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Effectiveness of a noise control program in a neonatal intensive care unit

Eficácia de um programa para redução de ruído em unidade de terapia intensiva neonatal

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ABSTRACT

Purpose: To evaluate the effectiveness of a noise control program in the Neonatal Intensive Care Unit of the Hospital Universitário Santa Maria (NICU-HUSM) in Santa Maria, Rio Grande do Sul, Brazil.

Methods: NICU-HUSM professionals were initially contacted through informal interviews during the morning, afternoon and night shifts. Leaflets were delivered and posters were installed to raise awareness of the harmful effects of noise on neonates and professionals and to suggest behavioral changes to reduce noise levels. The suggestions included avoiding loud talking, careful handling of the incubator doors and keeping mobile phones on silent mode. One month later, questionnaires were used to assess behavioral changes since

the first contact.

Results: Most of the professionals rated the NICU-HUSM noise level as moderate. Overall, 71.4% of the respondents acknowledged that their behaviors were noisy. The entire sample reported believing that the unit noise levels could be reduced by speaking lower, reacting more quickly to alarms and handling furniture more carefully. The NICU professionals reported adopting these behaviors.

Conclusion: This noise control program was considered successful because the professionals became aware of the level of noise and adopted behavioral changes to avoid generating unnecessary noise.

Keywords: Noise effects; Noise monitoring; Infant, newborn; Intensive care units, neonatal

INTRODUCTION

The treatment of high-risk neonates admitted to neonatal intensive care units (NICU) requires a quiet environment in addition to capable professionals and appropriate equipment. However, noise levels in hospitals, including in NICUs, are reported to be above acceptable levels. The Brazilian Technical Rules Association rule number 10152/1987⁽¹⁾ establishes hospital noise levels of 35 and 45 dB as desirable and acceptable, respectively.

However, at the NICU of the Hospital Universitário Santa Maria (HUSM) as in many other Brazilian NICUs, the measured noise is above the acceptable level. In Brazil, Aurélio⁽²⁾ measured the noise levels in the NICU-HUSM, which ranged from 43.3 to 114.9 dB(A) (mean 60 to 65 dB). These levels are excessive according to Brazilian and international rules. Other NICU studies have shown similar noise levels as in the study conducted in

Novo Hamburgo (Rio Grande do Sul, Brazil) in which levels between 48.3 and 82.6 dB(A) were found.⁽³⁾

Noise in NICUs results from different sources, including equipment, such as heart monitors, ventilators, oxymeters, infusion pumps, aspiration systems and incubators.^(3,4) Medical, nursing and other professional teams' conversations and parental visits are also directly related to increased noise levels.^(3,5,6) Some noisy professional behaviors can be prevented, such as talking, using mobile phones, radios or televisions and careless handling of furniture and equipment.^(4,7,8)

Daily exposure to high noise levels may cause physiological and behavioral changes, affecting newborns' recovery process. Likewise, professionals may be affected, and their performance levels may be reduced.

Newborns exposed to noise may have high blood pressure, increased heart rate, hearing loss,⁽⁹⁾ apnea, bradycardia, hypoxia, sleeping disorders and consequent fatigue, agitation, crying and irritability. In addition, noise may affect weight gain by increasing oxygen consumption and heart rate, thereby leading to increased use of energy.⁽¹⁰⁾

Healthcare professionals working in NICUs may have arterial hypertension, sleep and mood disorders, hearing loss, irritability, stress and fatigue, which may affect their working performance.^(4,8)

Educational programs aimed at this population are believed to contribute to noise control through behavioral changes. First steps to achieving a healthier environment include increasing awareness of the effects of noise on neonates and healthcare professionals, identifying behaviors that cause unnecessary noise and understanding how to change these behaviors.

Based on the observation of excessive NICU-HUSM noise levels,⁽²⁾ a noise control program was developed and proposed for this NICU. The aim of this article was to assess the effectiveness of a noise control program at the Neonatal Intensive Care Unit of Hospital Universitário Santa Maria, in Santa Maria, Rio Grande do Sul, Brazil.

METHODS

This study was conducted in the Neonatal Intensive Care Unit of the Hospital Universitário Santa Maria in Santa Maria, Rio Grande do Sul, Brazil between July 2009 and September 2009; this study was carried over from the study by Aurélio⁽²⁾ that was developed in this unit.

During the first phase, leaflets were distributed and posters were installed to educate healthcare professionals about the harmful effects of noise on neonates (Figure 1). This information compared the NICU-HUSM noise levels with daily noise levels (Figure 2) and provided strategies for noise control. Two speech and language therapist students, appropriately supervised by a responsible professor, gave informational lectures to the morning, afternoon and night shift personnel. Approximately 40 healthcare professionals took part in this phase and were educated about the effects of noise on neonates and on healthcare professionals' hearing and overall health, the current sources of noise and possible behavioral changes to ensure a healthier environment.

One month after the first phase, questionnaires (Appendix 1) containing open and closed questions were completed by the NICU-HUSM healthcare professionals to identify noise-related behavioral changes. The questionnaire included questions related to noise sources, noise impact on neonates, healthcare professionals and parents, possible noise-related behavioral changes and the identification of concerns the healthcare professionals had developed since the previous contact.

All 28 healthcare professionals participating in this phase had completed this questionnaire in the previous

Noise: harmful for newborn hearing.

Neonatal ICU noise may cause hearing loss among newborns, due to the immaturity of their hearing structures, the combination of noise and ototoxic drugs (ampicillin, gentamycin) and other issues.

Other noise effects include sleeping disorders, agitation, crying, irritability, fatigue and weight loss.

Acceptable neonatal ICU noise levels: 30 to 40 dB
Noise level measured at NICU-HUSM: 43 to 114 dB
(Aurélio and Tochetto, 2009)

Your behavior may contribute to newborn health reduce noise levels
You can:

- Lower your voice, music, telephones;
- Handle devices and hampers gently;
- Do not make noise over the incubator surface, which will reverberate inside.

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Figure 1- Informative leaflet on the harmful effects of noise, distributed at the neonatal intensive care unit.

NICU – neonatal intensive care unit; HUSM – Hospital Universitário Santa Maria.

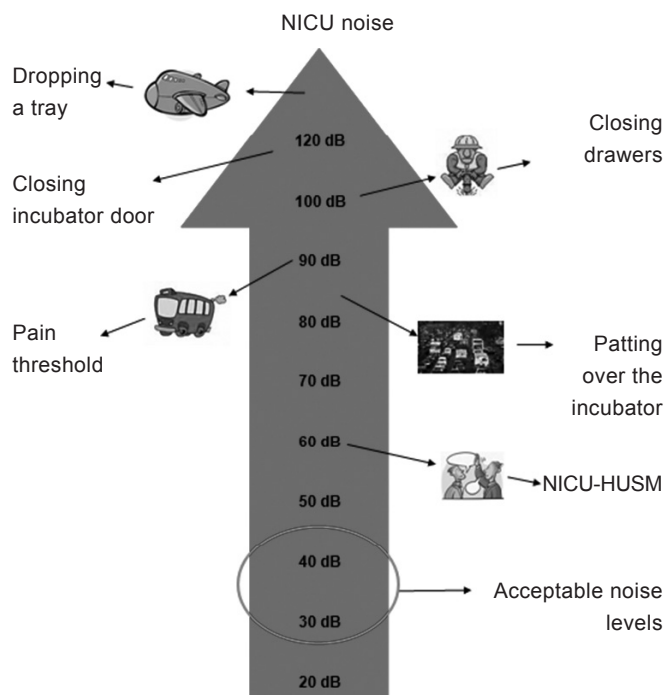


Figure 2 – Poster comparing noise in the neonatal intensive care unit and noise in daily life.

Source: Margotto (2004) apud Saraiva CAS. Fatores físicos-ambientais e organizacionais em uma unidade de terapia intensiva Neonatal: implicações para a saúde do recém-nascido [tese]. Porto Alegre: Escola de Engenharia da Universidade Federal do Rio Grande do Sul; 2004.

NICU – neonatal intensive care unit; HUSM – Hospital Universitário Santa Maria.

study.⁽²⁾ The responses to both studies were compared except for the responses regarding changes related to noise control.

The questionnaire data were inserted into shift tables

and were statistically analyzed using the chi-square test.

This study is part of a research project, titled Noise in a Neonatal Intensive Care Unit, which was approved by the institution’s ethics committee under the number 0158.0.243.000-07.

RESULTS

Questionnaires were delivered to 40 healthcare professionals; 28 completed questionnaires were returned by 8 nurses, 16 nursing technicians, 2 physicians and 2 physiotherapists.

When the responses were compared to those of the previous study,⁽²⁾ statistically significant differences were found only for the questions related to NICU-HUSM noise intensity and sources (Table 1). Overall, the noise intensity was rated as moderate (Figure 3).

Overall, healthcare professionals believe that there is a predominance of noise from equipment and healthcare professionals in the NICU-HUSM (Table 2); 71.5% of the healthcare professionals admitted that their own behavior generated noise. However, the difference between this percentage and the previous study⁽²⁾ was not statistically significant (Table 1). According to the healthcare professionals, most of the noise came from talking. No statistically significant difference was found between the healthcare professionals’ identified noise sources and the behaviors acknowledged to cause noise (Table 3).

All of the professionals stated that they believed that the noise level could be reduced. The main suggestions for reducing noise levels are shown in Table 4. There

Table 1- Comparison of the results of the completed questionnaires in Aurélio (2009)⁽²⁾ and this study

Question	Aurélio (2009) N (%)		This study N (%)		p value
Regarding noise level, most of the time you would say that in this NICU it is	Intense Moderate		Intense Moderate		0.037
	26 (60.5)	17 (39.5)	9 (32.1)	17 (60.7)	
Most of this NICU noise is caused by	Equipment		Equipment		0.005
	42 (97.7)		8 (28.6)		
Do you believe that your behavior in the NICU causes noise?	Yes		Yes		0.879
	29 (67.5)		20 (71.5)		
Which behavior causes more noise?	Handling equipment and conversation*		Conversation		0.945
			13 (46.5)		
Do you think that it is possible to control noise in this NICU?	Yes		Yes		0.945
	42 (97.7)		28 (100)		
Can the noise in this NICU harm the babies?	Yes		Yes		0.945
	42 (97.7)		28 (100)		

NICU – neonatal intensive care unit.* The author did not mention values.

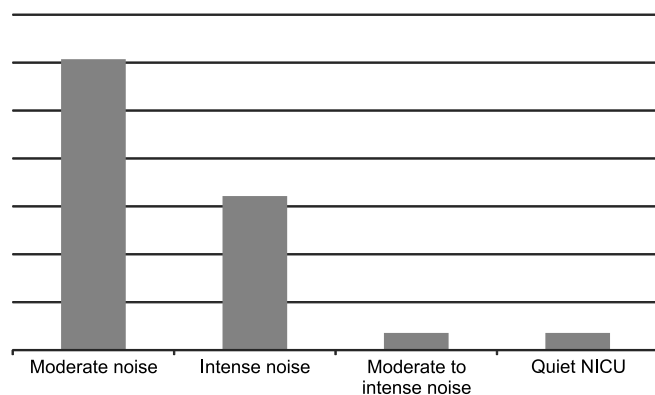


Figure 3 – NICU-HUSM noise intensity according to the healthcare professionals.

NICU – neonatal intensive care unit; HUSM – Hospital Universitário Santa Maria.

Table 2 – Noise sources according to the healthcare professionals

Noise sources	N (%)
Equipment and professionals	10 (35.7)
Equipment	8 (28.6)
Professionals	4 (14.3)
Equipment, professionals and students	4 (14.3)
Professionals and students	1 (3.6)
No response	1 (3.6)

Table 3 – Noise sources and behavior/procedures acknowledged by healthcare professionals to cause noise

Noise sources	N (%)	Behaviors and procedures	N (%)	p value
Talking	10 (35.7)	Talking	13 (46.4)	0.598
Speaking loudly	7 (25.0)	Speaking loud	10 (35.7)	0.523
Suctioning	6 (21.4)	Suctioning	2 (7.4)	0.185
Dragging furniture	2 (7.4)	Dragging furniture	2 (7.4)	1.000

Table 4 – Noise-controlling measures suggested by healthcare professionals and behavioral changes after education

Suggestions for noise control	N (%)	Adopted behaviors for noise control	N (%)	p value
Speaking more quietly	7 (25.0)	Speaking more quietly	22 (78.5)	0.021
Reacting promptly to alarms	4 (14.3)	Reacting promptly to alarms	19 (67.8)	0.007
Controlling noise when handling furniture	2 (7.4)	Controlling noise when handling furniture	16 (57.1)	0.003
Avoiding noisy shoes	1 (3.6)	Avoiding noisy shoes	11 (39.2)	0.008

was a statistically significant difference between the suggestions for noise control and behaviors adopted after the lectures (Table 4).

After receiving information, the most common behavioral change reported by healthcare professionals was talking more quietly (Table 5). All healthcare professionals reported at least 2 behavioral changes.

Regarding the harmful effects of noise exposure, all healthcare professionals acknowledged that noise could harm neonates, indicating as the main injuries irritability (21.4%), shortened sleeping time (21.4%), hearing impairment (14.2%), stress (14.2%), nervous system disorders (10.7%) and neuropsychomotor development disorders (10.7%). The responses regarding possible harmful effects for healthcare professionals

Table 5 – Healthcare noise control measures

I became more careful of	N (%)
Speaking lower	22 (78.57)
Not slamming the incubator door	21 (75)
Reacting promptly to alarms	19 (67.86)
Not dragging furniture	16 (57.14)
Closing hampers gently	16 (57.14)
Not putting objects over the incubator	14 (50)
Avoiding noisy shoes	11 (39.29)
Keeping cell phones on silent mode	6 (21.43)
All of the above	6 (21.43)
Lowering radio and/or TV sound	2 (7.41)

included stress (50%), irritability (28.5%), hearing loss (28.5%) and headache (14.2%). Harmful effects for parents included stress (39.2%), hearing loss (28.5%) and irritability (17.8%).

DISCUSSION

After the lectures, 60.7% of the healthcare professionals working at the NICU-HUSM rated the environmental noise level as moderate (Figure 3). In a previous trial involving this same NICU,⁽²⁾ 60.4% of respondents considered the noise level to be intense.⁽²⁾ This change in noise perception was statistically significant ($p=0.374$), showing that at least some of the healthcare professionals adhered to the noise control program.

The main source of noise identified by healthcare professionals was a combination of equipment and healthcare professionals' behavior (35.7%) (Table 2), which was a finding in agreement with the literature.⁽⁴⁾ Alarms, air conditioning, handling objects, dragging chairs, slamming doors and talking were reported as the main sources of noise pollution.⁽¹¹⁾ In contrast, in other studies, only equipment was reported to be responsible for the excessive noise.^(1,8)

Most of the healthcare professionals (71.4%) acknowledged that their own behavior was a source of noise. In the previous study,⁽²⁾ only 67.5% acknowledged their part in the sources of noise. Conversations (46.4%) and speaking loudly (25%) were the most frequently mentioned behaviors as observed in other studies.^(4,12)

After the lectures, NICU-HUSM healthcare professionals acknowledged that their behavior was a significant part of the noise (Table 1). In contrast, in the study by Aurélio,⁽²⁾ healthcare professionals pointed to equipment as the major source of noise.

Statistically significant differences were found between the healthcare professionals' responses about the major sources of noise at the NICU-HUSM ($p=0.0055$). This finding suggests that healthcare professionals became aware of their contribution to the noise in their workplace. Some studies point to awareness as the main means of controlling the noise level in NICUs.^(8,9,11,14,15)

All respondents acknowledged that noise is harmful to neonates with most respondents mentioning irritability and shortened sleeping time. According to the literature, excessive neonatal exposure to noise can cause sleeping cycle disorders,^(4,7,8,9,11) immediate vital sign changes⁽⁵⁾ and hearing loss.^(4,7,11,13)

All respondents acknowledged that the noise

in their workplace could harm their own health, predominantly through stress, which was mentioned by 50% of the subjects. In the previous study,⁽²⁾ the main reported effects resulting from noise were stress, irritability, fatigue and headache, which could impact the professionals' job performance and, consequently, harm their patients.^(4,8)

All NICU-HUSM healthcare professionals believed that it was possible to control the noise level. In the previous study, 97.67% of the healthcare professionals believed that reducing noise levels was possible.⁽²⁾ Based on their awareness of the harmful effects of noise for their patients and for themselves, healthcare professionals changed their noisy behaviors and improved the acoustic environment.

Based on the information provided, the number of professionals who stated that they had changed their behavior was higher than the number of healthcare professionals who suggested these changes; this difference was statistically significant (Table 4). In addition to talking more quietly, being careful not to slam incubator doors and promptly attending to alarms, the professionals reported being more careful when closing hampers. These results demonstrate the effectiveness of the program and healthcare professionals' commitment to improving the acoustic environment of their workplace.

Speaking loudly was reported by 23 respondents to be a source of noise generation (Table 3). After the educational program, 78.5% of the respondents began speaking more quietly (Table 4). In other studies, lowering of voices in NICU rooms was suggested as a possible method of noise control.^(9,14,15)

All healthcare professionals reported that they had changed at least 2 noise-generating behaviors. Other solutions identified by this group included keeping radios and televisions off and covering hamper lids to prevent noise.

Based on their awareness of the harmful effects of noise for their patients and for themselves, healthcare professionals changed their behaviors, rendering the NICU environment quieter. Accordingly, educational programs for NICU professionals are one way to control environmental noise.^(8,9,11,14,15)

Long-term evaluations show that behavioral changes are not as effective as interventions involving the physical environment. However, because these measures are not financially feasible for most NICUs, reminders can consistently motivate healthcare professionals to maintain acoustically healthier workplaces.⁽⁹⁾ Therefore,

we suggest that this issue should be periodically addressed with the healthcare team.

CONCLUSION

The NICU-HUSM noise control program was considered to be successful because healthcare professionals took greater care to prevent their professional behavior from causing unnecessary noise.

RESUMO

Objetivos: Avaliar a eficácia de um programa para redução do nível de ruído na Unidade de Terapia Intensiva Neonatal do Hospital Universitário de Santa Maria (UTIN/HUSM).

Métodos: O estudo foi realizado na UTIN/HUSM, em Santa Maria, Rio Grande do Sul. A primeira etapa constou de contatos verbais informais com todos os profissionais que atuam no local durante os turnos da manhã, tarde e noite. Também foram distribuídos folhetos e afixados cartazes apontando a no-

cividade do ruído para o neonato e para os profissionais e ainda mudanças comportamentais capazes de levar à redução do ruído neste ambiente. As sugestões foram: evitar falar em volume elevado, manusear cuidadosamente as portinholas das incubadoras e manter os aparelhos de celular no modo silencioso. Após um mês foram aplicados questionários para avaliar as mudanças comportamentais ocorridas neste período.

Resultados. Após o desenvolvimento do programa a maioria dos profissionais caracterizou o ruído da UTIN/ HUSM como moderado. Verificou-se que 71,4% dos profissionais admitem que seus comportamentos geram ruído. A totalidade dos profissionais referiu acreditar na possibilidade de reduzir o ruído da UTIN/ HUSM e para isso sugeriram falar mais baixo, responder rapidamente aos alarmes e cuidado ao manipular os móveis, medidas que foram adotadas por todos eles.

Conclusão: O programa para redução do ruído desenvolvido na UTIN/ HUSM obteve êxito na medida em que os profissionais passaram a ter cuidado para que seu comportamento não gerasse ruído desnecessário.

Descritores: Efeitos do ruído; Monitoramento do ruído; Recém-nascido; Unidades de terapia intensiva neonatal

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APPENDIX 1**QUESTIONNAIRE**

You are a

 Healthcare professional – Profession: _____ Student - Course: _____ Semester: _____Gender: F M Age: _____

Daily time at the NICU: _____

Room you stay in longest:

 Intensive care Intermediate care Isolation

1. Most of the time, you would say that this NICU is

 Quiet Moderately noisy Intensely noisy

2. In your opinion, this NICU noise comes mostly from

 Equipment Professionals Students Parents

3. Do you believe that your behavior in the NICU causes noise?

 No Yes Don't know

Your noise-generating behaviors are _____

4. Do you think that NICU noise can harm babies?

 No Yes Don't know

How? _____

5. Do you think that NICU noise can harm healthcare professionals/students?

 No Yes Don't know

Type of harm: _____

6. Do you think that NICU noise can harm the babies' parents or caregivers?

 No Yes Don't know

Type of harm: _____

7. Do you think that it would be possible to reduce the noise in this NICU?

 No Yes Don't know

How? _____

8. After the educational lectures, I started being careful of
- () Not slamming the incubator door
 - () Speaking lower
 - () Promptly responding to alarms
 - () Not putting objects over the incubator
 - () Lowering the TV sound
 - () Not dragging chairs or other furniture
 - () Closing hampers gently
 - () Not letting closet doors slam
 - () Discussing newborns' cases far from the incubators
 - () Turning my mobile phone off
 - () Being careful not to tap the incubator during cleaning
 - () Guiding parents to be quiet in the NICU and to talk as little as possible