Developmental Care in the NICU

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Kosair Children’s Neonatal Specialists, Louisville, KY

The speaker has signed a disclosure form and indicated he has no significant financial interest or relationship with companies or the manufacturer(s) of any commercial product/service that will be discussed as part of this presentation.

Session Summary

This session will provide an overview of rationale for, and interventions included in, developmental care of the newborn, as well as a scientific evaluation of the evidence for these interventions.

Session Objectives - need

Upon completion of this presentation, the participant will be able to:

- define neurodevelopmental care for at-risk premature infants;
- explain the pathophysiologic impact of prematurity on neurologic development, pre- and post-birth;
- describe the NIDCAP clinical practice approach: Newborn Individualized Developmental Care and Assessment Program
- review pertinent evidence-based research supporting the importance of an appropriate neurodevelopmental approach when caring for premature infants.

References


www.nidcap.org

**Session Outline**

See handout on the following pages.
Developmental Care of the Newborn

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Disclosure

• Nothing to disclose

• Author is NOT affiliated with NIDCAP.

Objectives

• Definition
• Neurodevelopmental review
• Clinical practices
• Supporting research
• Implementing developmental care

Foundation

Nothing we do can replicate intrauterine environment... but we can do our best to try.
Definition

A philosophy of care that uses a range of neurodevelopmentally supportive medical and nursing interventions to decrease the stress of preterm neonates in the NICU.

Normal Development

- The orderly development of movement, tone and reflex responses depends on the formation of a complex neuronal synaptic network, which involves a precise sequence of developmental processes.

Normal Development

- Including
  - Proliferation of the total complement of neurons in the brain
  - Followed by migration of neurons to specific sites within the CNS
  - Organization of synaptic interconnections

Normal Development

- Plasticity—Cortical projections deprived of their normal target seek out comparable targets and retain their orderly pattern of development
  - Even if there is early insult, there is still opportunity to maximize potential outcomes.
Motor Neuron Development
- Rostrocaudal
- Ventrodorsal
- Large neurons sooner than small ones

Neurodevelopment
- Neuronal proliferation
  - Neurons formed in the subependymal germinal matrix
  - Proliferation: 8-24 weeks (peak 12-20 weeks)
  - When neurons complete proliferation → migrate
- Neuronal migration
  - Peak period: 12-25 weeks gestation
  - Intermediate zone → cortical plate → multiple layers

Neurodevelopment
- Organization
  - Differentiation of neurons after migration
  - Processes
    - Neurons attain proper alignment, orientation, and layering
    - Formation of dendritic and axonal processes and synaptic contacts
    - Selective cell death (apoptosis) → elimination of neuronal processes and synapses
    - Proliferation and differentiation of glial cells
  - Disorders lead to behavioral, cognitive issues, ADHD
  - Proper connections are critical for further development
  - Elaborate circuitry of CNS

Myelination
- Begins by 11 wks gestation in the spinal cord...in brain during 3rd trimester.
- Continues into adulthood
- Most rapid phase of myelination occurs during the first 6 months of postnatal life
- In peripheral nervous system, motor roots before sensory...in CNS, sensory before motor.
Posture and Tone

- Explained by progression of myelination
  - Medial Subcorticospinal Pathway 24-30 weeks
  - Lateral Subcorticospinal Pathway 28-34 weeks
  - Corticospinal Tracts term

- Axial extension typically precedes flexion
- Finger flexion precedes extension
- Preference for right-sided head turning

Posture

- At 28 weeks, the quiet infant lies with minimal flexion of the limbs.
- At 32 weeks, there is distinct flexion of the lower extremities at the hips and knees.
- At 36 weeks, flexor tone in the lower extremities gives popliteal angle of 90° and consistent flexion at the elbows.
Early Development of Premies

- **<30 weeks**
  - Remains more or less in a drowsy state
  - Unstable physiologic signs such as cardiorespiratory changes
  - Flaccid muscle tone, few elicited responses and jitteriness
  - Little capacity to stay alert

- **30-34 weeks**
  - Longer periods of alertness, alternating with drowsiness and fussiness
  - Becoming physiologically more stable
  - Maturing motor system: disorganized movement including kicking, hand swiping, and some self-comforting movements
  - Attentive briefly

- **>34 weeks**
  - Neither shuts down nor becomes totally disorganized in the face of external stimuli
  - Shows appropriate signs of distress: crying or squirming in response to appropriate stimuli
  - Is able to be comforted and cuddles
  - Attentive to caregiver
Ex-Utero Neurodevelopment

- Premies on mechanical ventilation: ↓ dendritic spines, abnormally thin dendrites (Takashima et al, Neuropediatrics, 1985)
- Malnutrition has negative effects on organizational events (Cordero et al, 1992; Benitez-Bribiesca et al, 1999)
- Environmental influences on visual cortex organization in rats and monkeys (Sirevaag et al, Brain Research, 1987; Bourgeois et al, Proc Natl Acad Sci USA, 1989)
- Negative effects of *Haemophilus influenzae* in infant rat neuronal growth and synaptogenesis (Averill et al, Exp Neurol, 1976)
- Evidence of anoxia on rat developing cortex (Hicks et al, *Am J Pathology*, 1962)
- Effects of thyroid deficiency on organization of cortex in albino rats (Horn et al, Anat Rec, 1955)
- Negative effects of low protein diet on anatomic development of the rat brain (West et al, Brain Research, 1976)
- Effects of light deprivation on visual cortex (Globus et al, 1967; Valverde et al, 1967)
- Effects of undernutrition on decreased dendritic formation (Pysh et al, 1979; Bass et al, 1970)
- Postnatal development of the visual cortex and the influence of environment (Wiesel et al, 1982)

Natural Environment

- Infant "expects" to develop in the womb.
  - Dark
  - Warm
  - Wet
  - Muted sounds
  - Boundaries
- Improved understanding of the neurodevelopmental expectations of the fetal infant as expressed in the infant’s behavior may provide a reliable basis for the questioning, modification and adaptation of traditionally delivered newborn intensive care.
**NIDCAP (Federation International)**

**Vision**
- All newborn infants in intensive and special care nurseries receive individualized, developmentally supportive, family centered care so that they may realize optimal health and developmental outcome.

**Purpose**
- To serve as the authoritative leader for research, development and dissemination of the NIDCAP and for the certification of trainees, healthcare professionals, and nurseries in the NIDCAP approach

**Mission**
- To develop and support a worldwide collaborative community of trainers, healthcare systems, professionals, families, and other partners to assure that the highest quality of individualized, developmentally supportive, family centered care is available to all newborns in intensive and special care nurseries

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**NIDCAP GOALS**

- To mirror the benefits of the womb for preterm infants, the NIDCAP model minimizes outside stimuli; uses gentle-touch interventions, pain control, and other comfort measures such as swaddling and containment to support a baby during care and at rest; and promotes family bonding and participation in everyday care giving
- To allow the baby to focus his or her energy on sleeping and growing, not on tolerating care
- Observation of the preterm infant’s behavior provides a way to infer the infant’s developmental goals and to assess the infant’s current functional competence and state of equilibrium.

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**Concepts**

- Care is focused on patient in context of family
- Care no longer caregiver-oriented
- Care involves family in supportive education from first day
- Even preterm babies exhibit reliably observable behaviors
- Care is individualized based on behavioral cues of infant at that moment
- We use this information to decrease stress and increase calming behaviors
- Goal: potentially improve neurodevelopmental outcome
**NIDCAP**
- Synactive theory of infant development
- State organization no longer dependent on natural environment (e.g., maternal sleep-wake cycles, maternal hormonal or nutritional cycles)
- Infant must constantly reorganize all behavioral subsystems based on interaction with new artificial environment

**Behavioral Subsystems**
- **Behavioral subsystems**
  - Autonomic
  - Motor
  - State
  - Attentional / interactive
  - Self-regulatory

**Behavioral Subsystems**
- **Autonomic**
  - Respiratory patterns (↑RR or distress with stress)
  - Heart rate changes
  - Color fluctuations (mottling, cyanosis, pallor with stress)
  - GI signs (spitting, residuals, gagging, hiccuping)
  - Tremors, startles

**Behavioral Subsystems**
- **Motor**
  - Facial expressions
  - Truncal tone (↑ or ↓)
  - Arching or giving up
  - Fingers splayed or fist clenched = stress
  - Frequent squirming, extension of extremities = stress

**Behavioral Subsystems**
- **State**
  - Deep sleeping
  - Light sleep
  - Drowsy
  - Quiet alert
  - Active awake and aroused
  - Upset and crying

**Behavioral Subsystems**
- **Attentional / Interactive**
  - Approach vs avoidance
  - Yawning / hands up
  - Extension of extremities
  - Increased arousal / agitation

**Behavioral Subsystems**
- **Self-regulatory**
  - Bringing hands to midline / mouth
  - Peri-oral interest – pacifier
  - Flexion of extremity
  - Grasping

*All of our technological interventions focus on this one system*
Behavioral Subsystems

- Subsystems are interactive
  - Functional state of one system influences the others
  - Stability and efficient functioning of one system leads to more positive functioning of other systems
  - Smooth transition from state to state reflects organization and CNS control
  - NIDCAP uses subsystems to assess infant’s care plan
Clinical Implications

- Environment
  - Lighting
  - Sound

- Care-giving
  - Clustering of care
  - Fewer interventions
  - Infant positioning
  - Supportive behaviors

- Family-centered focus
  - Kangaroo care
  - Encourage visitation
  - Empower parents
Environment

- **Lighting in the NICU**
  - Stress of bright lights
    - Physiologic signs of stress documented
    - Decreased quiet sleep
    - Pupils unable to constrict completely until 28 weeks
    - Humane thing
  - ROP risk
    - Animal evidence of ROP with prolonged, bright light
    - No evidence in humans

- **Circadian rhythms are endogenous to humans, even preterm infants**
  - Average circadian time period in humans = 24.2 hours
  - Solar day is most common external factor
    - Strongest factor = light/dark cycle
    - Lesser factors = exercise, meal times, social activities
  - In utero: infant is exposed to maternal biorhythms
    - Circadian rhythm of fetal heart rate synchronized with maternal rest-activity, heart rate, cortisol, melatonin, and body temperature rhythms is present during the last 10 weeks of gestation.

Environment

- **Physiologic systems related to biorhythms**
  - HR, body temperature, sleep/wake cycles, hormonal secretion (cortisol, ACTH, melatonin)
  - Light/dark differential → retina → suprachiasmatic nucleus → rhythm
  - Cycled lighting > 32 weeks → ↑ wt. gain, ↑ quiet sleep, ↓ nighttime activity

Lighting

- **Keep ambient lighting ~ 20 ftc (dim)**
  - Support areas (e.g. charting, formula prep) away from baby’s bedside have higher lighting

- **New Standards for NICU Design**
  - Use spotlights for procedure lighting (instead of overhead lighting)
  - If spotlights and phototherapy over face → shield eyes
  - No direct line of vision with light source (cover top of incubator)
  - No direct sunlight in baby’s face (shades over windows)
  - Decrease ambient lighting level for a defined time period (7-12 hours) each day
Sound in the NICU

- Stress of loud sounds
- Physiologic evidence
  - ↑ HR, ↑ ICP, ↑ hypoxic events
- Humane thing
- Effect on sleep
  - ↓ quiet sleep = REM sleep
  - Neurodevelopment: best in quiet sleep
- Damage to hair cells
  - Hair cell function
  - Loud noise (>90 dB)
  - Sensorineural hearing loss

Environment

- Sound in the NICU
    - Keep baseline <50 dB
    - Keep transient <65 dB
  - AAP
    - Baseline >45 dB "should be avoided"
  - OSHA
    - Hearing damage >80 dB in adults
    - Hearing needs to be monitored for repeated exposure >85 dB
    - Levels of hearing damage in newborns are unknown.

Environment

- Sound in the NICU
  - Sources of sounds in NICU
    - Background institutional noise
    - Staff generated noise (voices, radio)
    - Closing portholes, cabinets, drawers, tossing garbage
    - Machines: ventilators, copy i
    - Telephones
    - Refrigerators
    - PA systems
    - Monitors, oximeters

- Reality
  - Average NICU baseline = 60-90 dB
  - Continuous background noise of hospital = 45 dB
  - Incubator noise = 40 dB
  - Incubator decreases environmental noise by 20 dB
Environment

- Sound in the NICU (cont’d)

<table>
<thead>
<tr>
<th>Noise</th>
<th>Average (dB)</th>
<th>Peak (dB)</th>
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<tbody>
<tr>
<td>Closing an incubator porthole</td>
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<td>111</td>
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<tr>
<td>Tapping incubator with fingers</td>
<td>70</td>
<td>95</td>
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<tr>
<td>Bumping incub. with metal wastebasket</td>
<td>62</td>
<td>85</td>
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<tr>
<td>Incubator alarm</td>
<td>67</td>
<td></td>
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<tr>
<td>IV pump alarm</td>
<td>56</td>
<td>76</td>
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<tr>
<td>Radio</td>
<td>63</td>
<td></td>
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<tr>
<td>Talking</td>
<td>60</td>
<td></td>
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</tbody>
</table>

Ways to decrease sound:
- Education / awareness
- Sound meters in unit
- No PA system in nursery
- No telephones near babies
- No travel paths / workstations / faucets near babies
- Acoustic ceiling tiles
- Sound thermal glass
- Sound absorbing flooring (carpet best)

Best acoustic protection for infants:
- well-designed incubator
- conscientious staff

Care-Giving

- Scope of problem
  - Infants disturbed >200 times in 24-hr period
  - Care-giving associated with 75% of all hypoxemic episodes

- Clustered care
  - Can vital signs be coordinated with feeds?
  - Can blood draw / x-ray wait until ‘intervention’ time?
  - Can exam wait until later?
  - Can physicians do exam together?
  - Do more noxious event last

- Fewer interventions
  - Do you need blood draws as often?
  - Can you decrease labs?
  - Is daily weight necessary?

- Pain assessment
  - Anticipate pain with procedures
  - Pre-terms can have increased pain response
    - Hypersensitivity
    - Allodynia
  - Pacifier / sucrose 2 mins before and after every procedure
  - Breastfeeding / kangaroo care
  - More complex pain control for more painful procedures
**Care-Giving**

- Infant positioning
  - Prone / supine
  - Neuromuscular development
    - Shortening of muscles / abnormal function
    - Decreased joint mobility
    - Decreased muscle strength
  - Self-regulating behaviors
    - Hands toward face
    - Flexion of extremities
    - Support for feet
    - ‘flexion and containment’
    - ‘Facilitative tuck’

**Importance of Positioning**

- Abnormal Positioning leads to:
  - Development of postural and skeletal deformities of the skull and spine and preferential gaze
  - Fine motor delays due to shoulder girdle tightness as a consequence of keeping arms in “W” position
  - Developmental delay of visual skills and functional preference for the right hand, inability to perform midline tasks or poor self-regulation
  - Gross motor delays including lower extremity tightness at hips, knees and ankles.
    - Leg positioning in “frogged” or “M” position
    - Influence on rolling, sitting, walking, crawling

- Good positioning promotes:
  - Postural and structural alignment
  - Self-regulation by encouraging hand-to-mouth activity
    - Less crying, conservation of calories for growth
  - Development of neuronal pathways and CNS organization
  - Decreased stress and agitation
  - Development of fine motor skills and shoulder girdle strength
  - Development of gross motor skills

Care-Giving

- Supportive behavior
  - Non-nutritive sucking
    - Suck = 12 wks; swallow = 26-28 wks; coordinated = 33-34 wks
  - Provide pacifier with NG feeds
    - ↓ defensive behaviors during tube feeding
    - ↓ time in fussy and active states w/tube feed
    - ↓ latency to sleep
  - Cochrane review (2005)
    - Easier transition to full enteral feeds
    - Easier transition to bottle feeds
    - ↓ LOS
    - No change in weight gain
    - No negative outcomes

Family Centered Care

- Kangaroo care
  - Skin-to-skin contact between infant and parent
  - Chest-to-chest
  - Upright prone position
  - Parent becomes thermal source

Kangaroo Care

- History
  - Beginnings unknown
  - Pre-supplemental heat source / radiant warmer
- Modern concept
  - 1983: Bogota, Columbia
  - WHO interest → developing countries
  - Research focus
    - Safety
    - Efficiency at temp control
  - 1987 - Introduced in U.S.
  - Susan M. Ludington, CNM, PhD
  - Kangaroo Care Research – Case Western Reserve

Kangaroo Care

- Process
  - Nurse moves baby and arranges tubes/connections, etc.
  - Level of acuity: determined by nurse and parent
  - Parent holds baby skin-to-skin
    - Diaper on
    - Cover over baby
    - Hat on small babies
  - Prolonged period (minimum 1 hour)
Kangaroo Care

- Parent gently rub infant's back, lightly rock, massaging, talking with infant, watch infant very closely
- Minimal interruption by nursing staff
- Infant remains monitored

In our units, Kangaroo Care is an expectation for stable infants. It has been added to our admission orders.

Kangaroo Care

- Maternal – infant bonding
- Family climate
  - Parents more prone to sensitive caregiving
  - ↑ positive perception of baby
  - ↑ state of readiness to detect and respond to infant’s cues
  - Stressful situations: mothers more competent
- Breastfeeding at discharge
  - Increased breastfeeding rates at discharge
  - Mother exposed to NICU pathogens via KC → antibodies
  - Mothers produce larger volumes of milk/longer period of lactation with KC

Kangaroo Care

- Physiologic effects
  - Less periodic breathing
  - Decreased stress markers
    - HR, BP, pulse oximetry, crying
  - Better temperature control
    - 11 studies: infant warming to slightly greater than baseline temp
    - 4 published studies: infant warming to baseline temp
    - 1 study: infant cooled but still within neutral thermal range
  - Increased daily weight gain
  - More quiet sleep
  - Oxygen requirement stable or decreased
  - Decreasedumber & severity of infections
    (inconsistent in studies)

Family Centered Care
**Family Centered Care**

- Twins/multiples in same incubator or crib
- Co-mattressing = separate blanket, same crib
  - Keeps them from being separated
- Co-bedding = same blanket, same crib
  - Promote similar biorhythm
  - Aid each other with warmth

**Family Centered Care**

- Visitation
  - Goal: encourage parental care of infant
  - Encourage support circle to visit
  - Allow as open visitation as possible
  - Visitors don’t increase infection rates
  - Prevent NICU parenting disorder
    - Abandonment
    - Neglect
    - Psychological disconnect

**Family Centered Care**

- Empower parents
  - Allow them to do much of infant’s care
  - Never tell parents not to interact with infant
  - Personalize infant’s space
- Advantages:
  - Improved satisfaction with care
  - Decrease parental stress
  - Increase parental comfort & competence with post D/C care
  - Decrease readmissions post D/C
  - Increase in success with breastfeeding
  - Decrease LOS
  - Increase staff satisfaction

**Family Centered Care**

1979: Dr. Adick Levin
- NICU established at Tallinn Children’s Hospital, Tallinn, Estonia
- 35 beds (infants <37 weeks)
- Nursing shortage → mothers called on to provide care
  - Stayed with infant until discharge
  - Moms taught to care for babies
  - 24/7 care by mothers w/assistance
  - Nurses gave meds
  - Nurses consulted with moms re: BF
Tallinn Children’s Hospital

- Dominant features
  - 24/7 care by mothers
  - Minimize exposure to infection (↓ contact between baby & staff)
  - Promoting breastfeeding
  - Using technology as little as possible
  - “hands off” approach

- Results
  - ↓ infections in infants
  - ↓ need for antibiotics
  - ↓ need for IVF
  - ↑ breastfeeding rates
  - Family social & psychological development improved
  - Mothers recovered from childbirth faster
  - ↑ maternal confidence in caring for infant
  - Mother-infant attachment enhanced

Family Centered Care

- Experience repeated with similar benefits:
  - Baragwaneth, South Africa
  - Addis Ababa, Ethiopia
  - Buenos Aires, Argentina
  - Santiago, Chile
  - Highwycombe, UK

Family Centered Care

- 1993: Pediatrics
- Helen Harrison (The Premature Baby Book) and Dr. Jerold Lucey
- Conference: 10 sets of parents of NICU babies
- Well-educated, in healthcare field
- Burlington, VT
- “Principles for Family-Centered Neonatal Care”

Family Centered Care

- “Principles for Family-Centered Neonatal Care”
- Based on open and honest communication between parents and providers on medical and ethical issues
- Information often vague, euphemisms used, half-truths, shielded from uncertainties or controversies
- To make informed decisions, parents must have the same facts and interpretation of those facts as the professionals
- Parents should have (or be told) all evidence to support therapy. If treatment is not used in most NICUs, provide information to support non-standard therapies. Participation risk in trend discussions.
- In situations with high morbidity or mortality, great suffering or significant medical controversy: fully informed parents should have right to make decisions regarding aggressive therapy for their infant.
  - Parents should be part of discussions in situations in which benefits of therapy are less than 60%.
Family Centered Care

- Expectant parents should be told about adverse outcomes and allowed to state in advance their treatment preferences if baby is born critically ill or extremely prematurely.

- Parents and professionals must work together to acknowledge and alleviate the pain experienced by infants in the NICU.
  - Some physicians still don’t acknowledge pain in neonates; parents see pain as a moral and medical issue; discussions of pain management should include parents.

- Parents and professionals must work together to ensure an appropriate environment for babies in the NICU.
  - The prudent and humane course is to protect babies as fully as possible from unnecessary light, noise, handling, uncomfortable positioning and deep disruption.

- Parents and professionals should work together to ensure the safety and efficacy of neonatal treatments.
  - Treatments offered to babies should be used in the context of properly controlled trials; regression not tested for safety and efficacy should have controlled trials.

- Parents and professionals should work together to develop nursery policies and programs that promote parenting skills and encourage maximum involvement of families with their hospitalized infant.
  - Parent support groups are helpful; network with other ‘veteran’ parents; allow liberal visits for relatives, siblings and family friends; NICU staff should encourage parents to assume nonmedical aspects of care and encourage ‘rooming in’ before D/C.

- Parents and professionals must work together to promote meaningful long-term follow-up for all high-risk NICU survivors.
  - All centers must provide follow-up services (some don’t); must continue to provide services x 3 yrs; better consistency of documentation/services so that meaningful data can be obtained to improve care.

- Parents and professionals must acknowledge that critically ill newborns can be harmed by overtreatment as well as by undertreatment; our laws and treatment policies must be based on compassion.
  - Rebut the notion that our infants are well-served by laws mandating life-sustaining treatment without regard to pain and quality of life; insist on rights and responsibility to ‘say no’ on behalf of your infant to burdensome, painful and unproven therapies.
Supporting Research

- Infants in NIDCAP had shorter stays on respirators, supplemental oxygen and feeding tubes (Becker 1991, Als 1994)
- NIDCAP babies started oral feeding sooner and had better average daily weight gain, shorter hospital stays and improved overall behavioral functioning (Fleisher 1995, Als 1994)
- NIDCAP babies showed reduced need for tube feeding, positive airway pressure and LOS (Fleisher 1995)
- Hospital costs were lower for NIDCAP babies (Fleisher 1995)
- VLBW NIDCAP participants have shorter duration of intravenous nutrition, shorter time to full oral feeds, shorter duration of intensive care and LOS, lower incidence of NEC, lower age at discharge, lower hospital charges, improved weight, length and head circumference (Als 2003)

- No difference in pain profile during eye exams but behavior scores were better in the NIDCAP group (Kleberg 2008)
- No difference in neurologic outcomes, mental or psychomotor outcomes at 1 or 2 years of age (Maguire 2009)
- Significant improvement in both short and long-term outcomes (Peters 2009)
- No difference in health related quality of life reported by parents (van der Pal 2008)
- NIDCAP babies had a significantly lower incidence of developmental delay and scored significantly higher than the control group on mean mental and physical indexes at 12 and 24 months corrected age (Resnick 1987).

Supporting Research

- NIDCAP infants had improved behavioral organization at 2 weeks and 9 months corrected age (Becker 1991)
- NIDCAP infants have enhanced autonomic, motor, state, attention, and self-regulatory functioning following the intervention compared with the control group (Als 2003)
- Preterm NIDCAP infants had better outcomes than non-NIDCAP infants in terms of behavioral performance and in the amount of activity found in the frontal lobe of the brain (Beuhler 1995)
- 8-year follow up found better right hemisphere and frontal lobe function in NIDCAP group (McAnulty 2009).

### Table: Variable Comparison

<table>
<thead>
<tr>
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<th>Control (n=51)</th>
<th>Experiment (n=56)</th>
<th>P value</th>
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<tbody>
<tr>
<td>Daily weight gain</td>
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<td>23</td>
<td>0.007</td>
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<tr>
<td>Vent. days</td>
<td>48</td>
<td>27</td>
<td>0.005</td>
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<tr>
<td>Oxygen days</td>
<td>106</td>
<td>60</td>
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<tr>
<td>Gavage days</td>
<td>87</td>
<td>55</td>
<td>0.03</td>
</tr>
<tr>
<td>Hospital days</td>
<td>128</td>
<td>84</td>
<td>0.007</td>
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<tr>
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<td>19</td>
<td>0.005</td>
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<td>46</td>
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<td>11, 34, 1, 0</td>
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### Supporting Research
- **NIDCAP studies – Als 2004 (cont’d)**

Bayley Scales of Infant Development, 9 months C.A.

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<th>Variable</th>
<th>Control (n=13)</th>
<th>Experiment (n=12)</th>
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<tr>
<td>MDI</td>
<td>96.55 (21.42)</td>
<td>116.24 (18.22)</td>
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<tr>
<td>PDI</td>
<td>84.29 (19.24)</td>
<td>99.18 (17.30)</td>
<td>0.0002</td>
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### Supporting Research
- **Dr. Westrup: Karolinska Institute, Stockholm (2000)**
  - First RCT outside of US
  - NIDCAP vs conventional care
    - Separate rooms (NIDCAP vs conventional)
    - Weekly NIDCAP assessments
  - <32 weeks, on ventilator at 24 hours
  - Mean birth weights: 840 g (C) vs 1083 (E)
  - Primary endpoints
    - Need for ventilatory assistance
    - Growth parameters
    - Hospitalization
  - Early termination
    - Nurses felt discomfort & disloyalty to controls (ethical pressures)
    - Spillover of staff when staffing was 'tight'

### Supporting Research

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control (n=13)</th>
<th>Experiment (n=12)</th>
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<td>Days on CPAP</td>
<td>44.1</td>
<td>27.0</td>
<td>0.045</td>
</tr>
<tr>
<td>Age at O₂ withdrawal</td>
<td>38.1</td>
<td>37.9</td>
<td>0.007</td>
</tr>
<tr>
<td>Days mec vent.</td>
<td>4.8</td>
<td>2.8</td>
<td>NSS</td>
</tr>
<tr>
<td>Mean OFC (cm/wk)</td>
<td>0.63</td>
<td>0.80</td>
<td>NSS</td>
</tr>
<tr>
<td>Weight gain (gm/d)</td>
<td>9.8</td>
<td>11.0</td>
<td>NSS</td>
</tr>
<tr>
<td>BPD: none, mild, mod, sev (at 16 wks)</td>
<td>5, 2, 4, 2 All needed O₂</td>
<td>6, 6, 0, 0 None needed O₂</td>
<td>N/A</td>
</tr>
<tr>
<td>Discharge age</td>
<td>41.0</td>
<td>41.1</td>
<td>NSS</td>
</tr>
</tbody>
</table>

### Supporting Research
- **Cochrane Review -- 2006**
  - 36 eligible RCT
  - Problems with analysis per Cochrane
    - 19 major interventions studied
    - No two studies measured identical interventions
    - Variable sample sizes – most small
    - Some NIDCAP nurses, some not
    - Difficult to compare severity of illness between subjects
    - Impossible to blind to caregivers
    - Some did not blind to assessors of data
    - Contamination of controls with DC practices
    - Old studies (back to 1980)
    - Some missing data unable to obtain for meta-analysis
    - Few trials were evaluated for each specific intervention
Cochrane Review 2006

- Inconsistent Results
  - ↓ LOS
  - Physiologic stability: ↓HR, ↓RR
  - ↓ days to full oral feeds
  - ↑ OFC gain
  - ↓ days on mech. ventilation
  - Improved daily weight gain
  - ↓ age at oxygen withdrawal
  - ↓ days on CPAP
  - ↓ hospital charges
  - Improved NB outcomes
    - 2 weeks, 9 months, 12 months

- Statistically significant findings
  - ↑ quiet sleep
  - ↓ BPD (moderate/severe)
  - ↓ NEC
  - ↓ family stress
  - ↑ family perception of child
  - ↑ behavior & motor skills at 5 y.o.

Supporting Research

- Cochrane Review (2006) conclusions:
  - Evidence of limited benefits of developmental care
  - No major harmful effects
  - Interventions demonstrate promising results
  - Interventions should be studied further in more consistent RCT

Implementation

- Commitment from all staff to change philosophy of care
  - Nurses & physicians
  - ‘all about me’ → ‘all about baby’
  - Give up control → give some to families

- Commitment from hospital / nursing administration
  - Training of all NICU staff
  - On-going education of new nursing hires
  - Allow nursing judgment and flexibility (e.g. after VS times)

- NICU design
  - Family space
  - Comfortable furniture
  - Environmental issues
    - Light
    - Sound
NIDCAP Certification

- The nursery applicant reviews the NIDCAP Nursery Certification Program: A Guide to Preparation, Application and Implementation of NIDCAP Nursery Certification in order to determine if the nursery is eligible for NIDCAP Nursery Certification;
- If eligible, the nursery applicant submits the NNCP Application: Part I and all supporting evidence;
- Should the NNCP Application: Part I be approved by the NNCP Director, the nursery applicant is then invited to submit the NNCP Application: Part II, Nursery Self-Assessment Questionnaire, the scored NIDCAP Nursery Certification Criterion Scales (NNCCS) as well as the completed NNCCS: Provision of Evidence;
- Once the NNCP Application: Part II is reviewed and approved by the designated NNCP Site Review Team, the NNCP Director, in collaboration with the nursery applicant and the Review Team, develops the NNCP Site Review Schedule. This schedule addresses the dates and times that particular activities (e.g., observations, interviews, chart reviews, etc.) will be conducted, and specifies the logistics for the site visit (see Preparation for the NNCP Site Review);
- NNCP Site Review: The nursery applicant is evaluated by three NNCP Site Reviewers, during a two- to three-day Site Visit, depending on the nursery’s size and complexity. This is followed by a one-day off-site, yet on-location, Site Review Team integration day to review the results of the site assessment; and
- Following the integration of the Review Process the NNCP Site Review Team develops an NNCP Summary Report and Recommendations that are shared with the NNCP Steering Committee and subsequently forwarded by the NNCP Director to the NFI Board of Directors. The NFI Board decides on the ultimate disposition of the application. Upon such disposition the nursery applicant receives the Review Team’s Summary Report and the NFI Board’s decision as to the application’s disposition.

NIDCAP Cost

- NNCP Application: Part I..........................USD 1,500.00
- NNCP Application: Part II..........................USD 9,000.00
- NNCP Site Review Visit............................USD 18,720.00*
- Total..................................................USD 29,220.00
  *Based on a three-day Site Visit.

- Does not include costs of renovations or upgrades.
- Process takes at least one year, 16 months is common, 2 years is not rare.

From www.nidcap.org

All NICU care is brain care.

Heidelise Als, PhD, Department of Psychiatry, Harvard Medical School, Children’s Hospital, Boston, 2006

For info about the organization, the program, conferences, certification and training.