

How Do I Get to Work in the NICU? Building Neonatal Knowledge Base, NICU Program Development, and Components of Evidence Based Therapeutic Intervention.

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Disclosures

- Full time salary from Community Health Network
- No other disclosures to be noted for this presentation



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Background

Medical life saving interventions have enabled booming neonatal survival rates among the most fragile infants (Costeloe et al., 2012).

The infant's ability to meet full nutritional needs while maintain cardiopulmonary stability often persists after all other milestones have been achieved (Bakewell-Saschs et al., 2009).

- Less than 1% of moderately preterm infants discharge home with TF, yet 55% have problematic feeding behaviors by 6-18 months of age.

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Background

Recent scientific advances now allows the clinician evidence-based guidelines on how to appropriately manage dysphagia in the NICU

(Zimmerman & Thompson, 2015).

Development of a high quality feeding program in the NICU has positive outcomes of improved parent-infant attachment, higher feeding success at discharge, reduced economic burden, and shorter hospitalizations

(Jadcheria et al., 2012).

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What is Neonatal Therapy?

- Goal of delivering *holistic, direct patient care* to establish feedings quickly, transition into full oral feedings, and discharge.
- Feeding is often the **last milestone** achieved in preterms.
 - 32.2% of late preterm infants (35-36 6/7) with diagnosis of poor feeding (Wang, et al., 2004).
- Function of both **maturation and experience**.
 - Developmentally ready and then given opportunity to practice.
 - NICU experience leads transitions across first year of feeding skill development & growth.

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Role of Therapy in the NICU

- | | |
|--|---|
| <p>1. Screen, evaluate, and/or treat infants in the NBN/NICU for diagnosis that may impact the infant's neurodevelopment.</p> | <p>4. Participate in education for various disciplines</p> |
| <p>1. Provide individualized therapeutic intervention
-to optimize development
-to prevent adverse sequelae</p> | <p>4. Lead or participate in committees in the NBN or NICU</p> |
| <p>1. Collaborate with staff and family regarding eval, treat, and d/c plan</p> | <p>4. Partake in yearly competencies for neonatal therapists</p> |
| | <p>*NANT recommends two years of infant/child developmental services and competency/validation of NICU CEUs.</p> |

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Why do we need NICU specific training?

- According to *NANT* and *ASHA*, the NICU is a specialized area of practice, requiring extensive knowledge, skills, and training.
- Encompasses an **integrated model** of therapy.
- Asking an untrained therapist to 'cover' the NICU is **unsafe!**
- Neonates are not small pediatric patients.

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ASHA Knowledge Requirements

- Normal embryology, perinatal, and postnatal infant development.
- Atypical infant development including current theories and research findings.
- Family dynamics and function.
- Ethical decision making involved with a team-based process.

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Neonates at risk for developing feeding difficulties

Born < 36 weeks	Transient Tachypnea of the Newborn (TTN)
Infant of a Diabetic Mother	Difficult/Prolonged Delivery
Congenital Abnormalities	NAS babies
Cardiac Issues	Genetic syndromes
Meconium Aspiration	Low birth weight (<1500 gms)

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When should we be consulted?

Monitoring and Prevention	Assessment and Intervention
<1500 grams of < 32 weeks GA	Structural abnormality
Intubated for more than 48 hours	Oral-Motor dysfunction
Multiple intubation attempts	Pharyngeal dysfunction
	> 35 weeks PMA with difficulty feeding

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Anatomy & Physiology for Neonatal Feeding

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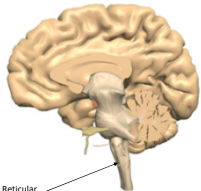
Fetal Oral-Motor Development

15 weeks	NNS and swallowing
21 weeks	Tongue thrusting
24 weeks	Consistent sucking and swallowing
24-28 weeks	Rooting
26-29 weeks	Lungs capable of breathing air; bitter taste distinguished
36 weeks	Swallowing amniotic fluid 500-1000 ml/day

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Sensory Experiences

- Interneurons and CPGs located in the medullary reticular formation of the brainstem **control & coordinate S/S/B.**
 - *adaptive* task-specific motor neuron networks (Barlow, 2000).
 - CPG output of 1:1:1 ratio (Suh, 2006).
- **Positive** sensory experiences are crucial to **optimize pattern formation and brain development** during critical periods for swallow proficiency (Hofstadler & Tremblay, 2006).



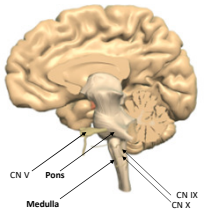
Reticular Formation

**Descending reticular nuclei are involved in reflexive behaviors (i.e. swallowing)

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Respiration and Feeding

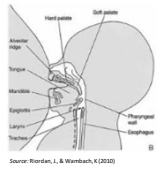
- Respiratory control center located in the **pons and medulla**
- Oral bolus stimulates CN V, IX, and X to **initiate the pharyngeal swallow**
 - Afferent signals are synthesized, achieving the precise motor swallow sequence
 - This takes precedence, resulting in **cessation of respiration**
- Once oral stimulation is removed, respiratory afferents control the **next respiratory cycle**



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Anatomical Difference of Infants and Older Children

Anatomy	Infant	Children
Oral Cavity	<ul style="list-style-type: none"> • Tongue fills the mouth • Edentulous • Tongue sits against palate • Cheeks have sucking pads • Smaller mandible • Sulci important for sucking 	<ul style="list-style-type: none"> • Mouth is larger • Tongue rests on the floor of mouth • Dentition present • Tongue rests behind the teeth • Buccinators are for chewing only • Sulci have <i>little benefit</i>
Pharynx	<ul style="list-style-type: none"> • No distinct oropharynx • Obtuse angle at skull in nasopharynx 	<ul style="list-style-type: none"> • Elongated pharynx-oro-pharynx • 90 degree angle at the skull base
Larynx	<ul style="list-style-type: none"> • 1/2 size of an adults • Half TVF of cartilage • Narrow, vertical epiglottis 	<ul style="list-style-type: none"> • Less than 1/4 TVC of cartilage • Flat, wide epiglottis



Source: Arvedson, J. & Brodsky, L. (2014) (2012)

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Physiology of Suck and Swallow

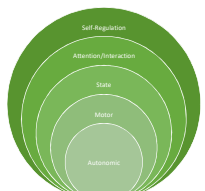
Oral Phase	Pharyngeal Phase	Esophageal Phase
<ul style="list-style-type: none"> • Tongue provides efficient anatomy for positive and negative pressures required for sucking <ul style="list-style-type: none"> ◦ A-P tongue movement decreases pressure which draws in nutrients • Lingual-palatal seal pools bolus in the oropharynx, preventing spillage 	<ul style="list-style-type: none"> • Bolus stimulates baro-, chemo-, and thermoreceptors which generate <i>afferent</i> activity <ul style="list-style-type: none"> ◦ Sensory relay nuclei and CPGs receive information/trigger swallow • Concurrent glottal closure & laryngeal elevation 	<ul style="list-style-type: none"> • UES relaxes, followed by peristalsis of the esophagus

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Synactive Theory in Practice

Synactive Theory of Development

- Emphasis on the infant's subsystem or development.
- Behaviors have specific meaning.
- In current struggle for integration within its environment.



Source: H. Als, 1982

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Autonomic and Motor Behaviors

Autonomic:	Motor:
Assessing homeostasis <ul style="list-style-type: none"> • Immature: bradycardia/tachycardia, apnea, tremors, decreased O2 • Mature: pink color, stable digestion, stable HR, regular respirations 	<ul style="list-style-type: none"> • Immature: frantic, finger splay, stop sign, extension, sitting on air. • Mature: sucking, hand-to-face, balance of flexion/extension, hand clasp

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State Behaviors

<p>Immature: Abrupt transitions, low-level/hyper-alertness, gaze aversion, floating eyes</p>	<p>Mature: Smooth transitions, self-consoling, focused, well-defined states, appropriate responses</p>
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Attention/Interaction and Self-Regulatory

<p>Attention/Interaction:</p> <ul style="list-style-type: none"> Stable autonomic, motor, and state Important because this is how the infant <i>learns</i> 	<p>Self-Regulatory:</p> <ul style="list-style-type: none"> Homeostasis and organization Infant is able to do things on their own Often happens <i>after</i> the NICU
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Controlling the Environment

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Sound

Preemies at greater risk for sensorineural hearing loss (Wachman, 2010).
 ▫ Adverse effects on infant physiologic stability and future neurodevelopment.
 AAP recommends **45 decibels or less** in the NICU (White, 2013).

<p>Common macro sources</p> <ul style="list-style-type: none"> Ventilators Bubble CPAP Monitors/pumps Doors/cabinetry Human voices 	<p>Common micro sources</p> <ul style="list-style-type: none"> Ventilators Monitors/pumps Incubator doors/motor Placing objects near/on incubator Opening packages Human voices
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** Available on Amazon for \$22.90

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Light

Important to decrease sensorimotor loss
 Measured in *foot candles* or *lux*
 ▫ <60 foot candles or **600 lux** recommended for the NICU(White, 2013).

<p>Common macro sources</p> <ul style="list-style-type: none"> External windows Phototherapy lights Overhead lights Computer lights 	<p>Common micro sources</p> <ul style="list-style-type: none"> External windows Phototherapy lights Procedural lights
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** Available on Amazon for \$29.99

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Equipment

Specialized equipment necessary and challenging to control.
 Vibration isolation pad recommended under leveling feet of permanent equipment (White, 2013).

<p>Common macro sources</p> <ul style="list-style-type: none"> Bed Chairs Respiratory equipment (ventilator/CPAP) IV pumps Feeding pumps 	<p>Common micro sources</p> <ul style="list-style-type: none"> Tubes IV's, PICC Positioning Equipment Pacifiers Phototherapy Respiratory equipment (tubes/masks/prongs)
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Laying the Foundation for Successful Oral Feeds

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Non-Nutritive Suck (NNS) and the Premature Infant

- NNS is a orrhythmic motor behavior that begins between **28 and 33 weeks GA** and is well-patterned by 34 weeks (Hack et al., 1985).
- Used to **assess feeding readiness**
- Occurs in bursts and pauses
 - 6-12 suck cycles that occur at 2 Hz (Wolff, 1968)



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Nipple Confusion

Bottle Nipple Confusion

Describes the effect that bottle-feeding has on nipple confusion.

Hypothesis: The experience of feeding from a bottle and exposure to the artificial teat will cause the infant to refuse the breast.

Pacifier Nipple Confusion

Describes the effect pacifier use has on nipple confusion.

Hypothesis: Giving an infant a pacifier will cause the infant to refuse the breast during breastfeeding, as a result of the exposure to an artificial nipple.

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Eliminating Nipple Confusion

World Health Organization (WHO)

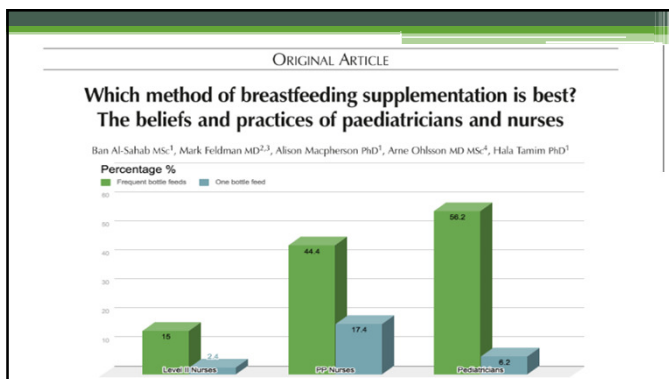
"Give no artificial teats or pacifiers to breastfeeding infants" (UNICEF/WHO, 2009)

American Academy of Pediatrics (AAP)

Recommends pacifiers be provided once breastfeeding has been initiated as a method to prevent *Sudden Infant Death Syndrome* (American Academy of Pediatrics Task Force on Sudden Infant Death, 2005)

Conflicting information has led to parents and healthcare professionals widely believing nipple confusion, despite the limited and conflicting evidence. (Cloherty, Alexander, Holloway, Galvin, & Inch, 2005).

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Non-Nutritive Suck (NNS) and the Premature Infant

- Dyscoordination secondary to *immaturity, comorbidities, and deprivation* (Bu'lock et al., 1990).
- NNS Improves
 - sucking skills
 - oral feeding skills
 - behavior and state control
- Training for the ultimate task of feeding!

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NNS Improves Sucking Skills

- Imperative in the **critical period of brain development** for intubated/tube fed neonates, which often cost them important orosensory and motor experiences (Barlow et al. 2008).
- NNS helps with **developing the neural networks** active during the suck pattern generation (Lund, Koita 2006).
 - **Enhances** the maturation of neural systems responsible (Barlow et al. 2006).
 - Earlier organized sucking skills (Berbaum et al., 1983).

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NNS Improves Oral Feeding Skills

Has been shown to...

- result in **higher feeding scores** (Pickler, Higgins, & Crummette, 1993).
- reduce the time and amount of required tube feedings (Feld et al., 1982).
- lead to taking **bottle feeds earlier** and took bottle feeds **faster** (Sehgal et al. 1990).
- reduce time from introduction to independent oral feeds (Zhang et al., 2014).
- **accelerate swallow frequency & development** (Reynolds et al., 2010).

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NNS Behavioral State

Multiple studies have shown the impact of NNS improving state transition before and after feeding.

- Improved behavioral state (Gill et al., 1992) with **fewer state changes** (McCain, 1995).
- More **frequent alert states** during feedings (McCain, 1995).
- **Less behavioral distress** and quicker sleep state return (DiPietro et al., 1994).
- **Better state control** pre- and post-feeding (Pickler et al., 1996).

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To wrap it up..

- Very little evidence to support nipple confusion.
- Additional benefits impacting growth, maturation, and gastric motility (Bingham 2009).
- Important for gavage fed infants.
- MANY studies to show that **improved NNS = improved NS**
 - ****Highly important for the premature infant population!**

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Preterm Nutritive Bottle Feeding

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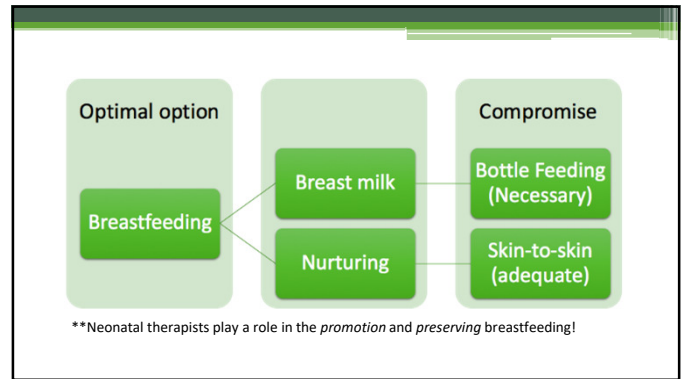


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Breastfeeding Evaluations

- Partner with your lactation consultant!
- Intervention includes...
 - Positioning
 - Latch/Attachment
 - Flow on Breast “Let-Down”
 - Pacing
 - Manual Compression
- Great majority of NICU infants are fed by bottle. ©Pruitt, 2011.

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Move from **Volume-Driven Culture** towards **Cue-Based Feeding**

- NICUs have historically been volume-driven, counting the milliliters consumed for adequate discharge (Juchter et al., 2012)
 - Pressure to “get infants to eat”
 - Efficiency > experience of feeding
 - Tendency to feed past the infant’s stop signs
- May lead to... (Thygesen 2007)
 - maladaptive feeding behaviors
 - learned feeding refusals
 - feeding aversions

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Infant Driven/Cue Based Feeding

Promotes **individualized** feeding experiences based on infant cues (Shaker 2013).

Prioritizes **quality of experience** over quantity ingested.

Infant and caregiver together **co-regulate** the feeding.

- **Dynamic and continuous assessment**
- Interaction helps **anticipate** infant’s needs throughout the feed, avoiding choking or major events of physiologic instability.

Forms the foundation for a **positive** infant-guided approach.

- Skills develop at the infant’s own pace → improved intake

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Move from **Volume-Driven Culture** towards **Cue-Based Feeding**

Volume-Driven Strategies	Infant-Guided Intervention
Removing blanket and feeding unswaddled	Supportive swaddling for postural stability and control
Increasing flow rate	Provide comfortable flow rate for protection
Prodding	Avoid prodding
Chin/Cheek Support	Provide co-regulated pacing and rest to support swallowing and breathing
Putting infant’s head/neck back	Provide an elevated side-lying position
continuing to feed despite <ul style="list-style-type: none"> • Disengagement • Swallow-breathe incoordination • Mild physiologic instability 	Use developmentally supportive framework for feeding with infants involving family

Source: Shaker (2013)

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Feeding Assessment Tools

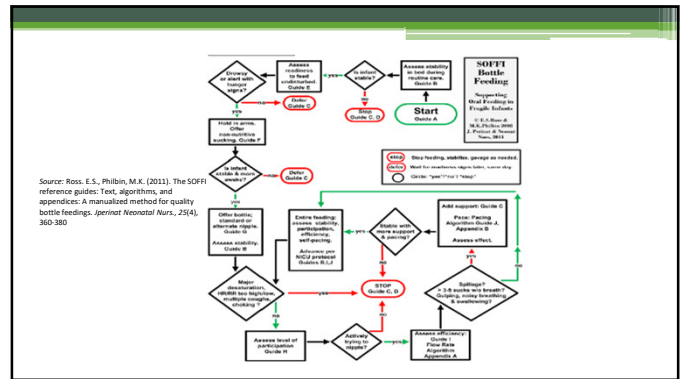
- **Neonatal Oral-Motor Assessment Scale (NOMAS)**
 - Disorganized vs dysfunctional sucking
 - 3 day certification course
- **Infant-Driven Feeding Scales**
 - Readiness, Quality, and Caregiver techniques
 - Online individual or unit-wide training
- **Early Feeding Skills Assessment (EFS)**
 - Assesses oral feeding **readiness**, oral feeding **skill**, and oral feeding **recovery**
 - 36 items

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The SOFFI Method

- Theoretical basis of the *Synactive Theory of Development*
- Addresses both **feeding readiness** and **real-time management** of feeding with quality as the primary objective.
- Algorithms for feeding:
 - Questions with yes/no answers
 - Answers affect the feed and lead to next set of assessment, decision, and action.
 - 1) Proceed along 2) Make a change
 - 3) Defer feeding 4) Stop and omit closely following feeds

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Feeding for Low-Risk Infants	Feeding for High-Risk Infants
Begin with: Level 1 nipple & standard cradle hold	Begin with: Ultra Preemie bottle nipple Side-lying/ horizontal milk flow External pacing
Implement the following as needed: 1. Slower Flowing Nipple Preemie Ultra Preemie 2. Horizontal Milk Flow Side-lying position Semi-upright position 3. External Pacing	As able trial one at a time: • Remove external pacing • Utilize standard cradle hold • Gradually increase flow o Preemie nipple o Level 1 nipple
	***High risk infants include... <30 GA Airway malformation BPD) Bronchopulmonary dysplasia Neurological injury (CHD) Congenital heart disease Infant with adverse clinical events with PO

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Slow Flow Bottle Nipples

- Regulates** the flow and coordination of S/S/B
- Slow flow may help in the *transition to breastfeeding*
- Helps manage autonomic stability, eliminate anterior milk loss, improved suck pattern, self-imposed breath breaks, less need for pacing

LOW

Dr. Brown's ultra preemie nipple

Dr. Brown's preemie nipple

Similac GOLD Slow Flow

Enfamil BLUE Standard Flow

FAST

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Horizontal Milk Flow

Reduced bolus size and assists with S/S/B coordination

Side-lying (a-c) and upright (d) for positioning with feeding
 Source: Dодrill (2016) *PEDIATRIC NEONATAL MEDICINE CLINICAL PRACTICE GUIDELINES Feeding in the Weeks Leading Up to Discharge*

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External Pacing

- Utilized when difficulty with self-coordination of S/S/B.
- Can be *scheduled* (e.g. every 3 sucks) or *on demand* (cue-based).
- Process involves...
 - Tipping the bottle *down* in order to slow the flow/reduce amount of milk in the nipple
 - Removing the nipple to initiate a breath break

Source: Dодrill (2016) *PEDIATRIC NEONATAL MEDICINE CLINICAL PRACTICE GUIDELINES Feeding in the Weeks Leading Up to Discharge*

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Importance of Documenting Objective Data

- Persistent systematic observation of the infants behavior **before, during, and after** intervention required to identify the infants neurodevelopmental and behavioral status to set appropriate goals.
- HR, RR, SaO2, Alert State, Pain Scale, Motor Patterns, Behavioral Cues, Self-Regulatory S/S, Positioning/posture, positional support
- Before (baseline), during (response to intervention), after (post-intervention 15-60 min post)

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Family Intervention in the NICU

- Parents judge their competence on how well their infant is feeding a growing (Dehan, 1998)
 - Leaves parents in *dissonance* and perception of being an outsider (Shaker, 2013).
 - **Anxiety, depression, loss of autonomy** (Ahlfeld, 2009).
- Mother-infant attachments occur during daily co-occupations (Paur-Barneloni, 2010).
- Maternal stress correlated to quality of mother-infant interactions.
- Involve parents in daily care- educate and explain *how and why* you are doing certain interventions.

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Development of a Feeding Program

- Identify a community need
 - You may be the difference between transferring and admitting the infant!
- Does your goal align with your organization's mission?
 - **PRIDE:**
 - Patients first, *Relationships, Integrity, Innovation, Dedication, Excellence*
- Find a physician champion/core team → internal buy-in
- Bring passion and EBP to the project.
- Determine a marketing plan
- Organize a referral base
- Keep going!

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Development of a Feeding Program

- Feeding team assigned:
 - SLP
 - Neonatologist/Pediatrician (depending on facility capabilities)
 - RN
 - NNP
 - Lactation consultant
 - Infection control nurse
- Six months for implementing education program
- Ten months for implementing the program in the NICU

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Where to start?

- Start in OP or EI
 - Developmental follow up program with the NICU babies.
 - Allows you to practice in a safe environment with no monitors or tubes.
 - Experience on life after the NICU and long term consequences from the NICU
- Observe OT/PT
 - Better grasp on neuromuscular development, infant handling, sensory regulation, etc.
- The more hands on with the *typical* infant helps you gain perspective on what is *atypical*

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Additional Important Scientific Knowledge

- Dynamic systems theory
- Attachment Theory
- Acute and chronic stress
- Acute and chronic pain
- NICU culture
- Medical procedures
- Typical Neurodevelopmental outcomes of preterm infants
- Basic anatomy and physiology of the neonate
- Embryology
- Family centered care
- Medical terminology
- Medical equipment/Commercial infant products
- Maternal risk factors & complications

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Recommended Book List from NANT

1. **Developmental and Therapeutic Interventions in the NICU**, Elsie Vergara "Sc.D. OTR FAO" and Rosemarie Bigsby "Sc.D. OTR FAO"
2. **Feeding & Swallowing Disorders in Infancy: Assessment & Management**, Lynn S. Wolf and Robert P. Glass
3. **Developmental Care of Newborns & Infants: A Guide for Health Professionals 1st & 2nd editions**, NANN and Carole Kenner
4. **Neurological Assessment of Preterm and Full-term Newborn**, Dubowitz, Lilly M. S. Dubowitz, Victor.; Mercuri, Eugenio.
5. **A Neurodevelopmental Care Guide to Positioning & Handling the Premature, Fragile and Sick Infant**, Dana Fern
6. **Supporting Sucking Skills in Breastfeeding Infants**, Catherine Watson Genna
7. **Competency Checklist for the Neonatal & High Risk Infant Therapist 3rd edition**, Edith Mak, OTR/L, Jane LurieHavner OTR/L and Nancy Forero-Lilienfeld PT – LA Children's
8. **Transformative Nursing in the NICU: Trauma-Informed Age-Appropriate Care**, Mary Coughlin RN MS NNP

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