Study of noise levels in a neonatal intensive care unit

Chantal Laroche and Paula Fournier

Audiology and S.-L. Pathology Program, University of Ottawa, Ottawa, Ontario, Canada, K1N 6N5

Abstract: In the past few years, much interest has been focused on the integrated care approach, where noise is seen as an element which can compromise the normal development of newborns in neonatal intensive care units. The objective of this study was to develop a methodology evaluating the impact of a training of the nurses, regarding noise levels existent within the neonatal intensive units of an Ottawa regional hospital. The average pre-training noise levels were of 53 dBA, 61 dBA and 65 dBA, for the night, day and evening shifts respectively. These levels largely exceed the maximal sound level of 45 dBA, recommended by the World Health Organization to avoid negative effects on sleep.

PROBLEM

In the past few years, efforts have been made to improve the physical and psychological environments (noise, lighting, handling) of neonates within the neonatal intensive care units (NICU). The focus of these efforts has primarily been centered on the nurses who are responsible for the majority of the care of the neonates. Furthermore, these efforts have been applied within the realm of the "Individualized developmental care for the very low-birth-weight preterm infant" model (1).

The caregivers in hospitals for sick children believe that a training program focused on the individualized development of premature neonates has proven itself and, as a result, this approach could improve the rate of survival in neonatology. Prior to providing this training to the nursing staff, it was imperative to first develop the evaluation tools. For this reason, it was crucial to foresee the validity and reliability of the evaluation method, in order to assess the outcome of the training program. First of all, the caregivers of an Ottawa regional hospital wanted to focus on the aspect of noise in NICUs.

OBJECTIVES

(a) The development of a valid and reliable method of noise level measurements inside the neonatal intensive care unit, in order to eventually evaluate the impact of the training program of the caregivers.
(b) The documentation of the principal noise sources in terms of origin and levels, prior to the training.

METHOD

The equipment used in this study included: a Toshiba T5200 portable computer & 01dB software (dB Trig: equivalent to a Type 1 integrating sound level meter (2) equipped with a 1/2" microphone (Cirrus) with windscreen ball.

Since one of the objectives of this study was to eventually analyze noise level differences pre- and post-training of the nurses, the noise measurement procedure had to be very strict and representative of those encountered on a typical day in the NICU. In order to do so, the authors of this study chose to adopt a method consisting of both a quantitative (noise levels as a function of time of the day) and qualitative (observation charts) approaches.

Samples of noise were taken during eight periods of eight hours, including work shifts consisting of three days (7am to 3pm), three evenings (3pm to 11pm) and two nights (11pm to 7am). The use of a computerized measurement was chosen in order to collect as many data as possible. The system permitted the recording of digitized sound samples directly onto the hard-drive, consisting of a few seconds each every five minutes. These recordings allow for their comparison with the measured sound levels and facilitate the recognition of noise sources identified by means of the observation chart.

The microphone was placed at 1 meter from the neonate's head and did not, at any time, interfere with the work of the nursing staff. The different microphone positions within the NICU, throughout the course of the eight sessions, will allow to better evaluate the pre and post-training differences in noise level measurements.
RESULTS

The average sound level is highest during the evening shifts (65 dBA) and lowest during the night shifts (53 dBA) (Table 1). The 24 hour period $L_{Aeq}$ is 62 dBA and significantly higher than the recommended levels one could expect to encountered in a private residence (35 dBA during the night and 45 dBA in the daytime ) (3).

<table>
<thead>
<tr>
<th>TABLE 1 Overall sound levels for a 24 hour period and calculated averages for each shift period</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day shifts</strong></td>
</tr>
<tr>
<td>$L_{Aeq}$</td>
</tr>
<tr>
<td>AVERAGE</td>
</tr>
<tr>
<td><strong>Evening shifts</strong></td>
</tr>
<tr>
<td>$L_{Aeq}$</td>
</tr>
<tr>
<td>AVERAGE</td>
</tr>
<tr>
<td><strong>Night shifts</strong></td>
</tr>
<tr>
<td>$L_{Aeq}$</td>
</tr>
<tr>
<td>AVERAGE</td>
</tr>
<tr>
<td><strong>24 hour period-$L_{Aeq}$</strong></td>
</tr>
</tbody>
</table>

DISCUSSION AND RECOMMENDATIONS

During the day shifts, the overall sound levels increased due to medical and radiology rounds. Moreover, the presence of conversation, of infant cries, as well as the set-off of alarms, contributed to these elevated sound levels. Fluctuating sound levels during the evening were usually due to excessive conversation (e.g. nursing staff shift change, medical intervention) or infant cries, which often lead to the more frequent set-off of alarms. Also, the noise levels were highly affected by the equipment functioning in the NICU.

The average sound levels are more elevated by as much as 5 dB in comparison with those obtained in previous studies. For example, Elander et al. (4) obtained overall sound levels of 57 dBA. Anagnostakis et al. (5) measured an overall sound level of 51 dBA, which, based on physics principles, represents more than ten times the acoustic energy in the NICU studied here. These significant differences could be explained in part, by the fact that the methods and protocols were not identical to those adopted throughout this study. However, these differences are probably due to the fact that the noise sources emit more important sound levels in this NICU.

The measurement method has been validated throughout this study. The various measurements will ultimately be repeated in a post-training session, in order to evaluate whether or not, based on this study’s recommendations and the training program, the noise related to human behaviors has significantly decreased. It is important however, to instate any of the equipment-related recommendations (ex. alarms) subsequent to the post-training analysis, given the fact that this study was conceived as to eventually evaluate the impact of the training program on the noise levels in the NICU.

ACKNOWLEDGEMENTS

This project was completed with the help of grants received from University of Ottawa. Sophie Heley is acknowledged for her help in regards to the English revision of this paper.

REFERENCES