Developmental and Interprofessional Care of the Preterm Infant
Neonatal Intensive Care Unit Through High-Risk Infant Follow-up

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KEYWORDS
- Preterm infants
- Developmental care
- Neonatal intensive care unit environment
- Oral feeding
- Neurodevelopment
- Developmental monitoring
- Early intervention

KEY POINTS
- Opportunities to improve cognitive, neuropsychological, and behavioral outcomes for preterm infants begin in the neonatal intensive care unit (NICU).
- Developmental care in the NICU includes changes in the delivery of medical and physical care, supportive handling techniques, infant-led oral feeding practices, and adaptations to the environment that limit infant stress and enhance self-regulation.
- The population of very low birth weight preterm infants is at highest risk for difficulties with transition to oral feeding and for persisting oral feeding challenges that continue to require skilled therapeutic assistance after discharge.
- Proactive developmental monitoring and implementation of timely therapeutic and educational early intervention services are essential to continue to support optimal outcomes for preterm infants.

DEVELOPMENTAL CARE OF THE PRETERM INFANT: NEONATAL INTENSIVE CARE UNIT THROUGH HIGH-RISK INFANT FOLLOW-UP

According to the National Vital Statistics Report published by the US Centers for Disease Control and Prevention (CDC) in January 2017,1 the preterm birth rate in the United States in 2015, covering all infants born less than 37 weeks, was 9.63%, a

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slight increase from 9.57% in 2014. The percentage of infants classified as low birth-weight (<2500 g) also rose slightly, from 8.00% to 8.07%, from 2014 to 2015. Infants classified as moderately low birthweight (1500–2499 g) increased from 6.60% to 6.67%, while the very low birthweight rate (<1500 g) remained stable at 1.40%. Advances in medical intervention and treatment have improved the survival of premature infants including the population of very low birth-weight infants, placing an ever-growing emphasis on improving the long-term developmental outcomes for this most vulnerable pediatric population.

In 1986, Public Law 99-457 was enacted to provide access to federal funding, so that each individual state could begin implementation of early intervention programs for at-risk children from birth to 5 years of age. At the same time, research by Als was initiated to determine if changes made even earlier during infant care in the neonatal intensive care unit (NICU) could have a long-lasting positive impact on the cognitive and behavioral outcomes of premature infants.2,3

Als studied the impact of the environment in the NICU on the developing brain of the premature infant and proposed a framework for interpreting and responding to an infant’s behavioral cues and providing care-based interventions to address the noxious effects of environmental stress upon the neonate.4–6 Multiple studies have demonstrated the positive effects of these “developmental interventions” in the NICU upon brain structure, motor organization and development, and longer-term cognitive and behavior outcomes.7–13

This article proposes that establishing a continuum of services beginning in the NICU and transitioning through careful developmental and interprofessional follow-up and availability of early therapeutic and educational interventions following discharge would best support the achievement of optimal outcomes for premature infants. Current protocols followed at the Joseph M. Sanzari Children’s Hospital at Hackensack University Medical Center have been utilized for illustrative purposes.

Getting off to a Good Start: Implementing Developmental Care in the Neonatal Intensive Care Unit

In the authors’ NICU, developmental care relates to

- Practices and protocols guiding medical interventions
- Approaches to physical care
- Guidelines for positioning and handling
- Noise and lighting control
- Relationship building and parental participation in infant care
- Oral feeding practices

The interprofessional team includes neonatologists, physician assistants, advanced practice and bedside neonatal nurses, physical and occupational therapists, speech-language pathologists, child life specialists, and social workers.

Emphasis on comfort care during medical procedures to minimize pain and stress includes providing non-nutritive sucking to promote calming and neurologic organization paired with sucrose, as well as hand hugging (cradling of the head with the hands). Nursing staff, child life specialists, and parents when appropriate can be present to provide comfort care during medical procedures. Clustering physical care promotes periods of uninterrupted rest/sleep and energy conservation. Physical and occupational therapists provide guidance for nursing and parents with respect to provision of an individualized developmental care plan to reduce environmental stress. Optimal positioning for postural support, skull shaping and energy conservation, as well as, handling techniques that encourage positive positional transitions are taught. Parents
are taught to identify their infant’s behavior cues to establish early parental confidence and success in meeting infant’s needs and to enhance the infant’s self-regulatory capabilities.

In the authors’ NICU, every effort is made to introduce direct skin-to-skin contact with parents as soon as the infant is deemed medically stable to accommodate transfer from the isolette. Kangaroo Care, where the infant is laid directly against the parent’s unclothed chest, has been found to improve temperature regulation, oxygen saturation, and sleep, as well as, positively initiate the parent-infant bonding process. Both mothers and fathers are encouraged to participate in Kangaroo Care. Nursing staff members provide parents with education regarding the positive effects of Kangaroo Care, encourage participation, and assuage parental fears. It can sometimes take the coordination of nurse, respiratory therapist, and an occupational or physical therapist to accomplish a successful transfer.

Steps are taken to minimize noise and provide positive auditory stimulation at appropriate decibel levels. Parents are encouraged to talk and read to their infants and can make voice recordings to be played when mother and father cannot be present. The authors’ NICU has also experimented with periods of live classical music provided by a child life/music therapist to promote calming and stress reduction for infants, parents, and staff. Harsh overhead bright lighting is avoided, unless medically necessary. Dimmers on all light switches provide the opportunity to situational alter lighting. Older infants can be transitioned to corner room areas with windows, allowing the opportunity for exposure to natural light.

Initiating oral feeding is a milestone event in the life of a premature infant and his or her parents. The authors’ NICU has adopted an infant-led approach to oral feeding based upon the Infant Driven Feeding Protocol developed by Ludwig and Waitzman. This approach emphasizes and measures the “quality” of oral feeding ability as opposed to quantity of intake, provides a unified vocabulary for both NICU staff and parents to use when discussing oral feeding and encourages parental competence, confidence, and independence while feeding their baby. Trained staff help to teach parents to identify well-defined infant behavioral cues to determine infant “readiness” to initiate oral feeding, as well as cues that indicate infant “stress” and the need to stop a feeding. Assessment by a speech-language pathologist is available to assist with selection of compatible bottle/nipple and identify individualized therapeutic positioning, oral feeding techniques, and strategies to support coordination of suck-swallow with breathing. The authors’ NICU actively encourages breast feeding as integral to the transition to oral feeding. A dedicated lactation consultant meets with each mother shortly after birth and provides education and assistance to help establish breast milk supply and encourage maintenance with a regular schedule of pumping. As an infant approaches the appropriate gestational age, mothers are encouraged to provide infants with the opportunity to engage in non-nutritive sucking at the breast during Kangaroo Care. Breast feeding opportunities supported by a lactation consultant are offered as part of an infant’s individualized feeding plan. Goals of oral feeding in the authors’ NICU are consistent adherence to our infant-led philosophy and to each infant’s individualized oral feeding plan, and to promote a positive bonding oral feeding experience for both parent and baby.

Although long-awaited and welcome, discharge can often be a stress-inducing time for parents. All team members participate in discharge planning, which includes support for the transition to outpatient care and identification of resources to address
uninterrupted continuation of medical care and therapeutic interventions when identified as an immediate need. Referral for longitudinal developmental follow-up is also included.

**Meeting Milestones: Developmental/Interprofessional Follow-up for the Premature Infant**

Premature infants are widely recognized as at-risk for various neurobehavioral impairments including, but not limited to, cerebral palsy, autism, and attention deficit hyperactivity disorder. Findings also indicate that slightly under half of the population of moderately low and very low birth weight infants are also at risk for demonstration of early abnormal movement patterns and postural instability with later-occurring developmental coordination disorders and minor neurologic dysfunction. Cognitive, neuropsychological, and behavior problems co-occur at a higher prevalence than neuromotor and neurosensory impairment. Performance of preterm infants compared with their full-term peers at preschool age was found to be deficient across the areas of language, attention, memory, visual-motor and visual-spatial processing, and executive functioning.

Studies have demonstrated evidence for improved cognitive, behavior, and motor outcomes of premature infants when provided with early educational and therapeutic interventions, making developmental monitoring and early referral for necessary services crucial to support optimal outcomes for these children.

The authors’ outpatient model for high-risk infant follow-up transitions responsibility for developmental monitoring from the neonatologists to developmental pediatricians. Preterm infants born at 34 weeks or younger are automatically referred for developmental follow-up upon discharge from the authors’ NICU. Participants in the infant follow-up program also include infants over 34 weeks with any pre-existing medical or genetic diagnosis that places them at risk of neurodevelopmental deficits.

The team includes developmental pediatricians, physical and occupational therapists, audiologists, speech-language pathologists, and a social worker. Initial evaluation with the developmental pediatrician is scheduled to take place at 4 months corrected age. Additional office visits are scheduled every 6 months over the first 2 years and beyond on an annual basis when continuing developmental monitoring is deemed appropriate. Developmental pediatricians identify undiagnosed or emerging medical/genetic comorbidities; track developmental progress across the domains of gross/fine motor, cognitive/linguistic, and behavior/social interaction; make referrals for necessary therapeutic interventions; and coordinate medical follow-up with each child’s pediatrician. It is important to establish strong working relationships with local community pediatricians. As a children’s hospital an integrated team of pediatric medical specialists is available to meet infant needs for specialized medical follow-up. The team relies upon community pediatricians to encourage participation in high-risk infant follow-up and to follow through with recommended therapeutic and early intervention services. Parents of premature infants are often exhausted and overwhelmed with the burden of unexpected medical care in the home and juggling of work with other family responsibilities and may not prioritize developmental follow-up until their infant has missed developmental milestones and has fallen behind. It is important for pediatricians to share positive outcome data related to early identification and intervention with parents of their premature patients during office visits.

On a case-by-case basis, outpatient follow-up with a physical or occupational therapist may be initiated immediately following discharge or recommended to take place within 1 to 2 months. Physical therapists play an active role in the surveillance,
prevention, and treatment of torticollis and plagiocephaly. Early gross/fine motor assessment includes evaluation of postural control and stability, identification of functional vs aberrant motor patterns, and observation of visual tracking and reach/grasping patterns. Therapeutic intervention is offered to establish functional movement patterns and support attainment of gross/fine motor milestones and development of visual-motor skills.

In adherence with universal hearing screening guidelines, newborn hearing screening is performed prior to discharge from the NICU. Infants with high-risk history, including prematurity with extended NICU stay and medical/genetic diagnoses that are highly associated with hearing loss are referred for ABR testing at 3 months and follow-up of hearing acuity again in the soundfield at the corrected age of 12 months to rule out possibility of any late-onset hearing loss that could negatively impact development of speech and language. Infants identified with hearing loss are followed by both audiologist and pediatric otolaryngologist, provided with any needed medical intervention, fit with hearing aids and assessed for candidacy for cochlear implant when appropriate.

Premature infants with a diagnosed oral feeding and/or swallowing disorder are transitioned from inpatient to outpatient therapy provided by a speech-language pathologist with the requisite education, training, and experience in treating pediatric dysphagia. The subsegment of premature infants who are very low birth weight and present with chronic lung disease or structural or cardiac anomalies are at the most risk for persisting feeding difficulties. Therapeutic intervention is provided to improve effectiveness, efficiency, and coordination of nutritive sucking and help reduce dependence upon alternative nutritional support. Intervention can continue as necessary to address longer-term oral-motor skill development and attainment of age-expected oral feeding transitions (puree → soft textured solids → chewable table food; breast/bottle → cup/straw drinking). Speech-language pathologists also evaluate and provide therapeutic intervention to establish and expand prelinguistic skills, language comprehension, nonverbal and verbal expression, and oral motor skills that support consonant production and functional articulation.

Parent education, participation, and provision of home carryover activities are an integral part of all therapeutic interventions provided across professional disciplines. All team members are knowledgeable with regard to additional available community resources and the referral process for government-funded state-run early intervention services. Consultation with the social worker can be arranged to provide information and guidance with respect to application for government financial resources. Short-term counseling may be provided to support parents and families dealing with competing priorities and the demands of caring for a premature infant at home. Longer-term mental health resources are provided when needed.

SUMMARY

Premature infants currently account for over 9% of all live births. The population of moderately and very low birth weight infants, is at the greatest risk for life-long cognitive, language, neuropsychological, and behavioral deficits. Addressing cultural change in the NICU and embracing a philosophy of developmental care that minimizes the negative effects of stress upon the developing brain and is responsive to the infant’s behavior is necessary to improve developmental outcomes. Proactive developmental monitoring (from an interprofessional perspective) following NICU discharge and timely provision of early intervention including therapeutic (PT, OT, and SLT) and educational services are also essential. Parental support to address barriers to

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participation in early intervention services including issues related to access, financial burden, and psychosocial concerns is needed. It is hypothesized that optimal outcomes for premature infants would best be achieved when developmental care provided while in the NICU is paired with proactive neurodevelopmental follow-up after discharge and timely access to early intervention services of adequate frequency and intensity. Future studies that evaluate infant outcomes given this combined approach are recommended.

REFERENCES


