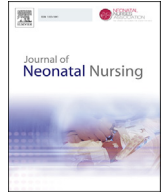




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Practice Guidelines

Shh...babies growing: A clinical practice guideline for reducing noise level in the neonatal intensive care unit

A B S T R A C T

This proposed clinical practice guideline addresses the rationale surrounding, and suggests methods to achieve, actual noise levels that are within recommended parameters within the neonatal intensive care unit (NICU) environment. The evidence for this guideline is rooted in review of randomized controlled trials, cohort studies, quantitative study findings, and expert committee opinion.

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Objective

The goal of this guideline is to provide tools and motivation for NICU care providers to maintain an environment supportive of premature and term infant development, growth, and neurosensory needs. Infants in the NICU are extremely vulnerable to noxious stimuli, such as loud or high frequency noise, and suffer many ill effects from exposure to such stimuli. Per AAP recommendation, 45 decibels (dB) is the maximum sustained noise level for the NICU environment, 46–50 dB noise level may not occur more than 10% of any hour, and the maximum, or peak, noise level may not exceed 65 dB and may only occur in a short burst (1997). To give perspective, 45 dB is equivalent to a conversation between two people at arm's length.

Background

According to Fortes-Garrido et al. (2014), average noise levels in the NICU they studied measured 10–40 dB above the AAP recommended level. The main contributing factors to this increase in noise were monitors, alarms, incubators, and conversation. Lasky and Williams (2009) found that respiratory support equipment also contributed to noise levels, especially for those infants who transitioned from an incubator to an open bed. Additionally, Wachman and Lahav (2011) found that an infant's own crying contributes to intra-incubator noise level. Pinheiro et al. (2011) found that the noise level inside incubators is directly related to the noise level outside of incubators, creating a cumulative effect on internal incubator noise levels.

The question of whether or not increased noise levels in the NICU affects infants, and, if so, in what way, has been addressed

in numerous studies. Almadhoob and Ohlsson (2015) explain that increased noise levels lead to increased stress on premature infants, which causes them to increase their metabolic rate, leaving fewer calories available for growth.

Caskey et al. (2011) found that increased ambient and electro-mechanical noises found in the NICU environment block infants from being able to hear and recognize parental vocalization. This lack of perceived parental speech leads to a delay in infant vocalization and subsequent speech as infants learn vocalization from the familiar sounds of their parent's speech from the infants' time in utero.

Wachman and Lahav (2011) note that premature infants lack the ability to filter or process noxious stimuli, such as loud noise, resulting in tachycardia with rebound bradycardia as well as increased blood pressure, increasing the risk for intraventricular hemorrhage, particularly in preterm infants. Additionally, oxygen saturation levels decreased with increased noise, and respiratory rates increased with a rebound decrease, leading to apneic spells in some infants. Further, increased noise levels preclude premature infants from reaching a quiet sleep state, disallowing time and calories needed for growth. Millette (2010) takes that a step further, noting that there is a decrease in growth hormone production with each incidence of exposure. These combined factors lead to a decrease in growth.

Lahav and Skoe (2014) found that exposure to increased noise levels and higher frequency sound, as in the NICU environment, increases the risk for auditory, language, and attention disorders. They note that the intrauterine environment includes low frequency noises, such as digestive noises, and maternal sounds, such as voice, and that auditory development of the fetus progresses from the inside out. Meaning, the inner ear structures

(i.e. bony labyrinth of the cochlea) are developed by 15 weeks gestation but the onset of cochlear function does not occur until 24 weeks gestation or later. At around 34 weeks gestation, the cochlear neurons have formed enough connections with the auditory brainstem for sound/noise processing to occur. Before this stage of development, they posit that repeated exposure to high frequency and long-lasting noise inhibits cortical and subcortical auditory development leading to poor frequency resolution at best and auditory processing disorders at worst.

Lejeune et al. (2016) note that tactile development is also compromised with repeated exposure to noxious noise. Brain imaging has shown that cortical pathways are not specific to one sense and that signals from other senses could be disruptive to the initial sensory signal path. This is significant in that it seems to demonstrate that disorganization occurs across all sensory processing when just one sense is overstimulated.

Following the recommendations found in this guideline should help to reduce spells of apnea, bradycardia, and oxygen desaturations, as well as to protect auditory and sensory development in NICU patients by protecting their sleep and growth cycle integrity.

Users and setting

This guideline is primarily intended for NICU nurses, as they are the front line caretakers of NICU patients. However, there is also potential benefit for neonatologists, respiratory therapists, radiology technicians, and other care providers in the NICU who follow these recommendations. Essentially any person who spends time in the NICU setting as a care provider or visitor may contribute to the environment in a positive or negative way and this guideline is intended to offer recommendations that enhance a culture of healing within the NICU environment.

Target population

The target patient population affected is NICU patients. These may include premature infants, full term newborns with congenital or perinatal complications, or any infant up to 44 weeks postmenstrual age admitted to the NICU.

Evidence collection methods

Studies included in the evidence base for this guideline were published between 2009 and 2016 with the majority published in 2011–2016. The recommendations were from expert committee statements made in 1997 from the American Academy of Pediatrics who based their recommendations on findings from the Environmental Protection Agency, Office of Noise Abatement and Control (1974). Those committees have not published any new recommendations specific to this subject area since then and the recommendations they made remain the current standards. Literature searches were conducted through CINAHL and key words used in varying combinations included NICU, neonatal intensive care, noise, noise level, auditory development, and prematurity. Search criteria included evidence-based, human, English language, and peer-reviewed. No date range was specified, though evaluation of articles to be included was targeted to be within five years. Some exceptions to that five-year range were used in order to round out the information base, as there is a dearth of randomized controlled studies in this area. Only one of the

evidentiary pieces was a meta-analysis rather than original research.

Recommendations and grading criteria

Rating system for the hierarchy of evidence:

Level I: Evidence from a systematic review or meta-analysis of all relevant randomized controlled trials (RCTs) or evidence-based clinical practice guidelines based on systematic reviews of RCTs.

Level II: Evidence obtained from at least one well-designed RCT
Level III: Evidence obtained from well-designed controlled trials without randomization

Level IV: Evidence from well-designed case–control and cohort studies

Level V: Evidence from systematic reviews of descriptive and qualitative studies

Level VI: Evidence from a single descriptive or qualitative study

Level VII: Evidence from the opinion of authorities or reports of expert committees

Method for synthesizing evidence

All evidence was thoroughly examined and evaluated for relevance and applicability. Authors who included a thorough discussion and explanation of their research and findings were included, as long as their articles were published within five years. The two exceptions were for authors who had published multiple articles and were regarded as experts in the subject and the aforementioned expert committee recommendations. Evidence was scoured for specific actions and/or practices, including equipment usage and choice, providers of NICU care could do to control noise levels.

Definitions

AAP	American Academy of Pediatrics
Decibel (dB)	A unit used to measure the intensity of a sound or the power level of an electrical signal by comparing it with a given level on a logarithmic scale
Incubator	An enclosed apparatus providing a controlled environment for the care and protection of premature or unusually small babies
NICU	Neonatal intensive care unit
Noise	Undesirable sound that is disruptive and physiologically or psychologically stressful
Sound	A vibration in a medium (air or liquid) perceived by the ear

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