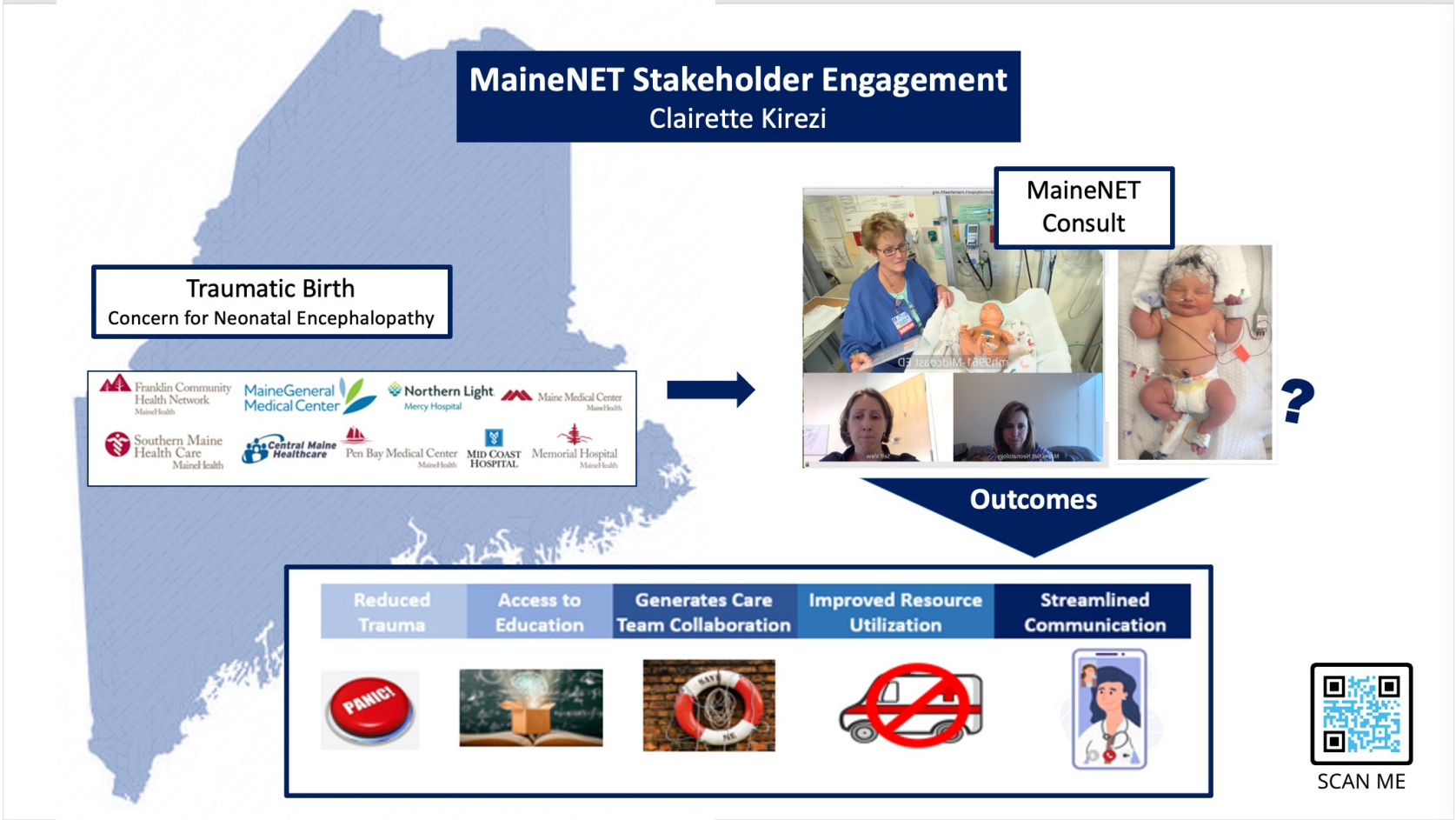
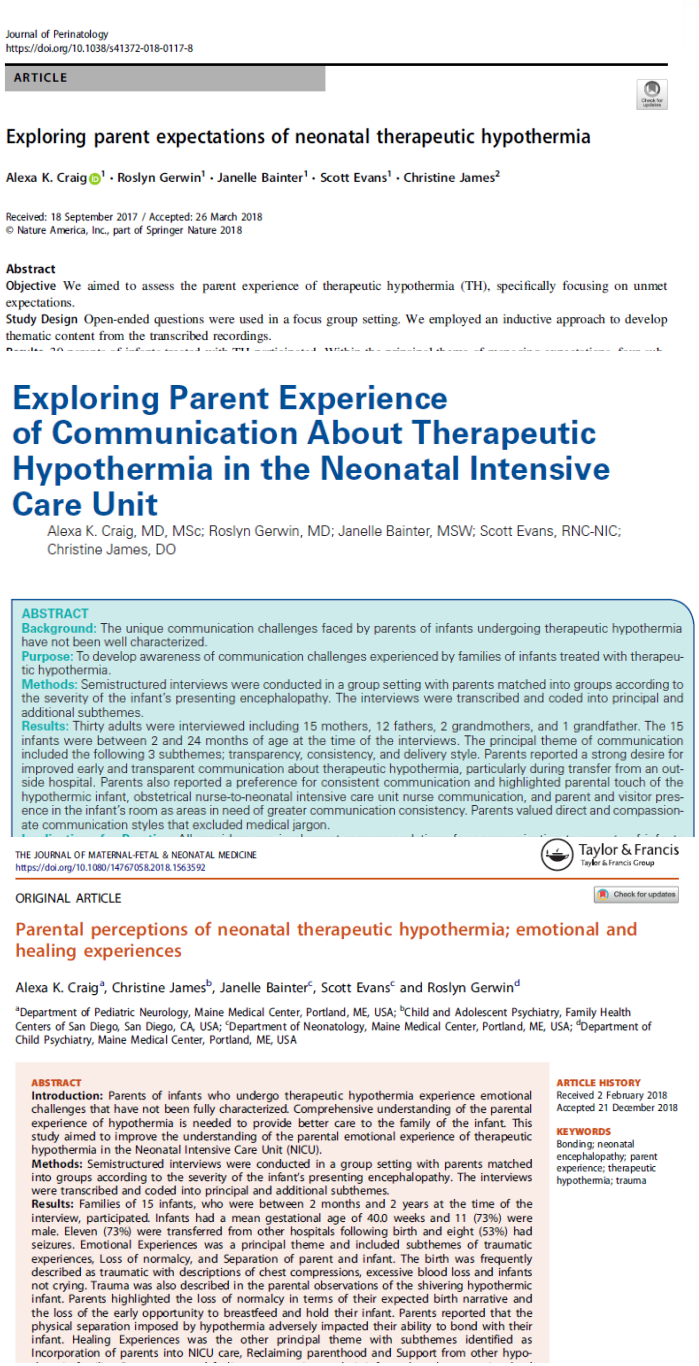


Stakeholder Engagement: Providers



Parent Interview Themes

- Unmet parental expectations
  - 4 subthemes
    - MORPHINE USE
    - PARENTS AS DECISION MAKERS
    - IMMEDIATE SURVIVAL
    - LONG TERM UNCERTAINTY
- Communication in the Neonatal Intensive Care Unit
  - 3 subthemes
    - TRANSPARENCY
    - CONSISTENCY
    - DELIVERY STYLE
- Traumatic and healing experiences
  - 7 subthemes
    - TRAUMA
    - LOSS OF NORMALCY
    - SEPARATION
    - INCORPORATING PARENTS INTO NICU CARE
    - RECLAIMING PARENTHOOD
    - CONNECTING WITH OTHER FAMILIES



Journal of Perinatology
https://doi.org/10.1038/s41372-018-0117-8

ARTICLE

Exploring parent expectations of neonatal therapeutic hypothermia

Alexa K. Craig[1] · Roslyn Gerwin[1] · Janelle Bainter[1] · Scott Evans[1] · Christine James[2]

Received: 18 September 2017 / Accepted: 26 March 2018
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Abstract
Objective We aimed to assess the parent experience of therapeutic hypothermia (TH), specifically focusing on unmet expectations.
Study Design Open-ended questions were used in a focus group setting. We employed an inductive approach to develop thematic content from the transcribed recordings.

Exploring Parent Experience of Communication About Therapeutic Hypothermia in the Neonatal Intensive Care Unit

Alexa K. Craig, MD, MSc; Roslyn Gerwin, MD; Janelle Bainter, MSW; Scott Evans, RNC-NIC; Christine James, DO

ABSTRACT
Background: The unique communication challenges faced by parents of infants undergoing therapeutic hypothermia have not been well characterized.
Purpose: To develop awareness of communication challenges experienced by families of infants treated with therapeutic hypothermia.
Methods: Semistructured interviews were conducted in a group setting with parents matched into groups according to the severity of the infant's presenting encephalopathy. The interviews were transcribed and coded into principal and additional subthemes.
Results: Thirty adults were interviewed including 15 mothers, 12 fathers, 2 grandmothers, and 1 grandfather. The 15 infants were between 2 and 24 months of age at the time of the interviews. The principal theme of communication included the following 3 subthemes; transparency, consistency, and delivery style. Parents reported a strong desire for improved early and transparent communication about therapeutic hypothermia, particularly during transfer from an outside hospital. Parents also reported a preference for consistent communication and highlighted parental touch of the hypothermic infant, obstetrical nurse-to-neonatal intensive care unit nurse communication, and parent and visitor presence in the infant's room as areas in need of greater communication consistency. Parents valued direct and compassionate communication styles that excluded medical jargon.

THE JOURNAL OF MATERNAL-FETAL & NEONATAL MEDICINE
https://doi.org/10.1080/14767058.2018.1563592

Taylor & Francis
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ORIGINAL ARTICLE

Parental perceptions of neonatal therapeutic hypothermia; emotional and healing experiences

Alexa K. Craig[a], Christine James[b], Janelle Bainter[c], Scott Evans[c] and Roslyn Gerwin[d]

[a]Department of Pediatric Neurology, Maine Medical Center, Portland, ME, USA; [b]Child and Adolescent Psychiatry, Family Health Centers of San Diego, San Diego, CA, USA; [c]Department of Neonatology, Maine Medical Center, Portland, ME, USA; [d]Department of Child Psychiatry, Maine Medical Center, Portland, ME, USA

ABSTRACT
Introduction: Parents of infants who undergo therapeutic hypothermia experience emotional challenges that have not been fully characterized. Comprehensive understanding of the parental experience of hypothermia is needed to provide better care to the family of the infant. This study aimed to improve the understanding of the parental emotional experience of therapeutic hypothermia in the Neonatal Intensive Care Unit (NICU).
Methods: Semistructured interviews were conducted in a group setting with parents matched into groups according to the severity of the infant's presenting encephalopathy. The interviews were transcribed and coded into principal and additional subthemes.
Results: Families of 15 infants, who were between 2 months and 2 years at the time of the interview, participated. Infants had a mean gestational age of 40.0 weeks and 11 (73%) were male. Eleven (73%) were transferred from other hospitals following birth and eight (53%) had seizures. Emotional Experiences was a principal theme and included subthemes of traumatic experiences, Loss of normalcy, and Separation of parent and infant. The birth was frequently described as traumatic with descriptions of chest compressions, excessive blood loss and infants not crying. Trauma was also described in the parental observations of the shivering hypothermic infant. Parents highlighted the loss of normalcy in terms of their expected birth narrative and the loss of the early opportunity to breastfeed and hold their infant. Parents reported that the physical separation imposed by hypothermia adversely impacted their ability to bond with their infant. Healing Experiences was the other principal theme with subthemes identified as Incorporation of parents into NICU care, Reclaiming parenthood and Support from other hypo-

ARTICLE HISTORY
Received 2 February 2018
Accepted 21 December 2018

KEYWORDS
Bonding; neonatal encephalopathy; parent experience; therapeutic hypothermia; trauma

Applied 11/22/22 : 300k/year x 4 years

U.S. Department of Health and Human Services

HRSA

Health Resources & Services Administration

NOTICE OF FUNDING OPPORTUNITY

Fiscal Year 2023

Federal Office of Rural Health Policy

Community Based Division

Rural Health Network Development Program

Funding Opportunity Number: HRSA-23-030

Funding Opportunity Type: New

Assistance Listings Number: 93.912

Application Due Date: November 22, 2022

- **Improve access:** by addressing gaps in care, workforce shortages, better workflows and/or improving the quality of health care services
- **Expand capacity and services:** by creating effective systems through the development of knowledge, skills, structures, and leadership models
- **Enhance outcomes:** by improving patient and/or network development outcomes through expanding or strengthening the network's services, activities or interventions
- **Sustainability:** by positioning the network to prepare for sustainable health programs through value-based care and population health management.

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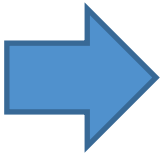
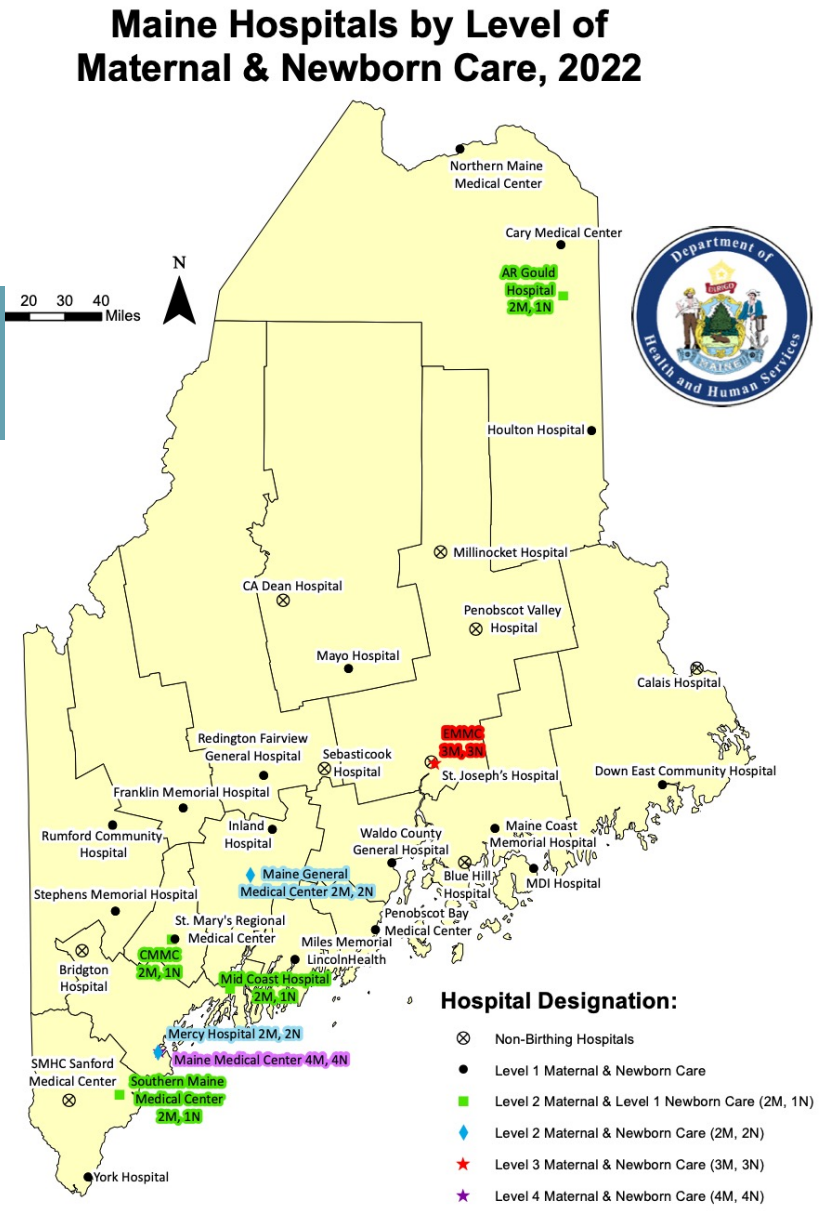


- **Improve access:** Expand Maine NET coverage from 7 to 10 southern ME rural hospitals
- **Expand capacity and services:** Expand Maine NET coverage to 9 northern rural hospitals AND add new service of telemedicine consults for non-neurological issues to all
- **Enhance outcomes:** by avoiding unnecessary transfers and developing a statewide algorithm to improve location of care for families (choosing the tertiary care closest)
- **Sustainability:** perform cost-analysis to demonstrate financial savings associated with decreased transfers and imrpoved referral patterns

Whole System Connected

- Maine Medical Center
  - Hub for south
- Northern Light Eastern Maine Medical Center
  - Hub for North
- Borderlands
  - Both can consult



Ongoing Research Using Telemedicine; Mild Encephalopathy

Stages of Neonatal Encephalopathy

AcuteCare
Rural Health Research
COBRE

NORMAL

MILD

MODERATE

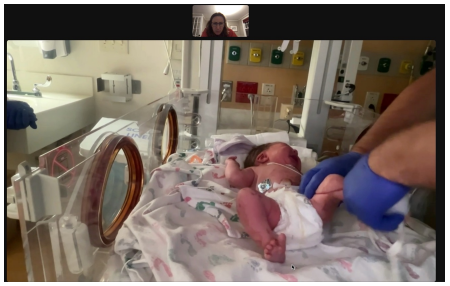
SEVERE

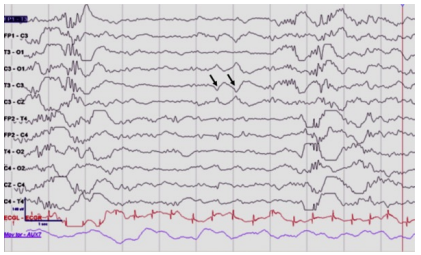
Telemedicine 2020-present-3rd Platform

AcuteCare Rural Health Research COBRE

AT RISK NEWBORN:

- MMC (n=11)
- NLEMMC (n=0)
- UVM (n=0)

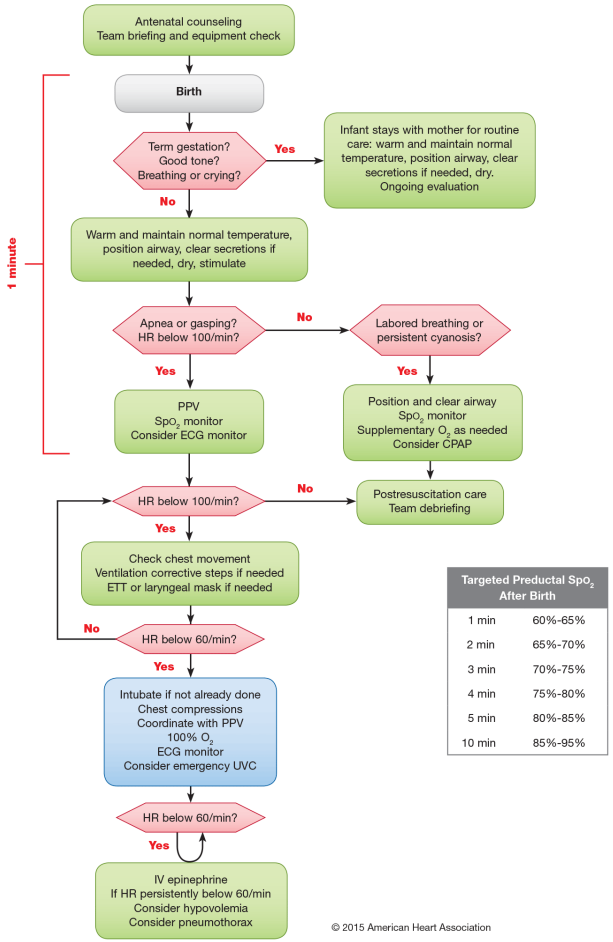




Other Uses of Telehealth: Simulation Training for Neonatal Resuscitation

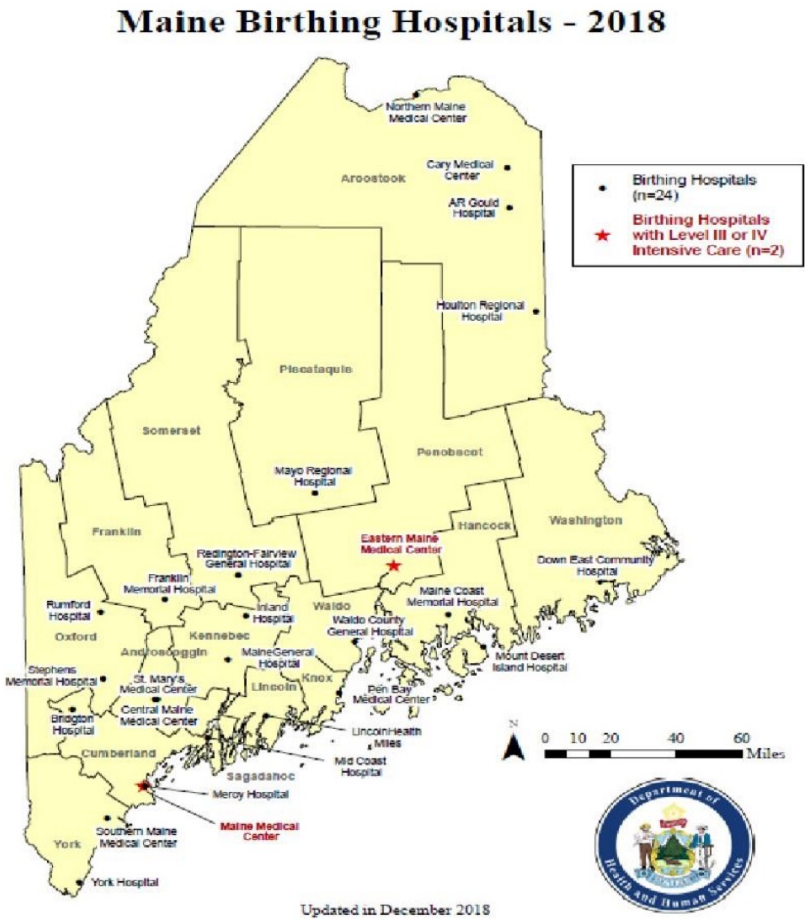
Newborn Resuscitation Program

Neonatal Resuscitation Algorithm—2015 Update

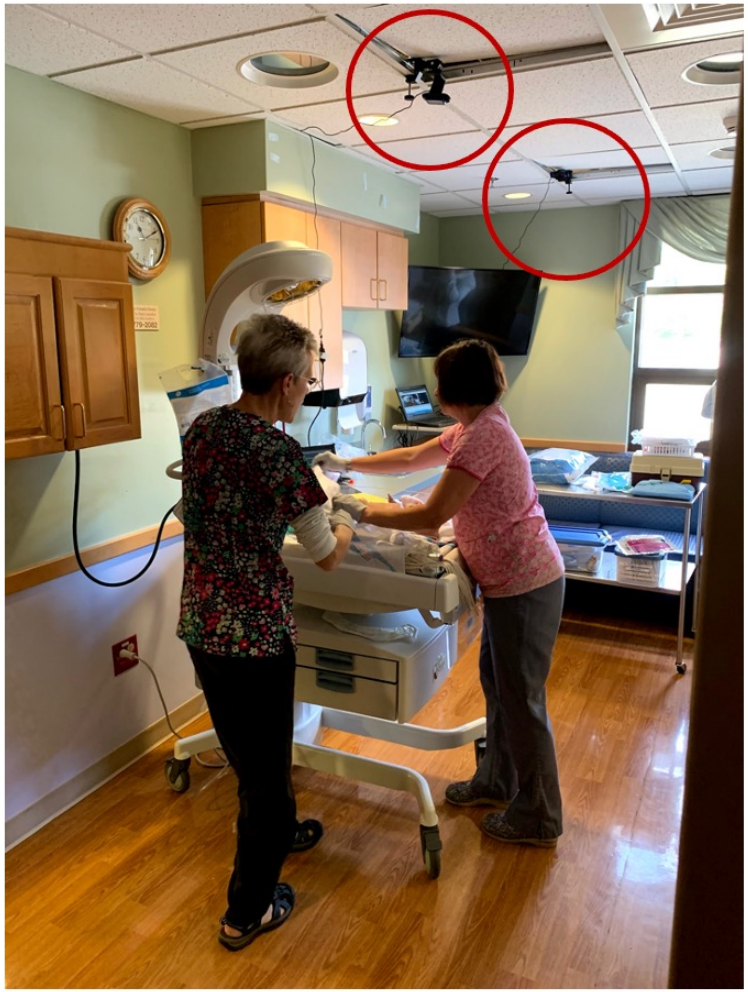


Targeted Preductal SpO_2 After Birth	
1 min	60%-65%
2 min	65%-70%
3 min	70%-75%
4 min	75%-80%
5 min	80%-85%
10 min	85%-95%

Road Trip: On-site Simulation Training



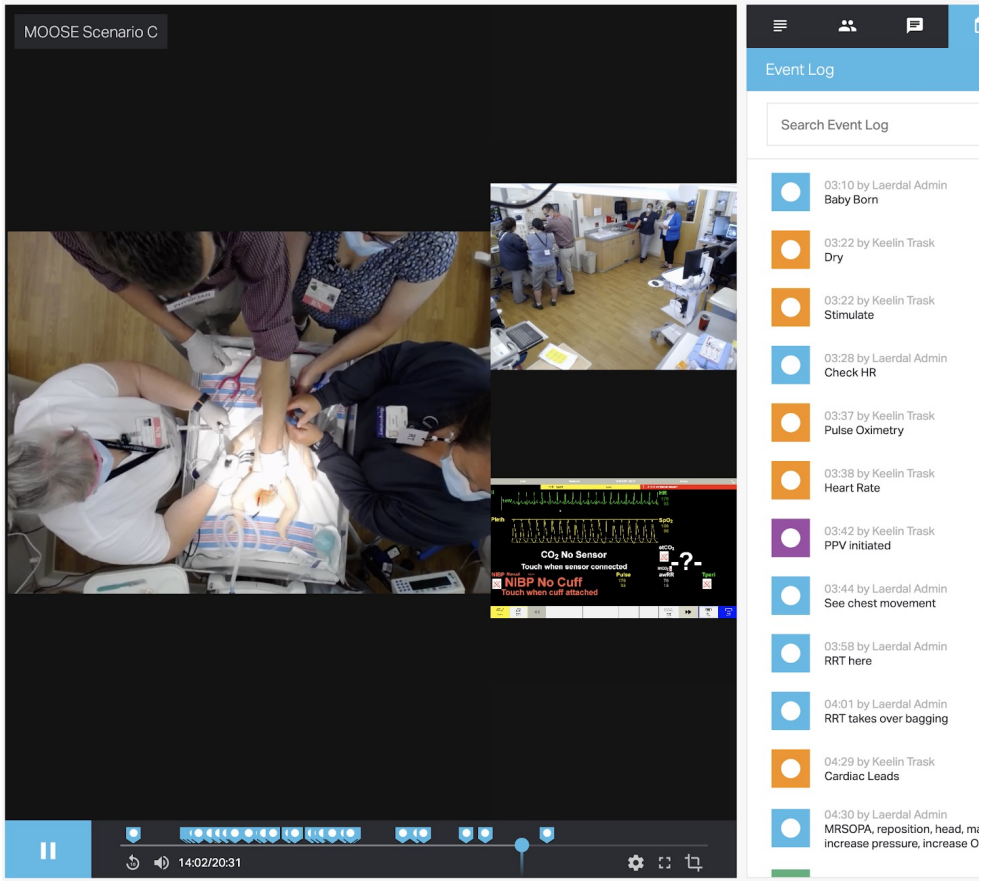
Resuscitation work: On-site simulation training



AcuteCare
Rural Health Research
COBRE

Allison Zanno MD, Misty Melendi MD, Micheline Chipman, RN, MSN, CHSE, Jeffrey Holmes MD, Alexa Craig MD, on behalf of the MOOSE Research Team; Maine Ongoing Outreach Simulation Education (MOOSE)

Assessing Performance-Scoring NRP



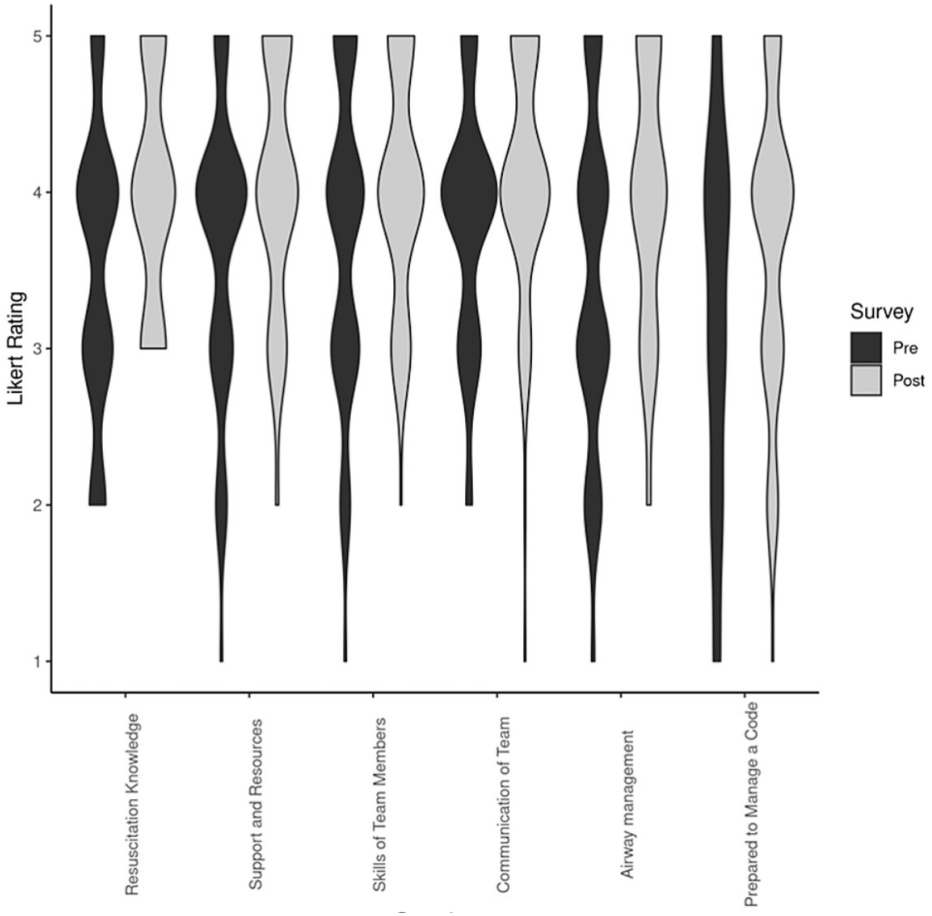
Cardiac Compressions

Administered	◯ Yes ◯ No
Appropriate decision based on clinical condition of infant (heart rate < 60 after 30s vent)	◯ (0) Performed poorly or omitted ◯ (1) Performed late or suboptimally ◯ (2) Performed adequately
Ventilation established prior to performing compression	◯ Yes ◯ No

Technique

	(0) Performed poorly or omitted	(1) Performed late or suboptimally	(2) Performed adequately
Correct Method (thumb)	◯	◯	◯
Correct rate and depth of compression (90 per minute)	◯	◯	◯
Correct rate of ventilation (30 per minute)	◯	◯	◯
Correct coordination with ventilation (3:1 ratio)	◯	◯	◯
Re-evaluation for response	◯	◯	◯
Appropriate interval	◯	◯	◯

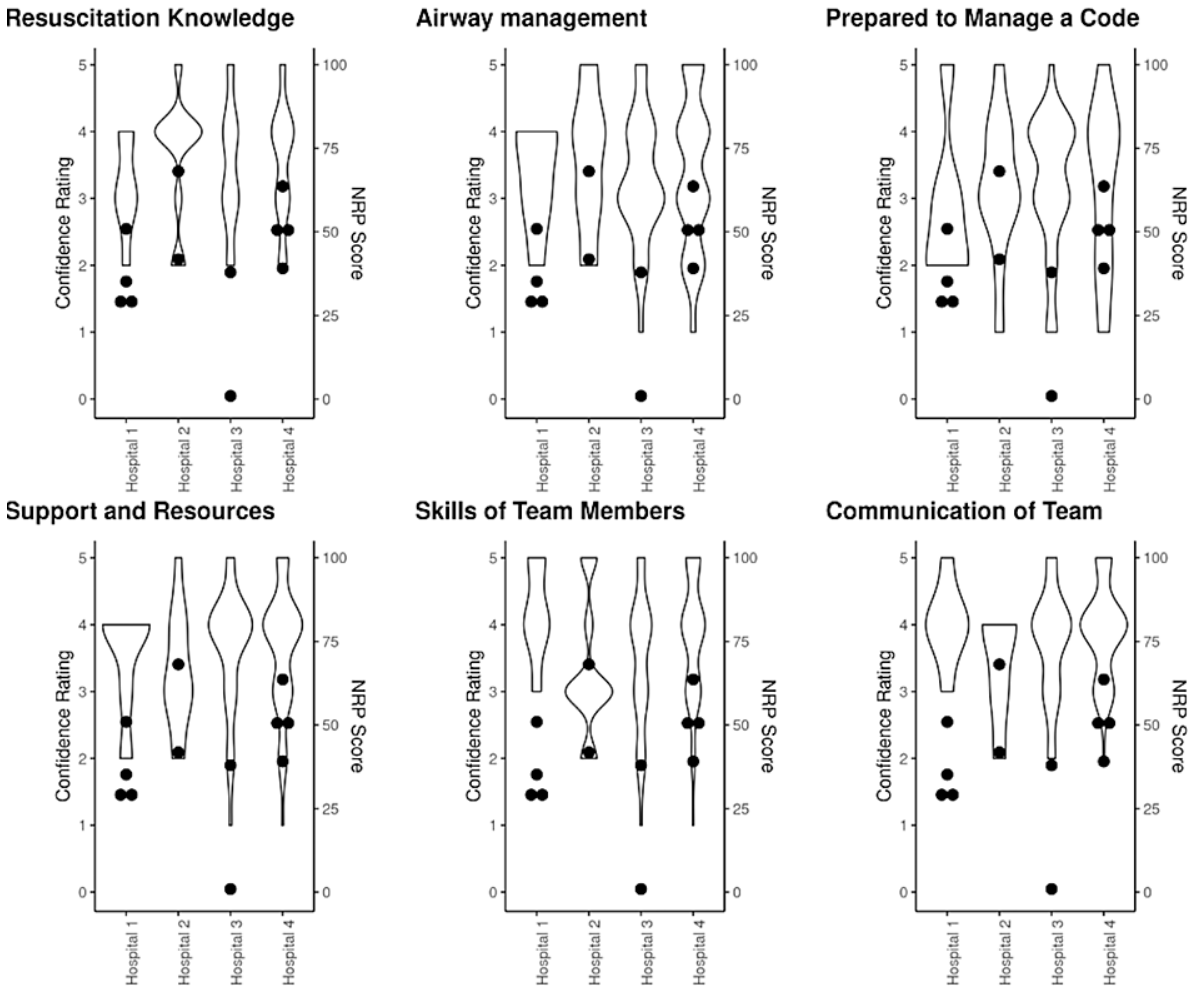
On-Site Simulation Training: Confidence



Confidence Improves

Zanno A, Melendi M, Cutler A, et al. (September 01, 2022) Simulation-Based Outreach Program Improves Rural Hospitals' Team Confidence in Neonatal Resuscitation. Cureus 14(9): e28670. doi:10.7759/cureus.28670

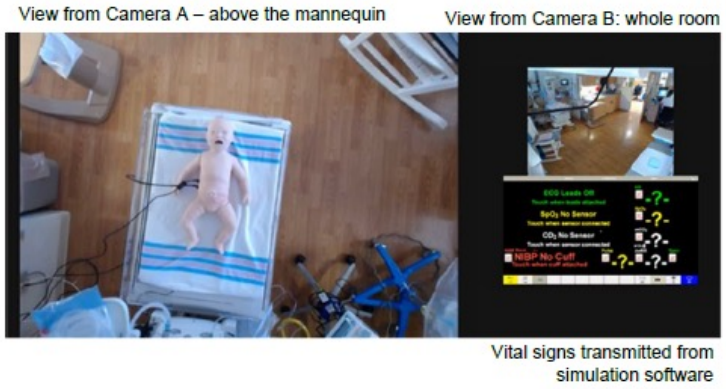
On-Site Simulation Training: Procedural Acumen



Acumen did NOT Improve

Zanno A, Melendi M, Cutler A, et al. (September 01, 2022) Simulation-Based Outreach Program Improves Rural Hospitals' Team Confidence in Neonatal Resuscitation. Cureus 14(9): e28670. doi:10.7759/cureus.28670

Telesimulation: Need more frequent training



Allison Zanno MD, Misty Melendi MD, Micheline Chipman, RN, MSN, CHSE, Jeffrey Holmes MD, Alexa Craig MD, on behalf of the MOOSE Research Team; Maine Ongoing Outreach Simulation Education (MOOSE)

Resuscitation work: Telesimulation

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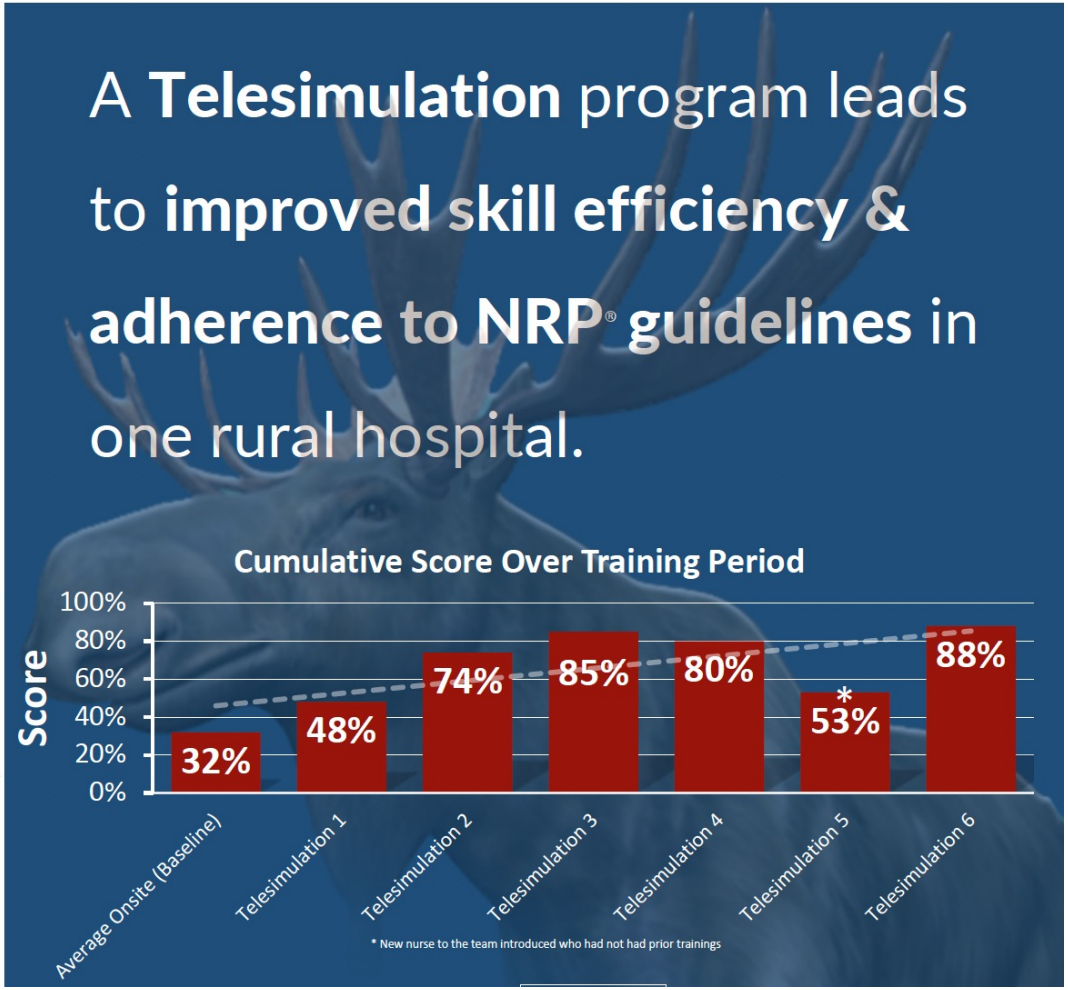
Resuscitation work: Performance Improves



Resuscitation work: Specific Skills

Skill	Average Baseline Time from Birth	Average Time from Birth after Telesim Sessions	Fold Faster
ECG Lead Placement	4:19	0:49	5.3x
Definitive Airway	11:47	4:31	2.6x
1st Epinephrine dose	14:08	9:30	1.5x

R01 due 5/31/23

Department of Health and Human Services

Part 1. Overview Information

Participating Organization(s)	National Institutes of Health (NIH)
Components of Participating Organizations	National Institute of Biomedical Imaging and Bioengineering (NIBIB) National Institute on Minority Health and Health Disparities (NIMHD)
Funding Opportunity Title	Technology Development to Reduce Health Disparities (R01 Clinical Trial Optional)
Activity Code	R01 Research Project Grant
Announcement Type	New
Related Notices	NOT-EB-22-016 - Notice of Change in Application Due Date for RFA-EB-21-001 NOT-OD-23-012 Reminder: FORMS-H Grant Application Forms and Instructions Must be Used for Due Dates On or After January 25, 2023 - New Grant Application Instructions Now Available NOT-OD-22-190 - Adjustments to NIH and AHRQ Grant Application Due Dates Between September 22 and September 30, 2022 NOT-OD-22-018 - Reminder: FORMS-G Grant Application Forms & Instructions Must be Used for Due Dates On or After January 25, 2022 - New Grant Application Instructions Now Available NOT-OD-21-181 - Updates to the Non-Discrimination Legal Requirements for NIH Recipients NOT-OD-21-169 - New NIH "FORMS-G" Grant Application Forms and Instructions Coming for Due Dates on or after January 25, 2022 NOT-OD-21-170 - Update: Notification of Upcoming Change in Federal-wide Unique Entity Identifier Requirements NOT-OD-21-109 - Expanding Requirement for eRA Commons IDs to All Senior/Key Personnel
Funding Opportunity Announcement (FOA) Number	RFA-EB-21-001

Meet Holobaby™

Three dimensional HoloBaby™ in top-down and side view. Hologram representation of monitor with vitals.

https://media.giphy.com/media/9xKwUeBAJNwBWHrtIt/giphy.gif

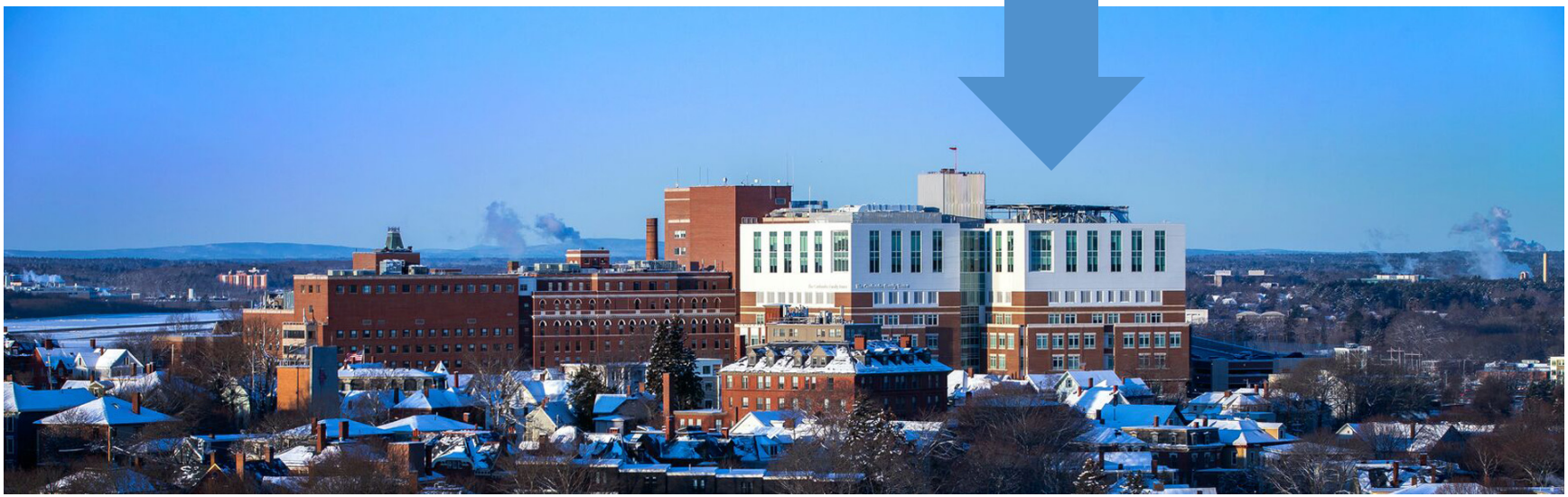
High Fidelity vs Holobaby™

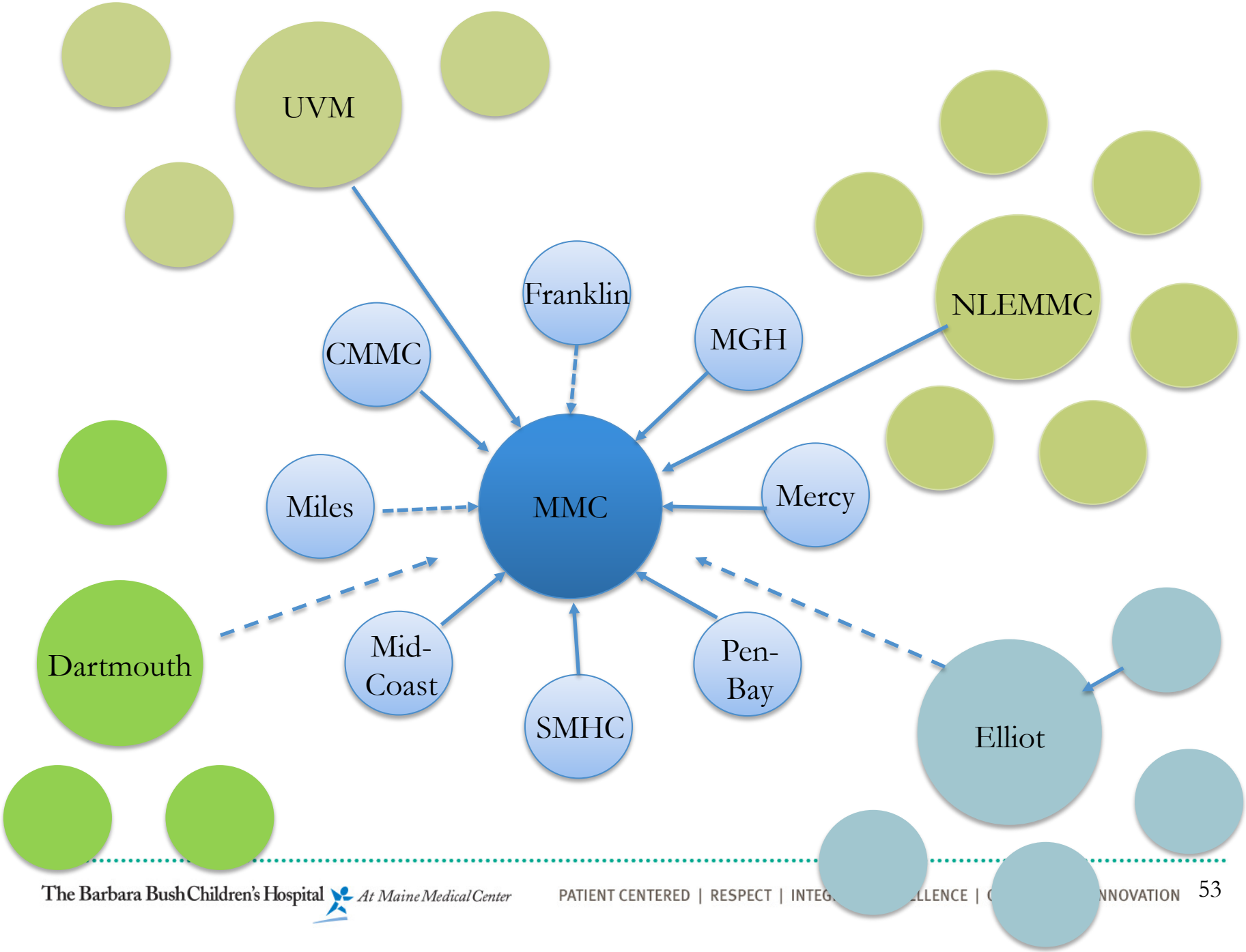
- Randomized non-inferiority cluster trial
  - 8 hospitals: 4 -> High Fidelity

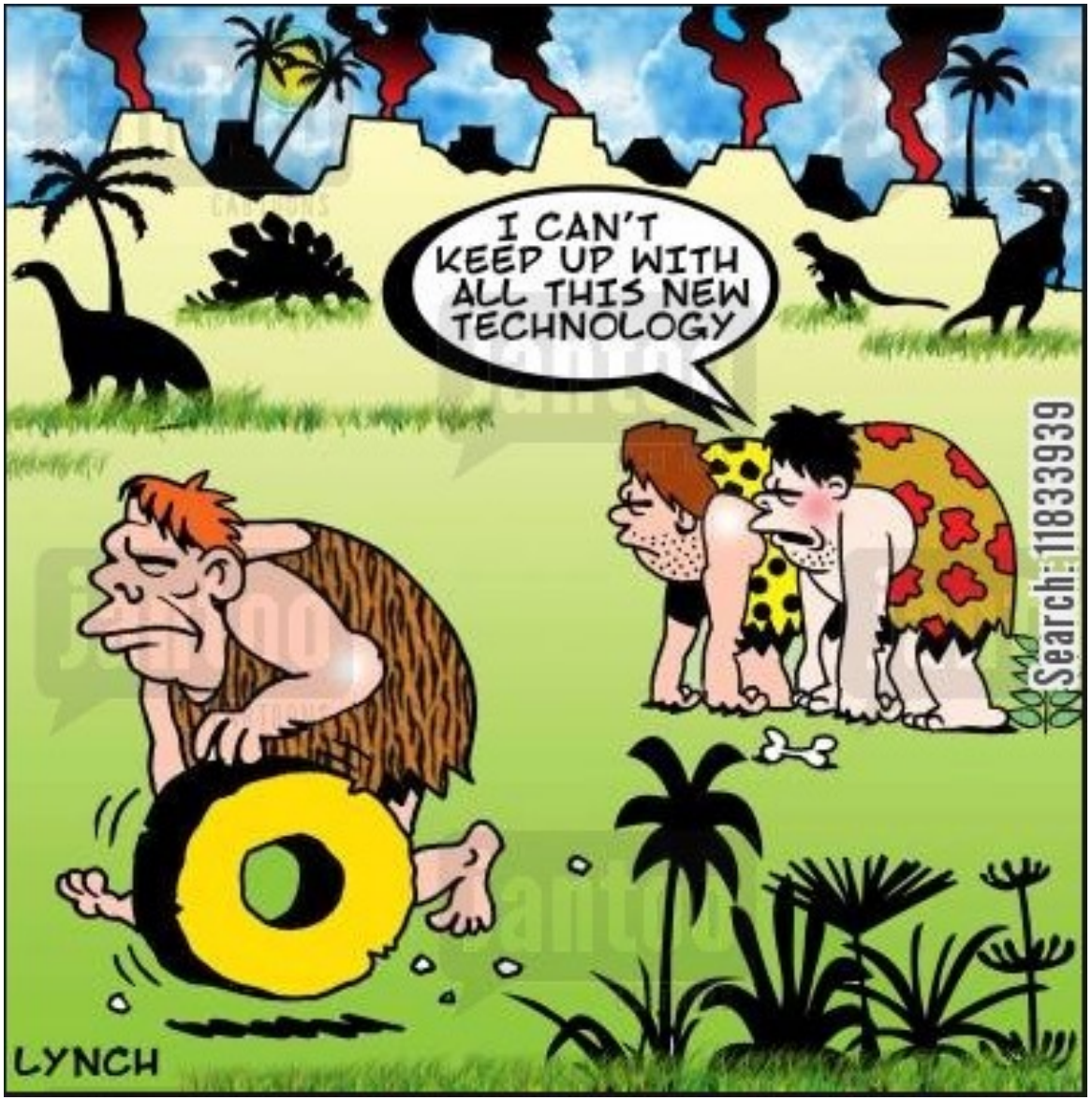
    4-> Holobaby™
  - Measure NRP Adherence as the primary outcome
  - Measure teamwork and communication as secondary outcome
- Aim 2 uses implementation science to insure consistency between sites and to develop tool box for broader future applications

Maine Medical Center

NICU




UVM
Franklin
CMMC
MGH
NLEMMC
Miles
MMC
Mercy
Dartmouth
Mid-
Coast
SMHC
Pen-
Bay
Elliot


I CAN'T KEEP UP WITH ALL THIS NEW TECHNOLOGY
Search:11833939
LYNCH

Thank you and questions??

Our Next Webinar

The NCTRC Webinar Series

Occurs 3rd Thursday of every month.

Telehealth Topic: Social Determinants of Health and Value-Based Pay
Hosting TRC: California Telehealth Resource Center (CTRC)
Date: April 20, 2023
Times: 11 AM – 12 PM (PT)

***Please check the NCTRC website for more information on the upcoming webinar.**

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https://www.surveymonkey.com/r/XK7R72F

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