Beyond Skin to Skin: The Science of Nurture

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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
Nervous system

Central nervous system (CNS)
- Brain
- Spinal cord
  Connects brain and peripheral nervous system

Peripheral nervous system
Carries messages to and from the CNS

Somatic nervous system
Controls voluntary muscles and transmits sensory information to the CNS

Autonomic nervous system
Controls involuntary body functions

Sympathetic nervous system
Aroused body to expend energy

Parasympathetic nervous system
Calms body to conserve and maintain energy
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
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 enable 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

Charpak et al, 2005, Acta Paediatrica
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, improve respiratory sinus arrhythmia (RSA), organized sleep, better cognitive control, and improved mother-child reciprocity
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?
Nurture Science Program

http://nurturescienceprogram.org
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.

Welch MG, Columbia University, Nurture Science Program
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

Welch et al, 2010, Neurogastroenterol Motil
Oxytocin Receptor Expression in Gut Epithelium

Welch, MG et al, 2009, J Comp Neurol.
OTR declines with age/weaning

![OTR averages graph](graph.png)
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

Infant/Child Needy

Contact with Mom

Conditioned Stimulus

Anxious Baby

Conditioned Response
Facilitating emotional connection and Co-regulation

The Calming Cycle

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

Infant/Child Needy → Contact with Mom → Needs Met

Contact with Mom → Conditioned Stimulus → Calm Baby

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 discomfort/distress
2. Mutually shared distress
3. Mutual resolution of discomfort/distress
4. Mutual calm that may include eye contact/sleep

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

**Calming Session**

**In Incubator**

- Scent Cloth Exchange daily
- 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
• Increased infant brain activity in frontal regions associated with regulation of emotion and attention  
  \( (p=.003 \text{ to } p=.00003) \)

• Decreased coherence = increased maturation of specialization of function in these same regions  
  \( (p<.01 \text{ to } p=.000013) \)

Welch et al, 2014, Clinical Neurophysiology
Hydrocel Geodesic Sensor 128-Channel Net (EGI)
FNI improved brain development

Welch et al, 2014, Clinical Neurophysiology
Frontal Polar Region

Associated with

- Emotion Regulation
- Attention
- Impulse Control
- Cognition
- Executive Function
- Modulation of Stress
FNI NICU RCT Published Results

- **36 Wks - Mom** Caregiving behavior p<0.01
- **40 Wks - Infant** EEG Power p<0.001
- **40 Wks - Infant** EEG Coherence p<0.001
- **4 Mos - Mom** Depressive symptoms p<0.04
- **4 Mos - Mom** Anxiety p<0.01
- **4 Mos - Infant** Lower heart rate during stress (in prep) p<0.02
- **18 Mos - Infant** Language, Cognition (Bayley) p<0.01, <0.04
- **18 Mos - Infant** Attention Problems (CBCL) p<0.02
- **18 Mos - Infant** Risk for Autism (MCHAT) p<0.01
Change in EEG power due to mothering behavior?

EEG Power
22-24 Hz (µV²)

SC Infant
Born 32 wks GA

FNI Infant
Born 28 wks GA

~34 wks
~6 weeks
~40 wks
Group change in EEG power for FNI vs SC

Active Sleep

- Electroencephalography (EEG) Power
  - 22-24 Hz (µV²)

Baseline
Near Term

FNI vs SC

p = <.001
Unpublished Data
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


