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SOURCES OF SOUND LEVELS IN NICU AND INCUBATOR

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ABSTRACT **Introduction:** Currently there is limited research regarding estimated intrauterine sound levels. Benzaquen, Gagnon, Hunse& Foreman (1990) suggest however that intrauterine noise consists predominantly of low-frequency noise with sound levels being 40 dB above 500 Hz. Ideally, to promote healthy auditory development, sound levels in the NICU should be consistent with intrauterine environment. **Methodology:** Each part has two sections A and B, the section A is from more sick babies requiring Level 3 NICU care, whereas the section B is for babies requiring Level 2 NICU care. Our unit is 20 beded NICU with 15 beds level III and 5 beds level II unit, the study was conducted in level III unit. **Results:** All sources of noise levels higher than 55 dBA in the NICU need to be eliminated or mitigated. Since the alarms of equipments were important sources of noise in the NICU, eliminating or decreasing volume of alarms will reduce sound level. Every NICU requires a sound level assessment system in order to achieve environmental noise limiting guidelines and to get closer to the standard sound levels. **Conclusion:** By evaluating sound levels, the sources of noise can be identified and their effects on sound levels can be studied.

KEYWORDS : NICU, Sources of Noise, Incubator

INTRODUCTION:

It is well known within the medical profession, specifically paediatric nursing, that care of fragile infants in the Neonatal Intensive Care Unit (NICU) can at times be challenging and draining, yet at the same time rewarding. Neonates admitted to the NICU are often premature, with potentially critical or life-threatening conditions, and are in need of constant medical monitoring. Neonatal nurses work as part of a team to provide appropriate interventions and exceptional care to those infants, and their families, who require assistance during their earliest stages of life.[1]

Providing a suitable environment for development in the NICU is important because many infants admitted are born prematurely. Noise level in the NICU plays an important role in staff communication, family interactions, and infant development.

The American Academy of Pediatrics recommends that sound levels be lower than 45 dBA in the NICU noise above 45 dBA may result in cochlear damage or disrupt the normal growth and development of premature infants (American Academy of Pediatrics, 1997).[2]

The human cochlea and peripheral sensory end organs complete their normal development by 24 weeks of gestation (American Academy of Pediatrics, 1997), making hearing the next to the last sensory system to mature. Auditory processing capabilities continue to develop with CNS organization and may be altered by auditory experiences that differ from the usual intrauterine influences (Blackburn, 1998). The auditory systems of premature neonates continue to develop during the time spent within the NICU, as births considered viable are around 23-25 weeks.[3,4]

Currently there is limited research regarding estimated intrauterine sound levels. Benzaquen, Gagnon, Hunse& Foreman (1990) suggest however that intrauterine noise consists predominantly of low-frequency noise with sound levels being 40 dB above 500 Hz. Ideally, to promote healthy auditory development, sound levels in the NICU should be consistent with intrauterine environment.[5]

This may not be considered practical, as NICUs are often characterized by loud unpredictable noise from extraneous sources such as alarms, ventilators, phones, and staff conversations (Wachman&Lahav, 2011).

Ambient sound levels in the NICU have been reported to range from 50 to 90 dBA, which farexceed the current recommended standards. The goal for a NICUenvironment is to meet the physiological and neurobehavioral needs of each infant to aid inemerging organization, growth and development. Modifications may include physical, environment (light and noise) and caregiving interventions.[6]

Sound occurring in the NICU can becategorized as background noise with occasional superimposed peak noises. High background noise occurring in the NICU may interfere with an infant'sability to discriminate speech, an important early step in language acquisition.

METHODOLOGY:

The study has two parts

1. Study of sound levels in NICU environment
2. Study of sound levels inside an incubator.

Each part has two sections A and B, the section A is from more sick babies requiring Level 3 NICU care, whereas the section B is for babies requiring Level 2 NICU care.

Our unit is 20 beded NICU with 15 beds level III and 5 beds level II unit, the study was conducted in level III unit.

Sound levels were measured by using a mobile phone with an application SOUND METER which can measure the average and maximum sounds levels over a period of time.

STUDY 1: studying the sound levels in NICU environment
Sound levels are measure during different time of the day and night for a continuous 1 hour. Sound levels average and maximum levels are detected.

STUDY 2: studying the sound levels inside the Incubator
Sound levels are measure during different time of the day and night for a continuous 1 hour. Sound levels minimum average and maximum levels are detected.

Our unit is located in a corner of a busy road and a college. The sound levels were measured during the various hours of the day [6 hours]. The hours chosen is because that is the period during which the maximum NICU personnel are present in the unit.

The instruments are kept inside the incubator to measure the sound

levels inside the incubator and outside the incubator to measure the sound levels in NICU environments simultaneously for an hour.

The instruments measure the average sound exposure, and maximum sound levels during the specific hours of the day

RESULTS:

There was a significant correlation between the number of people present in the ward and sound level. Since the presence of people is associated with noise, implementing regulations to limit the number of people attending an NICU at one time is essential.

All sources of noise levels higher than 55 dBA in the NICU need to be eliminated or mitigated.

Since the alarms of equipments were important sources of noise in the NICU, eliminating or decreasing volume of alarms will reduce sound level.

Every NICU requires a sound level assessment system in order to achieve environmental noise limiting guidelines and to get closer to the standard sound levels.

By evaluating sound levels, the sources of noise can be identified and their effects on sound levels can be studied. Moreover, the staff, especially nurses, can decrease sound levels by implementing new policies. Neonates will thus be faced less sound stimuli and a safe care environment would be created. The results of this study can also be used to create a protocol to reduce sound level.

***Table 1*: comparing the sound levels during Day and Night time**

	Parameters	standard	Day (Average)	Night (Average)
NICU environment incubator	Leq	45	55.33db	51.58db
	Lmax	65	85.58db	81.91db
	Leq	45	55.08db	50.83db
	Lmax	65	89.16db	87.41db

***Table 2*: sources of sound**

Sr. No	NICU environment	Decibles (Average)	Sr. No	Incubator	Decibles (Average)
1	Nurses rounds	51	1	Nurses rounds	50
2	Doctors rounds	57	2	Doctors rounds	56
3	Monitor alarm	69	3	Monitor alarm	69
4	Ventilator alarm	70	4	Ventilator alarm	70
5	Hand drier	86	5	Hand drier	84
6	Telephone	88	6	telephone	87
7	Crying of babies		7	Crying of babies	66
8	Sink		8	sink	63
			9	Closing off incubator	91
			10	Hitting on incubator	91

DISCUSSION:

Williams, van Drongelen&Lasky (2007) recorded and compared noise in different levels ofcare; isolation, level II, and level III within NICUs in two separate hospitals. Sound level (Leq)measurements were taken with a Larson Davis 703+ dosimeter and recorded for eight days.

Comparison of different NICU classification levels indicated that sound levels exceeded 45 dBA,more than 70% of the time, for all levels of care.

Liu's (2010) main objective was to decrease measured sound levels in the NICU through implementation of human factors and minor design modifications. Their hypothesis was that modifications to human behaviour and unit-design would result in a decrease in the measuredoccupied NICU sound pressure level. The study was a prospective time series, quasiexperimentaldesign, with ongoing measurements before, during, and after intervention cycles.Sound level measurements were made with a Larsen Davis Spark 706 dosimeter over a 24-hourmeasurement period. Staff education included increased awareness of human sources of noise.[7]

The staffs were encouraged to silence alarms immediately during care, set pagers to vibrate, andspeak softly during conversations. There was also an increased awareness of noise-generating behaviours such as hand washing, opening disposable equipment, and opening and closing entrydoors.

Minor unit-design modifications included using plastic garbage cans and turning off theunit intercom. This study was unable to demonstrate a significant decrease in soundmeasurementlevels from the baseline during or after implementation at any of the NICUsampling locations.

Kent, Tan, Clarke &Bardell (2002) examined the effect of staff activity on noise levels bycomparing recordings from two rooms of the NICU. In addition, a comparison was madebetween ambient room noise levels and those in an occupied incubator. Sound level measurements were performed using a Larsen Davis sound level meter and noise was measuredin the unit rooms A, B, C, and D. Recordings from two adjacent rooms indicated that room Bhad a significantly higher mean level (59 dB) than room C (56 dB). A significantly higher Leqand L10 were noted inside an occupied incubator relative to ambient room noise levelmeasurements.[8]

Kellam& Bhatia (2008) stated the AAP guidelines make no recommendations about specificsound frequencies that occur in the NICU. This study was designed to obtain a description ofhigh-frequency noise by using sound spectral analysis (SSA). It was an initial effort tounderstand the impact of sound frequency in the NICU. The SSA was conducted in two roomsof a level III nursery using a Larson Davis 824 sound level meter that was placed at a 45-degreeangle within 15 cm of the infants' ear. SSA was performed at patient bedside during shiftchange and around oscillator ventilators over a four-week period. Findings suggested the mostintense frequencies were clustered around one peak of 500 Hz forming a spike in the humanspeech frequency range. This indicates that staff speech contributed to atypical sound exposure.[9]

They concluded that there is a need to assess noise on a frequency basis and eliminate factorsthat add to high level of atypical sound.

Busch-Vishniacet. al (2005) focused on existing sound pressure levels in a major UShospital and used measured data to confirm the existence of a serious noise problem. Soundpressure level measurements were obtained at five different locations in Johns Hopkins Hospital,over a one year period. One minute Leq were taken in many locations on the unit includingpatient rooms, hallways and nurses stations using a Larsen Davis system 824.

Overall, the studyfound little variations in the measured sound levels from the five units studied. The average Leqvaried between 50 to 60 dBA. These levels exceed the current recommended guidelines by 20dBA on average levels and exceed the typical speech level of communication between twopeople of 45-50 dBA suggesting that staff may need to raise their voice routinely in order to beheard above the noise. This investigation concluded that the problem of hospital noise is clearlyunder-studied and not well understood

Darcy, Hancock & Ware (2008) evaluated the average sound levels in three different NICUs and compared them to the suggested guidelines set by the EPA and AAP. They also looked at thedifferences between the average sound levels during day shift and night shift. Sound levelmeasurements were made using a Sper Scientific Mini Sound Meter and sounds were measuredfor two different hours during the day and night shift. [10]

CONCLUSION:

All sources of noise levels higher than 55 dBA in the NICU need to be eliminated or mitigated.[30] Since the alarms of equipments were important sources of noise in the NICU, eliminating or adjusting alarms will reduce sound levels.[31],[32]

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