DETERMINING NOISE LEVEL AND ITS SOURCES IN NEONATAL INTENSIVE CARE UNITS OF SELECTED PUBLIC HOSPITALS IN KIGALI CITY

DUSABE RUTH
INTRODUCTION

• Environmental noise in NICU impact developmental progress of neonates especially preterm

• Preterm were affected by noise more than full term (Aly and Ahmed, 2016 p. 4)

• Technology improved survival of preterm but has also transformed NICU into very noisy places (Schokry, 2016 p. 4),

• WHO recommends mean sound level 35 dB in the hospital (WHO, 2017)

• AAP recommended noise level not to exceed mean value of 45 dB in NICU (AAP, 1997)

• Recognition help in reduction and maintenance, and improved neonatal outcome
Physiological effects include: increased blood pressure, changes in heart rhythm etc

Noisy NICU can lead to sensor neural with hearing loss and developmental delay

Disabling hearing loss in children was thirty four million (7.3%) of the 466 million neonates

Noise was a problem years ago where Environmental Protection Agency in 1974 stated an average sound level of 45 dB, which was adapted by AAP in 1997

(Schokry, 2016), (Santos et al, 2018 p. 121), (AAP, 1997)
• A neonate admitted in NICU comes from the uterus which provides protection of external noise up to 40 dB

• Conversation had the most value ranging between 80 dB to 95 dB

• Worldwide different published studies have report high noise levels in NICU range between 49 - 92 dB

• Worldwide prevalence estimates hearing loss in neonates is caused by noise level greater or equal to 20 dB which increased from 14.3% in 1990 to 18.1% in 2015

• (Jordão et al., 2017),(Caicedo,2017 p. 122),(Neumann et al, 2019).
• 52% of preterm infants treated in NICU had abnormal audiograms

• Noise in NICU affect growth and neurodevelopment of preterm infants

• There is a need to measure noise level & identify possible sources in NICU

• Limited publications or studies in Rwanda on determining noise level in different NICUs
Research objectives

Main Objective
• To determine noise level and possible sources of noise level in selected NICUs of public hospitals of Kigali city

Specific objectives
• To measure sound levels in NICU of selected public hospitals of Kigali city
• To compare sound levels at the NICU to that recommended by the AAP
• To identify possible sources of noise levels in NICUs of selected public hospitals of Kigali city
METHODOLOGY

• **Research design:** Non experimental simple descriptive cross sectional study design

• **Research approach:** quantitative approach

• **Population:** NICUs of selected hospitals (Kibagabaga District Hospitals, Muhima District Hospitals CHUK and RMH)

• **Sampling:**
  ✓ Probability simple random for selecting hospitals
  ✓ Time sampling for selecting time

• **Sample size:** number of records was 840

• sources of noise.
**METHODOLOGY CONT’**

- **Instrument:** sound level meter

- **Procedure:** six stations at five different times of the day (morning time, ward round, lunch time, shift changing and midnight).

- The same stations were also used for the whole week

- Observational checklist to assess possible

- **Data analysis:** descriptive statistics in terms of mean, standard deviation, maximum and minimum

- One way analysis of variance (ANOVA) was used to assess the significance
METHODOLOGY CONT’

• Ethical considerations:
  ✓ Ethical clearance was granted by IRB
  ✓ Hospital gave permission to conduct the research
SOUND LEVEL METER (Velleman 200)
RESULTS; I. Noise levels

Per day at each hospital

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 1</td>
<td>62.0</td>
<td>61.8</td>
<td>63.4</td>
<td>62.5</td>
<td>63.5</td>
<td>62.3</td>
<td>60.9</td>
</tr>
<tr>
<td>Hospital 2</td>
<td>64.2</td>
<td>63.9</td>
<td>64.7</td>
<td>65.6</td>
<td>64.0</td>
<td>64.1</td>
<td>64.3</td>
</tr>
<tr>
<td>Hospital 3</td>
<td>66.4</td>
<td>65.4</td>
<td>66.7</td>
<td>66.1</td>
<td>67.7</td>
<td>65.6</td>
<td>65.9</td>
</tr>
<tr>
<td>Hospital 4</td>
<td>63.7</td>
<td>65.0</td>
<td>63.0</td>
<td>64.3</td>
<td>65.2</td>
<td>65.9</td>
<td>68.0</td>
</tr>
</tbody>
</table>

per shift at each hospital

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Morning</th>
<th>Ward Round</th>
<th>Lunch Time</th>
<th>Shift Changing</th>
<th>Mid-Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 1</td>
<td>62.7</td>
<td>63.9</td>
<td>62.0</td>
<td>62.5</td>
<td>63.2</td>
</tr>
<tr>
<td>Hospital 2</td>
<td>64.7</td>
<td>64.5</td>
<td>63.9</td>
<td>65.0</td>
<td>63.2</td>
</tr>
<tr>
<td>Hospital 3</td>
<td>66.4</td>
<td>67.1</td>
<td>66.0</td>
<td>66.5</td>
<td>65.1</td>
</tr>
<tr>
<td>Hospital 4</td>
<td>65.3</td>
<td>65.3</td>
<td>63.9</td>
<td>62.3</td>
<td>68.3</td>
</tr>
</tbody>
</table>
Station 1 was high among all stations and it was near the entrance
Comparing hospitals NICU’s sound levels

- Statistically significant (P<0.001)
II. Comparing sound levels at the NICU to that recommended by the AAP

**Hospitals per day statistically significant \((P < 0.05)\)**

<table>
<thead>
<tr>
<th>Day</th>
<th>Hospital 1</th>
<th>Hospital 2</th>
<th>Hospital 3</th>
<th>Hospital 4</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monda</td>
<td>62.0</td>
<td>64.2</td>
<td>66.4</td>
<td>63.7</td>
<td>45.0</td>
</tr>
<tr>
<td>Tuesda</td>
<td>61.8</td>
<td>63.9</td>
<td>65.4</td>
<td>65.0</td>
<td>45.0</td>
</tr>
<tr>
<td>Wedne</td>
<td>63.4</td>
<td>64.7</td>
<td>66.7</td>
<td>63.0</td>
<td>45.0</td>
</tr>
<tr>
<td>Thursday</td>
<td>62.5</td>
<td>65.6</td>
<td>66.1</td>
<td>64.3</td>
<td>45.0</td>
</tr>
<tr>
<td>Friday</td>
<td>63.5</td>
<td>64.0</td>
<td>67.7</td>
<td>65.2</td>
<td>45.0</td>
</tr>
<tr>
<td>Saturday</td>
<td>62.3</td>
<td>64.1</td>
<td>65.6</td>
<td>65.9</td>
<td>45.0</td>
</tr>
<tr>
<td>Sunday</td>
<td>60.9</td>
<td>64.3</td>
<td>65.9</td>
<td>68.0</td>
<td>45.0</td>
</tr>
</tbody>
</table>

**Hospitals per time Statistically significant \((p < 0.05)\)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Hospital 1</th>
<th>Hospital 2</th>
<th>Hospital 3</th>
<th>Hospital 4</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>62.7</td>
<td>64.7</td>
<td>66.4</td>
<td>65.3</td>
<td>45.0</td>
</tr>
<tr>
<td>Ward Round</td>
<td>63.9</td>
<td>64.5</td>
<td>67.1</td>
<td>65.3</td>
<td>45.0</td>
</tr>
<tr>
<td>Lunch Time</td>
<td>62.0</td>
<td>63.9</td>
<td>66.0</td>
<td>63.9</td>
<td>45.0</td>
</tr>
<tr>
<td>Shift Changing</td>
<td>62.5</td>
<td>65.0</td>
<td>66.5</td>
<td>62.3</td>
<td>45.0</td>
</tr>
<tr>
<td>Mid-Night</td>
<td>63.2</td>
<td>63.2</td>
<td>65.1</td>
<td>68.3</td>
<td>45.0</td>
</tr>
</tbody>
</table>
possible sources of noise levels in hospitals 1, 2, 3 and 4

- HCP conversations were seen to all hospitals
• Sound level recorded in this study exceeded AAP (45 dB) recommendation (AAP, 1997).

• Noise levels increased during morning shifts to all hospitals compared to the night shift reported in other studies; (Matook et al., 2010, Garrido et al., 2017 p 124 and Ramm et al., 2017 p 38).

• Ward round was the highest time in all time with mean sound levels in all 4 hospitals (1, 2, 3 and 4) were 64 dB, 64.5 dB, 67.1 dB and 65.9 dB respectively.

• As Ramm et al., 2017 with 52.4 dB and Joshi and Tada, 2016 which was between 50 - 95 dB.
• The result for station (near the entrance) at each hospital (1, 2, 3 and 4) was high compared to other stations 63.7 dB, 64.8 dB, 67.1 dB and 65.5 dB respectively.

• Neille et al., (2014) that reported that sound level was higher on the measurement taken near the entrance (67.6 dB) and near nurses tea room (62.4 dB).
COMPARING NOISE LEVEL WITH THE RECOMMENDED

• The mean sound in this study was varying between 61.8 dB to 77.0 dB which was high to the recommendation of AAP.

• 56 and 81dB, Santa Marta- Colombia by (Garrido et al., 2017)

• Iran reported that Sound levels ranged between 56.10 dB -104.80 dB (Valizadeh et al, 2013 p. 19)

• Were all higher than standard levels according to the recommendation of AAP.
• High noise level was due to numerous source of sound. The possible sources may be the following; talking/conversations, staff activity, monitors, alarms, phones and others.

• Another study done in South Africa reported the same that conversations, another largest sound source was alarm monitors (Aljawadi et.al. 2017 p. 2743).

• A study done in Iran found out that phone ring tones and neonatal crying had the highest result (Blourchian and Sharafi, 2015 p. 23).

• Noise sources was greater than 45dB, with the exceptional high-frequency oscillatory from the ventilator (Neille et al., 2014 p. 6) which was absent in all NICU during the time of data collection.

• Also a study done by Santos et al, (2018) suggested that, this equipment could be modified for the safety of the neonates.
Limitations

- No NICU standard sound level in national guideline.
- Noise sources where not measured
- No NICU standard sound level in national guideline
Conclusion

- In all the NICUs, the noise level generated was greater than the safe limits established by WHO and AAP.
- Noise levels in all hospitals were high during the ward rounds and station near the entrance.
- The noise level ranged from 61.8 dB to 77.0 dB which was above the recommendation of AAP safe for neonates.
- The most frequent noise source was HCP conversation in NICU.
- The findings of high noise level have an effect on the neonatal care admitted in NICU.
- This will help in noise level reduction and monitoring in order to prevent the impact of noise to vulnerable neonates.
- Advocacy is needed for the health of neonates towards the noise free environment
recommendations

• HCP can play a big part in noise level reduction
• Every NICU requires a sound level assessment system in order to measure noise and try to reduce it, to the recommended standard of sound levels.
• Raising awareness, about noise exposure when planning the settings where newborns will be admitted.
• To turn off noise at the source and masking unwanted sound from the monitor and setting up noise control campaigns in hospitals.
• Neonatal beds (radiant warmer or incubators) have to be put far from the entrance and nursing station
Almadhoob, A. and Ohlsson, A. 2015 ‘Noise reduction management in the neonatal intensive care unit for preterm or very low birthweight infants (Protocol)’, Cochrane Database of Systematic Reviews, 1(1).


