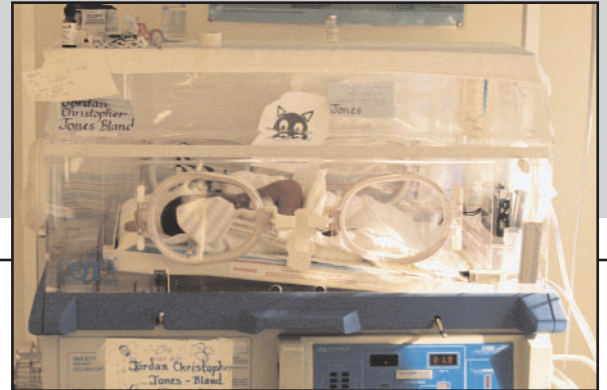


Noise in Neonatal Intensive Care Units

INTRODUCTION

Recent studies conclude that the average sound levels in a NICU (Neonatal Intensive Care Unit) ranges anywhere between 70 to 80 dB. The American Academy of Pediatrics, Committee on Environmental Health, recommends a maximum safe noise level of 45 dB in a NICU. **Failure to maintain noise levels under the maximum levels recommended by the American Academy of Pediatrics may result in numerous adverse noise-induced health effects on premature babies.**



HEALTH RISKS

Premature babies are very fragile and must cope with their environment with immature organ systems. Their auditory, visual, and central nervous systems are the last systems to mature. These last stages of development occur, in part, during the time the premature baby is in the incubator or NICU. It has been recognized that high noise levels exist in the NICUs and the incubator. There are four types of adverse noise-induced health effects on the premature baby to consider:

Hearing Impairment:

The American Academy of Pediatrics, Committee on Environmental Health has conducted numerous studies and documented that continuous noise exposure of premature babies cared for in a NICU can result in noise-induced hearing loss. Premature babies exposed to constant high levels of background noise have shown abnormal development of sound frequency discrimination. The bandwidth for the reception of sound in the ear actually increases or widens (in a noisy environment) so that the infant, as a child and as an adult, will be less able to discriminate between frequencies.

Sleep Disturbance:

Loud or sharp sounds can cause physiological changes during sleep such as high heart rate, fast breathing, apnea, and a drop in blood oxygen levels. These changes affect sleep, either by awakening the infant or by changing the sleep state, which causes the infant to experience unnecessary stress and lose needed sleep time.

Somatic Effects:

The increased number of awakenings and resultant crying effect due to noise levels in the incubator and the NICU, are a potential cause of hypoxemia and source of neonatal morbidity. Fluctuations in arterial oxygen tension, blood pressure, and intracranial pressure may contribute to hypoxic brain damage. The decrease in oxygen saturation of blood can affect the development of vital organs. The infant residing in a NICU or incubator can experience acute effects many times in the period of rapid brain growth. Potential consequences include increased risk of weakened vessel walls in the cerebral vasculature.

Auditory Perception and Emotional Development:

Current knowledge strongly suggests that stimulation provided by the auditory environment plays a role in the emotional development and in the development of auditory perception of the baby. The sound quality in an NICU and incubator is reduced, since speech and other relevant sounds are masked by different noise levels. The premature infant may have difficulty in making fine discrimination with respect to (the intonation of) the voice of the mother and caretakers, which may result in hindering the infant's emotional development.

OTHER RISKS

Industrial workers are protected by regulations under the Occupational Safety and Health Act that define noise as a hearing health risk and give direction on what needs to be done if excessive noise is detected. If noise is determined to be present, employers are required to apply either engineering or administrative controls to reduce the noise to safe levels. If these efforts are not successful, personal protective equipment must be provided. Industrial workers are considered at risk when levels exceed an 8 hour average of 85 to 90 dBA. Regulations do not exist for the control of noise exposure experienced by premature infants in NICUs. However, the evidence of adverse health effects is now documented and recommendations for control by experts in the field now exist. Awareness of the issue is also growing beyond the medical profession. These circumstances combine to typify a potentially litigious situation.

ROOT CAUSES

Since Neonatal Intensive Care Units were first set up, medical technology has progressed considerably. Over the last 40 years with the inventions of new equipment, the NICU has become a very noisy place. The general level of equipment noise and alarms, air-handling units, monitoring equipment, and communications systems all contribute to the ambient noise level. As the ambient noise level rises, the staff noises and voice level will also rise as they compete to be heard. Various studies have assessed the sources of hospital noise. Both continuous and variable noise sources were included. In one study, measurements were taken of the noise levels of different normal events in the NICU and inside and outside the incubator. The data was measured on the dB(A) scale using a sound level meter which was calibrated beforehand. Measurements were carried out over 5 minute periods, the results showing averages and standard deviation. The noisiest event corresponded to the incubator alarm, with an average noise level of 63.54 dB(A). Values inside the incubators for all events indicated noise levels of 55-56 dB(A). The table below provides an overview of different noise levels and their effects on the neonate.

Quality	Peak Intensity, dB(A)	Example	Inside Incubator	Effect
Just audible	10	Heartbeat		
Very quiet	20-30	Whisper		<35 dBA desired for sleep
Quiet	40 50	Average home Light Traffic for work	Background	<50 dBA desired
Moderately loud	60 70	Normal conversation Vacuum cleaner	Motor on & off Bubbling in ventilator tubing	Annoyance
Loud	80 90	Heavy traffic Telephone ringing Pneumatic drill	Tapping incubator with fingers Closing the metal cabinet doors under the incubator	Hearing loss with persistent exposure
Very loud	100	Power mower	Closing solid plastic porthole	
Uncomfortably loud	120 140	Boom box in car Jet plane 30 m overhead	Dropping the head of the mattress	Pain and distress

Source: American Academy of Pediatrics

SOLUTION

The American Academy of Pediatrics suggests NICU personnel should devise simple strategies to reduce the noise in the nursery (no tapping or writing on the tops of incubators and hoods, careful closing of incubator doors, soft shoes). If such simple, inexpensive strategies fail to reduce monitored noise levels, more technical strategies need to be considered. The American Academy of Pediatrics states that exposure to noise in the NICU may produce cochlear damage in the newborn and alter the normal development of premature newborns. It is part of the job of the caregivers to keep unnecessary noise levels down as far as possible.

The sound level meter (SLM) is a handheld instrument used in area noise measurements. A broad range of SLMs are available with varying levels of functionality. Very basic SLMs might only provide an indication of the current decibel or sound level (SPL) and the maximum sound level detected. The most advanced SLMs enable the caregivers to understand the frequency components of the noise so that appropriate engineering controls may be selected and applied. This type of SLM is referred to as an Octave Band Analyzer.

Quest Technologies offers several unique SLM solutions that allow the caregivers to determine an NICU's noise exposure and assist in the implementation of administrative and engineering controls. Sound Level Meters have significant value in an effective noise exposure management program.



SLMs allow the caregivers to:

- Perform initial walk through surveys of the NICU to determine which areas are the noisiest.
- Develop a noise level map of the NICU to facilitate implementation of effective administrative controls.
- Understand the frequency content of the noise in the NICU to facilitate selection and implementation of the proper engineering controls.
- Test new incoming equipment for specified noise emission limits.
- Periodically test existing equipment for undesirable changes in noise emission levels.
- Perform follow-up walk through surveys of the NICU to determine continuing compliance with noise exposure limits.

The Quest 261 Sound Level Detection System in conjunction with the light box, can be used to monitor several beds, hallways, and areas simultaneously. The microphone is suspended from the ceiling, and when levels are too high, a light with the message "Quiet Please" comes on. Then the nurse on duty can use this signal to ask families and staff to quiet down as appropriate. Some hospitals may choose to use the 261 but customize their own light system, or message, instead of using the standard light box.

Model 261 and light box allow the caregivers to:

- Monitor several incubators simultaneously without being in the NICU
- Monitor area noise levels continuously
- Activate a signaling device when a specified noise level has been exceeded

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Quest Technologies is one of the most widely recognized and respected manufacturers worldwide for life safety & health instrumentation and software. It is through our lifelong commitment to continuous quality improvement, product innovation, and a mission to delight our customers that we have achieved this status. We specialize in regulatory compliance and personal safety solutions for noise, heat stress, indoor air quality, and toxic/combustible gas monitoring applications. Quest Technologies solutions are available worldwide through a network of factory authorized dealers that specialize in life safety & health solutions.

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If you have any questions concerning our technology, pricing, availability, or would like to schedule a product demonstration, you may contact our customer service representatives at (800) 245-0779 or e-mail us at sales@quest-technologies.com.

PERTINENT WEBSITE LINKS

American Academy of Pediatrics
US Environmental Protection Agency

www.aap.org
www.epa.org

The advertisement features a central collage of application areas including: Noise Control Analysis, INDUSTRIAL NOISE MEASUREMENTS, Military, AIRCRAFT NOISE MEASUREMENT, ENVIRONMENTAL WORK SITES, community noise measurements, RESIDENTIAL, worker exposure profiles, vibration measurement, construction sites, research & development, product evaluations, toy safety testing, quality control, Law Enforcement Agencies, neonatal intensive care units, Traffic Studies, maintenance inspections, Engineering Control Studies, Machine Performance Analysis, and occupational noise measurements. Below the collage is the Quest Technologies logo and the text "Sound Level Meters & Vibration Monitors" and "www.quest-technologies.com". At the bottom of the advertisement is a photograph of several Quest Technologies sound level meters and vibration monitors.

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