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**PERINATAL NEUROSCIENCE and SKIN-TO-SKIN CONTACT**

**Speaker Disclosure**
Under ACCME guidelines:

a) I am the South African distributor of MIRIS: Human Milk Analyzer

b) My wife and I are owners and directors of NINO Academy (Tendotouch Pty Ltd) produce educational & promotional goods and materials related to the talk content.

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**First 1000 days =**

- **Gestation**
  - 270
- **Year one**
  - 365
- **Year two**
  - 365
- **Total**
  - 1000 days

**270 \rightarrow 365 + 365**

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**The Neuroscience of Birth & Breastfeeding**

- **The DNA**
- **Epigenetics**
- **The Brain**
- **Neurodevelopment**
- **Evolutionary Biology**
- **Environment**
- **Adaptation**
- **Experience**
- **Reproductive Fitness**

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**Figure 6.1. Summary of the current “central dogma” that underlies the analysis of all biological processes, including those that mediate basic psychobiological processes. The only major concept missing from this schematic is the environment, and these influences permeate all phases of these transactions.**

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**Genetics vs. Epigenetics**

- **Genetic Mutations**
- **Often Altered Functioning**
- **Epigenetic Changes**
  - **Often Altered Activity**

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**INK**

Scientific American, December 2011
... highly conserved neuro-endocrine behaviors

"Genome" - genes of species

"Genotype" - genes in specimen

"Phenotype" - specimen resulting from gene - environment interaction

INK

PENCIL

EPIGENES ...
controls on the DNA/gene "switches in the mind"

G x E

"Phenotype" - specimen resulting from gene - environment interaction

INK

PENCIL
fetal REM sleep (or active sleep) seems to be particularly important to the developing organism

... spontaneous synchronous firing

Marks et al 1995

"Neurons that fire together wire together while those which don't, won't”
Hebb/Carla Shatz

Early wiring phase
Pruning of excess
Adult stage (efficient)
Optimal neural pathways are selected - J-P Changeux

BRAIN WIRING
REM NR1 NR2 NR3 NR4
ACQUISITION poly-sensory input short-term memory stored cortex
Awake and REM
CONSOLIDATION transfer information "SNR" strong signals amygdala / hippocampus NREM stage 4
MEMORY FORMATION P waves returns into hippocampus organized REM

BRAIN WIRING
Peirano 2003

PATHWAYS → CIRCUITS → NETWORKS

Stanley Graven 2006

Sleep, Hormones, and Memory

Stanley Graven 2006

Peirano 2003
Brain Architecture and Skills are Built in a Hierarchical "Bottom-Up" Sequence

- Neural circuits that process basic information are wired earlier than those that process more complex information.
- Higher circuits build on lower circuits, and skill development at higher levels is more difficult if lower level circuits are not wired properly.

Slide by: Jack P. Shonkoff, M.D.

Newborn behaviour to locate the breast when skin-to-skin: a possible method for enabling early cell regulation

This was confirmed by demonstration of a statistically significant negative correlation between changes in \([\text{Hb O}_2]\) and postnatal age (r = -0.64, p < 0.001 with 95% confidence interval) (Fig. 1). Those babies showing the greatest increase in [\text{Hb O}_2] were between 6 and 24 h old at testing.

- In the 14 babies older than 24 h there was no significant difference between the changes in [\text{Hb O}_2] during control and colostrum exposure.
In the 14 babies older than 24 h there was no significant difference between the changes in [Hb O₂] during control and colostrum exposure.

Those babies showing the greatest increase in [Hb O₂] were between 6 and 24 h old at testing.

“...helpless, but raises its own temperature, has a higher blood glucose, metabolic adaptation faster.

(Widstrom 1987)

METABOLIC ADAPTATION

SSC started in the first 20 minutes after birth

SSC  Cot

Blood glucose (1 hr)  3.17  2.56
Base excess drop  3.4  1.8

(Christenson 1992)

Warming, feeding and protection behaviours are intricately, inseparably linked to the right place.

(Alberts 1994)

The Neuroscience of Birth & Breastfeeding

intricately, inseparably linked to the right place.

(Alberts 1994)
When does the infant become conscious?

The 'Stress' of Being Born

Scientific American 1986
Scientific American Mind 2009

You can never reach the same high levels of catecholamine levels during your whole life as at birth

Reduced catecholamine surge after C-section

Vaginal delivery  Elective C-section

The newborn brain consumes 50% of all the blood glucose
- In the adult 20%

The infant brain is not blank!
Resting activity
“stream of consciousness”

AT BIRTH, the brain has TWO CRITICAL SENSORY NEEDS:

SMELL & CONTACT connect direct to the amygdala

THE NEWBORN BRAIN
SKIN-TO-SKIN CONTACT fires and wires
the amygdala-prefronto-orbital cortical pathway (PFOC)
AMYGDALA: Emotional Processing Unit

Prefrontal cortex: Executive function

Social and Emotional Intelligence

**Behavioral activation system**
**reward-based (dopamine)**

**Simulation theory:**
**EMPATHY** is generated by inner imitation of actions of others

**Oxytocin**

Interpersonal awareness
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In humans, oxytocin increases gaze to the eye region of human faces and enhances interpersonal trust and the ability to infer the emotions of others from facial cues.
The BOND is made up of the sensory inputs from the parent to the infant.


Through “hidden maternal regulators”...

a mother precisely controls every element of her infant’s physiology.

warmth → activity level
milk → heart rate

"physiological set points"

internal working models
scripts - templates

from its heart rate to its release of hormones from its appetite to the intensity of its activity

(Gallagher 1992)

“needed neural processes...”

is very significant and potentially lasts a life time.

“It is a serious mistake to assume that the principles derived from careful animal studies do not apply to human infants. The risk of suppression or disruption of needed neural processes...”

Clinics in Perinatology, June 2004, Vol 31(2) page 210

Stanley Graven

Early neurosensory visual development of fetus and newborn.

NEURODEVELOPMENT
The DNA
EPIGENETICS
The Brain
NEURODEVELOPMENT
EVOLUTIONARY BIOLOGY

EXPERIENCE
ADAPTATION
BIRTH
BABY
ENVIRONMENT
REPRODUCTIVE FITNESS

The Neuroscience of Birth & Breastfeeding

The Brain
BONDING

"needed neural processes"
John Bowlby
secure attachment
“a safe base from which to explore the world”.

Psalm 22 v 9
“I learnt trust on my mother’s breasts”
The basic science of pediatrics.


Positive Stress

- Moderate, short-lived stress responses, such as brief increases in heart rate or mild changes in stress hormone levels.

Slide by: Jack P. Shonkoff, M.D.

The Neuroscience of Birth & Breastfeeding

Good

- An important and necessary aspect of healthy development that occurs in the context of stable and supportive relationships.

Bad
**Tolerable Stress**

- Stress responses that could disrupt brain architecture, but are buffered by supportive relationships that facilitate adaptive coping.
- Generally occurs within a time-limited period, which gives the brain an opportunity to recover from potentially damaging effects.

**Toxic Stress**

- Strong and prolonged activation of the body’s stress management systems in the absence of the buffering protection of adult support.
- Disrupts brain architecture and leads to stress management systems that respond at relatively lower thresholds, thereby increasing the risk of stress-related physical and mental illness.

**Psychobiological Roots of Early Attachment**

Mary Ainsworth (1913 – 1999)

... provide scientific evidence for Bowlby's theories.

Strange Situation Test:
- secure attachment
- insecure ambivalent (anxious)
- insecure avoidant

**SEPARATION DYSREGULATES CORTISOL**

Fig. 1. Schematic representation of the dynamics of early-separation responses based on the concept of an attachment bond as described by John Bowlby (Bowlby, 1982).

**WHY IS EARLY MATERNAL SEPARATION STRESSFUL?**

Fig. 2. Schematic representation of the dynamics of early-separation responses resulting from the loss of regulatory interactions within the mother-infant relationship.

components (e.g., nutrient, thermal/metabolic, or sensorimotor) of the infant's previous interaction with its mother and that the complex response to separation was due to the withdrawal of all these components at once.
Unsafe environment activates HPA axis (autonomic nervous system, ANS).

In response to stress, CRF ... and vasopressin are released ... anterior pituitary ... synthesis release ACTH ... glucocorticoids → CORTISOL

Earliest care at birth matters
Same gene → switched

Early stress alters gene expression, with health impact across lifespan.

BONDING components
Social
Emotional
Physical
Primate separation studies

Maternal Separation Paradigm
Early Deprivation (ED) vs control (CON)

- ED 11 Mat 30-120 min daily → 48w
- CON 4 Mat → → → → 48w

Adult: Attachment ANXIETY to partner
Child: Insecure attachment

BONDING consequence

Emotional
Social
Physical

CORTISOL

Adult: Higher CORTISOL and lower immunity (CD4 cells)

Child: Insecure attachment

ANS

Jaremka 2013

Primate Early Life Stress Leads to Long-Term Mild Hippocampal Decreases in Corticosteroid Receptor Expression


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Arabadzisz 2008

Repeated short separations:
LOW gene expression
CORTISOL

Correlate to human adult depression

Adults with depression, suicides:
LOW gene expression
smaller hippocampal volume
reduced expression frontal lobe

These findings translate previous results from rats / monkeys to humans

 Increased methylation of glucocorticoid receptor gene (NR3C1) in adults with a history of childhood maltreatment: a link with the severity and type of trauma
Adults with depression, suicides:
LOW gene expression
smaller hippocampal volume
reduced expression frontal lobe.

The neuroscience of birth & breastfeeding

2. ... advances in the biological sciences underscore the foundational importance of the early years and support an EBD framework for understanding the evolution of human health and disease across the life span.

3. The biology of early childhood adversity reveals the important role of toxic stress in disrupting developing brain architecture and adversely affecting the concurrent development of other organ systems and regulatory functions.
4. Toxic stress can lead to potentially permanent changes in learning (…), behavior (…), and physiology (…), and can cause… higher levels of stress-related chronic diseases, …increase the prevalence of unhealthy lifestyles that lead to widening health disparities.

5. The lifelong costs of childhood toxic stress are enormous, and effective early childhood interventions provide critical opportunities to prevent these undesirable outcomes and generate large economic returns for all of society.

6. The consequences of significant adversity early in life prompt an urgent call for innovative strategies to reduce toxic stress within the context of a coordinated system of policies and services guided by an integrated science of early childhood and early brain development.

**OF A GOOD BEGINNING COMETH A GOOD END**

*John Heywood, Proverbs (1546)*

*When is the beginning?*
"Non-pharmacological reduction of hypercortisolaemia in preterm infants"

Preterm infants experience prolonged severe stress with tenfold increases in stress hormones. Stress hormones at such levels are neurotoxic.

RCT on methods to reduce stress (at one hour):
- Cortisol: no change
- Endorphin: no change
- Massage: slightly lower
- Skin-to-skin: 66% lower, 74% lower

BERGMAN COMMENTARY - NEWBORN
Material absence is TOXIC STRESS

For separated preterm newborns, we have decades of evidence for this.

BERGMAN COMMENTARY - NEWBORN
Reducing toxic stress IS VERY EASY!!

EARLY YEARS \rightarrow \text{LIFE SPAN}

**Early years = early hours \& days**

BERGMAN COMMENTARY - NEWBORN

**REDUCE TOXIC STRESS**

MASSIVE COST $$ $$

TOXIC STRESS

EARLY LIFE \rightarrow \text{ADVERSITY}

**Early Life Adversity**

MAKES POORER
- Linguistic
- Cognitive
- Emotional
- Adaptation
- Responsivity
- Unhealthy lifestyle
- Chronic diseases
- Health disparity

LEARNING
Behavior
Mental well being
Physical well being
Mental/Behavior

MASSIVE COST $$ $$

REDUCE TOXIC STRESS

EARLY YEARS \rightarrow \text{LIFE SPAN}

**EARLY YEARS \rightarrow \text{LIFE SPAN}**

**EARLY YEARS \rightarrow \text{LIFE SPAN}**

**EARLY YEARS \rightarrow \text{LIFE SPAN}**

**EARLY YEARS \rightarrow \text{LIFE SPAN}**
An ecobiodevelopmental framework for early childhood policies and programs.

Innovative strategies ... ... reduce toxic stress

Creative new strategies

“compelling need for bold new strategies”

National Research Council 2000

Skin-to-Skin Contact

Attachment

Bonding

Breast-feeding

PERINATAL NEUROSCIENCE and SKIN-TO-SKIN CONTACT

BERGMAN COMMENTARY - NEWBORN

Reducing toxic stress IS VERY EASY!!

www.skintoskincontact.com

“...It is easier to build strong children than to repair broken men.”

Frederick Douglass (1817–1895)
MOTHER is the key to neurodevelopment ... ... because she is the RIGHT PLACE!!
RESILIENCE
(= STRESS RESISTANCE)
"capacity to maintain healthy emotional functioning in the aftermath of stressful experiences"

The Neuroscience of Birth & Breastfeeding

The DNA
EPIDEMIOLOGY
The Brain
NEURODEVELOPMENT
Behavior
EVOLUTIONARY BIOLOGY

ENVIRONMENT
ADAPTATION
EXPERIENCE
REPRODUCTIVE FITNESS

BIRTH
BABY
MOTHER
SEPARATION

BREASTFEEDING
FACE-TO-FACE CYCLE

Secure Attachment
Attuned parenting

Resilience

Vulnerability

Disordered attachment

SEPARATION VIOLATES the innate agenda of mother and baby

OXYTOCIN comes from

Cortisol

Oxytocin

Cervical dilatation

Breastfeeding
Skin-to-skin contact
Eye-to-eye contact

SEPARATION CORTISOL

OPPONENTS

SKIN-TO-SKIN CONTACT

Oxytocin
**Doula:**
An ancient Greek word meaning “handmaid.”

This term has come to represent a compassionate, experienced woman who provides physical, emotional, educational and practical support to another woman and her family during all the events surrounding childbirth.

birthdoulasofpittsburgh.com

**Birth companion**

... constant uninterrupted presence of another woman

birthdoulasofpittsburgh.com

**Issues in support of Baby Friendly Hospital Status**

- protect OXYTOCIN during labour.
- protect OXYTOCIN after birth.

**“ECD” Early Childhood Development**

- First 1000 days =
  - gestation: 270
  - year one: 365
  - year two: 365
  - total: 1000 days

- NINO application
  - First 1000 hrs = 1st six weeks
  - First 1000 min = 16.6 hours = 1st day
  - First 1000 sec = 16 minutes = 1st hour

**The Neuroscience of Birth & Breastfeeding**

- The DNA
- The Brain
- Behaviour
- Neurodevelopment
- Evolutionary Biology

**A mother and baby**

- It matters how we are born

DYAD are a single psychoneurobiological organism

<table>
<thead>
<tr>
<th>Environment</th>
<th>Adaptation</th>
<th>Experience</th>
<th>Reproductive Fitness</th>
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<td>Bonding</td>
<td>Separation</td>
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<td>Beyond</td>
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**IT MATTERS**

HOW WE ARE BORN
The Neuroscience of Birth & Breastfeeding

All this KNOWLEDGE ...

And this PUBLIC HEALTH ...

Depends on BREASTFEEDING...

... depends on skin-to-skin contact

... depends on AVOIDING SEPARATION

Nelson Mandela

... in describing the measure of a nation, he has argued that:

“There can be no keener revelation of a society’s soul than the way in which it treats its children.”

Looking Back, Moving Forward

WIC: Strengthening Families for 40 Years