

## ENVIRONMENTAL GUIDELINES

### BACKGROUND

In contrast to the uterine environment, the Neonatal Intensive Care Unit (NICU) is a harsh environment with excessive stimuli, loud noises, bright lights, noxious smells and overcrowding (1)

Premature infants are born at a critical time of brain maturation and organisation, there is little capacity for the brain to inhibit sensory overload or maintain physiological stability (2). The infant is also deprived of emotional and social contact with his parents (15).

Detrimental environmental effects on neonates have been reported as a consequence of negative stimuli.

### AIM

- To reduce harmful stimuli in the environment
- To promote sleep and stability
- To support optimal neurodevelopment.
- To ensure safety
- To prevent morbidity
- To promote health and wellbeing

### Noise

In NICU there is continuous background noise of equipment and sudden peaks of noise such as alarms sounding (4)

Hearing apparatus in the foetus is mature at 28 weeks and from 35 weeks gestation infants begin to habituate to sound by shutting out unwanted noise (3).

In premature infants excessive noise interferes with autonomic regulation causing increased heart rate, vasoconstriction, agitation, disturbed sleep/wake states, inability to attend to parent's voice above other noise and feeding to be less co-ordinated (4). Premature infants are more likely to have hearing impediments than their term counterparts (5), though it is not known if this is due to environmental conditions.

A Quiet time project in the unit also demonstrated a significant reduction in the mean heart rate of premature infants when they received a period of quiet time compared to the standard practice (16).

### Standard:

- Continuous background noise and operational sound should not exceed an hourly  $L_{eq}$  (average) of 45dB or an hourly  $L_{10}$  (level exceeded 10% of time) of 50dB
- Transient sounds or  $L_{max}$  (maximum noise level) should not exceed 65dB (6, 13).

An audit carried out at the LWH NICU in 2010 showed that minimum noise levels were >50dB in ITU. Transient noises were much higher e.g. intercom – 80dB and bins closing 75dB.

## **Interventions to reduce noise**

- Keep background lighting at low level in the nurseries (designated Quiet zones) this encourages people to lower their voices
- Avoid sudden loud noises
- Speak softly away from incubator and encourage others to do the same. Avoid calling across to another person across the room.
- Radios should not be in clinical areas
- When opening and closing portholes, drawers and doors do so quietly
- Individual babies are used to their family's music and sounds heard from within the womb - these can help to calm infants, but should be tailored according to gestation, health and infant's behavioural state (3)
- Respond to alarms promptly
- Avoid water in ventilator tubes, use sound filters on CPAP drivers
- Avoid putting things directly on top of incubators; insulate incubators with a padded cover
- Close bins quietly – if broken request a new one through ward manager
- Earmuffs are not recommended as they amplify internal sound and mask human voice (3,15)
- During night time, darken the nurseries and make afternoon quiet time like night time

## **Light**

The visual system is the last of the senses to develop. Infants born prematurely have poorly developed vision. They cannot begin to fix on an object until 32-34 weeks gestation and only by term are they sensitive to light contrast and distinguish bright colours such as red (3).

Lighting in neonatal units is used inconsistently and an understanding of its effects on premature and sick infants, families and workers is essential.

Light levels are measured in Lux\* or footcandles\*\*10.76 lux =1 foot candle.

### **Standard:**

- Ambient lighting levels should be adjustable and >10 and <600lux (1-60 foot candles) (13). Observational lighting should be around 600 lux (60 foot candles)(6)
- Separate procedural lighting should provide >2000lux (200 foot candles) and <2% should extend beyond the illumination field (13).
- Illumination of support areas should produce 3-400 lux at the eye or 1500-1200 lux at the work plane (13). For general office work/display screens 500 lux (50 footcandles)(7, 8)

Light levels at LWH NICU were measured in 2010 showing in some areas lighting was excessive e.g. daylight from windows reached 1000 lux however when blinds down light was reduced to 20 lux in I.T.U.

Poor visual function is a common outcome in very low birth weight children (9). High levels of light exposure are thought to be associated with retinal damage and may harm the developing visual system (10).

In very low birth weight infants, excessive lighting causes central nervous system arousal and signs of stress or avoidance behaviour such as staring or averted gaze (3). Strong light shining on the face will disturb sleep and inhibit communication between parents and infant. Sudden switching on of light can cause hypoxia.

Reducing light levels may facilitate rest, energy conservation and promote organisation and growth. Care can be managed safely in moderate lighting from 200-lux (3)

It is thought that disorganised lighting patterns can disrupt the development of natural circadian rhythms. Foetuses have biological rhythms in tune with their mother, but it is unknown if cycling of light affects circadian rhythms before term (11). The effects of a day and night cycling of light on preterm infants have shown benefits of better quality of sleep and energy conservation (12). Further evidence is needed to address concerns that staff working in a dimly lit environment will suffer eye strain, mood changes and that safety may be compromised (3).

### **Light Interventions.**

- Dim lights whenever possible. Use individual lighting or natural lighting rather than strip lighting where possible
- Shield premature infants from the direct light with incubator covers or eye shields; for observation, ensure the incubator is not completely covered.
- Infants should experience night and day from 34 weeks, while preparing for home. Entrainment to light from two weeks prior to discharge helps baby's to develop their own circadian rhythms, this can occur at 200-250 lux (11).
- Protect infants' eyes especially direct sunlight, when near large windows, procedure lights or adjacent to phototherapy lights
- Avoid sudden changes in lighting, warn people and turn lights down slowly using dimmer switches
- Decrease lighting when parents are visiting so baby can open his eyes

### **Odour**

Strong odours e.g. Chlorhexidine, alcohol and staff perfume, stimulate the infant's sense of smell on the NICU. Olfaction is well developed at birth and the smell of mother's breastmilk can be distinguished from strangers within the first week (13). An infant response to unpleasant smells is to alter respiration, increase heart rate and attempt to move away from the stimulus. The ability to recognise mothers smell may be blocked by other strong odour (3).

### **Interventions**

- Avoid wearing strong perfume
- Ensure hands are dry after using hand gel before going into incubator
- Suggest to parents that they have one or two washable comfort cloths(s) or toy(s) that they can hold close to their chest and then place in incubator/cot, so their infant can sense their parents smell.

- In turn the cloth can be taken home so parents can be comforted by their infants smell (3)
- An alternative for the infant is a gauze pad with mothers breast milk on (14).

### **Space**

Cot space is at a premium on the NICU. Cramped spaces have implications for privacy, parent-infant interaction, stress levels for parents and staff and increased noise and activity close to the baby.

Recommended bed space in the NICU is 120 square feet per incubator with 8 foot between each incubator (13).

### **Interventions**

- Every effort to make the best use of the space available, keep wires tidy, remove unnecessary equipment etc.
- There should be space for both parents to sit comfortably at the cot side and to allow for privacy.
- There should be sufficient wheelchair access (14).

## **REFERENCES**

1. Graven, S.N. (2000) Sound and the Developing Infant in the NICU: Conclusions and Recommendations for Care. *Journal of Perinatology* 20 (8)2: 588-593
2. Als H et al (2004) Early experiences alters Brain function and Structure. *Paediatrics* 113.
3. Warren I, Bond, C (2010) Guidelines for Infant Development in the New-born Nursery. Winnicott Baby Unit London 5th edition.
4. Watchman, E.M, Lahav, A (2010) The Effects of noise on preterm infants in the NICU. *Arch.Dis.Child Fetal and Neonatal* ed: published online Jun 2010 F1-F5
5. Davies A, Bamford J, Wilson L et al (1997) A critical Review of the Role of Neonatal Hearing Screening in Detection of Congenital Hearing Impairment *Health Technology Assessment*; 1 (10).
6. American Academy of Paediatrics (1997) Noise: A Hazard for Fetus and the Newborn Policy Statement (RE9278) *Paediatrics* Vol 100 NO 4 Oct 1997.
7. Rea, M (2004) Lighting for Caregivers in NICU *Clinical Perinatal* 31 229-242.
8. British Workplace Health and Safety Regulations 1992.

9. Cook, A., White, S., Batterbury, M., Clark, D., (2003) Ocular Growth and Refractive error development in premature Infants without R.O.P. Investigative Ophthalmology and Visual Science March 2003 Vol4 No3.
10. Birch E.E, O'Connor, A.R., (2001) Preterm Birth and Visual Development. Semin. Neonatology 6:487-497
11. Rivkees S.A (2004) Emergence and Influences of Circadian Rythmicity in Infants  
Clinics of Perinatology 31:217-228.
12. Schaal B et al (2004) Olfaction in Fetal and Premature Infants: Function Status and clinical implications. Clinical Perinatol 31 261-285
13. White R D (2007) Recommended Standards for Newborn ICU Journal of Perinatology 27(supplement 2), S4-S19
14. DOH (1989) Disability Discrimination Act (2004) Working for Patients 21
15. Padden T, Glenn, S (1997) Maternal Experiences of Preterm Birth and Neonatal Intensive Care. Journal of Reproductive and Infant Psychology Vol 15: 121-139.
16. Webster, D (2005) Correspondence to D. Webster, LWH NICU Crown Street, Liverpool L8 7SS.

\* Lux = Lumen per square metre

\*\* Footcandles = Lumen per square foot

**July 4th 2012 (version 4-NICU125)**