Clinical Pearl:
A Day in the Life: A Preemie Experience

Catherine Ney, MS, CCLS, Joseph R. Hageman, MD

"Have you, as a clinician, wondered what it is really like to be a premature infant being admitted to the Neonatal Intensive Care Unit? Even after spending time as a patient in the intensive care unit after a cardiac arrest, intubated, then post-operatively following a four-vessel bypass as I did in 2013, I do not think I really know what it is like for a preemie."

Have you, as a clinician, wondered what it is really like to be a premature infant being admitted to the Neonatal Intensive Care Unit? Even after spending time as a patient in the intensive care unit after a cardiac arrest, intubated, then post-operatively following a four-vessel bypass as I did in 2013, I do not think I really know what it is like for a preemie.

Catherine Ney, my co-author, and colleagues in the Developmental Care Committee have organized an excellent simulation for NICU nurses, neonatal and pediatric nurse practitioners, residents, fellows, and faculty with help from the experts in our Simulation Unit at the University of Chicago. The simulation explores aspects of an admission experience includes admission procedures highlighting the effects of the sensory experience (i.e., sound, noise, taste, smell, light, and positioning). Additional components to effectively simulate the neonate's experience included the sensation of a weighted positioner on your chest and movement restrictions due to an overly tight swaddle and poor positioning. One of the adults assumes the role of the patient as the providers complete admission tasks with a follow-up discussion regarding the effects on development, potential pathological effects, and how it must feel for the baby.

A comprehensive introduction, led by our Neonatal Nurse Practitioner Chris Elsen, highlights premature development through a developmental care lens that helps focus our participants before their breakout simulation sessions (1,2,3).

Pat Byrnes-Bowen, our physical therapist, explains the stages of development in utero and, as a consequence of preterm birth, what that infant will no longer have an opportunity to experience. As providers in this space, she discusses how we can use various tools and techniques to make the infant's extrauterine life as physically supportive as possible. Pat explains how positioning needs change and how important proper positioning can be to aiding in a successful life as a young child and adult.

Moving through our additional stations, participants discuss taste and smell with Julie Sadowski, Speech-Language Pathologist, and myself (Dr. H). In this session, participants learn about the aspects of development in utero that prepare infants for feeding later and how exposure to noxious smells can interfere with bonding and deter patient's from positive oral experiences. This simulation allows participants to smell common items used on or near these patients at a high concentration. They are encouraged to smell various containers and identify alcohol wipes, adhesive remover, and perfume. Even in the age of mask-wearing, these smells permeate without losing their potency (6,7).

"As the participants digest these thoughts, the lights are dimmed, and they are encouraged to get comfortable in their chairs with eyes closed as they are about to enter the world of a preemie for a few moments. Recorded sounds are played, starting with a heartbeat track that is layered with common noises on the unit. Participants appear visibly shocked as these noises begin and have thoughtful comments during our discussion"

As participants enter the sound and vision station, they often notice an iPad set up with a decibel reader that is left on throughout the discussion. Catherine walks them through the developmental components of life in utero and the fascinating way the evolution of pregnancy prepares infants for the outside world. For most of our patient population, this natural experience is stripped away as they are thrust into a space that assaults their immature sensory systems. As the discussion moves toward sound, graphs are highlighted with decibel level readings of physical spaces on our unit compared to the recommended level of 45dB's. The discussion in the room spikes to the mid 70dB range with just one person talking (8-11). As the participants digest these thoughts, the lights are dimmed, and they are encouraged to get comfortable in their chairs with eyes closed as they are about to enter the world of a preemie for a few moments. Recorded sounds are played, starting with a heartbeat track that is layered with common noises on the unit. Participants appear visibly shocked as these noises begin and have thoughtful comments during our discussion.

Prior to the final discussion, all participants are gathered for a presentation on mindfulness. Working in the health care field and in an intensive care unit demands more than clinical competence. Compassionate care supports a family-centered model but can be hard to sustain amid the daily challenges on our unit, not to mention the global pandemic. Participants are encouraged to explore the use of G.R.A.C.E. to help support their cultivation of compassionate care toward their patients and families and find ways to support their capacity to do so (12). .

We also discuss what the clinicians can do to be more sensitive to the infant's senses and developmental needs, optimize their NICU experience, and minimize the negative effects of this experience.

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We have had several nurses, NNPs, fellows, and attending neonatologists experience this simulation, and the feedback has been really positive thus far. We have a debrief and ask them what can be done to improve the experience and have received a lot of helpful feedback to refine the simulation.

This is by no means a unique simulation as other NICUs have been doing this for a number of years (Phillips https://www.learningconnection.philips.com/en/course/preemie-day), and Catherine has spoken with clinicians from other units about their programs.

We will continue to refine this Day in the Life simulation and plan to do some follow-up surveys for those clinicians who have been through this to see if it has affected their practice in the NICU. An educational handout with summaries of development and the senses is also provided (Appendix 1) for the attendees.

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References

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Disclosures: The authors have no conflicts to disclose

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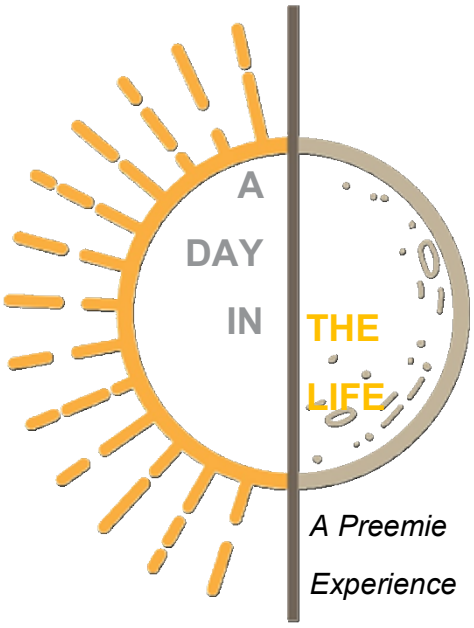
A Preemie Experience

Educational Handout



AT THE FOREFRONT OF Kids MEDICINE
UChicago Medicine
Comer Children's

Smell	Developmental Facts	Positive Impacts of Dev Care Practices	Negative Impacts in the absence of Dev Care Practices	Ways to Enhance Dev Care Practices
	• During gestation, the nasal orifices remain plugged until the 6th month or earlier, but then dissolve and allow fetuses to inhale amniotic fluid • Flavonoids and odorants in amniotic fluid allow for taste and smell experience and exploration while in utero • Preterm infants can both detect and discriminate between different odors as early as 28 to 29 weeks' gestation • The cephalic-phase responses are innate and learned physiological responses to sensory signals that prepare the gastrointestinal tract for the optimal processing of ingested foods. CPRs could be affected by inconsistencies in the associations between sensory signals and subsequent post-ingestive consequences	• The smell and taste of breast milk on a scent cloth can trigger the cephalic-phase response to help support absorption and digestion while infants are being tube fed • Tactile stimulation combined with odor and flavor stimuli appears to mediate important learning and builds faster oral feeding competence • Research has documented the ability of the positive smell of mother's milk to calm and organize the infant, as well as improve NNS and draw the infant toward mother's milk for breastfeeding.	Short Term: • Exposure to strong stimulants such as disinfectants, detergents, alcohol, etc. has shown decreased oxygenated hemoglobin over the parietal region of the brain Long Term: • Perception and past experiences with the taste and smell greatly influence emotions, psychological well-being, physiological and metabolic processes as well as interpersonal relationships and social associations	• Rub Purell in all the way before touching infant or entering isolette • If mother's milk is not available for olfactory stimulation, vanilla has been shown to also provide a calming effect on infants • Encourage skin-to-skin holding and the use of scent cloths to provide maternal scent • Avoid wearing perfumes/cologne (by staff or caregivers) as this can interfere with the infant's identification and response to their own mother's odor or to the appetitive behaviors to a feeding experience • Open alcohol wipe, adhesive remover, etc. outside of the isolette • Vent isolette when cleaning while infant remains inside or try to time cleaning when infant is participating in kangaroo care

Sight	Developmental Facts	Positive Impacts of Dev Care Practices	Negative Impacts in the absence of Dev Care Practices	Ways to Enhance Dev Care Practices

	• "All of the processes involved in the development of the structure and function of the human visual system…have a critical period between 20 and 40 weeks' gestation during which epigenetic events, toxic exposures and inappropriate external stimulation can produce significant alteration in the structure and function of the infant's visual system."
	
	• The visual system is not developmentally ready for visual stimulation until birth at term – external visual stimuli is not necessary for visual development
	
	• Excess visual stimuli can also interfere with auditory neurosensory development prior to 38 weeks
	
	• Premature infant has no pupillary reflex below 30 weeks' gestation and only variable responses until 32-34 weeks
		• Protecting sleep is critical for healthy visual development
		
		• Using indirect light except for procedures when lighting can be used with appropriate shielding of the baby's eyes
		
		• Standard lighting;
		  ○ 37 to 50 lux during nighttime
		  ○ 192 to 890 lux during daytime
		  ○ EX: phototherapy = 3000 lux
			Short Term:
			• When quality of sleep is compromised, infants burn extra calories due to stress
			• Excessive and early exposure to intense or flickering light can alter synaptogenesis in the visual and auditory system
			
			Long Term:
			• Direct ambient light has a negative effect on the development of a preterm infant's visual neural architecture
				• Use isolette covers as soon as possible for all infants in isolettes regardless of gestational age
				
				• Bright lights only as needed for assessments or procedures
				
				• When possible, shield infant's eyes from direct, overhead lighting, aiming to exclude the infant's head unless medically necessary

Sound	Developmental Facts	Positive Impacts of Dev Care Practices	Negative Impacts in the absence of Dev Care Practices	Ways to Enhance Dev Care Practices
	• Through pregnancy, the walls of the uterine lining begin to thin (timed with development of hearing structures/processes) to expose fetus to sound frequencies that are appropriate • From 32 weeks' gestation into the 2nd year of life is a critical period of development. Neural connections are forming and the auditory system is most vulnerable to the damaging effects of abnormal sensory input • Excessive sound may damage delicate auditory structures and increase the risk of auditory processing discrimination problems • Sensory interference occurs when stimuli are out of sequence or when intensity is inappropriate for the stage of development	• Directed human voice is important – background noise (conversation) does not provide infant with the appropriate stimulation needed for their auditory development. • Keeping noise levels low (closer to the recommended 45dB) helps reduces stressful stimuli that increased cortical levels that can alter the makeup of the brain (Mary Coughlin) • Engaging infant with a soft gentle voice prior to touching or handling infant (one modality at a time) helps them acclimate better and reduces their stress during interaction.	Short Term: • Physiological responses: increased crying, heart rate, blood pressure, decreased oxygen sats, sleep • Exposure to even moderate noise levels may delay normal auditory development • Noise on the unit masks meaningful sounds (i.e. parent's voices) needed for normal development Long Term: • Growth and development delays, hearing deficits, increased LOS, speech delays • REM sleep is greatly interrupted which is essential for early brain development	• Keep conversation noise levels down • Close portholes softly and encourage caregivers to do the same • Limit the time the top of the isolette bed is up, as possible • Turning off alarms as soon as possible • Answer or silences phones as soon as possible • Gather all materials needed before entering isolette for care; this will help avoid raising your voice over to ask others for forgotten materials

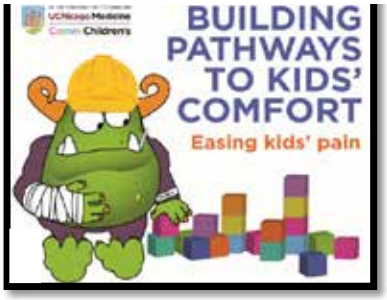
Taste

Developmental Facts	Positive Impacts of Dev Care Practices	Negative Impacts in the absence of Dev Care Practices	Ways to Enhance Dev Care Practices
• The pharyngeal swallow of amniotic fluid begins to emerge around week 10-14 weeks PMA • Babies will swallow about 600-800 mLs of amniotic fluid a day in the last trimester (premature infants are deprived of this sensory input and experiences compared to the infant in utero) • The infant in utero has plenty of opportunities to have their hands near their mouth for exploration and calming/comfort, while our NICU babies may miss out on these opportunities • Non-nutritive sucking develops around 27-28 weeks PMA which will help prepare and build a foundation for later feeding skills • "The processing of the taste and smell sensory environment significantly influences the entire developmental life of individuals from day one…Because of the early development of the smell and taste systems, early associations (positive and negative) can influence thoughts, emotions, and behaviors throughout the lifespan."	• Kangaroo care increases physiologic stability in infant (increased stability of O2, etc.) and stimulates breastmilk • Non-nutritive sucking on pacifier decreases time to transition from tube to oral feeds. • Supportive interventions which assist parents in reading the cues of their infant, and in supporting their infants' goal strivings has shown improved developmental outcome to 9 years of age. • Kangaroo care – studies show skin-to-skin results in MOB breast feeding exclusively and longer than controls	Short Term: • "Increased exposure to stressors in the NICU has been associated with alterations in neurobehavioral and brain structures at 40 weeks PMA" • "…neonates with comorbidities require additional time to show consistent oral feeding skills." Long Term: • "Although less than 1% of preterm infants required supplemental tube feedings at time of discharge from NICU, more than 50% of parents of NICU graduates report problematic feeding behaviors in their former preterm infant at the age of 18-24 months."	• Not only important to avoid/limit negative experiences, but also to provide positive experiences while not overwhelming infant • Promote skin-to-skin opportunities to allow for taste and smell of maternal milk and skin • Identify infant's engagement and disengagement cues to help parent learn infant's responses to build competence and confidence and prepare them for infant driven feeding in future • Offer pacifier as tolerated, - can begin offering around 27-30 weeks PMA – per cues. Recommend transitioning to standard/newborn nipple around 32 weeks to allow infant to ready for bottle feeds • "…successful feeding is related to maturation rather than feeding experience…the younger the infant is at birth, the longer it takes for that infant to achieve a mature suck pattern."

 Touch	**Developmental Facts**	**Positive Impacts of Dev Care Practices**	**Negative Impacts in the absence of Dev Care Practices**	**Ways to Enhance Dev Care Practices**
	• The womb, with its muscular uterine walls and amniotic fluid, provides continual sensory and kinesthetic input necessary for motor system development. • Swaddling and containment of the infant with general flexion of the extremities and trunk mimics the *in utero* environment. • Neural pathways for movement and position stimuli are intact as early as 23 to 24 weeks' gestation with greater discriminatory capacity probably beginning during the 28-32-week gestational time period. • Back to Sleep decreased the incidence of SIDS, but this change in sleep position has brought a new set of concerns, including a slower attainment of major milestones… and the development of positional plagiocephaly…"	• From birth, provide containment and body flexion of the newborn utilizing: fluidized positioner, swaddling, weighted positioner • Swaddling can decrease awakenings during quiet sleep and promote longer periods of REM sleep; appears to improve self-regulation, diminished stress response, and a decrease in arousal level • Swaddling can support Safe Sleep during supine positioning and decrease the risk of sudden infant death syndrome (SIDS) • Role modelling of appropriate positioning practices to parents and colleagues supports consistent experiences for the infant and their continued development	• Abrupt blood flow changes exert deleterious effects on the immature brain and appear to alter its subsequent development • Tight swaddling has the potential to interfere with normal respiratory effort and may potentially have orthopedic consequences • Prolonged inadequate support contributes to: asymmetries, atypical alignment, movement patterns which can negatively impact the infant, future motor development through overstretch injuries • Reinforcing arching and retraction through improper positioning prevents hands to midline can contribute to delays in fine and gross motor skills • Flat Head Syndrome • Torticollis	• Avoid extreme cervical rotation positions • Provide flexion, containment and alignment during all caregiving activities • Allow infant to move as would be typical in utero within the containment of the nest or swaddle. • Swaddles should allow hip flexion and abduction, not papoose • Ensure proper postural support: Physiologic flexion, Head/neck midline/neutral, Shoulder protraction, flexed upper extremities and lower extremities, Hands midline and to mouth, Posterior pelvic tilt, Foot bracing • Make certain monitors are not pulling on extremities and avoid placing weighted positioners on infants backs or chests

ChildKind Tips

On our journey to ChildKind, here is are tips for easing pain and promoting comfort based on the senses:



Providing mother's odor during invasive procedures (i.e. heel sticks) in infants has been shown to reduce reactivity and shorten the return to baseline.

Try to use bright lights as little as possible and use an eye shield or cloth to cover infant's eyes.

Decreasing unnecessary background noises and volume (i.e. conversations, alarms, doors) allows for increased opportunities for babies to experience positive auditory input through human voice (i.e. reading or talking softly at bedside).

Avoid frequent taping/re-taping around mouth and nose and try to transition from OG to NG, as able, to reduce negative oral sensory experiences.

Providing swaddling support on non-affected limbs during painful procedures like IV starts can help reduce stress, minimize physiological responses and help infant return to baseline quicker following procedure.

Noise Graphs

Comer NICU Noise Levels	
2nd Floor door entrance	72 (*90+) dB
Linen container	74 dB
ECMO, supply door	65 dB
HVAC, warmer	62 dB
Soft closing door, fridge door	68 dB
Alarm, sink/water, paper towel holder	73 dB
Rounds	91 dB
Empty room (4th floor)	51 dB

Sound Source	Sound Equivalents
Closing both porthole doors at the same time	122 dB = sound output of jack hammer
Shutting both cabinet doors near bed space at the same time	114 dB = jet plane take off
Placing infusion pumps on top of incubator	110 dB = jet plane take off
Setting milk bottle softly on top of incubator	96 dB = sound output of a lawnmower

Risk of Hearing Damage (OSHA)		
90 dB	8 hours	Factory, train
95 dB	4 hours	
105 dB	1 hour	Subway noise, motorcycle
110 dB	30 minutes	
120 dB	15 minutes	Chain saw, siren, rock concert
125 dB	Painful	

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