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INTEGRATIVE REVIEW ARTICLE

SCIENTIFIC PRODUCTION ON NOISE IN THE NEONATAL INTENSIVE CARE UNIT: INTEGRATIVE REVIEW

PRODUÇÃO CIENTÍFICA SOBRE RUÍDOS NA UNIDADE DE TERAPIA INTENSIVA NEONATAL: REVISÃO INTEGRATIVA

LA PRODUCCIÓN CIENTÍFICA SOBRE RUIDOS EN LA UNIDAD DE TERAPIA INTENSIVA NEONATAL: REVISIÓN INTEGRADORA

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ABSTRACT

Objectives: to analyze the scientific production on the noise in the Neonatal Intensive Care Unit and highlight strategies to reduce them. **Method:** literature in order to answer the research questions << What is the focus of studies on existing noise in the NICU? >> What strategies can be adopted to reduce these noises? >> held in October 2012 in LILACS, MEDLINE and BDNF with the intersection of the Health Sciences Descriptors Headings (MeSH): "Neonatal Intensive Care Units X Noise"; " Neonatal nursing." **Results:** the noise is considered one of the most significant stressors for the neonate and may be caused by excessive exposure to these noises from equipment, the physical structure and the personnel involved. **Conclusion:** It was agreed that the primary strategy for reducing noise is to conduct educational activities with all teams involved in the work of the NICU about the negative effects for the baby. **Descriptors:** Neonatal Intensive Care Units; Noise; Neonatal Nursing.

RESUMO

Objetivos: analisar a produção científica sobre os ruídos na Unidade de Terapia Intensiva Neonatal e destacar estratégias para redução dos mesmos. **Método:** revisão de literatura com vistas a responder as questões de pesquisa << Qual o enfoque dos estudos realizados acerca dos ruídos existentes na UTIN? >> Que estratégias podem ser adotadas para a redução destes ruídos? >>, realizada em outubro de 2012 nas bases de dados LILACS, MEDLINE e BDNF, com o cruzamento dos Descritores em Ciências da Saúde (DeCS): "Unidades de Terapia Intensiva Neonatal x Ruídos"; "Enfermagem neonatal". **Resultados:** o ruído é considerado um dos mais significativos fatores de estresse para o neonato, podendo ser causado pela exposição excessiva a esses ruídos provenientes dos equipamentos, da estrutura física e do pessoal envolvido. **Conclusão:** foi consenso que a estratégia primordial para redução dos ruídos é a realização de atividades educativas com todas as equipes envolvidas no trabalho da UTIN acerca dos efeitos negativos para o bebê. **Descritores:** Unidades de Terapia Intensiva Neonatal; Ruídos; Enfermagem Neonatal.

RESUMEN

Objetivos: analizar la producción científica sobre los ruidos en la Unidad de Terapia Intensiva Neonatal y destacar estrategias para reducción de los mismos. **Método:** revisión de literatura con vistas a responder las preguntas de investigación << ¿Cuál es el enfoque de los estudios realizados acerca de los ruidos existentes en el UTIN? >> ¿Qué estrategias pueden ser adoptadas para la reducción de estos ruidos? >>, realizada en octubre de 2012 en las bases de datos LILACS, MEDLINE y BDNF, con el cruzamiento de los Descriptores en Ciencias de la Salud (DeCS): "Unidades de Terapia Intensiva Neonatal x Ruidos"; "Enfermería neonatal". **Resultados:** el ruido es considerado uno de los más significativos factores de estrés para el neonato, pudiendo ser causado por la exposición excesiva a esos ruidos provenientes de los equipamientos, de la estructura física y del personal envuelto. **Conclusión:** fue consenso que la estrategia primordial para reducción de los ruidos es la realización de actividades educativas con todos los equipos envueltos en el trabajo de la UTIN acerca de los efectos negativos para el bebé. **Descritores:** Unidades de Terapia Intensiva Neonatal; Ruidos; Enfermería Neonatal.

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INTRODUCTION

The treatment and prognosis of critically ill patients have complex features to meet special needs. This is due to scientific and technological advances, to modernize the various equipment, to the discovery and development of drugs and the constant training of multidisciplinary working in these areas. This combination of factors makes it possible to increase the survival rate and quality of life of patients in Intensive Care Units.¹⁻²

The Intensive Care Unit is designed for patients who need a complete system for continuous monitoring of various vital biological parameters. Therefore, it is necessary the use of specific equipment and expertise of specialized human resources.³

According to the Ordinance of the Ministry of Health No. 3432 of 08/12/98, the ICU can be classified according to the group of people that meets in Specialized - focused on patients treated for certain (neurological, cardiac, specialty, etc.). Or according to age group: Adult ICU - Over 14 or 18 years, Pediatric ICU - from 28 to 14 days old or 18 years old (according to internal hospital routine), and the Neonatal ICU (NICU) - from 0 to 28 days of life.³

In NICU the risk and/or premature newborns (NBs) are assisted by a multidisciplinary team, which has specialized technological device, capable of providing the administration of various diseases treatments, as well as rehabilitation of premature babies. In addition to qualified and suitable equipment, another factor of great importance for the development and recovery is the existence of babies in the NICU, a quiet and peaceful setting.⁴

Studies show that the NICU environment is too stimulating to the constant presence of high intensity noise that can compromise the development of newborns. Noises are the sounds disorganized and frequencies physiologically incompatible with the human ear, which can cause physical injuries, psychological and behavioral disorders.⁵ According to the Brazilian Association of Technical Standards (ABNT) NBR 10152/1987, on the levels of noise for the acoustic comfort in a hospital environment, they must be between 35 and 45 decibels.⁶

Combating noise is therefore an integral element in serving infants and fundamental to the realization of the desired outcome in the treatment prescribed. Various equipment used in the NICU as an incubator, oximeter, ventilator, humidifier and an infusion pump,

and the very professional team can be a potent source of noise substantially increasing the exposure of newborns to acoustic discomfort and consequently becoming a source of stress to these babies.^{7,8} This is because, in the last quarter of life is occurring maturation of various organs and systems of the fetus and is between the 28th and 34th weeks of gestation reaching the apex of rate electrophysiological changes, auditory responses in the cortex and brainstem. At birth, babies go through several adaptations, including his organic system. At that stage, the hearing of the newborn is very sensitive, especially premature infants.⁸

The development of the central nervous system (CNS) of the newborn, whether preterm or term starts during pregnancy and their maturation process enables an integrated and harmonious neurological development, which is finalized at the end of the first year of life. It is noteworthy that the environment has a great influence on this process, being able to generate noises physiological and psychological changes to this harmful ripening.⁴

Excessive exposure to noise from the NICU environment may cause various problems including: apnea, changes in the states of sleep and wakefulness baby, leaving him angry and tearful, impairing their overall development and weight gain; excessive release of adrenocorticotrophic hormone, triggering a systemic reaction, followed by an increase in circulating adrenaline chain changes, along with the elevated heart rate, which generates a systemic vasoconstriction, pupil dilation, increased oxygen consumption, increased blood pressure and intracranial, which predisposes the newborns' intravascular cranial hemorrhage.^{4,5,9}

The loud and continuous noise may excessively stimulate the hair cells of the organ of Corti in newborns, which causes their destruction, resulting in progressive hearing loss.⁵ Among several comparisons on the representativeness of noise NICU for newborns, we analyzed that closing the door of the incubator has the intensity 100dBA, the same sound of a jackhammer, or even the fall of a tray that has the intensity 130dBA, comparable to a jet 30 feet tall.⁴

Based on these and from the professional experience of the researchers in the care of newborns admitted to NICU (witnessing prolonged treatment) excessive noise exposure in this environment negatively influences the recovery of babies because prolong hospital stay and increase the risk of irreversible damage. Hence, the relevance of

this phenomenon to better understand and seek, through scientific knowledge, encourage health professionals, especially nurses and their team, to pursue strategies aimed at minimizing the noise in the NICU and its harm to newborns.

OBJETIVES

♦ To analyze the scientific production on the noise in the Neonatal Intensive Care Unit and highlight strategies to reduce them.

MÉTODO

Integrative literature, obeying the following steps: establishing the objectives of the study and inclusion criteria articles; defining the information to be extracted from the research; selection of articles; analyzing the results; presentation and discussion of the findings of the review.¹⁰

To guide this review, the following research questions were formulated << *What is the approach of the studies conducted on existing noise in the NICU?* >> *What strategies can be adopted to reduce these noises?* >>

The searches were performed in October 2012 on the website of the Virtual Health Library (BIREME), more specifically the bases: Latin American and Caribbean Literature on Health Sciences (LILACS), Online Search System and Analysis of Medical Literature (MEDLINE) and the Database of Nursing (BDENF). To facilitate access to information,

we used the intersection of Descriptors in Health Sciences Headings (MeSH): "Neonatal Intensive Care Units X Noise"; "Neonatal nursing."

For data collection, we used a structured questionnaire containing information about the database, the location of the study authors, title and objectives of the article, the main results and conclusions.

To select the studies articles available on the subject the following inclusion criteria s were adopted: published articles between January 2002 and September 2012 in Portuguese and English. Exclusion criteria were studies published in the year 2002 and less repeated in more than one database, being counted only once.

For critical analysis of selected articles, there was the reading and interpretation of descriptive studies, through the identification of common ideas and content to conflicting objectives. This resulted in the initial selection of 20 items however, only 14 contemplated the relevant aspects of the proposed objectives and met the inclusion criteria.

RESULTS AND DISCUSSION

The distribution of papers according to which the database was indexed and year of publication is presented in Figure 1.

Database								
		LILACS		BDENF		MEDLINE		Total
Year	n	%	N	%	n	%	n	%
2005	0	0	1	7,7	0	0	1	7,69
2006	0	0	1	7,7	0	0	1	7,69
2007	1	7,7	0	0	0	0	1	7,69
2008	0	0	1	7,7	0	0	1	7,69
2009	0	0	0	0	0	0	0	0
2010	1	1	1	7,7	1	7,7	3	23,07
2011	3	23,07	0	0	2	15,38	5	38,47
2012	1	7,7	0	0	0	0	1	7,7
Total	6	46,15	4	30,8	3	23,07	13	100

Figure 1. Distribution of studies published between 2002 and 2012, according to the databases and year of publication. Natal / RN, 2012.

Figure 1 shows that most studies (38.47%) was published in 2011, followed in 2010, with 23.072%. In the years corresponded with the lower rate of publication with only 7.69% of the studies. This can be explained partly by the month in which the collection of these data was performed, ie, october does not

cover all of the work for the year 2012. It should be noted that the largest number of articles was found in the Lilacs database.

From the application of the established criteria, 13 articles were selected, as presented in Figure 2:

Title	Objective	Reference
Effectiveness of a program to reduce noise in Neonatal Intensive Care Units.	To evaluate the effectiveness of a program to reduce the noise level in the Neonatal Intensive Care Unit, University Hospital of Santa Maria (NICU / HUSM).	Weich ⁴
Noises in a Neonatal Unit.	To identify the causative factors of noise, in the locus of NIU; to measure the noise and noises at NIU in decibels.	Cardoso ⁵
Reducing the sound pressure level of the Neonatal Intensive Care Unit: strategies adopted by health professionals.	To check what are the noise sources detected and the strategies adopted by health professionals in a NICU in a teaching hospital in São Paulo-SP, Brazil.	Daniele ⁷
Sound Pressure Level in Neonatal Intensive Care Unit.	Check the sound pressure level (SPL) of two rooms of Neonatal Intensive Care Unit (NICU) and identify its sources.	Peixoto ⁸
Noise in Neonatal Intensive Care Unit during the passages of duty nursing and/or medical) and medical visits.	To check the Leq (average value of the sound pressure levels, integrated in a given time) during shift change nursing and/or medical and doctor visit to the Neonatal Intensive Care Unit (NICU) of a university hospital in Ribeirão Preto, SP , Brazil.	Ichisato ¹¹
Noise in a Neonatal Intermediate Care Unit of a university hospital.	Determine the ambient noise levels in the Neonatal Intermediate Care Unit of a university hospital in Ribeirão Preto, SP, Brazil.	Zamberlan ¹²
Noise generated during the handling of incubators: implications for nursing care.	To investigate the impact of noise levels found in incubators at a university hospital in Ribeirão Preto, SP, Brazil.	Rodarte ¹³
Perception of the multidisciplinary team on noise	To describe the perception of the multidisciplinary team on ambient noise in a NICU.	Silva ¹⁴
Noise inside the incubator in the Neonatal Intensive Care Unit.	To assess the levels of sound production and identify the sources that produce noise in the environment of the Neonatal Intensive Care Unit of a University Hospital in São Paulo-SP	Peixoto ¹⁵
Noise in the Neonatal Intensive Care Unit and inside the incubator.	To identify the sound pressure level (SPL) of the NICU and inside the incubator of a teaching hospital in a public university in São Paulo, SP, Brazil.	Pinheiro ¹⁶
Identification of sources of noise and sound pressure in a neonatal unit.	To identify sources of noise in the NICU and measuring sound pressure levels emitted by them.	Nogueira ¹⁷
Noise level in the Neonatal Intensive Care Unit.	To check the noise level of the Neonatal Intensive Care Unit and identify their sources.	Kakehashi ¹⁸
Noise in a Neonatal Intensive Care Unit: measurement and perception of professionals and parents	Meet the perception of professionals working in NICU and parents of hospitalized newborns over the existing noise, and compare it to the noise levels measured.	Aurélío ²⁰

Figure 2. Distribution of studies published between 2002 and 2012, selected in LILACS, MEDLINE and BDEF according to the title and objective data. Natal / RN, 2012.

The figure 1 shows that the objectives of most studies focused on the assessment of noise in the NICU, denoting the concern of researchers in measuring the level and sources of noise in this environment.

Adding the number of authors on each job have the amount of 58 authors distributed among the 14 selected articles. Many of these authors have written more than one paper on the subject, ie, when we exclude the authors who have published more than once, this number decreases to 34 authors who have developed this research segment, which leads us to conclude that, despite the importance of the topic, the scientific literature on the subject is scarce.

To facilitate the understanding of the subject of study, the results were organized and discussed under the following topics: effects of noise on the newborn; the sources of noise in the NICU and strategies for the control and reduction of noise in the NICU.

◆ Effects of noise on the newborn

While ABNT states that within the hospital environment the Leq (equivalent pressure level) and LFmax (maximum sound pressure level) are 35-45 dBA, the World Health Organization (WHO) recommends that the Leq is 30 dBA, the LFmax 40 dBA and during nighttime occurs reduction between five and ten percent of sound level.⁵

The sound level of 35 dBA can cause continuous EEG changes, changing the structure of sleep, leading to a vegetative reaction, because sleep is an important intellectual ability, physical recovery, brain growth and maturation of organs factor.¹¹

Exposure to levels above 45 dBA adversely affect attention, concentration and learning process. Greater than or equal to 60 dBA noise are associated with potentiation of the effects of ototoxic agents and sleep disorders.¹¹⁻²

Preterm newborns are more vulnerable to the effects of the environment and therefore are more prone to abnormal neurological development, since the lower the gestational age, the greater the chance of compromise because the brain of a preterm baby is immature process and record sensory information, which is extremely sensitive and unable to select reportedly due to a lack of inhibitory control. Because of the immaturity of the central nervous system, the auditory response of the cortex and brainstem are highly sensitive, even to obtain infections^{5,13}

The noise is considered as one of the most significant stressors for neonates during their stay. It is proven that excessive exposure to noise can result in various physiological and behavioral changes in infants, among which we can mention: apnea , damage the cochlea, irritability, altered states of sleep and wakefulness, hearing loss, stress, damage to

the nervous system and the neuro-psychomotor development, weight loss, cerebral intravascular bleeding, tachycardia, high blood pressure and decreased immunity, leaving the child more prone to infections. The noise can also generate definitive hearing damage because they can injure the cochlea, causing a hearing loss.^{4,11,14}

To get an idea of the damage caused by the noise, a loud noise near the neonate is perceived as a shock, which can cause a series of chain reactions, such as release of adrenocorticotrophic hormone and adrenaline into the bloodstream increasing the frequency cardiac, systemic vasoconstriction, pupil dilation and increased blood pressure and intracranial pressure, which may even result in an intravascular cerebral bleeding.⁸

♦ The sources of noise in the NICU

The noise of a NICU are from equipment, physical structure and personnel involved, professionals and parents. The crying of children is also a potent source of noise.¹⁴

For the case of an Intensive Care Unit, the NICU environment has a large technological device, and instruments such as pulse oximeters, mechanical ventilators, infusion pumps, incubators alarm (when they have a problem that hinders their functioning, their fire alarms generating noise).¹⁵

Newborns can stay in incubators or heated crib and the incubator provides enhanced thermoregulation. Inside the incubator, the noise tends to be higher, as the environmental sounds NICU partially pass through the wall of the incubator and are amplified. Besides these sounds there are other noises such as the sound of water in the ventilator circuit used by the baby, sounds emitted during the care of newborns, the sound of the NB, alarm equipment used in the care of the neonate, conversations between professionals and other people close to the incubator, placing objects on the dome of the incubator, physical examination, handling drawer cabinet incubator and even the act of closing the hatches.¹⁵⁻⁶

The noise level in the NICU environment depends on the shift, the area (medium risk, high risk or premature hospitalization sector) and executed procedures.¹⁷ Noises from the conversation is considered the main source of noise within a NICU and it is observed that this occurs in the morning shift where the routine care is more intense together with a higher

concentration of people in the place raising the sound pressure above 90 dBA .

The process of working in the NICU is noisy, activities at the counter (handling medical records, telephone unit, use of punch and stapler) and handling of materials (surgical instruments, life support equipment located near the beds) together are 12.2 % of the noises that are between 80 to 90dBA.¹⁷

Daily, in the NICU circulates doctors of various specialties, nursing staff, speech therapists, physiotherapists, diagnostic support technicians (X-rays, for example), cleaning staff service and family members of babies. This amount of people significantly interferes with the noise level¹⁸.

Generally, the shift change of the nursing staff and doctors is rather noisy generating sounds around 55.2dBA to 75.7dBA, values above the national and international recommendations for hospital environments.¹¹

♦ Strategies for the control and reduction of noise in the NICU

All noise sources highlighted by professionals were related directly or indirectly with the management of both the unit and human attitudes, although the architecture of the NICU does not present favorable acoustic conditions. Professionals working in the NICU have the perception that this is a noisy environment and often does not meet the recommended, then they can understand the problems caused by these noises and collaborate for reduction.¹⁹

The main strategies used to reduce noise in the NICU are educational programs, because if people involved (professionals, parents and visitors) have awareness of the effects caused by noise to newborns, it is possible to significantly reduce the sounds only with behavioral changes. This is the main way for a quieter environment in the Neonatal Intensive Care Unit.⁴

In educational activities is important to note that with relatively simple interventions, many complications that can be deadly for some babies are prevented. These are some of the possible strategies.^{7,14,19}

Objetive	Strategies
Avoiding unnecessary voice sounds	• To adjust the voice tone to the NICU environment;
	• Do not connect the sound or television within the NICU;
	• To educate parents and visitors about the volume of the voice;
	• To place warning stickers on the importance of silence and reduction of noise;
Preventing noise from appliances NICU	• Do not talk on the cell next to newborns;
	• Do not knock on the door of the incubator;
	• To decrease the volume of alarms and respond to them quickly;
	• Do not drag furniture;
Avoiding noise caused by professional	• Close the trash can smoothly;
	• To watch for accumulation of water from the ventilator circuit.
Avoiding excitement in the newborn	• Do not wear shoes that make noise;
	• To keep cellular phones in silent mode;
	• Encourage the mother to participate in the care of the newborn;
	• When possible, focus the procedures for the same time (bathing, weighing, collecting material for exams).

Figure 3. Distribution of goals and strategies for reducing noise in the NICU.

CONCLUSION

The scientific papers were all quantitative descriptive, involving professionals from the fields of nursing, medicine, speech therapy, engineering and statistics and most were conducted by nurses.

The focus of the research can be divided into three groupS: the perception of professionals and parents, the identification of noise sources and the strategies used to reduce them. There are few studies addressing the possible ways to make the environment of the NICU more humane in relation to the physical structure, equipment , lighting and noise.

Of all the strategies mentioned it is agreed that the essential to reduce the noise are educational activities with all staff involved in the NICU work on the negative effects of these sounds on the babies since combating noise is an integral element in meeting to newborns and fundamental to the realization of the desired result, which is the recovery of health.

Nursing plays a key role in combating noise because the professionals while working in the NICU, perform most procedures and remain continuous 24 hours with the newborns.

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