


Infant Feeding Journey for a NICU Patient

Part 1: Supporting Neurologic Development for Eventual Feeding Success


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Disclosures


- Megan has nothing to disclose
- Mindy is co-owner of EngageGrowThrive, LLC
- Justin & Ginny are the parents of the child discussed in this webinar



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Objectives

State	Two prenatal or antenatal factors that may impact feeding success.
Name	Two neuroprotective and two neuro-promotional strategies to support early feeding success.
Identify	Two specific pre-feeding activities to incorporate into care.




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Parent Story



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Prenatal, Antenatal, & Perinatal Considerations




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Prenatal Sensory Motor Development

FIGURE 2 ■ Sensory system development.


Developmental Age in Months	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40+
Touch	active endings in skin & functional							glycine levels diffuse across		skin developed & ready for massage					
Proprioception & Awareness	vestibular system functional				colic built functional		systems mature & functional								
Taste & Smell	small functional			systems mature & functional											
Vision	neuronal connections forming		synchrotopous firing of ganglion cells		visual ganglion cells begin to fire		inhibition of optical lighting		ganglion firing more coordinated with brain neurons		ready for typical mature visual experiences				
Hearing	cochlea formed		auditory system functional												
Speech	indeterminate & irregular slow patterns				tuning of hair cells begins and continues past birth age		auditory system functional		REM & non-REM maturing, increased quiet periods		continuing olfactory system maturing		equal REM & non-REM		

From: Knudsen, et al. Neonatal Netw, 2021



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Prenatal Sensory Motor Development



- Movement & Touch
 - Tactile- 12 weeks
 - Vestibular- 22 weeks
 - Kinesthesia + Proprioception maturation at ~32 weeks

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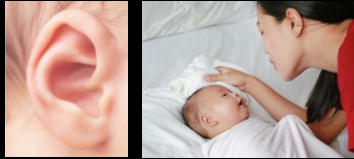
Prenatal Sensory Motor Development



- Chemosensory
 - Taste + Smell
 - 17 weeks, 24 weeks
 - 28 weeks scent recognition

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Prenatal Sensory Motor Development



- Hearing
 - cochlea ~15 weeks
 - functional ~25-29 weeks

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Prenatal Sensory Motor Development




- Swallow
 - 9.5 weeks, mouth opening no sucking
 - 18 weeks swallowing observed
 - 28-30 root, suck, swallow reflexes
 - slow & imperfect

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Neuroprotection

Antenatal & Perinatal Period


- Evidence-based strategies to:
 - Protect the brain
 - Reduce morbidities
- Single-center study
 - Earlier FOF transition
 - < non-invasive ventilation
 - Earlier full enteral feeds



Er, I. & Günelmez, A., *J Pediatr Res*, 2021

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Prenatal/Antenatal Antenatal Steroids (ANS)



- Antenatal Steroids (ANS) reduce morbidities
- Complete course confers most benefit
- Partial course also add benefit


	No ANS (n=848)	Partial ANS (n=1581)	Complete ANS (n=3692)
Mortality	43.1%	29.6%	25.2%
Severe IVH	23.3%	19.1%	11.7%
Death or NEC	48.1%	37.1%	32.5%
Death or NDI (18-22 mos)	68.1%	54.4%	48.1%

Adapted from: Chawla et al., *JAMA Pediatr*, 2016

Ryan, et al., *JPOH*, 2019; Gilardi, et al., *J Clin Med*, 2020; Norman, et al., *JAMA Pediatr*, 2017; Chawla, et al., *JAMA Pediatr*, 2016

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Prenatal/Antenatal Magnesium Sulfate for neuroprotection




- Protects brain, improves long-term outcomes
- Neonatal effects:
 - Apnea
 - Poor muscle tone
 - Lethargy
 - Feeding intolerance

Ryan, et al., JGIM, 2019; Sillat, et al., J Peds, 2014; Constantine, M, Weiner, S. Obstet Gynecol, 2009; Doyle, et al., The Cochrane Library, 2009. Repost image: istockphoto, CC BY-SA 4.0 via Wikimedia Commons

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Perinatal Delivery Room Management



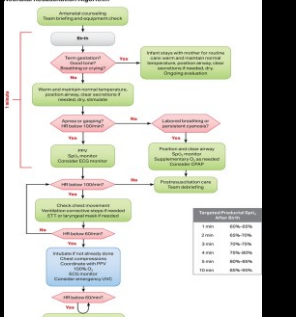
- Experienced team using standardized plan
 - Checklists
- Experienced airway management
- Begin neuroprotective strategies

Katheria, et al., Am J Perinatol, 2016; Textbook of Neonatal Resuscitation (NRP), 7th Ed, 2016; Katheria, et al., Resuscitation, 2013

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Delivery Room Management

- Airway
- Breathing
- Circulation
- Developmental Care




From: Textbook of Neonatal Resuscitation (NRP); Aziz, et al., Circulation, 2020

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Delivery Room Management

- Airway
- Breathing/Brain Care
- Circulation



From: Textbook of Neonatal Resuscitation (NRP); Aziz, et al., Circulation, 2020

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Trigemino-cardiac reflex

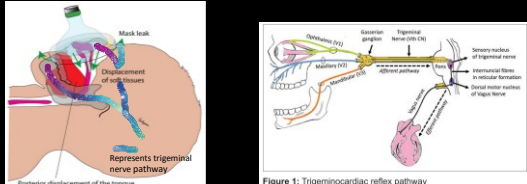


Figure 1: Trigemino-cardiac reflex pathway

Image from: Singh, G. & Chowdhury, T., J Neuroanaesth Crit Care, 2017


Modified from: Rajiv, et al., Essentials of Neonatal Ventilation, 2018

Kuypers, et al., Resuscitation, 2019; O'Donnell, C., Resuscitation, 2019; Rajiv, et al., Essentials of Neonatal Ventilation, 2018; Singh, G. & Chowdhury, T., J Neuroanaesth Crit Care, 2017

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Neuroprotection & Neuropromotion

The Early Weeks of NICU Care



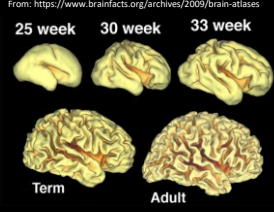
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Neuroprotection

- Pain & Stress
 - Impact physiologic stability
 - Brain changes:
 - Cortical thickness
 - Size
 - White matter

From: <https://www.brainfacts.org/archives/2009/brain-atlases>



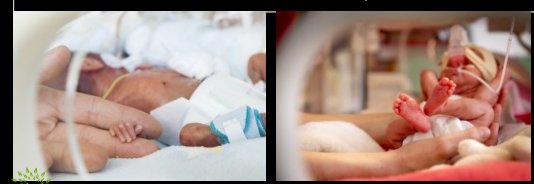
25 week 30 week 33 week
Term Adult

(McLwan, 2016; Pickler et al., 2010; Ranger et al., 2014; Smith et al., 2011)

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Neuroprotection

- Avoidance of Noxious Stimuli
 - Tactile
 - Chemosensory
- Care & Handling
 - Predictability reduces stress



(McLwan, 2016; Pickler et al., 2010; Ranger et al., 2014; Smith et al., 2011)

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Signs & Symptoms	Management
Apnea Apnea: 20-30 sec, cyanotic, bradycardic, limp	Apnea: 20-30 sec, cyanotic, bradycardic, limp • Start oxygen • Start ventilation • Start chest compressions • Start epinephrine • Start fluids • Start warming • Start glucose
Bradycardia Heart rate < 100	Bradycardia: Heart rate < 100 • Start oxygen • Start ventilation • Start chest compressions • Start epinephrine • Start fluids • Start warming • Start glucose
Respiratory Distress Grunting, nasal flaring, chest retractions, cyanosis	Respiratory Distress: Grunting, nasal flaring, chest retractions, cyanosis • Start oxygen • Start ventilation • Start chest compressions • Start epinephrine • Start fluids • Start warming • Start glucose
Temperature Instability Core temp < 36°C or > 38°C	Temperature Instability: Core temp < 36°C or > 38°C • Start warming • Start fluids • Start glucose
Jaundice Yellowing of skin, sclera, and whites of eyes	Jaundice: Yellowing of skin, sclera, and whites of eyes • Start phototherapy • Start fluids • Start glucose
Seizures Clonus, tonic arm abduction, tonic eye deviation, tonic head turning, tonic arm abduction, tonic eye deviation, tonic head turning	Seizures: Clonus, tonic arm abduction, tonic eye deviation, tonic head turning, tonic arm abduction, tonic eye deviation, tonic head turning • Start antiepileptics • Start fluids • Start glucose
Metabolic Abnormalities Acidosis, hypoglycemia, hyperkalemia, hypernatremia, hyponatremia, hypocalcemia, hypomagnesemia	Metabolic Abnormalities: Acidosis, hypoglycemia, hyperkalemia, hypernatremia, hyponatremia, hypocalcemia, hypomagnesemia • Start fluids • Start glucose • Start electrolytes • Start antacids

From: Knudsen, et al. Neonatal Netw, 2021

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Judicious Medication Use

Sodium Bicarbonate (NaHCO₃⁻)

Opioids

Benzodiazepines

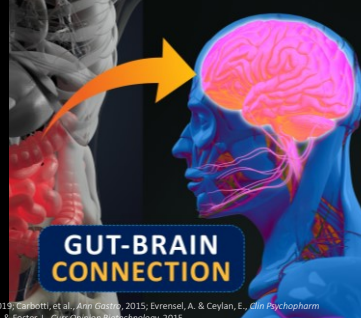
Antibiotics

Ryan, et al., JACH, 2019; Katheria, et al., J Perinatol, 2017; Ashney, J. & Poland, R., Pediatrics, 2008

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Gut-Brain Axis

- Dysbiosis increases risk of mental health disorders
 - Anxiety
 - Depression
 - Autism
- Gut microbiota can produce neurotransmitters
 - Norepinephrine, Dopamine, Gamma-aminobutyric acid, & Serotonin
 - Mood & state regulation, appetite & sleep



GUT-BRAIN CONNECTION


Sordillo, et al., JAMA, 2019; Caribotti, et al., Ann Gastro, 2015; Evrensel, A. & Ceylan, E., Clin Psychopharm Neurosci, 2015; Luna, R. & Foster, J., Curr Opin Biotechnology, 2015

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Judicious Medication Use

Mindfulness

- Consider impact of every drug
 - Caffeine
 - Multi-vitamins
 - Other oral meds



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between preterm and parents

Neuropromotion

- Supportive positive experiences
 - Positive touch
 - Positioning & handling
 - Smells & taste

Cone, et al., *JOGN*, 2013; Waitzman, K. A., *NAHR*, 2007

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Neuropromotion

- Sleep
- Skin to skin holding
 - Impacts growth, morbidities, pain, physiologic stability

Narciso, et al., *J Ped*, 2021; Boundy, et al., *Pediatrics*, 2016

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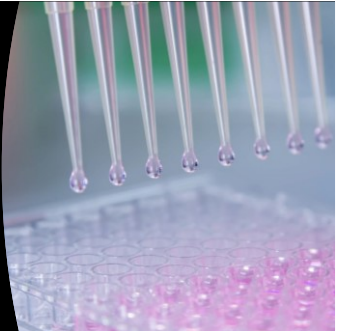
Pre-Feeding Activities



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Feeding Readiness Salivary Biomarkers

- Hunger signaling
- Energy homeostasis
- Olfactory neurogenesis
- Visual behavior
- Facial development



Maron, et al., *J Ped*, 2015

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Multimodal Parent Intervention

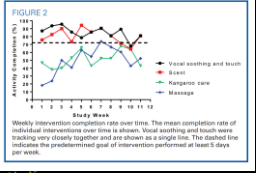


FIGURE 2
Weekly intervention completion rate over time. The mean completion rate of individual interventions over time is shown. Visual soothing and touch were tracking very closely together and are shown as a single line. The dashed line indicates the predetermined goal of intervention performed at least 5 days per week.

Intervention	23-28	28-28	29-32	33-36	≥ 37
Visual stimulation	100	100	100	100	100
Diaper exchange	100	100	100	100	100
Coordinated touch	100	100	100	100	100
Kangaroo care plus	100	100	100	100	100
Infant massage	100	100	100	100	100

FIGURE 1
Maternal administered interventions by gestational age. Developmentally appropriate timing of maternal-administered interventions. The dotted line indicated that infant massage can begin after 29 weeks and when deemed appropriate by the provider.

From: Letzkus, et al., *Adv Neonatal Care*, 2021

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Effect of Oral Motor Intervention (OMI) Meta-analysis

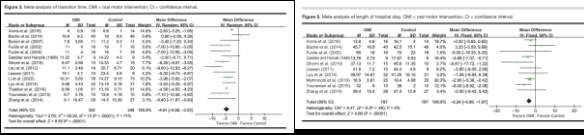


FIGURE 3
Forest plot showing meta-analysis results for OMI on length of hospital stay (LOS) and motor intervention (MI) - confidence interval.

Study	LOS (days)	MI (days)
Alvarez et al (2016)	1.0	1.0
Alvarez et al (2017)	1.0	1.0
Alvarez et al (2018)	1.0	1.0
Alvarez et al (2019)	1.0	1.0
Alvarez et al (2020)	1.0	1.0
Alvarez et al (2021)	1.0	1.0
Alvarez et al (2022)	1.0	1.0
Alvarez et al (2023)	1.0	1.0
Alvarez et al (2024)	1.0	1.0
Alvarez et al (2025)	1.0	1.0
Alvarez et al (2026)	1.0	1.0
Alvarez et al (2027)	1.0	1.0
Alvarez et al (2028)	1.0	1.0
Alvarez et al (2029)	1.0	1.0
Alvarez et al (2030)	1.0	1.0
Alvarez et al (2031)	1.0	1.0
Alvarez et al (2032)	1.0	1.0
Alvarez et al (2033)	1.0	1.0
Alvarez et al (2034)	1.0	1.0
Alvarez et al (2035)	1.0	1.0
Alvarez et al (2036)	1.0	1.0
Alvarez et al (2037)	1.0	1.0
Alvarez et al (2038)	1.0	1.0
Alvarez et al (2039)	1.0	1.0
Alvarez et al (2040)	1.0	1.0
Alvarez et al (2041)	1.0	1.0
Alvarez et al (2042)	1.0	1.0
Alvarez et al (2043)	1.0	1.0
Alvarez et al (2044)	1.0	1.0
Alvarez et al (2045)	1.0	1.0
Alvarez et al (2046)	1.0	1.0
Alvarez et al (2047)	1.0	1.0
Alvarez et al (2048)	1.0	1.0
Alvarez et al (2049)	1.0	1.0
Alvarez et al (2050)	1.0	1.0

From: Chen, et al., *Am J Speech-Lang Pathol*, 2021

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Other Ideas

- Mother's Milk
 - Oropharyngeal administration prior/during gavage feeding
 - Shortened O2 duration
 - Reduced feeding intolerance
 - Earlier FOF
 - Shorter hospitalization

Abd-Elgawad, Mahmoud, et al., JPEN, 2020



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Other Ideas

- Parents + Cares
 - Shortens hospitalization
 - Decreases readmission
 - Enhances breastfeeding outcomes
- Kangaroo Care
 - Increased skin to skin holding improves breastfeeding

Kolassa, et al., Nutritional Care of Preterm Infants, Vol. 122, 2021; Hake-Brooks, S. & Anderson, G., Neonatal Netw, 2008



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OIT

- OIT bags given to parents after delivery



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- Early Colostrum (OIT)
- Early Human Milk
- OG/NG Placement
- Scent Cloths
- Skin to Skin
- Early NN Breast Feeding/Nuzzling
- Taste Trials
- Planning for first feeding to breast



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Key Points

- Parents as Partners
- Holism/Synergism
- No interaction is too small

It's the little things that make life big!



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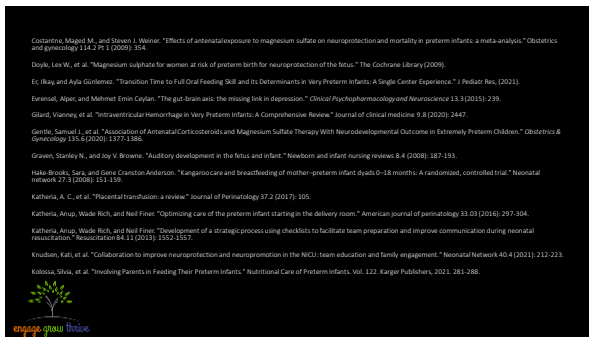
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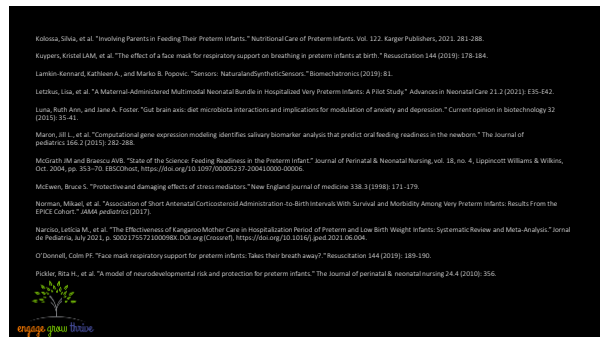
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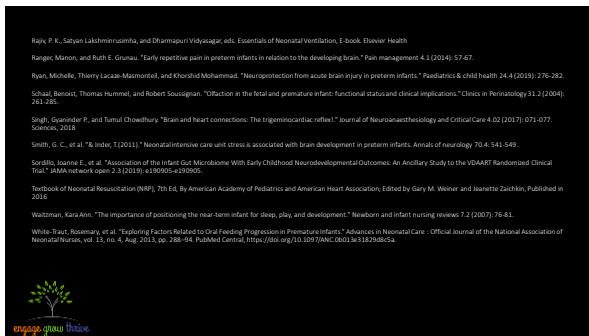
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