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The Institute for Johns Hopkins Nursing

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In this issue...Volume 2, Number 10

Developmental care has become a current "buzz word" in neonatal care. Although it is often used synonymously with the Neonatal Individualized Developmental Care and Assessment Program, the term actually applies to any strategy that makes the neonatal care unit environment more likely to result in appropriate developmental outcomes for preterm infants. Because the central nervous systems of infants develop rapidly during the third trimester of pregnancy or the preterm period, any care that infants receive can affect their developmental outcome. Thus, the decision is not between developmental care and usual care: it is between developmentally appropriate and inappropriate care.

Although some strategies, such as noise control and pain relief, have been widely adopted in practice, widespread adoption of developmentally appropriate care is hampered by the lack of studies showing the effectiveness of specific developmental care strategies and by the unknown effectiveness of complex programs that combine multiple strategies. In this month's issue, we focus on three specific components of developmentally appropriate care: a) using day-night cycled lighting in the NICU, b) interventions to help infants make the transition from gavage to bottle-feeding, and c) infant massage.

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Learning Objectives

The Johns Hopkins University School of Medicine and The Institute for Johns Hopkins Nursing take responsibility for the content, quality, and scientific integrity of this CE activity.

At the conclusion of this activity, participants should be able to:

- Understand the origins and background of developmentally appropriate care;
- Identify the effectiveness of three developmental care strategies: cycled light, feeding support, and infant massage;
- Understand the limitations of the studies of these strategies.

Program Information

CE Info

LENGTH OF ACTIVITY

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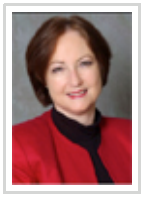

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0.5 hours

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COMMENTARY

Brain development is an "experience expectant" process through which normal species-typical experiences enable the brain to make structural and functional changes.[1] Since the preterm brain typically develops in the uterine environment, the atypical NICU environment affects the neurological development of preterm infants, and developmental problems may result from the interactions between specific neurological insults and the neurological changes created by life in the NICU environment.

Although developmental care is often equated with Als' Neonatal Individualized Developmental Care and Assessment Program,[2] the origins of this field of study are much older. In the 1970's, Cornell and Gottfried[3] critiqued the literature on infant stimulation by showing that the NICU was not characterized by a lack of stimulation but rather by inappropriate stimulation. In the early 1980's, additional studies provided further detailed descriptions of the NICU environment.[4]

While many developmentally appropriate strategies (i.e. noise control,[5,6] pain relief,[7,8] flexed positioning[9,10]) have been widely adopted in neonatal care, the more widespread adoption of developmentally appropriate care has been hampered by the growth of

programs that incorporate multiple strategies without determining their individual effects, as well as by the inclusion of practices with minimal empirical support, such as co-bedding of twins[11]. In addition, many studies of developmental care suffer from small sample sizes and methodological flaws.

Continuous bright lighting is known to be problematic for preterm infants,[12] but whether day-night cycling of light or darkness is better is unknown. Brandon et al and Rivkees et al compared these lighting patterns and found that infants cared for in cycled light showed earlier day-night differentiation in activity patterns; the studies, however, disagreed on whether infants in cycled light also had greater weight gain. Both studies had relatively small samples and included few infants younger than 28 weeks. Thus, the appropriate age to implement cycled lighting remains unclear.

Failure to progress to full bottle-feedings commonly results in prolonging the hospitalization of preterm infants. The studies by Law-Morstatt et al and Fucile et al tested developmentally supportive interventions to speed this transition. While these interventions seem promising, they have been tested with only very small samples and need more extensive evaluation before adoption into widespread practice.

Studies have demonstrated that massage is safe for preterm infants[13,14]; however, whether its routine use in the NICU is warranted is less clear. Although the studies by Aly et al. and Glover et al. suggest potential benefits of massage, these studies have methodological flaws and fail to consider the physical and social effects of massage in the same study. The conclusion of the Cochrane Review — that there is not enough evidence to support the routine use of massage in NICUs — continues to be true.[13]

1. **Greenough WT, Black JE, Wallace CS.** Experience and brain development. Child Dev 1987; 58:539-59

2. **Als H, Gilkerson L, Duffy FH, et al.** A three-center, randomized, controlled trial of individualized developmental care for very low birth weight preterm infants: Medical, neurodevelopmental, parenting, and caregiving effects. J Dev Behav Pediatr 2003; 24(6):399-408

3. **Cornell EH, Gottfried AW.** Intervention with premature human infants. Child Dev 1976; 47: 32-9

4. **Gottfried AW, Gaiter JL, eds.** Infant stress under intensive care: Environmental neonatology. Baltimore, University Park Press, 1985

5. **Johnson AN.** Adapting the neonatal intensive care environment to decrease noise. J Perinat Neonatal Nurs 2003; 17(4):280-8

6. **Philbin MK.** Planning the acoustic environment of a neonatal intensive care unit. Clin Perinatol 2004; 31(2):331-52

7. **Anand KJ, Hall RW, Desai N, et al.** Effects of morphine analgesia in ventilated preterm neonates: primary outcomes from the NEOPAIN randomised trial. Lancet 2004 22; 363(9422):1673-82.

8. **Anand KJ.** Clinical importance of pain and stress in preterm neonates. Biol Neonate 1998; 73(1):1-9

9. **Aucott S, Donohue PK, Atkins E, Allen MC.** Neurodevelopmental care in the NICU. Ment Retard Dev Disabil Res Rev 2002; 8(4):298-308

10. **Monterosso L, Kristjanson L, Cole J.** Neuromotor development and the physiologic effects of positioning in very low birth weight infants. J Obstet Gynecol Neonatal Nurs 2002; 31(2):138-46

11. **DellaPorta K, Aforismo D, Butler-O'Hara M.** Co-bedding of twins in the neonatal intensive care unit. Pediatr Nurs 1998; 24(6):529-31

12. **Miller CL, White R, Whitman TL, et al.** The effects of cycled versus noncycled lighting on growth and development in preterm infants. Infant Behav Dev 1995; 18: 87-95

13. **Vickers A, Ohlsson A, Lacy JB, Horsley A.** Massage for promoting growth and development of preterm and/or low birth-weight infants. Cochrane Database Syst Rev 2004:CD000390 Retrieved *12/31/2004*

14. **White-Traut RC, Nelson MN, Burns K, Cunningham N.** Environmental influences on the developing premature infant: Theoretical issues and applications to practice. J Obstet Gynecol Neonatal Nurs 1994; 23(5):393-401

CYCLED LIGHTING IN THE NICU

Brandon DH, Holditch-Davis D, Belyea M.
Preterm infants born at <31 weeks gestation have improved growth in cycled light compared with continuous near darkness.
J Pediatrics 2002; 140:192-9
(For non-journal subscribers, an additional fee may apply for full text articles)

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Rivkees SA, Mayes L, Jacobs H, Gross I.
Rest-activity patterns of premature infants are regulated by cycled lighting.
Pediatrics 2004; 113, 833-9
(For non-journal subscribers, an additional fee may apply for full text articles)

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Investigating the potential of cycled lighting to promote weight gain and establish circadian rhythms.

More than anything else, weight gain dictates the length of hospitalization for preterm infants. Previous research, which compared cycled light to continuous bright light, demonstrated continuous bright light to be associated with stress behaviors including apnea, bradycardia, and poor weight gain. Cycled light, on the other hand, appears to have the potential to influence weight gain through the promotion of sleep-wake states and circadian rhythm development.

Using a randomized longitudinal design Brandon et al. evaluated the benefits of low intensity cycled light for the health of preterm infants born at <31 weeks postmenstrual age (PMA). Sixty-two infants were randomized to cycled light from birth, at 32 weeks PMA, or 36 weeks PMA. Prior to the initiation of cycled light all infants were in continuous near darkness. Infants had a mean gestational age of 28 weeks and were similar across groups on all severity of illness measures with the potential to affect growth. The intervention began as soon as phototherapy was discontinued. Daylight was provided at 225 lux (8 am to 7 pm) and 5-10 lux (8pm to 7am) for near darkness; the two hours between 7 and 8 am and pm were used as transition hours during the nursing change of shift. The average length of cycled light was at least four weeks in each of the three groups. Infants exposed to early cycled light (at birth and 32 weeks PMA) gained weight at an accelerated rate compared to those infants that did not receive cycled light until 36 weeks PMA. Although infants did not differ on length of hospitalization or days of mechanical ventilation, this study was not adequately powered for those variables.

This study demonstrated benefits of cycled light over near darkness for growth during NICU hospitalization without any discernible negative effects of light exposure during the daylight hours. The fact that infants receiving cycled light from birth did as well as the infants receiving cycled light at 32 weeks PMA highlights the lack of clarity regarding to the optimal

time to implement cycled light for preterm infants. The limitations of this study include the lack of long-term health and developmental outcomes and the need for repetitive findings with a larger sample to evaluate the impact on length of stay.

In a 2004 report, Rivkees et al. evaluated the effects of near darkness and low intensity cycled light on circadian rhythm development in preterm infants born at <32 weeks. Sixty-two medically stable infants were randomly assigned to either cycled light or continuous near darkness beginning at 32 to 34 weeks PMA, for an average 25 days prior to discharge. Infants received day (239 ±29 lux) and night (<25 lux) cycling of light in a 12-hour on/12-hour off basis. Following discharge, there was no attempt to control the light environment provided by the parents. Infants in the cycled light group developed day-night differences in activity patterns one week after discharge, as compared to three weeks after discharge for the infants that were exposed to continuous near darkness. This study did not find differences in physical growth, and weight gain was analyzed differently than in the Brandon et al study.

This study demonstrated that rest and activity patterns could be synchronized with day and night cycling of light, indicating that preterm infants are capable of being entrained to the 24-hour day. The study utilized only healthy infants, so it remains unclear if smaller and more fragile preterm infants can be entrained by cycled light. In addition, other aspects of the care-giving environments with the potential to influence rhythms (i.e. feeding) were not examined. However, the benefits of circadian rhythms to the health of older children and adults would in the absence of any deleterious effects appear to support the cautious implementation of cycled light for healthy growing preterm infants.

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TRANSITIONING FROM GAVAGE

Law-Morstatt L, Judd DM, Snyder P, Baier RJ, Dhanireddy R.
Pacing as a treatment technique for transitional sucking patterns.
J Perinatol 2003; 23(6):483-8
(For non-journal subscribers, an additional fee may apply for full text article)

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Fucile S, Gisel E, Lau C.
Oral stimulation accelerates the transition from tube to oral feeding in preterm infants.
J Pediatrics 2002; 141(2):230-6
(For non-journal subscribers, an additional fee may apply for full text article)

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Fucile S, Gisel EG, Lau C.
Effect of an oral stimulation program on sucking skill maturation of preterm infants.
Dev Med Child Neurol 2005; 47(3):158-62
(For non-journal subscribers, an additional fee may apply for full text article)

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Investigating the benefits of feeding skills interventions.

Premature infants with increased work of breathing and/or oxygen requirements during the transition period from gavage to oral feeding are at increased risk for apnea, bradycardia, and oxygen desaturations and increased fatigue during feeding, as well as prolonged transition times to full oral feeding. Law-Morstatt et al studied the effectiveness of a paced bottle-feeding protocol for infants with respiratory diagnoses who were assessed to have difficulty coordinating sucking and swallowing with respiration. The bottle-feeding protocol was structured to limit the length of sucking bursts and lengthen the duration of swallowing and breathing periods and was specified in relation to the infant's assessed skill. In addition, feeders were instructed to adapt the protocol during the feeding in relation to infant cues of distress or fatigue, either through provision of longer rest periods or cessation

of oral feeding.

Eighteen infants fed with a traditional feeding approach were compared with 18 infants receiving the paced feeding protocol. Coordination of sucking pattern was assessed weekly and used to fine-tune the pacing protocol for the experimental group. At discharge 50% of the paced group had developed an organized pattern of sucking compared to 6% of the traditionally fed group. While oxygen saturation and apnea were not measured, the paced group of infants had significantly less bradycardic episodes (13.6 vs. 6.1 mean bradycardias per week) during feedings throughout the transition to full oral feeding. Groups did not differ in length of stay or weight gain during the study.

Law-Morstatt et al demonstrated that a feeding intervention tailored to the sucking, swallowing, and breathing capacities of the individual infant can promote the development of organized feeding patterns and assist the infant to regulate physiologic stability. Interestingly, infants receiving the paced feeding protocol had a higher rate of gavage feeding, perhaps contributing to less bradycardia, yet the transition period to full oral feeding was not lengthened and they were discharged, on average, 1.55 weeks earlier (and at a younger post-conceptional age) than the traditionally fed group.

Fatigue is a common feature of early preterm oral feeding, and inadequate energy or endurance for feeding is often the reason cited for early cessation of a feeding session. Fucile et al (2002, 2005) have studied the effectiveness of an oral motor stimulation program on preterm infants' motor skill development. 16 healthy preterm infants less than 29 weeks gestation were given an oral motor stimulation program once they no longer required continuous positive airway pressure, and 16 infants served as a control group. A systematic protocol of 12 minutes of stroking to their cheeks, lips, gums, and tongue and 3 minutes of non-nutritive sucking practice was administered to the experimental group prior to one gavage feeding per day for 10 consecutive days.

In 2002, Fucile et al demonstrated that infants who received the oral stimulation program fed a higher percent of their prescribed intake at a higher rate of milk transfer (ml/min) at three time points: when they were taking one to two, three to five, and six to eight oral feedings per day. Further, the experimental group also attained full oral feeding seven days earlier than the control group.

Fucile et al's 2005 study examined the effect of the intervention on specific components of sucking. For this study, sucking skills were examined at two feedings during two time points: when the infants were able to orally feed one to two feedings per day, and when they were able to orally feed six to eight feedings per day. This study demonstrated that while the oral stimulation program had no effect on sucking pattern maturation or sucking frequency during feedings, infants given oral motor stimulation and non-nutritive practice prior to the initiation of oral feeding were able to generate stronger sucking expression during the early time points. The authors conclude that enhanced tongue and jaw muscle tone and coordination may contribute to infants' ability to express milk more effectively during early oral feedings. The Fucile et al studies add to our understanding of the oral motor component of early feeding skill and demonstrate that feeding interventions can advance preterm infants' ability to orally feed.

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INFANT MASSAGE

Aly H, Moustafa M, Hassanein S, Massaro A, Amer H, Patel K.
Physical activity combined with massage improves bone mineralization in premature infant: A randomized trial.
J Perinatol 2004; 24:305-9
(For non-journal subscribers, an additional fee may apply for full text article)

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Glover V, Onozawa K, Hodgkinson A.

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Benefits of infant massage for mothers with postnatal depression.
Seminars in Neonatology 2002; 7(6):495-500
(For non-journal subscribers, an additional fee may apply for full text article)

view full article

Investigating the benefits of massage for infants and mothers

Several studies have evaluated premature infants' responses to various massage techniques. Although benefits (including improved feeding progression, weight gain and shortened length of hospital stay) have been reported, and the safety of massage with human social interaction has been repeatedly documented, the underlying mechanism(s) have not been specifically determined. Therefore, massage in association with human social interaction remains under-subscribed as an acceptable developmental intervention.

Using

diagnosed with periventricular leukomalacia. Res Nurs Health 1999; 22:131-43.

3. **White-Traut RC, Nelson MN, Silvestri JM, Patel M, Vasan U, Meleedy-Rey P.** Multi-sensory intervention for extremely premature high-risk infants: Developmental patterns of physiologic response to ATVV Intervention. J Obstet Gynecol Neonatal Nurs 2004; 33:266-75.

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Respiratory Therapists
Contact your state licensing board to confirm that AMA PRA category 1 credits are accepted toward fulfillment of RT requirements.

Target Audience · back to top
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Learning Objectives · back to top
The Johns Hopkins University School of Medicine and The Institute for Johns Hopkins Nursing take responsibility for the content, quality, and scientific integrity of this CE activity. At the conclusion of this activity, participants should be able to:

• Understand the origins and background of developmentally appropriate care;
• Identify the effectiveness of three developmental care strategies: cycled light, feeding support, and infant massage;
• Understand the limitations of the studies of these strategies.

Faculty Disclosure Policy Affecting CE Activities · back to top
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• Dr. Nogee has indicated a financial relationship of grant/research support with Forest Laboratories and has received an honorarium from Forest Laboratories.

- Dr. Lawson has indicated a financial relationship of grant/research support from the NIH. He also receives financial/material support from Nature Publishing Group as the Editor of the Journal of Perinatology.

All other faculty have indicated that they have not received financial support for consultation, research, or evaluation, nor have financial interests relevant to this e-Newsletter.

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