NOISE IN THE RECEPTION AND CLEANUP AREA FOR HEALTH PRODUCTS OF A MATERIAL AND STERILIZATION CENTER

Ruído na área de recepção e limpeza de produtos para saúde de um centro de material e esterilização

El ruido en el sector de recepción y limpieza de productos sanitarios de un Centro de Material y Esterilización

Caroline Salvagni[1], Vânia Maria de Araujo Giaretta[2], Maria Belén Salazar Posso[3]

ABSTRACT: Objective: This study aimed to verify the sound pressure level (SPL) in the reception area and cleanup in a Supply Center and Sterilization, identifying their sources of noise. **Method:** This is a cross-sectional study, descriptive-exploratory field with quantitative approach, carried out in an establishment of mid-sized healthcare of São José dos Campos (SP), Brazil. The data collection took place in June and July of 2014 using a sound-level meter to identify the SPL. The measures were taken in the afternoon, in timetables established by the technical manager of the sector and based on a moment of greater activity and other activity cleaning (purging) areas. **Results:** We found high NPS on the local site. **Conclusion:** NPS measured in the study environment is sufficient to cause physiological and psychological changes in the professionals who work there.

Keywords: Noise. Noise measurement. Sound contamination. Sterilization

RESUMO: Objetivo: Este estudo teve como objetivo a verificação do nível de pressão sonora (NPS) na área de recepção e limpeza (expurgo) do Centro de Material e Esterilização, identificando suas fontes de ruído. **Método:** Trata-se de um estudo transversal, descritivo-exploratório, de campo, com abordagem quantitativa, realizado em um estabelecimento de assistência à saúde de médio porte em São José dos Campos (SP), Brasil. Os dados foram coletados nos meses de junho e julho de 2014, utilizando-se um decibelímetro Icel Manaus DL-4100® para a identificação do NPS. As medidas foram realizadas no período da tarde, em horários estabelecidos pelo responsável técnico do setor, baseadas em um momento de maior atividade e outro sem atividade no expurgo. **Resultados:** Foram encontrados NPS elevados no local. **Conclusão:** O NPS mensurado no ambiente estudado é suficiente para causar alterações fisiológicas e psicológicas nos profissionais que trabalham nesse local.

Palavras-chave: Ruído. Medição de ruído. Poluição Sonora. Esterilização.

RESUMEN: Objetivo: Este estudio tuvo como objetivo verificar el nivel de presión sonora (NPS) en el sector de recepción y limpieza de un Centro de Material y Esterilización, identificando sus fuentes de ruido. **Método:** Se trata de un estudio transversal, descriptivo-exploratorio, de campo, con abordaje cuantitativa, realizado en un establecimiento de asistencia a la salud de porte mediano en São José dos Campos (SP), Brasil. La recolección de los datos se ejecutó en los meses de junio y julio de 2014. Se utilizó un decibelímetro Icel Manaus DL-4100® para la identificación del NPS. Las medidas fueron realizadas en período de la tarde, en horários establecidos por el responsable del sector e basadas en el momento de mayor actividad e otro sin actividad en el expurgo. **Resultados:** Fueron encontrados NPS elevados en el local. **Conclusión:** El NPS mensurado en el ambiente estudiado es suficiente para causar alteraciones fisiológicas e psicológicas en los profesionales que trabajan en este local.

Palabras clave: Ruido. Medición del ruido. Contaminación sonora. Esterilización.

[1]Nurse. Student of the Graduate course of Nursing in Surgical Center, Anesthetic Recovery and Material and Sterilization Center of the School of Nursing of the *Hospital Israelita Albert Einstein* (FEHIAE). E-mail: carolsalvagni@hotmail.com
Rua Tubarão, 120. Jardim Aquarius. CEP 12246-140. São José dos Campos (SP), Brasil. Telefone: (12) 98259-4949
[2]Nurse. Master in Biomedical Engineering by the Universidade do Vale do Paraíba (UNIVAP). Professor of the Nursing Course of the Fundação Universitária Vida Cristã (FUNVIC), Faculdade de Pindamonhangaba (FAPI) and of the Universidade de Taubaté (UNITAU). E-mail: vania_giaretta@yahoo.com.br
[3]Nurse. PhD in Nursing by the School of Nursing of the Universidade de São Paulo (USP). Retired Chair Professor of the UNITAU. Collaborating Professor of the FUNVIC. E-mail: mbelen@terra.com.br
Received: 11 June 2015. Approved: 15 Sep. 2015
DOI: 10.5327/Z1414-4425201500030006

INTRODUCTION

The noise may be understood as any uncomfortable, unpleasant or undesirable sound which causes negative effects over an individual, being able to trigger physical (hearing loss), physiological and psychological alterations as long as they exceed the limits of tolerance regulated[1,2].

With the industrial development in the 1970s, here was also an advance in surgical technique, and consequently there are new equipments and surgical instruments, improving the techniques and processes of cleaning, sterilization, preparation and storage of clothes and materials in the Material and Sterilization Center (*Centro de Material e Esterilização* – CME)[3,4].

The sound captured by the average human ear is in the range from 20 to 20,000 Hz mean, with a minimal pressure variation to be noticed[5-8].

The ear is the organ responsible for capturing the sound, subdividing it into 3 parts: the outer, the middles and the inner ear, and it is located in the temporal bone, being responsible for balance and hearing. The outer ear filters the sound and forwards it, through the ear canal, to the eardrum, which, in turn, vibrates and transmits it to the ossicles in the middle ear and, through the mechanical force transformed in hydraulic pressure, transmitting it to the inner ear, which transforms it into electrical energy and nervous stimulation, producing, thus, the sound sensation[5-7]. Therefore, the sound is a sensation perceived and interpreted by the mechanical vibration waves brain in all variations of pressure in an elastic means able to pressure the ear[6,7].

The vibrations cause the sound wave emitted by a source of sinusoidal aspect, which is a mechanical process of compression and rarefaction in an elastic means, whether it being: gas, liquid or solid, with defined speed. It is called frequency (*f*) the number of cycles per second in this oscillatory process. A sound cycle is the distance between long and rarefied intervals, in turn, it is expressed in Hertz (Hz), which are the number of cycles per second[8]. The inverse of *f* is the period (T), time of duration of a cycle. Considering the wave in relation to the distance, in a full cycle one may obtain the length of the wave, represented by I[5]. The basic characteristics of a sound are translated by its intensity and height, once that the first one allows distinguishing whether the sound is strong of weak, and the second, whether the sound is low or high pitched[5].

The interpretation of the sound occurs in both objective and subjective ways[5,6]. The objective way (physical sound) comes from the mechanical vibration able to press an elastic means, leading to the hearing sensation. The subjective interpretation comes from living experience when hearing a sound, pleasant or not, linked to emotional and imaginative states[5].

The CME as a technical support area, is responsible by the processing involving: receiving, selecting, cleaning, sterilizing, storing and distributing medical and hospital articles to all units of thee institution, providing conditions for the direct assistance to the health of both ill and healthy individuals[9,10].

The interest and the motivation for the study of this theme arose during the development of the curricular trainee program of the CME. With the participation in the dynamics of the work, it is possible to feel an acoustic discomfort and to listen to complaints about headaches, tiredness and fatigue of the professionals who worked there daily. Later on, when verifying the little literature existing about the noise in the CME, specifically in the purge section or reception and cleaning section, this study was intended to be developed. Therefore, the objective of this study was to identify the sound pressure level (SPL) and to evaluate the mains sources of sound emission in the reception and cleaning area of a CME.

METHODOLOGY

It is a cross-sectional, descriptive and exploratory study, in the field, with a quantitative approach, because this is what best fits the desired goal. The study was carried out considering the ethical and legal aspects of resolution No. 466/2012 of the National Health Council (*Conselho Nacional de Saúde* – CNS)[11], not involving human beings directly, therefore, it was not necessary to use the Informed Consent. However, a letter of consent was requested, signed by the representative of the institution, authorizing, thus, the access to the physical space and issuing of photos.

This study was carried out at the reception and cleaning sector of the CME of a midsize Hospital in the *Vale do Paraíba Paulista* region, in the period from June to July 2014.

The CME has 40.34 m^2, distributed in 12.52 m^2 of sterilization area, 12.318 m^2 of material preparations area and 15.505 m^2 of reception and cleaning area. In this area, the architectural features are: floor and walls with glazed tiles in standardized size, two glass Windows in order to receive health products and dirty ones from the Surgical Center (SC) and of other units of the institution, ceiling with concrete lining (Figures 1 and 2).

With the objective of defining the possible locations and positioning for the sound level meter, a pre-test was performed in the storage sector of the material and in the locker room of the SC, measuring the sound pressure level (SPL) of these sectors. The measuring occurred for 5 minutes in each point, in the afternoon (13h30min), in the beginning of functional activities, without interfering on them. The measures were conducted by a sound meter, Icel Manaus DL-4100®, (Figure 3) manufactured under the Standard regulations of IEC 61672 type 2 and ANSI S1.4 type 2, which evaluates it in a scale from 30 to 130 dB (divided into four ranges), precision of 1.4 dB, weighting circuit A and C, frequencies between 31.5 Hz and 8 KHz and different time response (fast and slow).

Figure 1. Reception and cleaning. On the back, view from the reception of the dirty material from the Surgical Center. Personal collection. São José dos Campos (SP), Brazil, 2014.

Figure 2. Reception and cleaning. To the right, view from the glass door of staff entrance of the purge and the woden one to receive dirty material from hospitalization units. Personal collection. São José dos Campos (SP), Brazil, 2014.

The A curve is used in evaluations with continuous and intermittent noises and the curve C for impact noises. In this study, the sound meter was set for slow responses, weighted in A (dBA)[12,13]. The slow response circuit is used situations in which the level of the noise is excessively in variation, a mean value is obtained, while the impulsive circuit is used in order to measure the impact of noises[5]. For measuring the SPL of the environment being studies, the sound meter was calibrated, the certification was under the number 09153/14 of the ISOMETRO® in June 2014. The SPLs obtained in the pre-test were not considered in the research.

The measures were conducted in the afternoon, beginning at 13h30min, this being the time Schedule established by the technical responsible of the CME, based in a moment of a Day with increased activity, which happens in the afternoon, and of another without activities (Sunday), at the same time.

The measures were conducted with a sound meter on the Mayo table in the Center of the place, with a microphone positions perpendicular to each wall of the environment, 1.20 m above the ground and 1.20 m from the source of the

Figure 3. Sound meter Icel Manaus DL-4100®, device was used for measuring. Personal collection. São José dos Campos (SP), Brazil, 2014.

noise. Each direction received a number, in order to facilitate, visually, the results in the tables.

RESULTS

In this study, as shown in Figures 1 and 2 the reception of dirty material area is contiguous to the cleaning (purge) one, where the noise is continuous during the functional activities. In this case, it was considered the mean reference value or the evaluation criteria level value (ECL) of 50 dBA, considering that the recommended one for hospital and enclosed facilities is in the range of 45 to 55 dBA[12]. 40 measures were conducted, 5 minutes each, of SPL in the areas of reception and cleaning: 20 in a Day without activities (no devices turned on and no professionals), and 20 in a Day with activities (with ultrasound, compressed air and professionals carrying out their activities), and in each direction 5 measures were conducted in the same period and time schedules, meaning, in the afternoon, , at 13h30min. Noting that the reception window remained closed at the time of the collection, as well as the *vitraux* of the room (Figures 1 and 2) and the doors to access the environment.

In Tables 1 and 2, direction 1 corresponds to the microphone turned to the direction of the window of the material preparation area, Direction 2 refers to the microphone positioned at the entrance door for employees, which is also the entrance for dirty materials from the hospitalization units of the institution. Direction 3 corresponds to the microphone placed towards the sink for washing of the materials and for the ultrasonic washer. And finally, direction4 refers to the microphone facing the window for receiving dirty materials from the SC.

Table 1. Sound pressure level and their respective means of the 4 directions in the purge without activity (n=20). São José dos Campos (SP), Brazil, 2014.

Time (min)	Direction 1 (dBA)	Direction 2 (dBA)	Direction 3 (dBA)	Direction 4 (dBA)
1	57.1	55.7	63.2	65.2
2	54.0	52.8	68.2	65.9
3	57.9	56.8	62.4	65.8
4	54.4	64.4	74.1	65.5
5	57.1	66.1	68.0	65.6
Mean	56.1	59.2	67.2	65.6

In Tables 1 and 2, there are the noise means for each of the measured directions. The highest SPL mean found in the purge without activity was with the sound meter facing direction 3 (sink for washing the materials and the ultrasonic washer), measuring a noise of 67.2 dBA. The lowest SPL mean, for the same conditions, was with the sound meter facing direction 1 (window in the material preparation area), 56.1 dBA. (Table 1).

Table 2 presents the results found in one Day of activities (work routine with cleaning of the materials, use of compressed air and ultrasonic cleaning). In these conditions, the lowest SPL mean found was 70.9 dBA, with the sound meter facing direction 4 (receiving site for contaminated material of the SC). The highest SPL mean was 77.2 dBA, positioning the sound meter in direction 1 (window for the clean purge area).

When comparing the measures of days with and without activities, it is noticeable the significant difference of dBA only in the third and fourth purge measures (Figure 4).

Table 2. Sound pressure level and theur respective means of the 4 directions in the purge with activity (n=20). São José dos Campos (SP), Brazil, 2014.

Time (min)	Direction 1 (dBA)	Direction 2 (dBA)	Direction 3 (dBA)	Direction 4 (dBA)
1	76.8	72.2	74.5	70.9
2	74.9	71.2	75.5	73.1
3	76.1	75.0	74.9	65.4
4	78.4	80.4	76.0	71.8
5	79.6	77.2	72.0	73.2
Mean	77.2	75.2	74.6	70.9

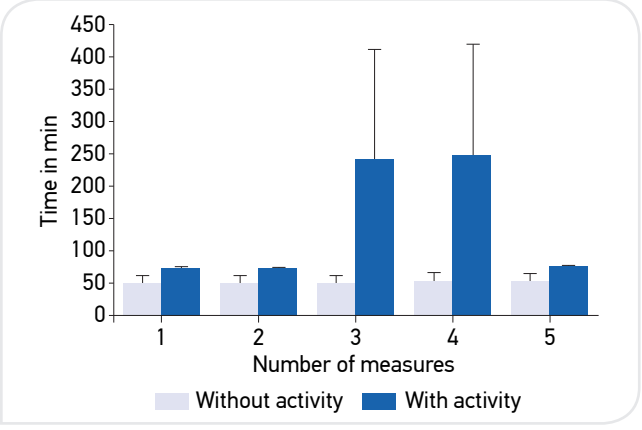

Figure 4. Comparison between the measure in a day without activities and with activities (n=40). São José dos Campos (SP), Brazil, 2014.

DISCUSSION

The noise is a part of our daily lives, in the streets, in companies and, also, in hospitals. Several studies have been showing that it is the noisy hospital environment which is able to cause physiological and psychological changes in both patients and professionals[1,10,13-15]. The disorganized, unpleasant sounds, in a physiologically conflicting frequency to the humans are considered noises[14].

The main sources of noise emission in the CME are: the autoclave in use, the ultrasonic washer of materials, chatting, people moving, among others[14], a situation also noticed in this study.

Thus, the data of the study showed that the SPL in the activity site had mean values of 74.5 dBA and, in the site without activities, the mean SPL was 62.0 dBA, i.e., the difference between the Day with and without activities was 12.5 dBA. These values are above the reference mean (50 dBA) established in this study, according to the criteria for enclosed hospital environments[12].

The highest mean SPL values (77.2 dBA, Table 2) found were in the measuring with the sound meter directed towards the window of the clean area (direction 1), which may suggest that it is due to the material preparation area, an area adjacent to the reception and cleaning one and, since the doors remain open, it favors the spreading of high-pitched noises from conversations among employees, a conduct corroborated by Conegero; Rodrigues[13] also asserting its negative influence on the health of the professionals and in the acoustic profile of the place.

The reception and cleaning area is a relatively small place, which has a large concentration of employees working in the CME or in other units, such as the surgical Center and hospitalization units, resulting, thus, in conversations with high SPL. During the study, this conduct was observed in the sector and also proven by Lopes[15]. The excessive conversation may interfere in the focus of employees, leading to a poor preparation of the material for sterilization. Noises above 45 dBA hamper speech intelligibility, causing people to speak louder, and from 50 dBA on, they cause sleep disturbance and irritability[1,12,15].

The high SPL measured may, also, be a result of noise emission of the equipments used, such as: compressed air and the ultrasonic washer. The compressed air is used for drying up the materials with lumen, it should be noted that despite making loud noises it is used only for short periods of time, which characterizes the SPL variation in the environment focused in this study. However, this emission in addition to the other noises in this environment may affect the health of the employees working there for 8 hours a day.

The occupational exposure to intense SPL for extended periods of time is associated to many systemic manifestations, such as: general increase of the awareness, fatigue, accelerated heart rate and breathing, increased muscle tone, increased production of thyroid hormones, stress, migraine, body aches, among others. It is noteworthy that even though this is not the objective of this study, in the collection period, it is possible to hear complaints of employees about come of the symptoms reported by the authors mentioned[1,2,16,17], such as: tachycardia, stress, migraine, fatigue.

In relation to the physical structure, the reception and cleaning area of the CME of the institutions studied was not built with a material which absorbs sound waves. According to Newman[18], the porous materials absorb and attenuate sound intensity, however, this kind of material should not be used when building CMEs, due to its need to observe aseptic principles. There is the possibility of building two walls with sound absorbing materials, or, also, in the absence of those, with air mattresses between them, isolating from 5 to 10dB[18].

Therefore, the study demonstrates that none of the values obtained was above the maximum allowed by the NR15[19], which is 85 dBA during 8 hours the tolerance limits for continuous and intermittent noise. However, it is recommended that the SPL for hospitals and enclosed facilities is in the range of 45 to 55 dBA[12], observe that both in days of intense activities and in days without activities, in the total measures in the reception and cleaning areas of the studied CME, the SPL was way above the recommended (Tables 1 and 2). This way, the SPLs found in the studied environment may cause adverse effects to the health of professionals and patients.

Intense and permanent noises may cause several disorders, significantly changing the mood and the ability to focus on actions performed by human beings[15,16]. With a free of noise environment or with appropriate SPLs for each kind of environment, the professionals are less psychologically tired and stressed, causing them to have motivation to work and higher professional performance[16].

CONCLUSION

This study presented the existence of elevated mean levels of SPL varying from 56.1 to 67.2 dBA in days without activity. And in the Day with activities it was 70.9 to 77.2 dBA, above the recommended for enclosed hospital environments. These values may cause physiological and psychological changes in employees who develop their professional activities in the area of reception and cleaning of the CME.

Despite the provision of ear plugs, there is no adherence to its use by the employees. In order to reduce noise levels, it would be necessary to perform changes which would cover the architectural aspects of the unit and also incentive programs for building awareness of professionals on the use of hearing protection equipment.

The results showed it is essential to take actions to minimize the SPL in the area studied. Some simple and urgent measures are suggested, such as: keeping the door to the material preparation area closed, performing frequent rotation of work schedules of the employees and guiding them as for the importance of the use of hearing protection, clarifying the physical and psychological effects that the exposure to elevated SPLs may cause and reducing the sound of the Bell on the site. And other more costly measures, such as: changing the architecture of the physical area of the unit, in order to mitigate the SPL of this environment.

In order for the implementation of minimization strategies of the SPL, the cooperation of the entire team of workers of the CME as a whole, as well as the participation of the leaders of the institutions, is necessary.

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