Beyond Skin to Skin: The Science of Nurture
Alice K. Gong, M.D.
Professor of Pediatrics
Rita and William Head Distinguished Professor of Environmental and Developmental Neonatology

Acknowledgement
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Objectives
• Describe the development of the autonomic nervous system
• Review the benefits of skin to skin care in the NICU setting
• Describe Nurture
• Discuss the long term consequences of nurture or lack thereof
• Identify the goals of Family Nurture Intervention in the NICU

Background
• Animal observations
  – High Nurture
  – Optimal Development
• Close contact mother and young defines mammals
Animal research

- Early maternal contact in rodents
  - Bio-behavior processes promote physiologic and behavior development
  - Impact on brain systems that manage stress and enhance social adaptation
  - Maternal licking/grooming alters glucocorticoid receptor gene expression in rat pup’s hippocampus, enhancing stress regulation in adult
- Early maternal deprivation
  - Lifelong negative effects on offspring

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Development of ANS

- Most during last trimester and continues through first year postpartum through interactions with Mother
- Ensure infant can breathe, obtain food, maintain body temperature
- Progressive change allows infant to develop independence
  - Ability to regulate physiological and behavior state
  - Interact with mother to acquire basic needs, food, warmth, protection

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Polyvagal Theory

- Developed by Stephen Porges
- Three phylogenetic stages of mammalian development of ANS
  - Social communication (facial expression, vocalization, listening)
  - Mobilization (fight-flight, tantrums, crying)
  - Immobilization (feigning death, vasovagal syncope, shutdown)
- The circuits developed in inverse order such that the newest circuit is used first. If that circuit fails to provide safety then the older circuits are recruited sequentially.
  - For term infants, expression of newest circuit involves coordination of sucking, swallowing, breathing.
Prematurity

- Major health care problem worldwide
- Advances in medical technology have enabled survival of immature and sick infants
  - May need many months of ICU care that preclude contact with mother
- Brain development is disrupted and vulnerable to insults
  - Last trimester, brain triples in weight (100 to 300 g)

Clinical effects

- Combination brain immaturity and maternal separation
  - Infant
    - Learning disorders
    - Behavior disorders
    - Disorganized sleep patterns
  - Mother
    - Anxiety
    - Distress
    - Depression
  - Leads to interruption of mother-infant emotional connection

Skin to Skin (Kangaroo Care)

- Initially developed in Bogota Columbia to cope with lack of incubators to enable premature infants to maintain body temperature.
  - Found also to increase breastfeeding rates, earlier discharge, lower nosocomial infections, lower severe illnesses.
  - Lower resource utilization
  - Improve maternal satisfaction and confidence

Clinical Evidence

- 2016 Cochrane Review
  - Data from 21 studies including 3042 VLBW infants
  - Reduced risk of death, nosocomial infections, hypothermia
  - Increased growth in weight and length
  - Increased breastfeeding
- 2014 Feldman et al
  - 73 infants (1 h of skin to skin, 14 days) vs routine incubator care
  - 10 years later: study group had attenuated stress response, improved respiratory sinus arrhythmia (RSA), organized sleep, better cognitive control, and improved mother-child reciprocity

Charpak et al, 2005, Acta Paediatrica
Controversy

- Many studies from developing nations with limited resources for comparison
- When can an infant “tolerated” skin to skin?
- How much is needed?
- Is it the mother-infant separation that causes instability?

New Ideas and Concepts

- Emotional connection and co-regulation
  - biological mechanisms began in-utero between mother and infant
  - After birth, reciprocal parent-infant-interactions promote emotional connection and co-regulation, the basis of “nurture.”
  - Critical for optimal family communication, behavior and development
  - Break lead to symptomatic and impaired development
  - Facilitating parent and infant - key to overcoming emotional, behavior, and developmental problems.

Nurture Science Program

- http://nurturescienceprogram.org

Facilitating emotional connection and Co-regulation

Over time Calming Cycle interactions lower levels of stress in both the mother and the infant, and do so in less and less time

Welch MG, 2016, Acta Paediatrica
Combined secretin/oxytocin reduces cytokines in rat colitis

OTR declines with age/weaning

OT/OTR signaling in gut cells

- Oxytocin signaling slows cellular metabolism while cell catches up with load of stress molecules
Aversive Behavior – Conditioned Stress Response

Infant/Child Needy

Stressful Contact

No calming

Contact with Mom

Conditioned Stimulus

Infant/Child Needy

Anxious Baby

Conditioned Response

Facilitating emotional connection and Co-regulation

The Calming Cycle

Level of Stress

High

Low

SEPARATION

STRESS

REUNION

Calming Session

Time

Over time Calming Cycle interactions lower levels of stress in both the mother and the infant, and do so in less and less time.

FNI counter-conditioning

Infant/Child Needy

Contact with Mom

Needs Met

Contact with Mom

Calm Baby

Conditioned Stimulus

Conditioned Response

New Paradigm

A.

Self-regulation

B.

Psychological Co-regulation

C.

Visceral/autonomic Co-regulation
FNI Calming Sessions

- Create Emotional Connection and Autonomic Co-regulation
- Nurture Specialists Administered
- Engage mother and infant in repeated calming sessions
- Experiential, not didactic
- Counter-conditions Adverse Experiences in NICU
- Mother calms baby ⇔ Baby calms mother
- Co-conditions the ANS of mother and baby

Premature Infants

- Separated from mother at birth for life-saving interventions (focus on cardio-respiratory needs)
- Follow up studies support much higher rate of social perceptual deficits, poor social and behavior outcomes even in those who seem to be “normal”.

Phases of Calming Session

1. Separate mother & infant from stress
2. Paving the way for baby
3. Mutual practice of desensitization
4. Repeated Calming Sessions help restore co-regulation between mother and infant/child

Family Nurture Intervention in the NICU

Pavlovian co-conditioning of Autonomic Nervous Systems of mother and baby
Family Nurture Intervention (FNI)

- **Novel Approach**
  - Other approaches help baby to “self-regulate”
  - FNI → Co-regulation

- More co-regulation → more emotional connection
- More emotional connection → more co-regulation

- Ability to co-regulate extends to others

Facilitating Mother-Infant Connection

**In Incubator**

- Scent Cloth Exchange
- Firm Constant Touch
- Eye Contact
- Vocal Exchange
- Communication of Emotion

**Out of Incubator**

- All of above, plus
  - Skin-to-skin or Clothed Holding
  - Family Support Sessions

First RCT of FNI at Columbia University Medical Center

- 2008-2012
- 150 infants randomized to FNI or standard care
- 26-34 weeks gestational age at birth
- Cohort in follow-up up to age 5
Important Finding

- Goal was to establish emotional connection before discharge
- Average dose of facilitated FNI <1 hour/day
- Both FNI and SC groups had equal amount of skin to skin care

FNI improved brain development

- Increased infant brain activity in frontal regions associated with regulation of emotion and attention  
  \( p=0.003 \) to \( p=0.00003 \)
- Decreased coherence = increased maturation of specialization of function in these same regions  
  \( p<.01 \) to \( p=.000013 \)

EEG Findings

Hydrocel Geodesic Sensor 128-Channel Net (EGI)

Welch et al, 2014, Clinical Neurophysiology
**Frontal Polar Region**

*Associated with*

- Emotion Regulation
- Attention
- Impulse Control
- Cognition
- Executive Function
- Modulation of Stress

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**FNI NICU RCT Published Results**

<table>
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<th>Group</th>
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**36 Wks -**  
**Mom** Caregiving behavior \( \uparrow \) \( p<0.01 \)

**40 Wks -**  
**Infant** EEG Power \( \downarrow \) \( p<0.001 \)

**40 Wks -**  
**Infant** EEG Coherence \( \downarrow \) \( p<0.001 \)

**4 Mos -**  
**Mom** Depressive symptoms \( \downarrow \) \( p<0.04 \)

**4 Mos -**  
**Mom** Anxiety \( \downarrow \) \( p<0.01 \)

**4 Mos -**  
**Infant** Lower heart rate during stress (in prep) \( \downarrow \) \( p<0.02 \)

**18 Mos -**  
**Infant** Language, Cognition (Bayley) \( \downarrow \) \( p<0.01, p<0.04 \)

**18 Mos -**  
**Infant** Attention Problems (CBCL) \( \downarrow \) \( p<0.02 \)

**18 Mos -**  
**Infant** Risk for Autism (MCHAT) \( \downarrow \) \( p<0.01 \)

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**Change in EEG power due to mothering behavior??**

- SC Infant Born 32 wks GA
- FNI Infant Born 28 wks GA

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**Group change in EEG power for FNI vs SC**

- **Active Sleep**
- **Baseline**
- **Near Term**

\( p<0.001 \)
Unpublished Data

How is FNI different?

- **Co-regulatory**, physiological not psychological.
- Not self-regulation
- FNI is between the mothers and children.
- Primary goal of FNI is to get *emotional connection & co-regulation* between mother and infant
- *Experiential* (physical calming cycle), not didactic
- Mutually benefits mom and child
- Becomes a *parenting tool* that family uses at home to modulate behavior
- Effective with *single moms*, even where there is insufficient emotional support for the mother at home.

Multisite Replication and Effectiveness Trials

- Replication of Family Nurture Intervention (FNI) in CUMC NICU
- Part of a multi-site collaborative study with UT Health at San Antonio, South Miami Hospital, and The Valley Hospital, Ridgewood, NJ

FNI Conclusions

- Shows significant improvement in preterm infant behavior and development across multiple domains
- Helps both mother and infant/child
- Prevents and protects against a wide range of developmental delays
- Evidence based
- Fills a care gap
- Low cost with high ROI
Bibliography


