Developmental Care:
Best Practice in the Neonatal Intensive Care Unit

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Objectives:

- What is the History of the NICU
- Identify Levels of Neonatal Intensive Care Units
- Understand the Synactive Theory of Neurobehavioral development
- Identify neonatal behavioral organization
- Define Developmentally Supportive Care
- Understand basic fetal, brain, and sensory development of the neonate
- Understand the Scope of Practice for a Neonatal Therapist
- Identifying evidenced based research supporting long term outcomes

What is the History of the NICU

Timeline

1880 - Stephane Tierne invented the first incubator
1893 - First special care unit for preterm newborns in Paris (Dr. Pierre Budin)
1896 - Physicians Alexandre Lion, Martin Couney, and Pierre Budin continued as pioneers in the evolution of the incubator. Soon after they introduced the incubator to the United States
1898-1943 – “Incubator Baby slide shows”
Preterm infants coined as congenital weaklings

1930s-1960s - Julius Hess (American Physician) known as the father of Neonatology, created advanced incubators in which oxygen can be delivered to the babies, he tied together many strands of the development of neonatology
1960s-70s – Brazelton’s NBAS (Neonatal Behavior Assessment Scale)
**WHAT IS THE HISTORY OF THE NICU**

**Timeline**
- 1985 – NIDCAP (Newborn Individualized Developmental Care and Assessment Program), concern for how environmental factors effect babies outcomes (Als)
- 1982 – APIB (Assessment of Preterm Infants Behaviors)
- 2000s –
  - Individualized
  - Relationship-based
  - Family Centered
  - Developmentally supportive care

**STATISTICS**
- 380,000 babies are born each year in the United States.
- 13 million pre term deliveries (any baby born less than 37 weeks GA) occur per year around the world with an overall incidence of about 10% percent
- In technologically advanced areas, the incidence carries from 5-12%
- In areas that are less developed, it maybe as high as 40%
- Infants born at 24 weeks have a survival chance of 50% in modern tertiary care centers
- 98% of infants born after 28 weeks survive
- Major disability rate for infants born at or below 25 weeks stands at about 25%
- Infants 25-27 weeks ga at about 15%
- 10% dc home with no major disabilities at 23 weeks
- 25% dc home with no major disability at 24 weeks
- 35% dc home at 25 weeks with no major disability
- 50% dc home at 26 weeks or greater with no major disability

**Preterm Birth: Risk Factors**
- Risk Factors:
  - Previous preterm birth
  - Multiple births
  - Medical conditions
  - UTI
  - Obesity
  - Being Under weight
  - Sexually transmitted diseases
  - Injurious drugs
  - Stress
  - Domestic Violence
  - Drugs
Preterm Birth: Risk Factors

- Diabetes
- High blood pressure
- Late or no health care during pregnancy
- Smoking
- Certain racial and ethnic groups
- Drinking alcohol

NICU Basics

- NICU levels of care
- Classification of age
- Prematurity classification
- Birth weight classification
- NICU environmental considerations and equipment
- NICU baby families
- Common diagnoses in the NICU

NICU Levels of Care

Level I: Well baby nursery
- Evaluation and postnatal care of newborns
- Neonatal Resuscitation
- Stabilization until transfer to facility at which specialty care is provided

Level II: (A-B) Transitional nursery - Need continuous ongoing care
- "Feeders and growers"
- Level II (A) No capabilities of ventilation
- Level II (B) can provide mechanical ventilation for brief durations (24 hours)
- Birth weight < 1500 grams
- Resuscitation and stabilization before transfer to NICU
**NICU Levels of Care**

**Level III (A-D) Neonatal Intensive Care unit**
- Medically complex
- Babies on ventilators
- Babies requiring major surgeries

> Level III (A) hospital and or state mandated restriction on type of mechanical ventilator
> Level III (B) No restrictions on type of mechanical ventilation
> Level III (C) Major surgery performed on site, no surgical repair of serious congenital heart anomalies that require ECMO
> Level III (D) or Level IV Major surgical repair or serious congenital heart anomalies that require cardiopulmonary bypass and or ECMO

**Classification of Age**

- Gestational age (GA)
- Post Conception Age
- Chronological age
- Corrected Age

**Prematurity Classification**

- Prematurity = 28-37 weeks GA
- Micro Premie = <28 weeks GA
- Full Term = 37-42 weeks GA
- Post Term = > 42 weeks GA
Birth Weight

- Normal - > 2500 grams (8 oz)
- Low birth weight - 1500-2500 grams (5 oz)
- Very low birth weight - 1000-1500 grams (3 oz)
- Extremely low birth weight - <1000 grams

Environmental Considerations: Open Bay vs Single Room

Environmental Considerations: Equipment
Environmental Considerations: Noise

**Table: Noise levels**

<table>
<thead>
<tr>
<th>Quality</th>
<th>Peak Intensity, dBA</th>
<th>Example</th>
<th>Impact on baby</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiet</td>
<td>30-50</td>
<td>Whisper</td>
<td>Background</td>
<td>20 dBA desired for sleep</td>
</tr>
<tr>
<td>Very quiet</td>
<td>0</td>
<td>Rustling</td>
<td>Sleep on and off</td>
<td>20 dBA desired for speech</td>
</tr>
<tr>
<td>Moderate</td>
<td>60</td>
<td>Vacuum cleaner</td>
<td>Squeaking rubber tire</td>
<td>Taping incubator with tape</td>
</tr>
<tr>
<td>Loud</td>
<td>90</td>
<td>Power washer</td>
<td>Spraying water from hose</td>
<td>Closing the metal window doors on the incubator</td>
</tr>
<tr>
<td>Very loud</td>
<td>120</td>
<td>Power motor</td>
<td>Closing solid plastic conduit</td>
<td>Hearing loss with persistent exposure</td>
</tr>
<tr>
<td>Uncontrollable</td>
<td>140</td>
<td>Bouncing baby in chair</td>
<td>Crying</td>
<td>Pain and distress</td>
</tr>
</tbody>
</table>

Environmental Considerations: Noise and Lighting

- No noise > 45 decibals
- Decrease loud noises at the bed side including our speaking voices
- Avoid direct light to newborns eyes at all times.
- Use natural light when able (regulates circadian function)
- Cyclic lightening (12 hours on 12 hours off)
- Protect and facilitate REM sleep
- Know the light equipment lux levels to adjust and reduce infant exposure

Families

- Families in crisis
- Unexpected delivery
- Family unit is separated
- Overwhelming NICU environment
- Decreased effective communication
- Financial considerations
- Maternal Health
- Transportation or travel issues
- Loss, shock, grief
- Maternal depression and coping
Common Diagnoses in the NICU

- Prematurity
- Maternal complications
- Low Apgar scores
- Neurologic disorders
- Meconium aspiration
- Dysmorphic or genetic abnormalities
- Viral bacterial Infections
- Drug/Alcohol exposure

- Prolonged rupture of membrane
- Respiratory distress syndrome
- Rule out sepsis
- Cardiac deficits
- IUGR, SGA, LGA
- Neuromuscular disorders
- Infants requiring Echmo or Nitric Oxide
- And the LIST GOES ON and ON

Theoretical Frameworks

- Dynamic systems theory
- Attachment Theory
- Family centered care
- Synactive Theory
Dynamic Systems Theory

Attachment Theory

"A bond between an infant and a caregiver, usually its mother. Attachment is generally formed within the context of a family, providing the child with the necessary feelings of safety and nurturing at a time when the infant is growing and developing. This relationship between the infant and his caregiver serves as a model for all future relationships" (Gale, 2005)

Family Centered Care

- Family/Caregivers are the Center
- Developmental care
- Parent/caregiver education
- Individualized treatment plans
- Supporting and Collaborate
Synactive Theory of Development

Als proposed that developmental processes are based on the neurodevelopmental subsystems interactions with neonates internal functioning, its environment and caregivers.

- Hierarchical and independent organization of subsystems.
- Stability and differentiation of each subsystem emerges subsequently.
- Neurobehavioral development is influenced by environmental.
- Infants actively attempt to modulate their environment.
- Infants continue to communicate their levels of stress and stability through approach and avoidance behaviors.

Identifies 5 separate but interdependent subsystems of behavioral maturation:

- **Autonomic**: breathing, HR, color, GI function, involuntary muscle actions.
- **Motor**: infants muscle tone, posture, movement, and habituation of movement.
- **State**: deep sleep, light sleep, drowsy, quiet awake, active awake, crying.
- **Attention**: interaction.
- **Self-regulation**: the task of the NICU infant.

Achieved when the challenges of the task meet the competencies of the infant.
Synactive Model of Infant Behavioral Organization

**State & Attention**
- Restless, irritable, rapid state changes, eye floating, roving eye movements, glassy-eyed alertness, staring, hyperalert, frenzy, whimpering, crying, inconsolable

**Motor**
- Tremors, startles, deviations or hypokinesia, hand postures, head postures, face expressions

**Autonomic**
- HR and BP changes, increased oxygen, decreased oxygen

**STRESS/INSTABILITY**
- Defensive, Avoidance Behaviors
  - Restless, irritable, rapid state changes, eye floating, roving eye movements, glassy-eyed alertness, staring, hyperalert, frenzy, whimpering, crying, inconsolable

**STABILITY**
- Approach Behaviors
  - Smooth, well-modulated posture & tone, hand/hand search, smooth, regular respiratory rates, stable heart rates, stable SpO2, pink in color, stable viscera with no hiccups, gags, emesis or grunting

**Autonomic**
- Signs of stress:
  - Physiological instability including respiratory changes (Pauses, tachypnea, gasping)
  - Color changes (changes to mottled, flushed, pale, dusky, cyanotic, gray or ashen)
  - Visceral responses (including hiccups, gagging, spitting up, grunting, straining)
  - Motor: Tremors, startles, twitching, coughing, sneezing

- Signs of Stability:
  - Smooth, regular respiratory rates, stable heart rates, stable SpO2
  - Pink in color
  - No signs of tremors, startles, twitching, gasping, straining, grunting
### Motor

**Signs of Stress:**
- Fluctuating tone, uncontrolled activity
- Flaccidity (e.g., gape face, low tone in trunk, limp lower extremities and upper extremities)
- Hypertonicity (leg extension and sitting on air, upper extremity salutes, finger flics, and fistling, trunk arching and tongue extensions)
- Hyperflexions (trunk, lower and or upper extremities, frantic, diffuse activity extremities)

**Signs of stability:**
- Consistent tone, controlled activity, trunk and extremities appropriate for post-conceptual age
- Smooth-controlled posture, movements of extremities and head
- Motor control can be used for self-regulation

### State

**Signs of stress:**
- Diffuse or disorganized state including range and transition
- During sleep notes twitches, sounds, whimpers, jerky movements, irregular RR, fussy, grimmaces
- During awake state abrupt changes, eye floating, glad eyes, gaze aversion, worried or dull look, hyper-alert, panicked, weak cry, irritability

**Signs of stability:**
- Clear state
- Well-defined sleep states, smooth transitions between states
- Good self quieting and consolability, focused, Clear alertness, robust cry

### Attention/Interaction

**Signs of stress:**
- Effort to attend and interact to specific stimulus elicits stress signals of other subsystems
- Autonomic: Irregular RR, color changes, visceral responses, coughs, yawns, sneezes, sighs, straining, tremors, twitches
- Motor state: Fluctuating tone, frantic diffuse activity, eye floating, glassy eye, hyperalert, panicked, worried, gaze aversion, week cry, irritability, becomes stressed if more than one type of stimulus is given at a time, abrupt state changes

**Signs of stability:**
- Responsive to auditory, visual and social stimulation, actively see out auditory stimulus
- Able to shift attention, smoothly from one stimulus to another
- Face demonstrates bright-eyed purposeful interest varying between arousal and relaxation
Self Regulation

- Infants use of physiologic, motor, and state strategies to move independently to a sleep or calm-alert state
- Infant’s efforts to achieve, maintain or regain balance and self organization

Stress/Avoidance vs. Readiness/Approach Signs Examples

- [Images of signs examples]
States/Behavioral Organization (Als.)

- Deep sleep (quiet)
- Light sleep (active rem)
- Drowsy (sub optimal for feeding, infants may not transition to higher state, transitional state)
- Quiet alert (best for treatment interventions)
- Active Alert
- Crying (stress)

Video Reference:
http://www.youtube.com/watch?v=bgTVnxBfg8q

Deep Sleep

- Stable and Organized: Sleeps with regular breathing, relaxed and no activity
- Stress and Disorganized: Sleeps with startles, jerks and tremors, irregular breathing
Light Sleep

- Organized: Low activity level, some startles and some sucking
- Disorganized: Diffuse movement, whimpering, irregular breathing, facial twitching

Drowsy

- Organized: Drowsy with low activity, facial grimaces, vocalization.
- Disorganized: Drowsy with glassy eyed dazed look, diffuse movements, many vocalizations, newborn sounds, grimacing.

Quiet Alert

- Organized: Quiet Alert, minimal activity, bright focused attention, low or minimal activity.
- Disorganized: Hyper-Alert: awake, eyes wide open, frantic look, intense. Lidded-Alert: awake, quiet, alert, appears fatigued, eyes glossed over
Active Alert

- Organized: Awake, aroused, smooth active movements
- Disorganized: Awake and alert, distressed face

Crying

- Organized: Strong Rythmical
- Disorganized: Weak/strained cry with grimace

Theoretical Framework to NICU Practice

- Developmentally supportive care has emerged from the Synactive Theory to what is now the NIDCAP (Newborn Individualized Developmental Care and Assessment Program)
- It is a multidisciplinary approach to care
- It begins at the birth of the infant rather than once the infant is medically stable
NIDCAP

- Aims to create a relationship-based developmentally supportive environment for preterm infants and their families
- The approach is based on three assumptions (Als, 2009)
  - Observation of infant behavior
  - Care-giving staff benefits from supportive education
  - Changes and adaptations of care lead to improved medical well-being

NIDCAP Research Trials

- Several Randomized Controlled Research Trials
- Consistent evidence to support the following:
  - Improved lung function
  - Feeding behavior and growth
  - Reduced length of hospital stay
  - Improved neurobehavioral, neurophysiological, and neurostructural functioning
What is Developmentally Supportive Care?

- Reflective, self-aware practice as a framework of practice versus task-oriented, intensive care work.
- Relationship engagement excellence
- Technical skills in the face of physical and emotional vulnerability
- Reduce the discrepancy between the womb and the NICU environment
- Take into account the infant’s current thresholds of behavioral organization

What is Developmentally Supportive Care?

- Diminishing stress and supporting each infant’s strengths and competencies
- Interventions tailored to meet the unique needs of infants
- Each infant is an active participant in all care
- Family is valued as infants most consistent nurturer
- Infant and parent must receive individualized support throughout the NICU hospitalization for optimal outcomes.

Developmental Care is Family Centered Care

- Recognizes family as the constant in the child’s life
- Involves families in planning, delivery and evaluation of health care services
- Fosters independence and empowerment while providing support
- Promotes individualization of care
Developmental Care is Family Centered Care

- Allows unrestricted access to their infant
- Assess the emotional well-being and competence and evolving confidence in parenting their infant
- Access to resources and supports that assist them in their short and long term parenting needs

The Impact of Developmentally Supportive care on Brain and Sensory Development

- Premature infants are fetuses developing rapidly in an extrauterine setting
- Brain growth is developing more rapidly than any other time throughout their life
- Infants expect 3 secure environments, the womb, parents body and community
- The intensive care unit provides challenges for the growth and development of the brain and sensory systems
- The brain and the sensory systems are continuously dependent on each other for normal structural and functional development
- Adverse sensory stimulation, repeated painful or stressful procedures alter intracranial pressure and cerebral blood flow

The Impact of Developmentally Supportive care on Brain and Sensory Development

- The neurologic and sensory systems DO NOT exist as separate entities
- Every sensory experience is recorded in the brain > behavioral response > sensory experience.
- When premature infants have sensory experiences that are inappropriate for their stage of development > neurodevelopment occurs differently than it would have in the womb.
- Different neurosensory and neurobehavioral outcomes in premature vs. term
A look at embryonic and fetal development

"When we touch the skin we touch the brain."

Unknown
The Brain Basics

Frontal Lobe
Basal Ganglia
Parietal Lobe
Brainstem
Temporal Lobe
Spinal Cord
Occipital Lobe
Dura
Cranium
Cortex
Cerebellum

Brain Development

- Organization (24 weeks to post birth): the "wiring" of the brain.
- Organizational disorders result in altered functioning and learning in the brain
- Myelination (8 months to post birth)
  - Involves forming supportive tissues around nerve cell to promote effective communication between the areas of the brain.

Wider Than The Sky

Video reference:
https://youtu.be/MSSHUDVNbGs
Brain Development

- Cephalocaudal or also known as top-down; head to toe – Term infants
- Development of the head and brain tends to be more advanced than the rest of the body.
Brain Development

Prematurity leads to infants initially developing Caudo-Cephalic; toe to head or also known as bottom up. Involuntary and unconscious > related to physical effects of environmental stimuli. For example: withdrawal from heel sticks promotes flexion of the LE’s. Babies rely on the bottom up – this becomes a cycle due to the early birth which is traumatizing for the infant and then becomes a Top-Down progression.

Brain Development

Cognitive structures of the brain impact the emotional and instinctive systems as well as motor development. Regulation of the Nervous System impacts Cognition. Affects the physical then the cognition - later impacts the emotional and instinctive systems.

Sensory Development
Sensory Development

- Develop in the following order from early gestation forward:
  - Tactile and Proprioception
  - Vestibular
  - Chemoreceptive- Gustatory and Olfactory
  - Auditory
  - Visual

Tactile System

- Tactile system is fully developed at 23 weeks GA, the first system to fully develop
- Touch Develops first around the mouth—
  - Head— Toe (mouth hands and feet are most sensitive)
- 24 weeks GA infants are sensitive all over the body
- Only one that is fully myelinated at birth
- “Touch is the foundation of all experiences”
- Touch is the only sense we cannot live without!
Vestibular System

- Helps to stand up right against gravity, stabilize visual field, detect head movement and gravitational pull, impacts emotional regulation.
- Early in utero at 10 weeks joined with cochlear system in the ear.
- 23-24 weeks GA semi-circular canals function.
- Moro reflex is present at 30 weeks GA.
- Full moro response at term.
- Muscle tone is influenced by this system.

Chemoreceptors

- Chemoreceptors.
- Recognition of parent.
- Development of attachment.
- Feeding and later dietary preference.
- Olfactory is imbedded in mucus.
- Olfactory tract transmits the signals to the olfactory cortex and limbic system.
- Smell is linked to memory.
- Taste buds are on the tongue and soft palate.
- 14-17 weeks GA taste buds are detected.
- 24-27 weeks GA infants react to bitter tastes.
- 28-29 weeks GA infants react to sweet and sour.
- 30 weeks infants have presence for some tastes.
- By end of the last trimester swallow huge amounts of amniotic fluid and taste different flavors.

Auditory System

- Auditory.
- Auditory systems are in place at 24-25 weeks GA.
- At 24 weeks GA, infants move in response to loud noise.
- At 26-28 weeks GA loud noises can produce physiological changes in HR, RR, BP and O2 saturations.
- At 28 weeks GA infants can discriminate loud pure tones between mother and father.
- Hearing maturation for auditory processing continues to develop through 40 weeks.
Visual System

Vision
- Structures in place 23-24 wks
- Maturation and differentiation active until early infancy
  - At term: attend to forms, objects, faces and able to track horizontal, some vertical
  - See object to 2.5 feet and attend best at 8-12 inches
- Human face is preference
- Vision is the last system to fully develop

“Experience is the Sculpture”
Heidelise Als

Implications for the NICU
- Provide infant-driven family-centered, developmentally supported care
- NICU care is Brain Care!
- We must consider the developmental age of the infant before providing interventions
- Provide intentional bedside care
- Understand that we are visitors in the home of these tiny newborns and their families
- Collaborate with one another
- Consider your team members as supportive allies rather than competition
- Modify the environment
- Provide infant-driven assessment and intervention
The Role of Neonatal Therapy

According to National Association of Neonatal Therapists (NANT):

- Neonatal Therapy is defined as "the art of integrating Typical development of the infant and family into the environment of the NICU."
- Incorporates theories, scopes of practice from respective disciplines (PT, OT, SLP)
- It requires advanced knowledge (diagnoses, medical intervention)
- It promotes optimal long term developmental outcomes and nurtures infant parent relationships
- Address neurobehavioral, neuromotor, neuroendocrine musculoskeletal, sensory and psychosocial

The Role of the Neonatal Therapist

- Delivers direct patient care and consultative services to premature and medically complex infants.
- Uses an integrated, neuro-protective, family centered model.
- Support optimal long term development, prevent adverse sequelae, nurture the infant-family dyad.
- Provide education to the family and NICU team.

Scope of Practice

Underlying assumptions according to NANT:

- Promote safety and practice in a safe manner.
- Are unique members of the NICU team and value collaboration.
- Practice and advocate for age appropriate, neurodevelopmental care.
- Are fervent advocates for infants and families
- Respect cultural diversity
- Respect the privacy rights of the infants and family and manage information accordingly
Scope of Practice

- Practice within their respective disciplines scope of practice
- Strive to prevent iatrogenic problems associated with prematurity and the NICU environment
- Promote a healing, neuro-protective environment in the NICU
- Are cognizant of current practice trends and strive to improve neurodevelopment outcomes based on research and evidence
- Identify potential ethical conflicts and access proper avenues for resolution

Practice Environments

- NICU Levels I-V
- NICU follow up program
- Newborn nursery

Assessment

- Environmental (including equipment)
- Neurobehavioral
- Neuromotor
- Pre-feeding skills
- Oral feeding and swallowing
- Musculoskeletal
- Sensory
- Family
**Intervention**

- Neurobehavioral (autonomic, Motor, state, attention/interaction and self regulation)
- Neuromotor (positioning/handling, development of normal movement patterns, reflex development, tone)
- Environment (modify and adapt to suit the needs of the infant’s current development)
- Family (educate, promote parent participation and independence to transition home, psychological support, facilitate bonding and attachment)

**Interventions**

- ADLs (feeding, sleep, bathing, play/interaction)
- Musculoskeletal (normal posture alignment, prevent effects of iatrogenic deformities, support and facilitate development of antigravity movements, strength, improve physiology tolerance)
- Sensory/pain (protect and facilitate sensory development, sensory integration and provide non-pharmacological interventions to prevent pain)
- Safety (do no harm, engage with staff to promote a safe environment, risk management)

**Positioning/Handling**
Positive Touch/Hand Containment

Kangaroo Care/Skin to Skin

Fostering Parent-Child Bonding
Supporting Activities of Daily Living

Interventions

Do the next right thing

- Improve Outcomes through evidenced-based practice
- Receive proper NICU training, know your organization's stance on providing therapy services in the NICU.
- For example: American Occupational Therapy Association's (AOTA) position paper defining criteria to work in NICU as well as skill set (Vergara et al.)
- Require advanced level expertise and clinical reasoning
- Experience in pediatric occupational therapy is essential
- Extensive continuing education
- A mentor with advanced skills in the NICU
Do the next right thing

- Join professional organizations (NANT, AOTA, APTA, Special interest groups)
- Find a mentor!

Evidence?
Early experience alters brain structure and function (Als 2004)

- Study design: Randomized control trial tested the neurodevelopment effectiveness of the NIDCAP (Newborn Individualized Developmental Care and Assessment Plan).
- Subjects: 30 preterm infants and their families.
- Experimental Group: 16 infants received individualized interventions to reduce infant stress by NIDCAP trained professionals.
- Control Group: 14 infants received standard care practice.

Early experience alters brain structure and function (Als 2004)

- 3 aspects of Development were measured:
  - Neurobehavioral outcomes: APIB (2 weeks corrected age and the Bayley Scales of Infant Development (9 months corrected age)).
  - Neurophysiologic outcomes: Sleep EEG cortical spectral data gathered on the same day of developmental testing.
  - Neurostructural outcomes: 2 MRI Methods.
  - Weight, height and head circumference also measured at 9 mos.
Early Experience Alters Brain Structure and Function (Als 2004)

- Developmental Outcomes
- 2 weeks PCA
- Intervention group showed significant improvements in the Mental Development Index, Psychomotor Developmental Index, engagement, emotional regulation, motor quality (Bayley 2)

EEG Results/Neurophysiological Outcomes
- Intervention group demonstrated increase coherence between the left frontal region, occipital and parietal regions
- Changes were present in functional connectivity between brain regions, with preferentially broad enhancements of frontal to occipital coherence

MRI Results/Neurostructural Outcomes
- Significant improvements in maturity, with specific trends in the frontal white matter, right internal capsule and left internal capsule
Alterations in Brain Structure and Neurodevelopment Outcome in Preterm Infants Hospitalized in Different Neonatal Intensive Care Unit Environments (Pineda et al, 2014)

- Longitudinal study 136 preterm infants < 36 weeks GA (2007-2010) in a 75 bed level 3 unit.
- Evaluate between NICU room types: assigned open wards or assigned private rooms
- Primary outcomes at 2 years: Significant delay in language

Study conclusion
- Need for further research on the affects of different amounts of sensory exposure

Clinical Implications
- Bright and noisy NICUs needed to be modified
- Infant's need their parents and families to provide appropriate stimulation for development
- Appropriate and timed sensory stimulation is crucial for development
Conclusion

"If we are fortunate to stand on the shoulders of giants, it will allow us to see a broader vision."
—Heidelise Als

Questions

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