

Alarms and the Neonate: Give Me My Earmuffs

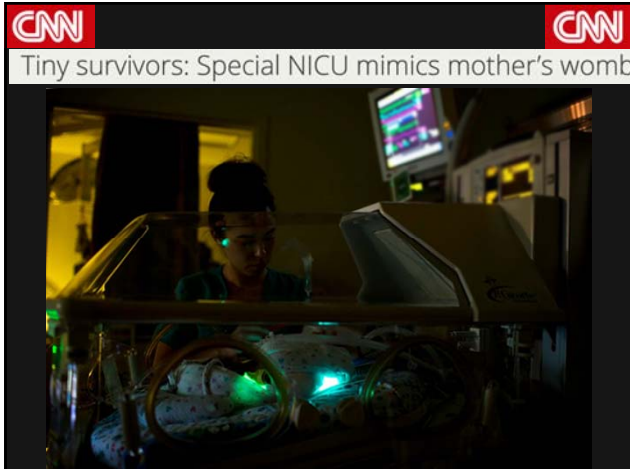
17th Annual Rainbow Respiratory
Conference
Friday September 4th, 2015
Independence, Ohio

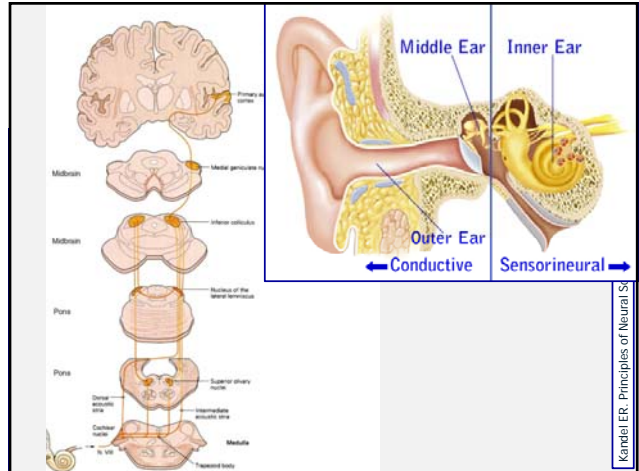
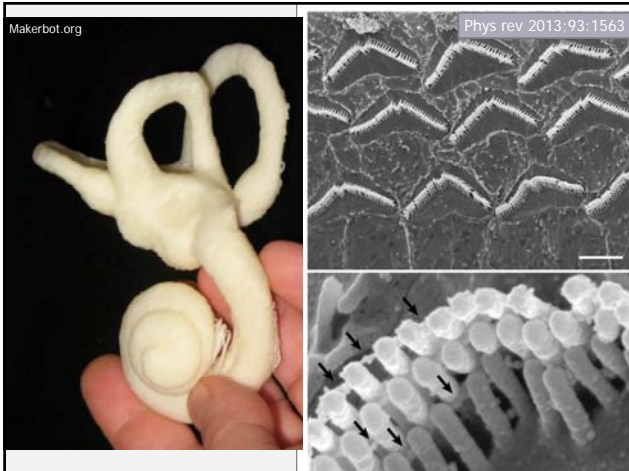
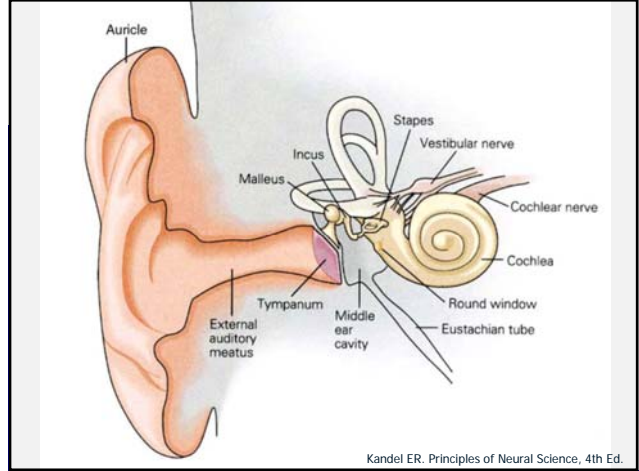
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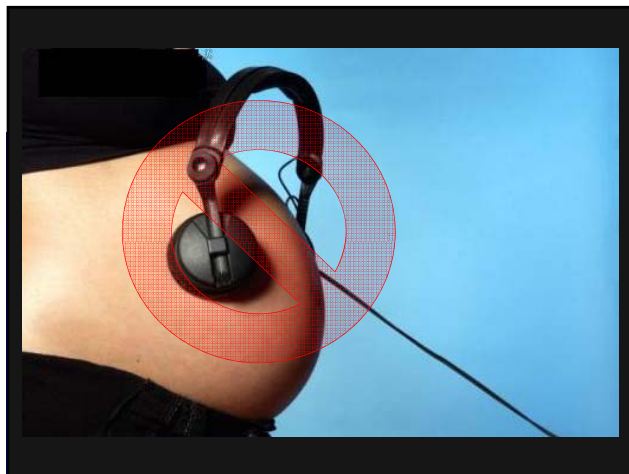


Nothing to disclose


Any use of brand names is not
in any way meant to be an
endorsement of a specific
product but to merely
illustrate a point of emphasis

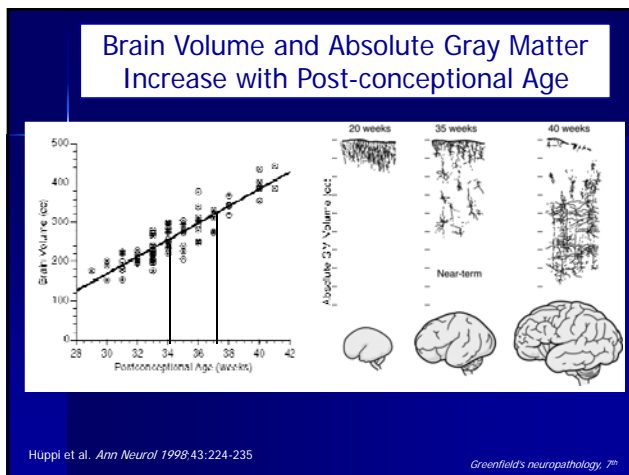






Auditory Environments Compared

		
How	Amniotic Fluid	Air
What	Mother's voice	Alarms, Vents, Etc.
When	Circadian	Round the Clock



Premature Infants are at Risk for Hearing Loss

- Incidence of hearing loss up to 13%
 - Compared to 2% for all newborns
- Possible contributing factors
 - Environment
 - Medications (diuretics, aminoglycosides)
 - Seizures
 - Hypoxia



Clin Perinatol 2008;35:163

Potential Consequences Poor NICU Sound Control

- Increased Apnea / Bradycardias
- Oxygen desaturations
- Increased blood pressure
- Hearing impairment
- Speech delay
- Sleep disturbance
- Inflammation / Stress response



Arch Dis Child Fetal Neonatal Ed 2014;99:F203

Potential Benefits of Sound Controlled NICU

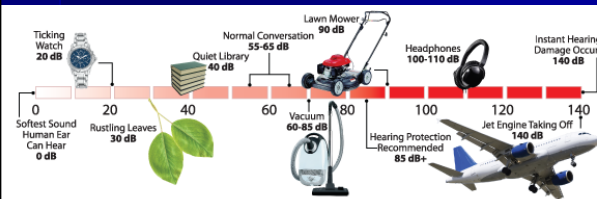
- Increased physiologic stability
- Better growth rates
- Age-appropriate neurosensory maturation
- Facilitated parent-infant attachment
- Improved long-term speech and language



J Perinatology 2000; 20:S88

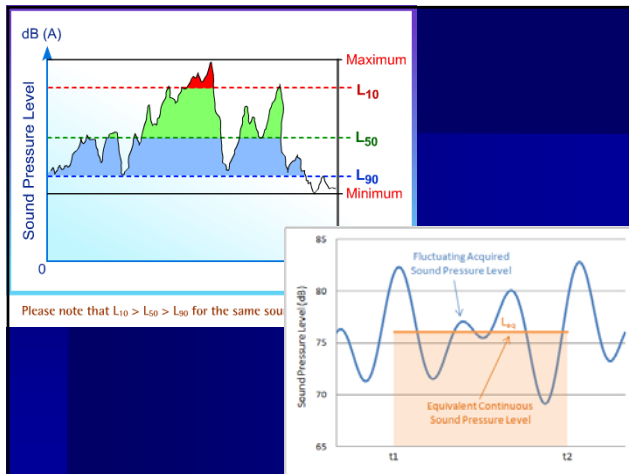
The Decibel (dB)

- Unit used to measure the intensity of a sound
- Semi-logarithmic scale– hearing is sensitive
- Threshold of hearing is 0 dB



How Loud is Too Loud?

- 85 dB – 8 hours
- 100 dB - 15 minutes
- 110 dB - 1 min



Noise
Impacts
Caregivers!



What should the level of
noise be in a NICU?

Guidelines for Perinatal Care Bed Space Goals

- Continuous background sound and transient in any bed space should not exceed:
- L_{eq} hourly – 45 dB
- L_{10} hourly – 50 dB
- L_{max} – 65 dB



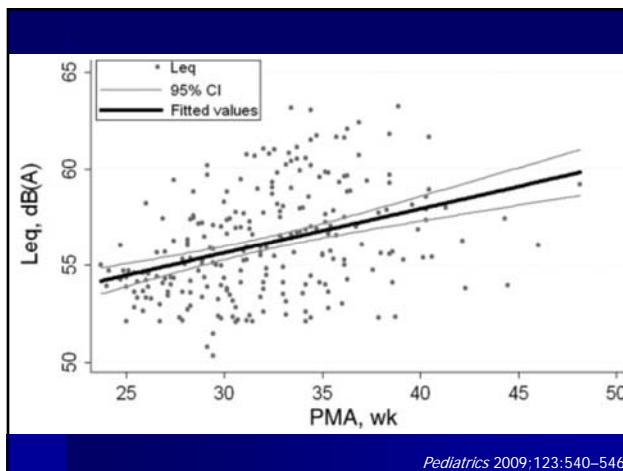
How are we doing?



University of Texas Houston

- Microphones secured inside the bed of each study newborn within 30 cm of their ear
- dB recorded at 1 second intervals
 - 20 hours weekly to 36 weeks corrected
 - 20 hours q 2 weeks 36-40 weeks corrected
 - 20 hours q 4 weeks >40 weeks

Pediatrics 2009;123:540-546



Pediatrics 2009;123:540-546

Why would noise levels go up as preemies got older?

- Change in BED TYPE
 - Older incubators are louder
 - Newer incubators are quieter
 - When relatively quiet in the NICU, newborns in older incubators experienced noise levels ~8 dB more intense than in newer incubators
 - Crib fully exposed to external environment
- Change in RESPIRATORY SUPPORT

Pediatrics 2009;123:540–546



Columbia



- Large urban tertiary care NICU
- Measured dB in 7 areas for 1 week
- **Mean dB 57 ± 3**
- **99.99% levels measure >50 dB**
- **0.01% of levels measure <50dB**
- Peak noise during rounds and visitation

CICSD 2010;37:69







Sources of Noise in the NICU

- Building noise (HVAC)
- Respiratory equipment
- Incubator motors
- Incubator doors and portholes
- Monitors
- Crying infants
- Alarms
- Phones / Pagers / Voceras
- Conversations – staff, family
- PA systems
- Televisions
- Tube systems
- Automatic doors
- Supply cabinets
- Pyxis machines

Sources of Sound NICU Rooms


- Quiet – 47 dB
- Talking – 49 dB
- Radio – 53 dB
- Sink faucet – 57 dB

Thomas & Uran. MCN, Am J Mat Ch Nur. 2007;32:250

Sources of Sound Inside Incubator

- Motor off – 38 dB
- Motor on – 60 dB
- CR alarm – 59 dB
- IV pump alarm – 61 dB
- Ventilator tube bubbling – 61 dB



Thomas & Uran. MCN, Am J Mat Ch Nur. 2007;32:250

Sources of Sound Inside Incubator

- Finger tapping on hood – **65 dB**
- Closing incubator cabinet – **73 dB**
- Closing incubator porthole – **73 dB**
- Dropping head of mattress – **87 dB**



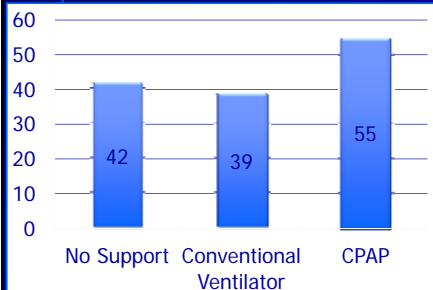
Thomas & Uran. MCN, Am J Mat Ch Nur. 2007;32:250

Sources of Noise in the NICU

- Routine care activities: 58-76 dB
 - Placing formula bottles on the bedside table
 - Closing storage drawers
 - Opening packaged supplies
- Alarms: 57-66 dB
 - IV pumps, cardiorespiratory monitors
- Respiratory Equipment

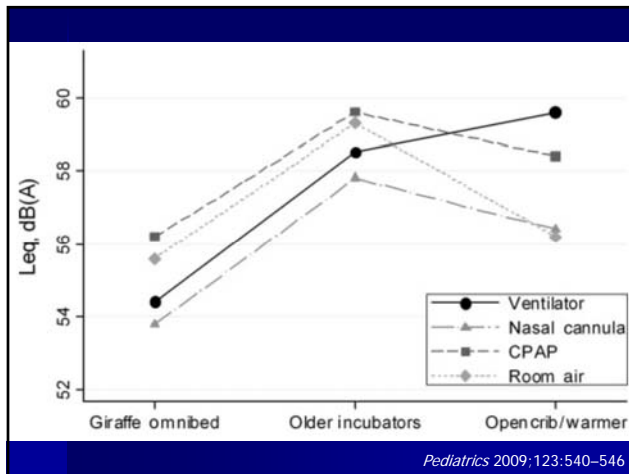
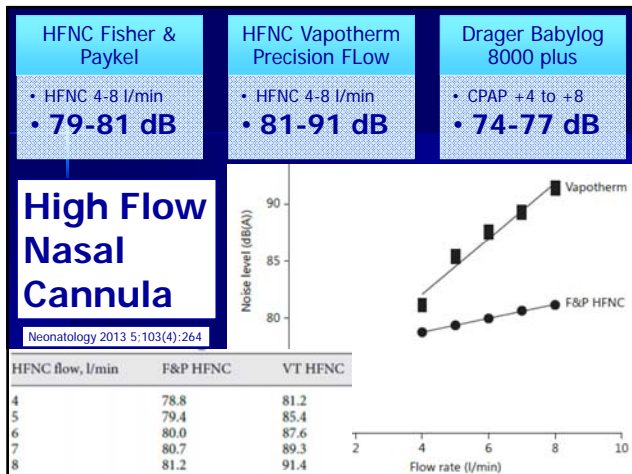


Respiratory Support

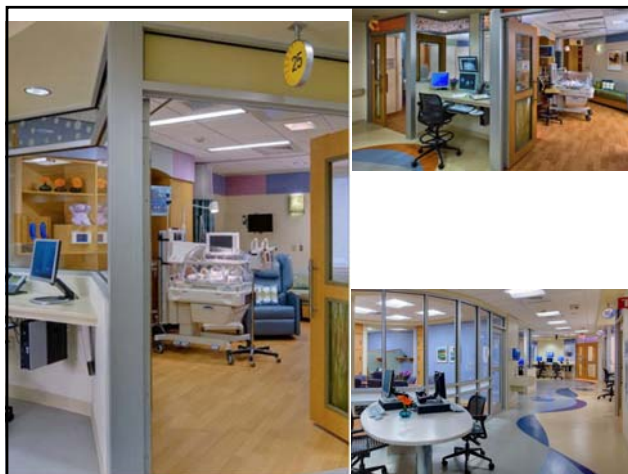


Arch Dis Child Fetal Neonatal Ed 2003;88:F315





What Can We Do to Reduce Noise Levels?



Methods:

- Short term ambient sound monitoring was performed prior to occupancy in the new unit and after the move in the empty old unit.
- An industrial engineer collected data using a Larson-Davis noise dosimeter
- Dosimeters logged in the “A” weighted scale with a 5dB doubling rate and slow response.
- Maximum peaks were measured on the “C” weighted scale.

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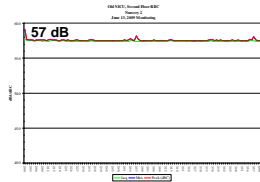
Sound Reduction Measures:

- Highest Performing Acoustic Ceiling Tiles
- Acoustic panels wrap room perimeter
- Soft resilient flooring
- No overhead paging

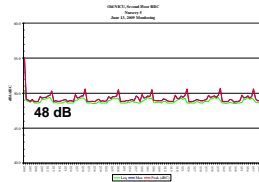
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Unoccupied Old NICU

Unmodified 6 bed bay

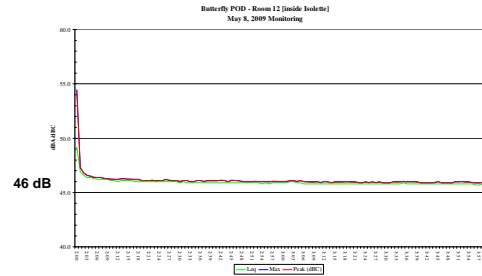


Modified 6 bed bay



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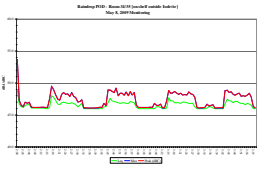
Unoccupied New NICU



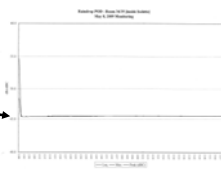
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Unoccupied New NICU

Outside Incubator



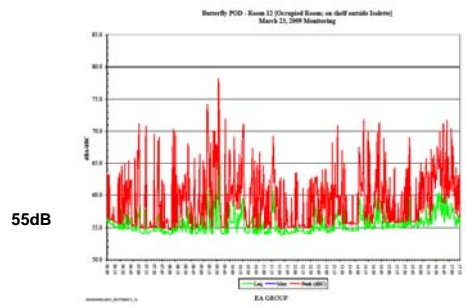
Inside Incubator



45 dB

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Occupied New NICU Single Rm



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Conclusions:

- Ambient noise was reduced from an average of 58 DB to 49 dB by post build modifications in our old NICU.
- Significant cycling variation was seen presumably related to HVAC.
- In the new NICU ambient noise was 46dB outside the incubator with HVAC artifact, but this was reduced to 45.5 dB in the incubator without HVAC variation.

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Conclusions:

- In the occupied new unit, sound guidelines were met.
- As in previous studies, staff and patients significantly contributed to sound.
- Even in new units, ongoing education about the role of personnel in noise pollution will continue to be needed.

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Implementing a Noise Reduction Policy

- Reminders posted in patient areas
- Presentations about the policy to all services and departments involved in patient care
- Hospital newsletters & e-mail reminders
- Education of family members
- Contests and rewards →



Wang D et al. Arch Dis Child Fetal Neonatal Ed 2014;99: F203




"As a parent with a baby in the NICU, coming into this whole experience was a very stressful and discouraging time.

So every day I looked forward to Quiet Hour... I looked forward to that time where it was quiet and there were hushed tones and dim lights and I knew it was a time that we could save our conversations for a later time. It was a time that we could keep the babies at the forefront of our minds and keep their healing a priority for us.

Looking back on this whole experience and as a parent, I can definitely say that Quiet Hour and the consistency of it every single day was one of the key factors in getting him healed and getting him grown to the size that he needed to be. It was the biggest factor in getting us home."

— former NICU parent, talking about Quiet Hour

Sssshhhh...
it's Quiet Hour.
Learn how this practice helps babies — and how you can support this important aspect of good newborn care.



Ear Plugs



- 34 VLBW infants
- RCT
- Earplugs worn continuously until 35 weeks or discharge
 - Removed for social visits
- Appear to be safe
- Better weight gain
- ELBW improved developmental scores

Journal of Perinatology (2009) 29, 358



Iran J Nurs Midwifery Res. 2014;19:107



Better Incubators

Publication number: US20140003614 A1
 Publication type: Application
 Application number: US 13/710,862
 Publication date: Jan 2, 2014
 Filing date: Dec 11, 2012

Automated Oxygen Adjustment

- Infant may spend more time in target range for saturations
- Decreases workload for staff
- Decreased alarms
- The technology is here today but needs further testing

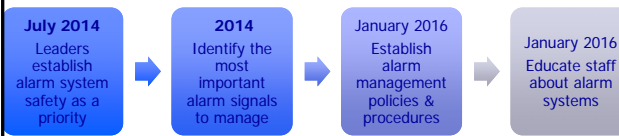
Alarm Fatigue

- Alarms become white noise and staff don't hear or respond to them
- A NICU audit - 38,000 alarms in one week!
- 126 alarms per bed per day
- NICU Top 5 – Pulse ox, Apnea, EKG, Ventilator, Infusion pump
- Every single time vent alarm sounds baby is exposed to ~68 dB when in an isolette!

JCAHO National Patient Safety Goal 06.01.01

"Reduce the harm associated with clinical alarm systems"

Elements of Performance for NPSG.06.01.01



Improved Building Acoustic Environment Design

- | | |
|--|--|
| <ul style="list-style-type: none"> ■ Heating ■ Ventilation ■ Air Conditioning ■ Plumbing ■ Electrical | <ul style="list-style-type: none"> ■ Vacuum tube systems ■ Door mechanisms ■ Large non-medical equipment <ul style="list-style-type: none"> – Refrigerators – Freezers – Ice machines – Storage / Supply |
|--|--|



8th Consensus Conference on Newborn ICU Design

RESPIRATORY THERAPISTS CAN IMPACT THE INTENSIVE CARE NURSERY BY PRACTICING DEVELOPMENTAL CARE THROUGH SOUND REDUCTION




Renee Bebko-Bartle RRT - Lee Williford RRT
 Christoph P Hornik MD - Angela Maskill RRT
 William Malcolm, MD - Ira Cheifetz MD FAARC

OBJECTIVES: To better quantify sound levels of various NICU equipment/procedures

METHODS: 7 respiratory care patient encounters monitored over 5 minutes with and without a sound reducing intervention. 10-24 observations were collected for each encounter type

Intervention	Equipment	Difference (dB)	P value
Exhalation tubing moved from inside isolette to outside	Airlife CPAP System	4.6 dB 76.9 → 72.3	<0.001
Jet box in isolette covered with 2 cloth diapers	Bunnell Jet (HFJV)	2.4 dB 69.1 → 66.7	<0.001
Two people used to remove isolette top	Drager Isolette	6 dB 73.5 → 67.5	0.010
Gently pulling and supporting bed tray	Drager Isolette	14.6 dB 81.8 → 67.2	<0.001
Vent alarm sounds: isolette door closed instead of open	Drager Ventilator (vent on pt's right) (vent on pt's left)	3.1 (71.9 → 68.8) 2.9 (70.5 → 67.6)	<0.001
Rinse tubing in saline vs. leaving secretions in tubing	Suction Tubing/ Neosucker	15.4 dB 81.7 → 66.3	0.009

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CONCLUSIONS: Sound levels using all types of types of equipment were above 45 dB, with or without intervention. Noise reduction interventions, however, were statistically significant for each equipment type. Based on previous research, a 3 dB change equates to a sound pressure level variation of about 50%. Respiratory therapists can greatly impact their patients' exposure to noise which may promote improved clinical outcomes.

