

Determinants of noise level in the neonatal intensive care unit at Castle Street Hospital for Women, Colombo, a level III tertiary care facility

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Abstract

Introduction: Advances in modern neonatology have improved survival of extremely premature and extremely low birth weight babies. Increased noise level is proven to be harmful to preterm babies and term ill babies in various ways. Determinants and baseline noise level should be assessed before necessary intervention.

Objective: To assess the determinants of noise level at a level III neonatal intensive care unit (NICU) at the Castle Street Hospital for Women (CSHW), Sri Lanka.

Method: A prospective observational study was done at NICU, CSHW, Sri Lanka. Data were collected using two NDI USB Digital sound level data loggers that recorded noise level on a weighted decibel scale (dBA) every minute continuously for three weeks. Data was exported using provided software. Average noise level was analysed separately for consultant ward round (9am-12pm), nursing handing-over time (Daily 7-7.30am, 1-1.30pm and 7-7.30pm), admissions/emergencies (time taken from records) and a period supposed to be silent (Daily 1am-3am). Recommended standard ambient noise level for NICU by the American Academy of Paediatrics as well as Australasian Health Infrastructure Alliance is less than 45dB.

Results: Average noise level recorded in NICU was 60 dBA which is considerably higher than recommended levels. During the consultant ward round the average noise level was 60.2 dBA. Noise levels at the morning, afternoon and evening

handing-over times were 62.9, 62.7 and 60.9 dBA respectively. Noise level at the supposed silent period (Daily 1am-3am) was 56.8 dBA. During admissions or emergencies which required ventilation (CPAP/conventional), the average noise level was as high as 65.8 dBA.

Conclusions: Noise levels recorded in the NICU at the CSHW, Sri Lanka in all circumstances were higher than the recommended noise levels. Main contributions were machine alarms and conversations.

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(Key words: Noise level determinants, level III care, Neonatal Intensive Care Unit, noise level data loggers, quality newborn care)

Introduction

Advances in modern neonatal care have improved the survival and outcome of high risk preterm and extremely low birth weight babies over the past few decades¹. The number of preterm deliveries has also increased due to better antenatal fetal monitoring compared to the past². With advancement of care for extremely premature and extremely low birth weight babies in Sri Lanka, it is time for us to improve the quality of developmental care in the neonatal intensive care units (NICUs)³.

Studies have shown that for the fast recovery and wellbeing of the patients, health care environment plays a major role⁴. Premature babies lose their protective environment *in utero* thus exposing themselves to the external environment including the central auditory organs⁵. Further, many researchers have shown that loud noises are a primary stressor for ill preterm neonates as well as for the staff working in the environment⁶.

Even term neonates who are sick lose their ability to filter noxious stimuli so that they are vulnerable to loud noises which can still harm the auditory system⁶. *In utero* fetuses only receive expected low frequency high quality sounds through amniotic fluid medium. However, in a NICU they will receive high frequency unexpected noises from ventilator alarms, fans, monitors, infusion pumps, voices, banging incubator porthole doors etc. through air medium. In preterm neonates this

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difference (acoustic gap) may harm the smooth development of the auditory system⁷. It can be as harmful as causing an intracranial haemorrhage⁸. These effects later on will lead to development of auditory, language and attentive problems in childhood⁹.

It has been shown that aminoglycoside administration in the background of loud noises can potentiate reactions which can increase the ototoxicity¹⁰. Loud noises at NICU can affect cardiovascular and respiratory instability and cause sleep deprivation. The effect on neurodevelopmental outcome is still to be determined⁹. Similar results were obtained by several other researchers who found that loud noises increase heart rate and respiratory rate and decreased peripheral oxygen saturation¹⁰. Exposure to loud noises for more than 48 hours is considered a risk factor for hearing loss¹⁰.

It has also been shown that preterm newborns exposed to loud noises take a long time to achieve weight and they have a prolonged NICU stay¹¹. Committee on environmental hazards of American Academy of Paediatrics has concluded that increased noise in NICU will cause detrimental side effects to extreme premature as well as sick neonates. It clearly says loud noise may result in cochlear damage and may disrupt the normal growth and development⁶.

Thus, having a desired noise level in a NICU is important. Recommended standard ambient noise level for NICU is less than 45dB by the American Academy of Paediatrics as well as Australasian Health Infrastructure Alliance, 2013^{6,12}. However, studies have shown that in many NICUs sound

level exceeds that of recommended level in various ways¹³. Often, staff are not aware how loud the surrounding noises actually are¹⁴. There are neither published data, to the best of our knowledge, in Sri Lanka with regards to the average noise level and causes for the increased noise level nor any research being carried out to optimise the noise level in NICUs.

Objectives

To assess the determinants of noise level at a level III NICU at the Castle Street Hospital for Women (CSHW), Sri Lanka.

Method

An observational prospective study was carried out in CSHW which is one of the largest tertiary care maternity hospitals in Sri Lanka. The CSHW NICU is recognized as an institute with level III care¹⁶. It provides care to extremely premature neonates and term sick newborns.

The NICU is 1680m² large and it consists of 6 beds as Intensive Care Unit and other 5 beds as High Dependency Unit (Figure 1) NICU equipped with 7 ventilators including 1 high frequency oscillatory ventilator, 3 CPAP machines, High flow Oxygen meters, multi-para monitors for every bed and 4 infusion pumps per each bed with incubators/open warm cots, suction apparatus and phototherapy units. NICU can perform routine procedures done in all level III NICU including intubation, arterial and venous line insertion, X-ray facility, ultrasound and 2D echo facilities, emergency resuscitation and so on. NICU phone is kept in the nurses' station.

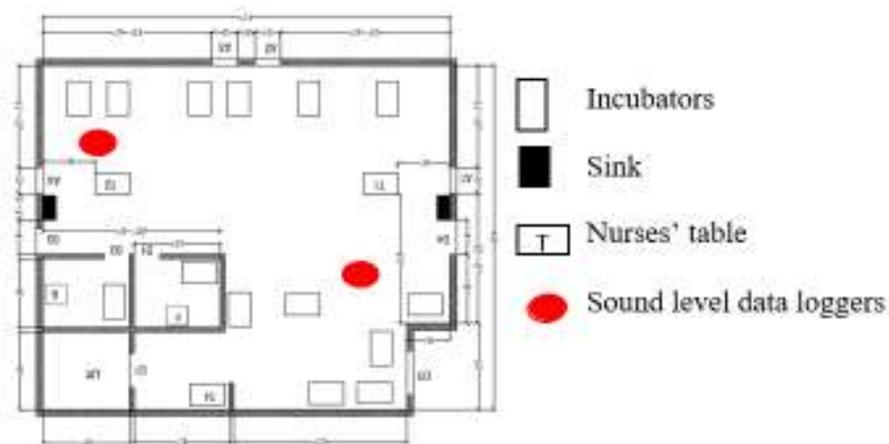


Figure 1: Neonatal intensive care unit

Consultant ward rounds were done every day inside the unit 9 am to 12 pm and nursing handing over was done 7.00 am to 7.30 am, 1.00 pm to 1.30 pm and 7.00 pm to 7.30 pm every day. Noise level

data collection was done using two digital sound level data loggers fixed in NICU as depicted in Figure 1 which continuously recorded noise level each minute noise level along with the date and the

time of recording. It had a battery life span of 6 months even with continuous use. Data loggers were fixed 2 feet below the ceiling and 8 feet above the ground. Study was conducted for a period of three weeks starting from December 2016 after the approval of relevant authorities. The noise level was calculated as an average for the period of three weeks and compared with the standard recommended levels. Average noise levels were analysed separately for consultant ward round (9am-12pm), nursing handing-over time (Daily 7-7.30am, 1-1.30pm and 7-7.30pm), admissions/emergencies (time taken from records) and a period supposed to be silent (Daily 1am-3am).

Ethical clearance and consent, and confidentiality of data: Approval was taken from the Ethics Review Committee of the CSHW prior to conducting this research. Informed permission was taken from the Director of the Hospital. All the staff members including doctors, nurses and attendant staff were informed regarding the noise level data logger recordings and it was emphasized that it will not record individual voices but only the noise level.

Results

Average noise level recorded in NICU was 60 dBA. During consultant ward round average noise level was 60.2 dBA. Morning, afternoon and evening handing-over time, noise levels were 62.9, 62.7 and 60.9 dBA respectively. Noise level at supposed silent period (Daily 1am-3am) was 56.8dBA. There were 15 admissions during the study period, 8 needed CPAP and 7 needed conventional ventilation. There were 2 medical emergencies. Analysis of those instances revealed an average noise level of 65.8dBA.

Discussion

The average noise level recorded in the NICU was 60dBA which is considerably higher than the recommended standard ambient noise level for NICU by the American Academy of Paediatrics and Australasian Health Infrastructure Alliance which is less than 45dBA^{12,16}. The morning, afternoon and evening handing-over time noise levels were 62.9, 62.7 and 60.9 dBA respectively indicating contribution of human voices to noise level. Noise level at the supposed silent period (1am-3am daily) was 56.8dBA indicating contribution of alarms and machines. This study clearly shows that the average noise level of the NICU exceeds recommended ambient noise level for a NICU. Main contributors are human voices, alarms, machines and various emergencies which increase the voice rather due to the anxiety of the medical professionals in response to the situation. This needs to be addressed to provide better environment for these babies. As the first step it is

imperative to conduct educational sessions mentioning the value of controlling noise for the whole team taking care of ill and preterm babies representing all the levels of professionals. A noise level policy can be introduced so that the recommended levels can be achieved slowly in stepwise pattern. Noise level alert meter indicating noise level and posters reminding the noise level policy may be useful in achieving the desirable noise level which in turns increases the quality of newborn care.

Conclusions

Noise levels recorded in the NICU at the Castle Street Hospital for Women, Sri Lanka in all circumstances were higher than the recommended noise levels. Main contributions were machine alarms and conversations.

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