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Physical Therapy in the NICU: Advanced Topics

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Key Topics

- Review of synactive theory and basic NICU concepts
- The medically complex NICU patient
  - Current understanding of pathologies
- Evidence-based clinical decision-making
- Functional documentation in the NICU
  - Applying the ICF model to develop functionally-oriented problem lists and goals.
My NICU site: South Miami Hospital’s NICU

- 34 Level II, 15 Level III neonatal intensive care beds.
- South Miami Hospital was the ninth hospital in the U.S. to earn the Joint Commission Gold Seal of Approval for Prematurity.

Synactive theory of development

- Describes infant behavior and development according to 5 interacting subsystems:
  - Autonomic or physiologic
  - Motoric
  - State organization
  - Attention / interaction
  - Self-regulation

- Disorganization in one system affects others → loss of homeostasis.

- Infant gives behavioral cues to indicate system instability/stability.
The NICU patient…what we may see

- Autonomic
  - Shallow breathing, retractions, pauses in respiration, changes in heart rate, moderate color changes with handling, reflux and feeding intolerance, startles and tremors

- Motor
  - Decreased tone or transient changes in tone, decreased physiological flexion, decreased midline activity, weak suck, fluctuating reflexes, posture overtaken by gravity demands.

The NICU patient: what we may see

- State transition
  - Difficulty achieving and maintaining sleep state or alert state
  - Transitions not smooth
  - Night/day switching
  - Impacted by motor and autonomic issues

- Attention/interaction
  - Largely affected by state transition issues as well as motor and autonomic
  - Hypo or hyper-responsiveness
  - Difficulty processing multiple concurrent stimuli
The NICU patient: what we may see

- Self-regulation
  - Dynamic ability to respond to environmental demands and regulate own responses
  - Very challenging!!!
  - Integration of all other synactive theory items

How do we approach treatment?

- Progressive approach
  - Start with the basics
    - Address essential stability (eg autonomic) before mobility or responsivity
  - Progress according to infant response, age and developmental stage
  - Adapt the task demands to what the infant can reasonably respond to
  - You can’t go wrong by starting simple! First do no harm…
  - Good reference: NICU care path by Byrne
### Intervention

**Facilitate Calm State and Motor Organization**
- Assist with non-nutritive suck, containment, skin-to-skin care, and positioning, (may include hydrotherapy)

**Positioning and Handling** (may include hydrotherapy for medically stable infants typically at least 32 weeks postmenstrual age)
- Address head shaping and musculoskeletal integrity
- Promote comfort and respiratory function, including skin-to-skin care
- Promote skin integrity (assist with scar management)
- Promote sustained movement
- Provide gentle range of motion as indicated
  - Stretching as needed
- Facilitate periods of exploratory movement
- Promote alerting and interaction (e.g., ATTV)

### Movement Therapy

**Facilitate development and strength through**
- Guided extremity movements (allow infant to push against you)
- Increased time in upright position
- Varied developmental positions
- Enhancement of trunk mobility and diaphragmatic breathing
- Promotion of anti-gravity movements
- Neurodevelopmental techniques (e.g., NDT)

**Oral Motor**
- Facilitate one-motor organization and functional oral feeding through:
  - Oral stimulation and non-nutritive sucking during gavage feedings
  - Initiate nutritive sucking with small amounts of breast milk or formula
  - Nutritive sucking and small volume nipple feeding 1-2 x/day
  - Gradual increase in frequency, volume and duration of nipple feedings
  - Progression to autonomous nipple feeding

**Family Support and Education**
- Provide preparing for Your Baby to Come Home® handout
- Infant behavior and cues (parent facilitates transition between states and recognizes infant’s readiness for feeding and play)
- Promote skin-to-skin holding and parent-infant touch
- Promote social interaction and graded stimulation
- Facilitate participation in care and graded handling
Why do we see what we see in our NICU patients?

It all goes back to what is supposed to happen in normal development

Each week matters!

Preterm birth and system maturity

- Think about all the “developmental milestones” that occur during the third trimester in different body systems
- Missing these will predispose preterm infant to injury and dysfunction…
- 3rd trimester – Pulmonary system
  - Critical time for lung development!
  - Surfactant production
  - Pressures on lungs determine development
Preterm birth and system maturity

- 3rd trimester – Neurological system
  - Major changes in neurological tissue
    - More than 33% of brain size increase happens in last 6-8 weeks!
    - Completion of neuronal migration, synapse creation, myelination
    - Changes in blood vessel structure and perfusion patterns
    - Changes in blood vessel ability to auto-regulate
    - Central pressure fluctuations and susceptibility to changes
    - Certain brain cells more vulnerable to injury than in full term (ischemia-reperfusion, infection, etc)

- 3rd trimester – Motor development
  - Musculoskeletal system - Flexor tone developing throughout this trimester
    - 32-34 weeks peak period for LEs
    - 35-37 weeks peak period for UEs
    - 38-40 weeks full term axial trunk control
  - Ratio of slow-twitch to fast-twitch fibers
    - Preterm have <type I compared to term
    - Implications?
  - Ossification of bones and structural changes in connective tissue
    - Preterm: incomplete ossification, laxity.
Preterm birth and system maturity

- 3rd trimester – Motor development (cont)
  - Oromotor:
    - Maturation of suck-swallow coordination
    - Feeding behavior in preterm: fewer sucks, fewer sucks/burst, lower max pressure

Preterm birth and system maturity

- 3rd trimester – Sensory systems
  - Touch → vestibular → smell/taste → hearing → sight

  - Compare in-utero to NICU experience
    - Touch?
    - Vestibular?
    - Olfactory/gustatory?
    - Hearing?
    - Visual?
The NICU environment

- Over-stimulation or under-stimulation?
  - Neither is totally true
  - Clinicians should:
    - Offer appropriate stimulation – touch, handling for interaction
    - Reduce inappropriate stimulation – lights, noise

- Key is to MODULATE environmental stimulation
- Respond to infant signals
- Educate parents on those signals

Evidence-based approaches to modulating NICU environment

- Guidelines for tactile stimulation
- Early exposure to mother’s scent
- Minimize exposure to noxious odors
- Assess noise levels and develop noise reduction plan
  - General
  - Surrounding isolette
- Assess light levels, reduce appropriately
- Preservation of sleep
Poor positioning

Proper positioning
We haven’t talked about the fifth vital sign yet…
Pain in the preterm neonate

- Pain pathways active at 20-24 weeks GA
- Pain modulatory tracts not active until 36-40 wks GA
- RESULT: more sensitivity to pain than older or term infants

Assessment?
- Physiologic manifestations
- Behavioral manifestations
- Standardized measures – NPASS scale

**N-PASS:** Neonatal Pain, Agitation, & Sedation Scale

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<th>Sedation</th>
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<th>Pain / Agitation</th>
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<tr>
<td>Vitals</td>
<td>Normal</td>
<td>Normal</td>
<td>Prominent tearing</td>
</tr>
</tbody>
</table>

Assessment of Pain/Agitation:
- Pain component is the 0-3 score – assessment for pain should be included in every vital sign assessment
- Pain is accepted as 0-3 for each behavioral and physiological criteria
- Mtile pain score is determined as a positive number (0 → 10)
- Treatment interventions are indicated for scores > 3
- Interventions for lower pain/palpable stimuli are indicated before the score reaches 3
- The goal of pain treatment/intervention is a score ≤ 3
- More frequent pain assessment intervals
- Endotracheal tube or line which may cause pain, especially with movement (e.g. cuff hall) – at least every 2-4 hours
- Parenteral medications for analgesia – in grams for pain behaviour, for every 4 hours until sedation
- Post-op pain – at least every 2-4 hours for 24-48 hours, then every 4 hours until discharge
Alleviating pain in the preterm child

- Nonpharmacological
  - Reducing stimulation
  - Swaddling
  - NNS = non-nutritive sucking
  - Rocking
  - Containment
  - Music
  - Breast milk or sucrose solution
- Pharmacological

The medically complex NICU patient
Neurologic conditions

- Intraventricular hemorrhage (IVH)
- Periventricular leukomalacia (PVL)
- Hypoxic ischemic encephalopathy (HIE)
- Seizures

**Intraventricular hemorrhage (IVH)**

- **GM-IVH**
  - Risk factors: <1500 g, <32 weeks (inversely related)
  - Hemorrhage in germinal matrix that may extend into intraventricular space
    - Grade I: GMH, only minimal or no IVH
    - Grade II: IVH, no ventricular distention
    - Grade III: IVH >50% area with ventricular distention
  - GM = Site of glial cell proliferation until 32 weeks; decreases in size until involution at 36 weeks.

- **PVH-IVH (periventricular hemorrhagic infarction)**
  - AKA grade IV IVH
  - Periventricular hemorrhage which affects parenchyma
    - Associated with decreased venous flow in medullary vein

**CONTINUED**
IVH

- IVH due to poor blood flow autoregulation and sudden changes in flow or pressure
  - Infant: GA, ELBW, seizure, birth events, metabolic instability, RDS
  - Environmental: Mechanical ventilation, tracheal suctioning, handling, stressors (light, noise)
- Emphasize: reduce fluctuations in flow due to positional changes, minimize stressors during caregiving

IVH

- Acute treatment:
  - Maintain oxygenation and perfusion, maintain glucose levels, maintain temperature, minimize handling, use proper positioning (use prone or side-lying with head in midline or to the side without neck flexion)
- Neurodevelopmental outcomes
  - Outcomes depend on hemorrhage severity
  - GM-IVH → spastic diplegic CP most common
  - Periventricular (grade IV) → increased mortality, spastic hemiparesis, asymmetric quadriparesis, severe cognitive and motor deficits in both UEs and LEs.
Periventricular leukomalacia (PVL)

- Risk factors: <32 wks GA, cardioresp. involvement
- Necrosis of white matter around ventricles in response to prior injury (ischemia-reperfusion)
- Mechanisms: Poor vascularization, increased sensitivity to injury, perinatal infection, exaggerated inflammatory response
- Affects motor, cognitive, and visual outcomes
  - Most common: Spastic diplegia, with or without hydrocephalus

IVH, PVL: Prognosis

- Soul, 2008:
  - Risk factors for neurodevelopmental involvement:
    - GA
    - Bilateral lesions
    - IVH grade
    - Presence of PVL
  - 1:10 infants born at <32 weeks GA will have CP and 1:2 will have learning difficulties
Hypoxic ischemic encephalopathy (HIE)

- Perinatal decreased blood flow to brain from maternal, uteroplacental, or fetal complications
- Causes lack of oxygen and nutrients
  - Early and delayed damage
- Clinical signs: lethargy, hypotonia, weak suck, weak Moro, bradycardia, periodic breathing. Varied degrees of severity up to coma.
- Used to treat supportively; but emerging treatments: neuroprotective approaches
  - Hypothermia
  - Free radical scavengers
  - Excitatory amino acid antagonists
- Long-term outcomes: spastic or atonic quadriparesis, cognitive impairment, ataxia, bulbar palsy, other sequelae.

Seizures

- Etiology in neonates
  - Hypoxia, stroke, metabolic disease, drug-induced, withdrawal syndrome, idiopathic
  - Can be tonic-clonic but can also be difficult to recognize (eye deviations, chewing motions)
- Treatment: maintain airway, monitor vitals, antiepileptic medication (?)
- PT implications
  - Recognize a seizure
  - State transition impaired if child on anticonvulsants
Respiratory conditions

- Respiratory distress syndrome (RDS)
- Bronchopulmonary dysplasia (BPD) and chronic lung disease of infancy (CLD)
- Meconium aspiration syndrome (MAS)

Respiratory distress syndrome (RDS)

- Risk factors
  - GA<34 weeks, males, maternal diabetes, Caucasian, family hx of RDS, thoracic malformations/lung hypoplasia
- Antenatal steroids?
- Clinical signs
  - > resp rate, retractions, nasal flaring, cyanosis, hypoxia, expiratory grunting
- Management
  - Surfactant administration – prophylactic?
  - Assisted ventilation / oxygen supplementation
  - PT: in acute stage, minimize environmental stimulation; NIDCAP to guide care plan; positioning and handling guidelines

continued
Bronchopulmonary dysplasia (BPD) and chronic lung disease of infancy (CLD)

- Chronic pulmonary conditions due to abnormal repair of lung tissue; infant requires supplemental oxygenation.
- CLD diagnosed at 36 weeks GA
  - Infant still needs oxygen, and has abnormal physical exam and x-ray
- Multifactorial etiology
  - High pressures and volumes, sepsis, ELBW, males
- Prevention: antenatal steroids, surfactant, reduce pressures and volumes in mechanical ventilation, O2 saturations 90-95%, amino acid supplementation
- Treatment: Steroids, reduce pressures and volumes in mechanical ventilation, diuretics, O2 saturations 90-95%
- NICU graduates with BPD/CLD may have symptoms into early adolescence

Meconium aspiration syndrome (MAS)

- Respiratory distress (with no other cause) in infant born through meconium-stained amniotic fluid
- Term and near-term infants
- Chicken and egg situation:
  - Is meconium aspiration the cause, or meconium in the fluid from another factor that causes the resp distress?
- Treatment
  - Antibiotics, surfactant
- Handling considerations
  - Hypersensitivity to environmental stimuli
- Follow-up considerations
  - 20% developmental delays

continued
Cardiac conditions

- Congenital heart defects
  - Acyanotic vs cyanotic ($O_2$ sat)
    - Acyanotic (PDA, VSD, ASD, pulmonary or aortic stenosis, coarctation of the aorta)
    - Cyanotic (Tetralogy of Fallot, transposition, atresias, truncus arteriosus, HLHS, others)
  - VSD (ventricular septal defect)
    - Most common congenital heart defect
    - Ventricular shunt, commonly L → R
    - Presentation: resp distress, diaphoresis, fatigue during feeding, weight loss
    - Surgical closing if clinically relevant
      - The earlier, the better
  - PDA (patent ductus arteriosus)
    - Oxygen is the strongest stimulus for closure
    - Responsiveness of smooth muscle to oxygen related to GA
    - Clinical signs: murmur, > heart rate, resp distress, failure to gain weight, pulmonary edema
    - Management: ventilation/fluid restriction/diuretics; nonsurgical closure with indomethacin; surgical closure.
Other systems

- Metabolic bone disease
- Necrotizing enterocolitis (NEC)
- Gastroesophageal reflux disease (GERD)
- Retinopathy of prematurity (ROP)
- Hyperbilirubinemia
- Fetal alcohol syndrome (FAS)
- Neonatal abstinence syndrome

Metabolic bone disease

- Postnatal bone mineralization < intrauterine bone density for same GA
- Risk factors: nutrition, medication, vitamin D deficiency, lack of mechanical loading
- Increased risk of fractures and positional deformities
- Prevention!!! (Versaw-Barnes & Audrey Wood)
  - Good nutrition
  - Safe handling
    - Maintain alignment during line placement
    - Do not pull by axilla or rib cage to move
    - Do not lift by grasping ankles for diaper change
  - Positioning to prevent deformities
  - Physical activity? Insufficient evidence
Necrotizing enterocolitis (NEC)

- 1-3:1000 live births; GI emergency
  - Overall mortality 15-30%
- Ischemic necrosis of intestinal mucosa → infarction.
  - Multifactorial etiology
- Incidence inv. related to GA and BW
- Presentation: thermal instability, vomiting, abdominal distention, bloody stools, lethargy, < urine output.
- Complications: sepsis, meningitis, shock, respiratory failure, chronic malabsorption
- Long-term neurodevelopment: in those treated surgically - CP, visual deficits, intellectual disability
- PT: minimize stress (environment and handling), positioning with support for lines, monitor development

Gastroesophageal reflux disease (GERD)

- All infants have some degree of reflux (GER): sphincter tone, short esophagus, small stomach
- GERD = pathologic GER
  - Esophageal inflammation, dysmotility, pain
- Poor feeding, vomiting, oral aversion, irritability, poor weight gain, possible anemia, apnea, aspiration, CLD
- Management: positioning, changes in timing/volume/composition of feeds, pharmacological, surgical
  - Prone, head of bed elevated to 30°, left-side lying.
- Other PT considerations: behavioral changes, arching, increased tone in extremities.
Retinopathy of prematurity (ROP)

- **ROP** = disorder of blood vessel proliferation in the developing retina (prior to 40 weeks)

- **Risk factors**
  - Extreme prematurity and VLBW → increased incidence and severity.
  - Maternal factors: preeclampsia, smoking, diabetes

- **Oxygen and non-oxygen regulated growth factors**
  - First period – hyperoxia suppresses growth factors → capillary death → retinal hypoxia
  - Second period (32-34 wks GA) → growth factor response to hypoxia → pathological neovascularization, fibrous scar, retinal detachment
  - Followed by regression – could resolve or result in blindness.

- **ROP**
  - Treatment: laser photocoagulation.
  - Growth factor therapies being explored
  - Prevention? Optimal O₂ saturations not determined

- **Screening is paramount (early dx)**
  - <30 weeks GA or <1500 g
  - OR >30 weeks GA or <2000 g on oxygen supplementation

- **Screening causes pain and stress**
  - NNS, oral sucrose, and breast milk shown to decrease pain responses
  - Nesting, containment, respond to infant cues by providing support and comfort
  - Anesthetic drops – mixed results
Hyperbilirubinemia

- In preemies, immature hepatic function, RBC hemolysis from birth injuries, polycythemia.
- Kernicterus → encephalopathy.
  - Athetosis, hearing loss, limitation of upward gaze, intellectual disability
  - Flow through BBB enhanced in sepsis, anoxia
  - Can occur at low levels in ELBW infants
- Phototherapy or exchange transfusion
- PT implications
  - High bilirubin → Decreased arousal, lethargy
  - Phototherapy: limits positioning choices, forces use of eye shields.
  - Options: On/off cycles > 1 hr; fiber optic phototherapy using wrapping blanket.

Alcohol exposure and Fetal alcohol syndrome (FAS)

- Alcohol crosses placenta and fetal blood-brain barrier
  - Infant withdrawal signs: irritability, tremors, apnea, hypertonia, sensory hypersensitivity, seizures
  - Management: decrease sensory stimulation, administer phenobarbital for seizures
- FAS is a spectrum of disorders (FASD):
  - Growth deficiency, cardiac defects, and CNS disturbances (craniofacial anomalies, intellectual disability, neurobehavioral problems)
- Prevention!!
Neonatal abstinence syndrome

- Onset within 72 hours after birth
- Irritability, tremors, apnea, hypertonia and hyperactive DTRs, seizures, apnea, sleeplessness, uncoordinated suck-swallow, high-pitched cry
- Specific assessment tools: NICU Network Neurobehavioral Scale (NNNS), Neonatal Drug Withdrawal Scoring System (Lipsitz)
- Management: swaddling, NNS, reduced sensory stimulation, medication

Tests and measures

No time to cover, but here is a quick list of what's out there! Kahn-D’Angelo and Versaw-Barnes provide good summaries of these (see reference list).

- Dubowitz (GA)
- NBAS (neurobehavioral)
- NAPFI (neurobehavioral)
- NAPI (neurobehavioral)
- APIB (neurobehavioral)
- GMA (motor qualitative)
- AIMS (motor)
- NNNS (neurobehavioral in drug-exposed and high-risk)
- TIMP (functional motor)
- NIDCAP (developmental care strategies)
- NOMAS (nutritive and non-nutritive suck)
- NCAFS (parent-infant feeding interaction)
- EFS (feeding readiness and tolerance)
- NBO (parent relationship)
Current evidence on therapeutic interventions and other NICU topics

- Cochrane Reviews
  
  [http://neonatal.cochrane.org/our-reviews](http://neonatal.cochrane.org/our-reviews) (select the “full list” tab). Some examples:
  
  ◦ Developmental care
  ◦ Light reduction to prevent ROP
  ◦ Positioning during mechanical ventilation
  ◦ Non-nutritive sucking
  ◦ Physical activity programs to promote bone mineralization and growth

Continued

- Cochrane Reviews
  
  ◦ Massage
  ◦ Kinesthetic stimulation for apnea
  ◦ Positioning for acute respiratory distress
  ◦ Kangaroo care
  ◦ Pre-discharge “car seat challenge”
  ◦ Early intervention programs post-discharge
Developmental care


- What they looked at:
  - "Developmental care is a broad category of interventions designed to minimize the stress of the NICU environment. These interventions may include elements such as control of external stimuli (vestibular, auditory, visual, tactile), clustering of nursery care activities, and positioning or swaddling of the preterm infant. Individual strategies have also been combined to form programs, such as the 'Newborn Individualized Developmental Care and Assessment Program' (NIDCAP)."

- Research question:
  - In preterm infants, do developmental care interventions reduce neurodevelopmental delay, poor weight gain, length of hospital stay, length of mechanical ventilation, physiological stress and other clinically relevant adverse outcomes?

Developmental care

- What they found:
  "The review of trials suggests that these interventions may have some benefit to the outcomes of preterm infants; however, there continues to be conflicting evidence among the multiple studies" ..."

  - Some benefit: decreased moderate-severe chronic lung disease, decreased incidence of NEC and improved family outcome.
  - No benefit, or detriment: mild lung disease, length of stay
  - NIDCAP: some evidence for long-term positive effect on behavior and movement at 5 years corrected age, but no effect on cognition. Other individualized developmental care interventions have also demonstrated some effect in enhancing neurodevelopmental outcome.
What are some things to ponder regarding these conclusions?

- Conclusions limited by quality of individual studies
  - Sample size (??)
  - Controls (???)
  - Design differences (?)

- We need more research!! Who’s up for it?

Light reduction to prevent ROP

- Evidence that bright light DOES NOT cause the problem and does not add to the problem
Positioning

- During mechanical ventilation
  - Doubtful on sustained improvement due to positioning BUT
  - Evidence of short time benefits from prone positioning (improved oxygenation, fewer episodes of poor oxygenation)

- During acute respiratory distress
  - Prone sats better than supine by 2%
  - Rapid respiratory rate decreased in prone (4 breaths/min lower)

Non-nutritive suck

- NNS
  - Similar weight gain with and without NNS
  - No negative outcomes of NNS
  - NNS groups in 2 studies had shorter hospital stays, less defensiveness during tube feedings, less time in fussy state during and after feeding, and achieved sleep faster.
  - In one study, transition to oral feeds was easier in the NNS group
Physical activity for bone growth and mineralization

- Short-term positive effect on bone growth and development
- No long-term data
- Cannot recommend as standard procedure due to lack of long-term data

Massage

- Randomized control trials: Massage vs “still, gentle touch”
- Increased weight gain, reduced hospital stay, increased scores on developmental tests, fewer postnatal complications
- Reviewers comment on reliability issues
- No negative effects
Kinesthetic stimulation to prevent or treat apnea

- Explored the use of oscillating mattresses or rocking motions and their effect on apnea
- Found no clinically useful reduction of periods of apnea
  - Shorter breathing pauses in one study, but not clinically relevant.
- No harmful effects found.

Kangaroo care

- Reduction in severe illness, infection, breast-feeding problems
- Improved parental satisfaction and parent-child bonding
- No differences in mortality
- Concerns about methodological quality
  - More research needed
Car seat challenge

- No evidence of benefit
- Desaturation, apnea or bradycardia in car seat challenge may not accurately represent potential for harm
- Test increases parental anxiety about transporting infant

Early developmental intervention programs after NICU discharge

- Effective at improving cognitive development short to medium term (up to preschool)
- Limited evidence long-term
- Variability in program components/implementation limits conclusions
Other evidence

- Containment
  - Improved autonomic stability and reduced stress during heel sticks, suctioning (Sweeney, 2002)

- Plagiocephaly
  - Reduced incidence with gel pads, water pillows, positional changes (Sweeney, 2002)

- Quality of developmental care
  - Infant-centered programs with effective pain management protocols had better neurobehavioral outcomes (Montirosso, 2012)

Other evidence

- Environmental controls
  - Lightning
    - Reduced lightning – longer periods of eye opening, improved autonomic stability (Fielder, 2000)
    - Studies being done on cycled lighting
  - Sound
    - Excessive noise associated with apnea, bradycardia (Levy, 2003)
    - Hearing impairments and delayed language development? Need more studies
Another cornerstone: Family-centered care

- Respect
- Choice
- Information
- Collaboration
- Strengths
- Support
- Empowerment
- Flexibility

www.familycenteredcare.org

Parents should...

- Feel welcome at all times
- Be encouraged to participate in child’s care
- Be engaged in a therapeutic relationship with health care providers
- Have access to support groups
NICU parent education

- Discussion of goals, purposes and services.
- Orientation to the follow-up plan after D/C.
- Information on infant's temperament, signals, and ability to interact with the environment.
- Instructions on selected developmental activities and handling techniques.
- Community resources.
- Information on normal development.
- Other miscellaneous info
  - Tummy time
  - Back to sleep campaign
  - Child safety
  - Age-appropriate activities and toys

Functional documentation in the NICU
A journey through models: from Disablement to “Enablement”

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<td>-Activity</td>
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<td>-Disability</td>
<td>-Handicap</td>
<td>-Societal Limitation</td>
<td>-Contextual factors</td>
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Limitations of Non-ICF Models

- Focus on “disablement” & disease vs. health
  ◦ Negative perspective
- Ignored factors outside of the individual that influence health or disability
  ◦ Missing personal & environmental view
- Confusing terminology-same name with different meanings
  ◦ Different use of word disability

Blackinton, 2007
Views on “Disability”

- Medical view
  - Disability is feature of the person, directly caused by disease, trauma, or condition that requires medical care to “correct” problem

- Social view
  - Disability is feature of society, requiring a political response. For example, inaccessible environment (attitudes and social norms) needs policy change

- Biopsychosocial view (ICF Model)
  - Disability is complex issue involving person, environment, & society
  - Optimal patient outcomes can only be achieved if we look at the “big picture”

Blackinton, 2007

International Classification of Functioning, Disability and Health (ICF)

- Purposely Designed
  - Focus on health & function, NOT disease & disability (words are purposely positive)
    - Two sides of same coin: functioning vs disability
    - Functioning
      - All body functions, activities, & participation that people use to have a meaningful life
  - Framework to define health and health-related outcomes
  - Biopsychosocial Model: Combined medical view & social view of disability

Blackinton, 2007

CONTINUED
Interaction of Concepts in the ICF

Health Condition (disorder/disease)

Body function & structure (Impairment)

Activities (Limitation)

Participation (Restriction)

Environmental Factors

Personal Factors

Contextual Factors

ICF Components

<table>
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<th>Activities/Participation</th>
<th>Personal and Environmental Factors</th>
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<tr>
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<td>Capacity, Performance</td>
<td>Barriers (-), Facilitators (+)</td>
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WHO, 2002
How does the ICF help standardize the continuum of care?

- Unifying framework for interdisciplinary work
- Provides functional indicators for interventions and outcomes
- Identification of environmental barriers and facilitators – “big picture”
- Continuity in documentation across services and in transitions
- Standard reference frame for health information management and patient advocacy

Simeonsson, 2009

Using the ICF in children

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<th>FOCUS</th>
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Lollard, 2005
All that sounds good, but…

- How is this model applicable to NICU?
- How can we possibly reflect the unique characteristics of this setting and patient population?
- The ICF “is not designed for neonates”
  (Disagree)
- I don’t want one more source of paperwork!!
  (I hear you)

ICF and NICU

- The NICU is actually an excellent setting in which to apply the ICF!!
- The ICF interfaces seamlessly with the concept of developmentally supportive care in the NICU, as well as with family-centered care approaches
ICF and NICU

- The ICF enables us to obtain a better understanding of how contextual factors can be used or modified to result in improved patient outcomes.

- The ICF model also emphasizes that there are both strengths and weaknesses in every patient, and that both must be understood in order to create a customized treatment plan that results in optimal progress.

Let’s put the ICF to work

- Mock case:

Meet baby D

This is not a real patient, but a composite created by my imagination to practice application of the ICF.
Baby D enters the world

- D was born at 29 3/7 weeks gestation. There were no records of prenatal care.
- Birth was via vaginal delivery due to spontaneous preterm labor. Labor was complicated by fetal stress, decreased fetal movement, and maternal pre-eclampsia. Blood tests done prior to delivery revealed recent drug use (positive for cocaine, marijuana). Mom reports that she took the drugs to relieve labor pain.
- Baby was moderately unresponsive at birth and required suctioning and oxygen administration. Birth weight was 1150 grams (50%), length 38 cm (50%), head circumference 27.4 cm (50%). Apgar scores were 4 at 1 minute, 6 at 5 minutes, and 8 at 10 minutes.

Postnatal history

- D was admitted to NICU at birth due to prematurity, respiratory distress, maternal drug use, and possible sepsis.
- Placed on respiratory support for two weeks (three days intubated, then CPAP). Weaned to oxygen via nasal cannula at 31 2/7 weeks CGA.
- Other complications included: withdrawal syndrome (resolved), IVH grade I bilateral, minimal PDA, moderate VSD, GERD, hypoglycemia (resolved), at risk for retinopathy of prematurity. No surgeries planned at this time.
Family Demographics and History

- D’s mother is 19 y/o, father unknown. No medical records of prenatal care.
- Mother is Caucasian, primary language is English, high school dropout. She has no available family support system - left home at age 15 due to physical abuse.
- She was employed until six months ago in retail, but currently unemployed. Eligible for Medicaid.
- Currently lives with a female friend in an apartment that is owned by her friend’s mother. The friend’s mother, who is retired, is supportive and will allow her to continue living there after the baby is discharged. She has also offered to help care for the baby on the condition that D’s mother should look for a job.

Family Dynamics

- Mom usually visits the NICU once every two days for about three hours at a time. She reports transportation difficulties that prevent her from visiting more often.
- The social worker is directly involved in the case and provides counseling and monitoring of mother/baby relationship.
- In order to keep baby, mom will need to remain drug-free for a trial period, enter a counseling program, and undergo periodic random drug testing by the social services case worker.
- The mother has agreed to these conditions and is currently looking for employment. She seems upbeat about starting a new life, and she is bonding well with her baby during visits.
D at 31 5/7 wks CGA

- D continues to have difficulty holding normal range temperature, so D is still in the isolette.
- D is on nasal cannula (1 L rate, 25% O2)
- Just started feedings through OG tube, but hasn’t been responding well to feedings as per RN.
- D is on day 8/10 of apnea and bradycardia watch.
- D has a fungal infection in the diaper area diagnosed five days ago.
- Current medications include ampicillin, gentamicin, Zantac, caffeine citrate, and diflucan.
- D is able to self-regulate ~25% of the time, but overall requires increased caregiver input for self-regulation

Current status and family goals

- This is a former 29 3/7 week GA baby, currently 31 5/7 wks CGA, who shows fair state transition, fair self-regulation, and decreased attention/interaction skills. Even with oxygen support, autonomic stability is fair and this causes decreased endurance and tolerance to activity and handling. Muscle tone is decreased for CGA, and motor control and neuromuscular coordination are impaired. Posture is impaired, with decreased physiological flexion. NNS is poor, baby gags on pacifier, and feeding is through OG tube. Few positive oral experiences.
- Parental goals for intervention: (1) learning how to handle and hold her baby without D crying and desaturating, (2) baby moving to a crib and starting oral feedings, and (3) having baby look at mom’s face and follow her voice.
Sample ICF problem list

**Body function/structure problems**

- Reduced physiological flexion.
- Low muscle tone in upper extremities and in trunk.
- Fair muscle tone in lower extremities.
- Moderate bilateral trunk tightness to lateral flexion and rotation.
- Shoulder girdle retraction and elevation.
- Poor non-nutritive suck with poor seal.
- Oral defensiveness (?)
- Impaired autonomic stability.
- Requires nasal cannula for respiratory function.
- Low energy reserves
- Difficulty regulating temperature
- Potential for integumentary disruption

Sample ICF problem list

**Activity limitations**

- Difficulty reaching quiet alert state, decreased alertness
  - Difficulty with state transition and self-regulation
- Difficulty performing age-appropriate self-calming activities, such as bringing hand to mouth, due to decreased midline control of upper extremities.
- Difficulty with oral feeds and sucking on a pacifier.
- Difficulty demonstrating well-modulated spontaneous/elicited activity for CGA
- Difficulty focusing on audiovisual stimuli or initiating tracking
Sample ICF problem list

**Participation restrictions**
- Difficulty interacting with caregivers due to:
  - Decreased level of alertness,
  - Autonomic instability,
  - Decreased self-regulation.
- Difficulty in play activities that include audiovisual components due to decreased tolerance for stimulation.
- Difficulty bonding with mother due to impaired attention/interaction skills, reduced tolerance to handling, and inability to receive oral feeds from mother.

Contextual Factors Influencing Plan of Care and Prognosis

**Personal (baby)**
- Baby associates handling with painful medical procedures and reacts negatively to handling due to fear and stress (negative)
- Medical issues limit baby’s oral food intake and sensory experiences (negative)
- Baby responds well to containment and familiar voices (positive)

**Personal (mom)**
- Mother is very motivated to learn how to take care of the baby (positive)
- Mother has a history of drug problems (negative)
Contextual Factors Influencing Plan of Care and Prognosis

- **Environmental**

   Barriers:
   - Baby is in an isolette, which limits interaction with the environment. The isolette acts as an echo chamber and distorts or amplifies noises. The baby is unable to focus properly on visual stimuli outside of the isolette due to distortion of the image.
   - Decreased repertoire of positions
   - Loud alarms from adjacent beds act as a noxious stimulus and increase irritability. The need for a bright light to perform medical procedures negatively impacts proper state transition.

- **Environmental**

   Barriers:
   - Mother’s difficulty with transportation makes it hard for her to see the baby as often as she’d like to.
   - Maternal social environment (old circle of friends, etc) may continue to make drugs available to her.
   - Mother is unemployed, and candidate employers may not be supportive of her needs as a new mother.
Contextual Factors Influencing Plan of Care and Prognosis

- **Environmental**
  - Facilitators:
    - Medical insurance is available
    - Mother’s friends are available for housing and babysitting support
    - Early intervention program is coordinated with NICU services and will be available for follow up
    - Environmental modifications/supportive devices can be utilized to minimize negative environmental impact

Plan of Care

- **Environmental Modifications** — reduce lights/noises; use isolette cover; use a gel pillow to prevent sustained pressures on developing skull; use bendy bumper, swaddling, and other equipment as appropriate to promote physiological flexion, calming sensory input, and physical boundaries.

- **Positioning** — promotes improved flexor posture, prevents further positional deformities and loss of range of motion, reduces trunk tightness, improves shoulder girdle posture, promotes functional use of the upper extremities, and promotes calming, self-regulation, and smooth state transition by increasing comfort and reducing stress.
• **Infant massage** – improves calming and self-regulation skills, provides positive tactile stimulation, improves response to touch, maintains skin hydrated to prevent loss of integrity, improves circulation, and improves parent-baby bonding when the parent performs the massage. Some studies show reduced hospital stay, fewer complications, but more research needed.
  
• **Oromotor stimulation** – both with the pacifier (NNS) and with a nipple (nutritive suck) when the baby is ready.
  ◦ Use pacifier with OG feedings.
  ◦ Positive vs negative oral stimulation
  ◦ Feeding techniques, oral muscle training, promoting good breathe-suck-swallow coordination
  ◦ Involve mother in order to maximize outcomes

• **Audiovisual stimulation** – promotes age-appropriate interaction with the environment, bonding with mother and caregivers, improves the ability to accept stimulation without losing autonomic or behavioral stability, and promotes normal sensory development.

• **Vestibular stimulation** – can be used to promote alertness (fast rocking) or as a calming stimulus to aid self-regulation (slow rocking). Also exposes baby to different positions, effects of gravity, simulates in-utero stimulation.

• **Therapeutic exercise / Neuromuscular activities** – Elicited activity promotes muscle tone improvement, increased coordination of movement, adequate response to stimuli, proper reflex development, and development of proper functional strategies. Physical activity benefits short-term bone development and growth. Promotion of midline activities will enhance self-regulation and ability to interact with caregivers.

**CONTINUED**
• **Developmental family-centered care and education:**
  ◦ *Personalized developmental care plan:* note specific stressors that should be avoided during handling, as well as best calming strategies for this particular baby.
  ◦ *Kangaroo care:* may promote bonding, improve sleep, reduce motoric disorganization, improve breathing.
  ◦ *Developmental family-centered care* may decrease the number of days on oxygen support, decrease the number of days before the infant is able to nipple-feed, and decrease the overall length of stay in the NICU.
  ◦ *Parent education:* positioning strategies, knowledge of infant signals for interaction, infant care. Mom seems eager to learn. Access to transportation/community resources/support groups may be helpful. Involving friend’s mother may be an option.

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**Goals**

• **Short-term:** In two weeks,
  ◦ D will demonstrate increased alertness >60 second periods before feeding/changing times.
  ◦ D will complete a 20 minute kangaroo care session without desaturations to enhance parent-child bonding.
  ◦ D will demonstrate improved NNS to fair strength, 2-3 bursts, with fair seal; to prepare for successful feeds.
  ◦ D will demonstrate increased self-regulation >50% time
  ◦ D will demonstrate increased upper extremity midline activity > 50% to be able to self-calm and explore.
  ◦ The mother will demonstrate knowledge of proper positioning and infant interaction signals, and correctly interpret D’s signals during interaction 5/5 times.
Goals

• **Long-term:** At discharge,
  ◦ D will perform audiovisual tracking >30° with eyes/head
  ◦ D will demonstrate well-modulated spontaneous/elicited activity >90% to interact with the environment
  ◦ D will demonstrate bilateral head turn in prone 2/3 trials for safe face clearance.
  ◦ D will demonstrate ability to complete a 30-cc oral feeding in 20 minutes with proper breath-suck coordination.
  ◦ The mother will be independent with baby care and she will be able to promote appropriate feeding skills.
  ◦ The mother will be able to provide age-appropriate audiovisual stimulation as part of a home “exercise-play” program, and demonstrate the activities to the PT.

Prognosis

• Prognosis is good. D’s medical status is steadily improving, and the mother has a positive attitude and is willing to learn and participate in the baby’s care. The baby should be followed up in an early intervention program.
• Possible factors that could negatively impact prognosis would include recurrent maternal drug use, inability to find employment, and any future issues with housing arrangements. Emergence of these factors would require reassessment of prognosis.
Closing thoughts on documentation

- Chances are you have been using the ICF all along even if you were not aware of it!!
  - We all try to look at the big picture because it makes sense to do so.
- Using the terminology consistently facilitates communication and coordination between disciplines
- There is no need for additional paperwork or headaches. Just incorporate the model into what you already do.

SUCCESS
Because you too can own this face of pure accomplishment
Closing thoughts... An interesting development...

- [http://news.byu.edu/archive11-apr-prematurebirth.aspx](http://news.byu.edu/archive11-apr-prematurebirth.aspx)
- Brigham Young University Researchers discover method to predict premature birth
  - New blood test predicted more than 80 percent of premature births
  - The research is based on the level of certain peptides and proteins in the mother's bloodstream during the second trimester
  - As of 2015, the method has been licensed to Sera Prognostics – they are working on bringing a diagnostic test to market.

References

- Cochrane Neonatal Group. [http://neonatal.cochrane.org/our-reviews](http://neonatal.cochrane.org/our-reviews)
References

References


Thank you! Questions?