SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

The study sought to understand the effects of sound frequency in a neonatal intensive care unit (NICU).

Sound Spectral Analysis in the Intensive Care Nursery: Measuring High-Frequency Sound

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Key Concepts/Context

Little is known about how high-frequency, prolonged intense noise effects auditory development in preterm infants. However, some research indicates that premature infants who are exposed to persistent noise might experience some interference with their development of frequency discrimination and problems with sound-pattern recognition.

American Academy of Pediatrics (AAP) Committee on Environmental Health recommends that continuous noise levels should not exceed 50 dBA [according the 1997 article by the Committee on Environmental Health of the AAP, the decibel level should not exceed 45 dBA].However, the guidelines make no recommendations about specific sound frequencies.

Methods

This industrial hygiene study was designed to gather initial descriptive data on sources of high-frequency sound in a 40-bed, Level III NICU. The unit is a traditional open range with unbuffered care centers that produce several sources of sudden unpredictable sounds, such as pneumatic doors and tube system, Pyxis machine, supply cabinets, telephones, addressograph, and a fax machine. Other sources of noise include areas where staff congregates, such as the physician dictation/charting spot and nurses' stations.

Researchers conducted the sound spectral analysis (SSA) in two identically configured rooms of the hospital nursery using a Larson Davis 824 sound level meter. A wall for electrical systems separated each 60-foot square room. In addition, each room was lined with 20 infant care beds and had two workstations. Within each section of the nursery, there were three isolation rooms.

To avoid conflict with patient care, such as vital signs and feeding, the researchers did not take measurements during those times. They only assessed the extraincubator care environment. The investigators placed the SLM microphone at a 45° angle within 15 cm of the infant's ear at the left side of the baby's bed to get the measurements. However, to prevent obstacles to the extracorporeal membrane oxygenation (ECMO), the researchers secured the microphone for the sound-frequency measurements almost 6 feet from the infant.

To ensure a representative sampling, the researchers gathered data on weekend afternoons when families visited, as well as on weekdays during physician rounds. For over 4 weeks, the researchers gathered more than 40 hours of data between 7 a.m. and 10 p.m. Once stored, the SSA results of the spectral analyses were downloaded into the principal investigator's personal computer via a data port.

Findings

The study found that intensive care nurseries are filled with atypical high-frequency sound and these finding suggests that NICU environments should be modified to make the sound spectrum more compatible with the developing brains of preterm infants.

Little is known about the long-term effects of prolonged exposure to high-frequency sound. However, a 26-week fetus would normally be exposed to a frequency not higher than that of his or her mother's voice, which is approximately 500 Hz. According to the authors, ECMOs are exposed to 16,000 Hz at a signal exceeding the AAP Committee on Environmental Health guidelines for NICUs.

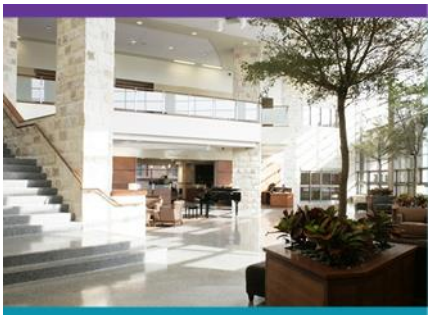
The authors found that the bimodal distribution of the most intense frequencies clustered around one peak of 500 Hz. They conclude that this spike in the human speech-frequency range indicates that staff speech contributed to atypical sound exposure and is problematic in NICUs.

Limitations

The findings of this case study are not generalizable.

Design Implications

Results of this industrial hygiene study suggest several nursing implications. In particular, nurses need to assess noise on a frequent basis and eliminate factors that add to the high level of atypical sound exposure in the NICU. Human behavior, as well as specific types of equipment and unit configuration, has a major impact on the sound frequency spectrum.



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Changing the structural environment of a NICU requires surface materials that absorb and/or diffuse the energy of atypical sound. More information can be found in "Planning the Acoustic Environment of a Neonatal Intensive Care Unit," Appendix B, by M. K. Philbin, in volume 31 of *Clinics in Perinatology* (2004), which lists multiple suitable materials for rendering existing NICU environment more developmentally "sound."