

Sound Pressure and Temperature Centering of Material and Sterilization

ORIGINAL

Klessiane Mendes de Fontes¹, Iolanda Beserra da Costa Santos²,
Leila de Cássia Tavares da Fonseca², Luiz Bueno da Silva³, Ericka Silva Holmes⁴,
Suzana Cristina Andrade Bezerra⁵, Adriano Furtado Lima⁶, Bruna Ferreira dos Santos⁷,
Izaura Cleone Ferreira dos Santos Cadete⁸, Barbara Jeane Pinto Chaves⁹

Abstract

Objective: Gauge the sound pressure and temperature levels emitted by the equipment of the drying and sterilization rooms of the Material and Sterilization Center and compare them with the current legislation.

Method: It is an experimental study with a quantitative approach, implemented in a school hospital in Joao Pessoa-PB. The data were obtained by a sound pressure meter and a thermal stress meter in September 2016.

Results and Discussion: The data evidenced high sound pressure levels, reaching a mean of 71.25 and 76.25 dB (A), in the drying and sterilization rooms respectively. The levels found do not exceed that recommended by NR15 (Regulatory Norm 15) which is 85dB (A), but NBR 10152/87 (Brazilian Norm 10152/87) indicates levels between 45 and 55 dB (A) for acoustic well-being. As for the temperature the measured mean ranged between 24.91 and 25.87°C.

Conclusion: The levels of sound pressure and temperatures found in the environment can cause physiopsychological changes in the professionals that works in this services.

Introduction

As a science, material sterilization is less than two hundred years old. With the discovery of bacteria and a growing search for bacte-

- 1 Nurse Graduated from the Federal University of Paraíba.
- 2 Professor. Doctor of the Department of Clinical Nursing, UFPB.
- 3 Professor. Post-Doctor, Department of Engineering of Production of the UFPB. Researcher of Labor Analysis Laboratory.
- 4 Nurse. PhD student in the Postgraduate Program in Decision and Health Models, UFPB.
- 5 Nurse CME at Lauro Wanderley University Hospital, EBSERH. Specialist in Public Health Nursing.
- 6 Nurse. Specialist in Occupational Health and Urgency/Emergency.
- 7 Nurse CME at Lauro Wanderley University Hospital, EBSERH.
- 8 Nurse CME at Lauro Wanderley University Hospital, EBSERH. Specialist in Labor Nursing and Family Health.
- 9 Nurse CME at Lauro Wanderley University Hospital, EBSERH. Specialist in Labor Nursing.

Contact information:

Ericka Silva Holmes.

✉ ericka_holmes@hotmail.com

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rial death, much was developed in the sterilization process, until the 1940 cleaning and preparation of the materials were performed in the nursing unit itself, the service was decentralized. In the 1950s, the first centralized materials plants, centralized and semi-centralized, where the material was sterilized in a single place [1].

At the end of the 20th century, there was a need to improve the techniques and processes of cleaning, preparation, sterilization and storage of materials, and the Material and Sterilization Center (CME) managed by a nurse and defined as a unit of technical support to all care units responsible for the processing and sterilization of surgical instruments and clothing [2].

The CME is defined as a hospital unit that provides indirect care to the patient, having as main focus the processing of materials/articles used in the care of the user of the service, in all its diversity. It is an environment with an exemplary complexity that favors the worker's exposure to risks, considering that the professional works in direct contact with organic fluids, heat and chemical substances due to chemical and thermal processes of disinfection and sterilization, in a confined environment, under-routines boring and/or exhaustive and often insufficient human and material resources [3].

In this context, the processing of articles in the CME of a hospital must be carried out based on the knowledge and analysis of the environmental risks allied to an adequate physical space, that allows the unidirectional flow of the people and the materials with security. From this perspective, the environment that is located in the CME requires the attention of the nurse in all stages of the process, from the reception of the articles to the distribution for hospital use [4].

CME is considered to be a sector within the hospital setting in which the specific practices of processing the resulting articles or products, particularly clinical and surgical interventions, make nursing professionals more vulnerable to occupational accidents [5].

During the processing of materials, nursing professionals are subjected to numerous physical, chemical, biological, ergonomic, and other risks. Physical hazards, according to Regulatory Standard 9, are the various forms of energy to which workers are exposed, such as: noise, vibrations, abnormal pressures, extreme temperatures, ionizing radiation, non-ionizing radiation, as well as infrasound and ultrasound [6]. Specifically in CME, the physical hazards that are most often encountered are noise and extreme temperatures [7]. Concerning noise, some authors mention that intense exposure leads to the development of noise-induced hearing loss (NIHL), an occupational disease that induces a gradual decrease in auditory acuity due to the continuous exposure to high sound pressure levels, which increases with Time, it may be irreversible, but it is preventable [8]. This exposure causes extra-auditory problems, which affect the worker's quality of life, such as: irritability, stress, constant headaches, sleep disturbance, work accidents, hypertension, cardiovascular disease and impair activities that require concentration, speed and precision of movements.

Regarding noise levels, the World Health Organization (WHO) recommends that, in hospital environments do not exceed 30dB (A) [9]. While the Brazilian Standard/NBR 10152/87, registered in the National Institute of Metrology, as well as, Standardization and Industrial Quality (INMETRO), Establishes for hospitals values of sound levels ranging from 35 a 45 dB (A) As acceptable value for apartment sites, wards, nurseries, surgical centers. In the laboratories and public use areas a variation between 40 e 50 dB (A). For services, levels are indicated between 45 e 55 dB (A) [10].

With regard to workers' health, Chapter V of the Consolidation of Labor Laws (CLT), by means of Administrative Rule no. 3214/78, establishes limits of tolerance or occupational exposure to noise, according to Norma Regulamentadora n.15 (NR-15), which is continuous or intermittent, the criterion level of 85 dB (A) For a period of eight hours of

exposure [11]. In workplaces where activities that require attention and intellectual use are performed, it is recommended by Regulatory Norm n° 17 (NR-17) follow the conditions of acoustic comfort established by the Brazilian Standard (NBR) n° 10152, the acceptable level is up to 65dB (A) [12]. Due to the potential risk that noise poses to hospital EMC teams, it is indicated that its measurement is performed by sound conditions when identified, this will favor the implementation of effective control changes in noise reduction [13].

In the context of temperature, in the environment where the machines are located, for disinfection and/or sterilization, the classification of the Pan American Health Organization (PAHO), reports that poor ventilation is characterized as an ergonomic risk, and in this study, it is intimately Heat-linked [14]. A study that sought to evaluate the temperature and humidity of the CME environment of six hospitals in Londrina/PR and showed that the environmental temperature of the units surveyed was higher than that recommended by Regulation Norma 17, which is 20 to 23°C, although a Of the units had the lowest temperature, achieved by an air conditioner, this condition did not offer thermal comfort to the worker [3-12]. When exposed to high temperatures on a regular basis, the nursing professional may suffer several health consequences such as fainting, heat exhaustion, heat shock, heat stress, liver damage, hydroelectrolytic imbalances, and renal failure.

The risk of serious heat-related illnesses can be reduced by various measures to combat them, such as acclimatization, control of exposure to thermal stress and maintenance of hydration [16]. In view of this theme, we highlight two fundamental aspects that adequately confirm the justification of this study: the relevance of risk measurement in order to preserve the health of workers in the sterilization sector, with the purpose of extinguishing or mitigating them, such as the implantation or adjustment Of personal protective equipment (PPE) when there is no possibility of nullifying the risks.

The second aspect is represented by the author's involvement in the field of CME assignments, as a nursing technique, handling the equipment for approximately 7 years, where during her work practice it was possible to identify innumerable health discomforts, damages caused as a result of Exposure to noise and high temperatures. Among the physical hazards in CME, exposure to noise and high temperatures were selected because they are directly linked to the handling of existing equipment in the sector. Considering this context, the objectives of the research are: To gauge the sound pressure and temperature levels emitted by the existing equipment in the Material and Sterilization Center and compare with the current legislation.

Method

This is an experimental study with a quantitative approach, carried out in the rooms of drying and sterilization rooms of the Material and Sterilization Center of the Lauro Wanderley University Hospital, located in the municipality of João Pessoa- PB, in September 2016. For the realization The measurement of noise and temperature, a day of intensive handling of the equipment was chosen. The data collection was performed in the morning and evening hours according to the functionality of the devices and activities of the professionals in the routine of the service.

A total of 92 temperature measurements were performed in the sterilization room, 46 in the morning shift and 46 in the afternoon. In the drying room 108 temperature measurements were performed, 54 in the morning shift and 54 in the afternoon. As for the measurements of sound pressure levels, 31 measurements were made in the sterilization room, 15 in the morning shift and 16 in the afternoon, while in the drying room 25 measurements of sound pressure level were performed, 10 in the morning shift and 15 in the afternoon.

The sites chosen for this research were: the drying room of material that exists the thermody-

nestrictor barrier, which operates at a temperature of 90°C and a material dryer that is standardized at 80°C, in the period of twenty minutes, the sterilization room that exists Two autoclaves in full operation with variations of 134°C for 10 minutes and 121°C in twenty minutes, both of the brand Baumer, identified as autoclave 1 and 2, models B365 and B300 respectively.

The data were collected using a Bruel & Kjaer, 2250-L model, an Instrutherm sound pressure meter, model DEC-5000, both used to measure noise and a thermal stress meter, Of the brand Instrutherm, model TGD-300 used to evaluate the thermal conditions of work environments, which provided us with elements of Dry Bulb temperature, Humidity Bulb thermometer temperature and Air Humidity. The data were organized in a spreadsheet using Excel 2016 for further analysis and graphing.

The measurement was carried out by a team of Teachers and Students of the Graduate Course of Production Engineering of the Federal University of Paraíba-UFPB, integrated distinctly to the campus I located in João Pessoa, under the coordination of Prof. Dr. Luís Bueno da Silva, who was willing to collaborate in this phase of the research. Based on the findings of the temperature and the noises that were measured, a comparison was made with the current legislation that deals with the subject, in order to communicate to the nursing professionals who work in the places assessed, in order to inform them about the risks to which they are Exposed. The data originated from the risk measurement are organized in graphs and analyzed according to the literature.

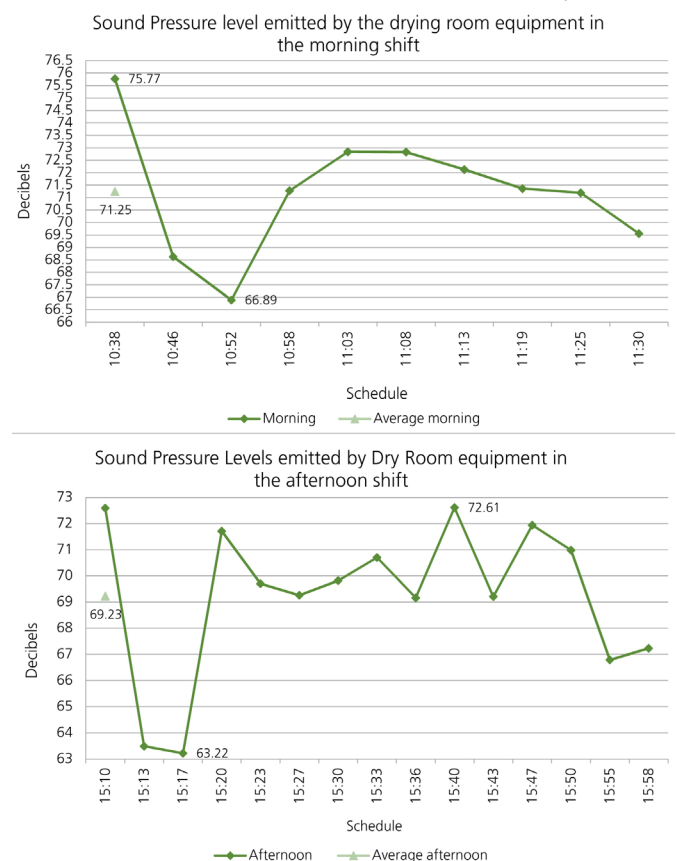
Results

The measurements of the sound pressure level (NPS) during the morning shift in the drying room ranged from 66.89 to 75.77 dB (A) Which were obtained during the operation of the equipment, showing an average of 71.25 dB (A). When mea-

sured in the afternoon, NPS measurements in the same room ranged from 63.22 to 72.59 dB (A), Also obtained during the operation of the equipment, evidencing an average of 69.23 dB (A), as shown in **Figure 1**.

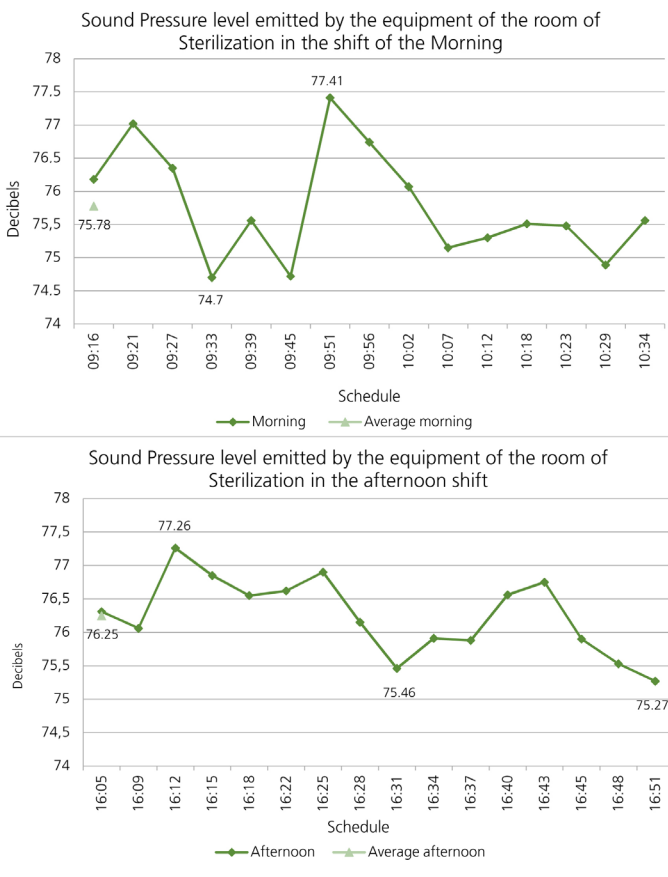
Figure 1 shows that the time of greatest concentration of noise in the CME drying room was 75.77 dB (A) at 10:52 a.m. in the morning and 15:10 a.m. in the afternoon with a variation of 72.56 DB (A) corresponding to the time when the nursing professionals of the units and other sectors of the hospital had more activities, by returning the material for cleaning, drying and sterilization. Noise is understood as any uncomfortable, unpleasant or undesirable sound that causes in the individual negative

Figure 1: Sound pressure levels emitted by the drying room equipment in the morning and afternoon shifts, in the material and sterilization center of HULW/PB, 2016.



Source: Direct research gauging by the sound pressure meter at HULW's CME, 2016.

Figure 2: Sound pressure level emitted by the equipment of the sterilization room in the morning and afternoon shift, in the material and sterilization center of HULW/PB, 2016.



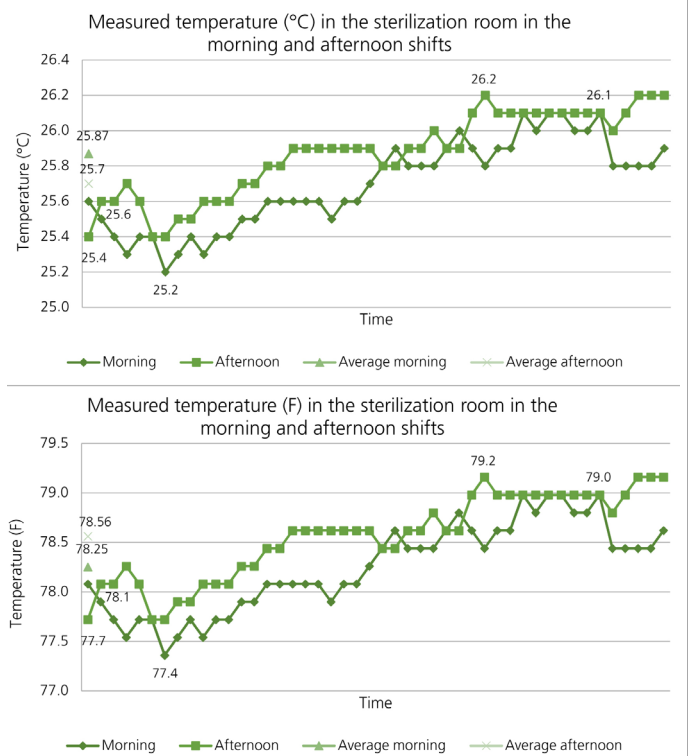
Source: Direct research gauging by the sound pressure meter at HULW's CME, 2016.

mechanical force transformed into hydraulic pressure, transmits the sounds to the inner ear, Electrical energy and nerve stimulation, producing, the sound sensation [18].

In the sterilization room, a NPS elevation was evidenced in both shifts, ranging from 74.7 to 77.41 dB (A), in the morning, obtaining an average of 75.77 dB (A), while The afternoon was verified a variation of 75.27 to 77.26 dB (A), with average of 76.25 dB (A), as shown in **Figure 2**.

Regarding temperature, the sterilization room measurements showed temperatures ranging from 25.2 to 26.1°C, with an average of 25.70°C in the morning shift, whereas in the afternoon the values ranged from 25, 4 and 26.2°C, with a mean of 25.87°C, as shown in **Figure 3**.

Figure 3: Temperature measured in the sterilization room in the morning and afternoon shifts in the material and sterilization center of HULW/PB, 2016.



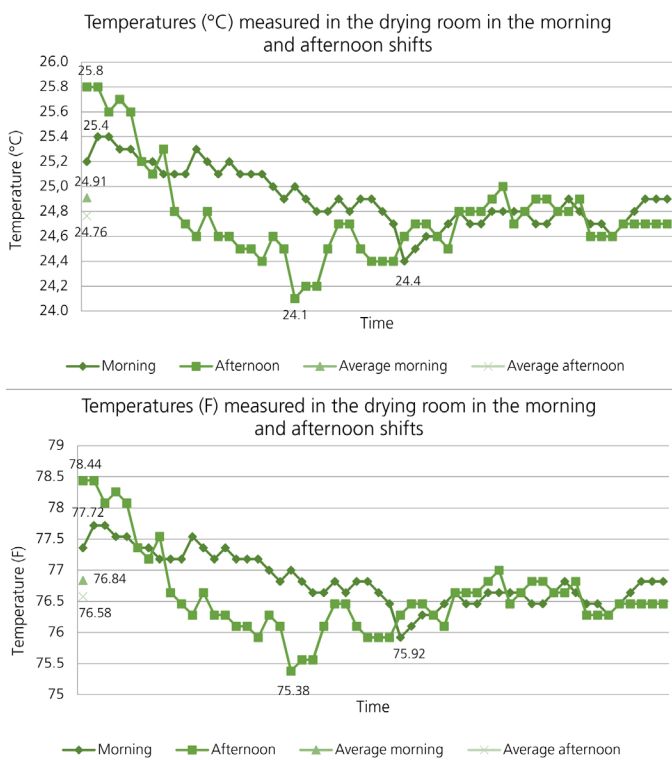
Source: Direct research gauging by the thermal stress meter at the CME of HULW, 2016.

effects, which can trigger physical changes (hearing loss), physiological and psychological as long as they exceed the limits of tolerance regulated [17].

The sound is picked up by the normal human ear when it is in the range of 20 to 20,000 Hz on average, with a minimum pressure variation to be perceived 5-8. The ear is the organ responsible for capturing sound, subdividing into 3 parts: the external, middle and inner, which is located in the temporal bone, has as its function the balance and the hearing. The outer ear picks up and filters the sounds and directs the ear canal through the ear canal to the eardrum which vibrates and transmits to the ossicles of the middle ear and, through the

In the drying room, the temperatures found in the morning shift varied between 24.4 and 25.4°C, obtaining an average of 24.91°C, in the afternoon shift, values of 24.1 to 25.8°C, With mean temperature equivalent to 24.76°C as depicted in **Figure 4**.

Figure 4: Temperature verified in the drying room in the morning and afternoon shifts in the material and sterilization center of HULW/PB, 2016.



Source: Direct research gauging by the thermal stress meter at the CME of HULW, 2016.

Discussion

Regulatory Norm 15 (NR-15), of Ordinance N/3.214/1978 establishes limits of tolerance for continuous or intermittent noise, based on the limit of 8 hours for the level of 85 dB decibels [11]. However, when exposure to intense noise within the aforementioned limit is continued, there may be structural and functional changes in the inner ear, which determine the occurrence of noise-induced hearing loss (NIHL), whose auditory symptoms alter

and decrease the individual's quality of life, Both in the workplace, social and family.

In NBR 10.152 - Acoustics - Evaluation of ambient noise in buildings with a view to user comfort, some health center environments and respective acceptable noise values are characterized based on sound levels dB (A) and on "evaluation curves of Noise, through which a sound spectrum can be compared, allowing identification of more significant frequency bands that need correction "[10]. This information is given in **Table 1**.

Table 1. Values dB (A) and NC.

Location: Hospital	dB (A)	NC
Apartments, Nurseries, Nurseries, Surgical Centers	35 - 45	30 - 40
Laboratories, Areas for public use	40 - 50	35 - 45
Services	45 - 55	40 - 50

- The lower value of the range represents the sound level for comfort, while the upper value means the sound level acceptable for the purpose.
- Levels higher than those established in this Table are considered as discomfort, without necessarily entailing risk of damages to health. Source: Adapted from ABNT, 1987 [10].

Since exposure to noise can lead to extra auditory symptoms such as irritability, stress, constant headaches, sleep disturbance, work-related accidents, hypertension, cardiovascular disease, and even impair tasks that require concentration, speed and accuracy of movement, we consider That both the NPS averages found during the morning shift, 71.25 dB (A), and the afternoon shift, 69.23 dB (A), in the drying room, as well as the means in the morning shift, 75, 77 dB (A), and in the afternoon shift, 76.25 dB (A), in the sterilization room, do not comply with the current legislation regarding acoustic comfort.

Noise above 45 dB (A) impairs speech intelligibility, causing people to speak louder, and from 50 dB (A) causes sleep disturbance and irritability, as well as occupational exposure to intense NPS by one Prolonged period is associated with several systemic manifestations, such as: elevation in the general level of vigilance, fatigue, acceleration of heart and

respiratory rate, alteration of blood pressure and intestinal function, dilation of the pupils, increase of muscle tone, increase of production of Thyroid hormones, stress, migraine, body aches, among others [18].

The NR 17, which aims to establish parameters that allow the adaptation of working conditions to the psychophysiological characteristics of workers, in order to provide maximum comfort, safety and efficient performance, establishes that the Effective Temperature Index is between 20 and 23°C in workplaces where activities that require constant intellectual solicitude and attention are performed, as is the case in all sectors of CME. Considering the above, the temperature averages found in Figures 5 and 6 (25.70°C in the morning shift and 25.87°C in the afternoon shift in the sterilization room, 24.91°C in the morning shift and 24.76°C found in the afternoon shift in the drying room) do not comply with current legislation.

These alterations in the environmental temperature characterize the presence of physical risk, which causes discomfort, physiological alterations ranging from mild, such as (rash, syncope, cramp) to severe (exhaustion, injury, thermal shock or sun exposure), compromising worker health And their professional performance [7].

Conclusion

The findings demonstrate that the sound pressure levels found in the drying and sterilization rooms were not above the maximum allowed by NR 15, which is 85 dB (A) for eight hours of exposure to continuous or intermittent noise. Considering the acoustic comfort recommended by NR 17, the values found exceed the upper limit of the sound pressure levels recommended for hospitals, which are 45 to 55 dB (A), which can cause multiple adverse effects on the health of professionals working in the center Of material, between the two NRs there are contradictions in this matter.

As for the intense and permanent noises can cause several disturbances, significantly altering the humor and the capacity of concentration in the actions carried out in the service. With the environment free of noise or with NPS adequate, the professionals are less tired and stressed, this brings motivation to work and obtain greater professional income. Exposure of the worker to high temperatures can cause discomfort, decreased productivity, and other negative health consequences. It was evidenced an increase in the temperature of the environment to the point of extrapolating the limits recommended by NR 17, which vary between 20 and 23°C.

The region in which the hospital is located recorded temperatures ranging from 24 to 30°C, on average, during the period in which it was measured, which makes the temperatures evidenced in this study more uncomfortable. Due to the high temperature and noise in the investigated sectors, it is recommended that these environments be monitored in accordance with the legislation and that the management of the service can offer workers greater comfort.

This work is expected to alert managers to the availability of ear protectors, to encourage the use of personal protective equipment in a correct and complete way, in order to minimize exposure to noise. It is important to suggest the purchase of new equipment that emits little or no noise.

As for exposure to temperature, we suggest that the aeration necessary to lower the temperature in the work environment to provide greater comfort to workers is provided. It should be added that the tests used were reliable and provided nursing professionals with an interest in the subject a new vision, providing a range of contributions to prevent physical and emotional exhaustion in the hospital service. By identifying the risks to which workers are exposed, we can intervene with educational action, aiming at eliminating or reducing exposure to these, resulting in the improvement of the working environment, consequently the promotion and pro-

tection of workers' health, although it constitutes a challenge, Because they require complex technical solutions and specialized professionals for such performance.

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