

Diurnal Sound Levels in the Neonatal Intensive Care Unit



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Significance

- The NICU sensory experience may interfere with infant cochlear development and physiological regulation.
- The American Academy of Pediatrics (1996) suggests that NICU sound levels > 45db (decibels) are cause for concern
- Recommended Standards for Newborn ICU Design states that, "overall continuous sound in any NICU should not exceed an hourly Leq of 45 db or a max of 65 db" (2007)
- The fetal auditory system can process sounds by 25 weeks' gestation. Sounds louder > 70 db cause changes in a preterm infant's heart rate, blood pressure, respiratory rate, oxygen and glucose consumption, and gastric activity (Graven, 2000).
- Current research - NICU sound levels 50-80 db (decibels) with peaks > 100dB (Gray, Ternullo & Armstrong, 1998).
- Research limitations – short time frames, lack of day/night comparisons & specific unit characteristics, concealment of sound recording equipment from staff and visitors.

Theoretical Framework

Als (1982)' synactive model proposes simultaneous infant subsystem and environment interaction as it progresses to more sophisticated levels of physiologic and behavioral differentiated organization. Noise in the NICU environment affects infant autonomic, motor, state organization, attention-interactive and regulation systems which impact optimal development.



SoundPro SL/DL Sound Meter & 'Dummy' Boxes

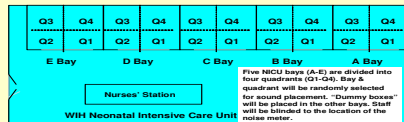
Purpose

To measure ambient noise in a large Level III NICU using random sampling.

Specific Aims

1. To measure diurnal sound levels in a large Level III NICU
2. To determine db level differences across bays, quadrants, and shifts
3. To determine the association of sound levels with infant acuity and number of staff, infants, and equipment.

NICU Bays with Quadrants



Methods

Setting: "Bay style" NICU organized into 5 bays with average census of 65 infants
Design: Descriptive randomized block design with 4 replicates.
Noise Meter: SoundPro SL/DL handheld noise meter (Quest Technologies, Inc). Records & stores dbs for 12 hr intervals. Software included for spreadsheet and graphical data display.
Sampling Plan: Sound levels: Leq, Lpeak, Lmax q 60 seconds for 40, 12-hr (7am-7pm; 7pm-7am) intervals totaling 480 hours

Unit variables: Number of staff, infants, and ventilators

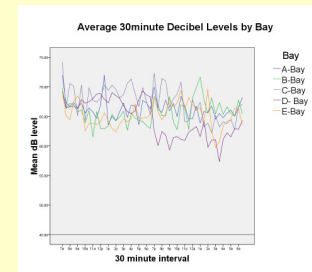
Analysis

Noise level data were imported into Excel/SPSS. Log10 dB were converted to linear scale. Time series data were viewed for each bay and quadrant by 12 and 24 hour segments. Graphs display dB level variability for quadrant and bay for 24 hours. Mann-Whitney test and the Wilcoxon rank-sum test were used.

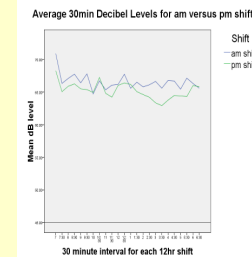
Leq – average db level
LMax – highest reading for 1sec constant
LPeak - highest reading for 50microsec

Exchange Rate (ER) – doubling rate
Increase of 3db = doubling of sound level

Results



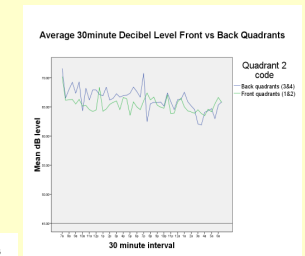
Quadrants 3 & 4, at back, had higher average db



AM Shift had higher average db than PM Shift

Exchange Rate of 3db
e.g., 83 db is twice as loud as 80 db

C Bay, in middle of NICU, had highest average db



Results Summary
480 hrs of data: 100% were >45db
64.1% were >70db
28.2% were average peak >110db
Leq range: 49.5 - 89.5 db
Lpeak range: 66 - 138.9 db
Lmax range: 50 - 105.2 db
Aim 3. Only 1 significant association - more respiratory equipment associated with higher db
Low variability for infant acuity and number of staff

Implications

- Nurses are more likely to adopt developmental care practices when given specific knowledge of environmental over stimulation (Aita & Goulet, 2003)
- Innovative design and precise sampling provides an evidence-base to promote change in NICU policies & care practices to improve infant outcomes.