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Noise Reduction in Hospital with Help of Sound Absorbing Materials

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Abstract:-Noise can cause an individual to have an unfavourable physiological or psychological response, which can have long-term consequences for mental and physical health.

The goal of this study was to examine sound variations as qualified by hospital group and patients, to addaimprovedperceptive of soundlevel and frequencies sensible in hospital setting over extended periods of time (weeks), and to implement a low-cost behavior modification programmed and use good noise-absorbing material to reduce noise.

Behavioral change, medical staff training, and the use of noise absorbing material are all suggested as ways to reduce excessive noise, according to the findings of our study.

Hospital noise has also been linked to several physiological and psychological disorders in patients. In light of the findings, it is critical to support the well-being of admitted patients by reducing noise levels. (Nélio Silva &MadalenaCunha 2014).

I. INTRODUCTION

Noise is a proven physiological and psychological stressor that occurs in the environment and surrounds a hospital. Because at an Indian government hospital, a larger number of people visit each day, and more unwell patients visit. Noise affects the body in the similarmethod that stress does, plus it have the probable to harm fitness over time.

Hospital sound level frequently surpass those suggested by the World Health Organization or Indian agency, according to documents. The WHO recommends a noise level of 40 to 45 decibels, although maintaining this level is difficult. Over the years, hospital patients' exposure has been researched more than professional exposure However, because of the kinds of patients involved—ill and premature babies—intensive care units (ICU) present significant complications.

Noise, in fact, can cause other auditory impacts in professionals, such as burnout, tension, and weariness. Noise has been linked to various negative fitness results, like that B.P, heart rate, and cardiovascular disorders other hypertension.

Sound generated by the noise source is reduced as a result of aextraaccuratedeveloped methodas well asextra flexible structural plan. The use of noise-fascinating materials or structure is thought to be an effective way to reduce noise propagation and diffusion.

So, we're attempting to reduce hospital noise at a cheap cost using effective materials that are readily available in our country, transportation that is quick in the hospital, and data analysis that can achieve a range of hospital noise.

II. PROBLEM STATEMENT

Hospitals are already noisy, and they're only becoming louder. According to several WHO committee investigations, medical institute sound levelhave been steadily risingin since 1960. In this investigation involvement (Ryherd,Waye&Ljunkvist, 2008). The World Health Organization has advise that sound levelin the patient rooms are treated or watched be supposed to not exceed 35 **dB A** and**30 dB (A**) in ward rooms this data collected by(Richardson et al,in 2009,or ryherd,Okcu,Hsu,Mahapatra,2011).

In the US Environmental Protection Agency recommended that the peak sound level of noise in a hospital not exceed 45 decibels (dB) during the day and 35 dB at night in 1974. In most hospitals, noise levels are greater than these limits, and in intensive care units, noise levels are significantly higher (Li et al., 2011).

Researchers have established that all hospitals, regardless of size, are held to the same standards or the kind of patients they are responsible for, exceed the EPA and WHO acceptable noise levels at all times of the day, every day of the week (Choiniere, 2010). We may expect that as technology advances Because the lives of certain patients are on the line, the number of sources of noise will grow as well.

Alarms, paging systems, telephones, computer printers, ice machines, staff conversations, televisions, delivery carts, clipboards (Joseph & Ulrich 2007, Mackenzie &Galbrun 2007 as cited in Pope, 2010), heating and cooling systems, overhead fluorescent lights, computer monitors, noise generating beds, ventilators, and other medical equipment are just some of the noise sources in hospitals. high-pitched sirens to notify medical situations, staff and patient dialogues, doors opening and closing, housekeeping and linen carts rolling over linoleum floors, overhead paging,

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sink faucets running, and objects being dropped (Lawson, et al, 2010). (Lawson, et al,2010).

Noise stimulates the sympathetic nervous system and the pituitary gland, resulting sympathetic and endocrine responses that are frequent in stressful situations. Stress theories have been used to explain people's negative reactions to their surroundings, which are often linked to poor heal According to Topf and Dillon (1988), the human impacts Noise-induced stress can be caused by a variety of factors a reduction in continuedconcentration, quick Detection, many single tasks, and accidental memory are all examples of this. Noise-induced stress has been linked to been associated to exaggerated and hasty judgments, as well as a reduction in sensitivity to others (Choiniere, 2010). Identification of the key determinants of human pleasure is single of the key scientific research objectives in the realm of subjective well-being.

III. REASEARCH QUESTION

The following were the research questions posed for this study:

• What is the noise level in the hospital as a result of various equipment and processes?
• What impact does hospital noise have on patients' well-being?
• What are the various sound-absorbing materials available?

A. Purpose of the Study

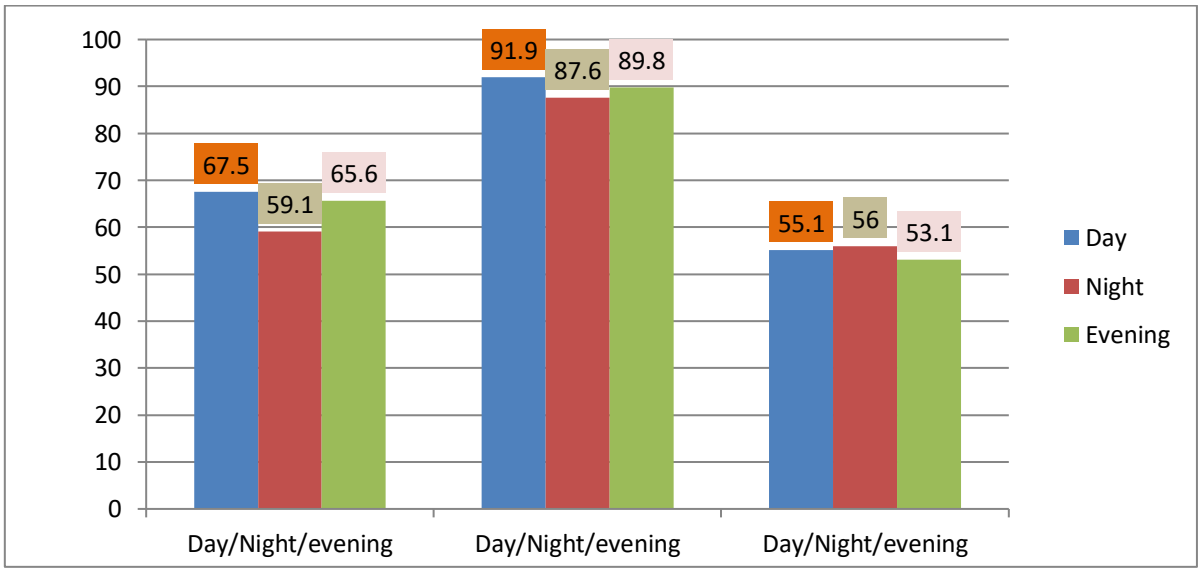
Given the foregoing, the goal of this study was to discover the best and most cost-effective sound-absorbing materials for hospitals.

B. Noise sources with walk through inspection

Two trained researchers conducted walk inspections of the three Intensive care units under investigation to describe the built environment and internal spaces. We gathered thorough information regarding the building environment, including traffic, rural and urban surroundings, external noise sources, and construction characteristics. All relevant information was identified, including locations, finishing materials, and conditions related to the floor, walls, ceiling, windows, and ground, as well as installed equipment and health care processes.

Sources of noise	Noise level dB-A
Equipment movement	90
Connection of gas supply	88
Items falling onto the floor	Up to 92
Pager	84
Talking	75-85
Nebulizer	80
Telephone	70-80
Ventilator alarm	75-85
Endotracheal aspiration units	60-78
Meeting room	80
Work station	90

Noise levels according to day/ night shifts, Average (Leg), the highest (Lmax) and the Lowest (Lmin) noise levels.



C. Material for using noise absorbing:

In this study f material when used in hospital. The property of surface by which sound energy (kinetic energy) is convert into other form of energy, generally heat energy (due to friction) and get absorbed.

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D. The degree to which this surface affects the absorption of sound is known as absorption coefficient.

The following is a mathematical representation of the situation:

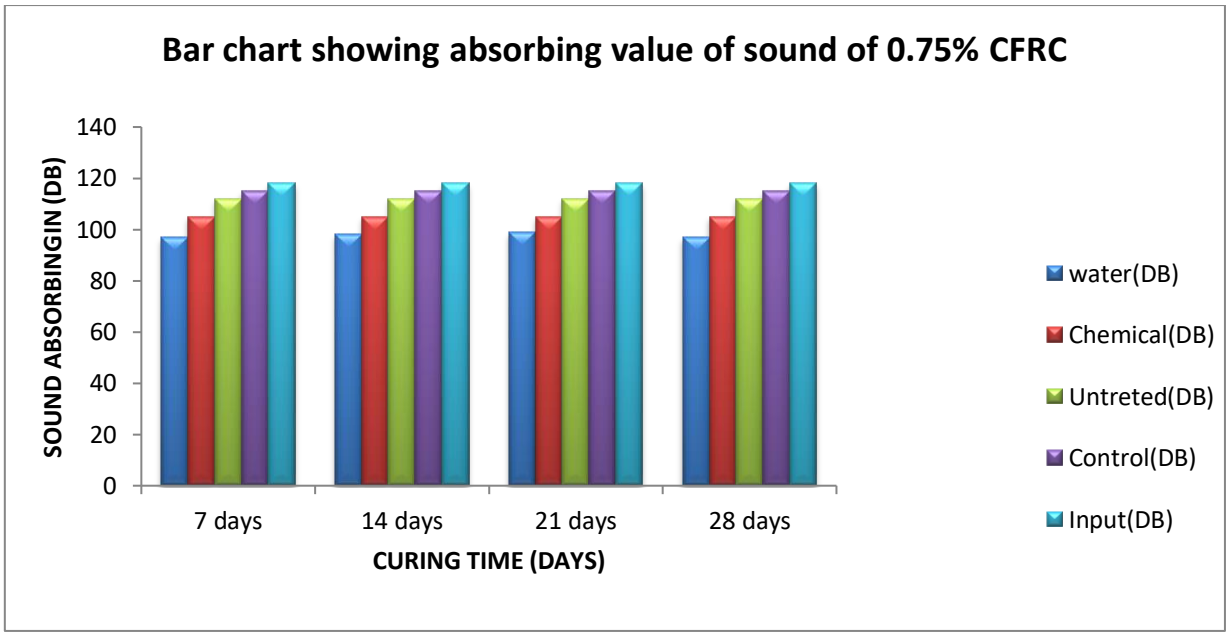
Alpha = (1- Ir/Ii) Sound absorption, where Ir is the reflected sound one-sided intensity and Iimeans is the incident sound other sided intensity. The coefficient of sound absorption ranges from 0 to 1. A good sound absorber should be long-lasting, fire-resistant, and effective over a wide frequency range with a high coefficient of absorption.

E. There are three different types of sound absorption materials.

- Porous materials: such as fibre boards, mineral wool, and insulating blankets, for example.
- Membrane or non-perforated absorbers: this material is ideal for low frequency. Paneling made of wood and hardboard, gypsum boards, suspended plaster ceilings, window glazing, and wood floors and platforms are only a few examples.
- Cavity or Helmholtz resonators: These are made up of an enclosed body of air encased within hard walls and connected to the surrounding space by a narrow hole called a neck.

The maximum number of absorption coefficients in a big absorbing sound medium can be found in this material. Materials are divided into categories based on the types of materials that will be used in the hospital.

- The results of an experimental research of coconut fibre reinforced concrete's acoustic performance are provided in this article (CFRC). CFRC was added to the cement at 0.25, 0.5, 0.75, and 1 as percentages. The purpose of the acoustic examination was to figure out how much sound the fibrecould absorb. According to the study, the concrete reinforced with coconut fibre has the best sound absorption power. The data will be useful in the construction of sound-proof reinforced concrete slabs, walls, and other components. In a laboratory experiment, the use of standards required. By beating the husk dry and then soaking it in water, fibres was extracted from the back of the husk. The percentage of NaoH concentration used was one percent. The former was done to ensure that the fiber would not be harmed before being used in concrete. A concrete panel (15cm x 15cm x 15cm) created from a 1:3:3 mix ratio was placed in a wooden box with a loud speaker to magnify the frequency generated to test the acoustic qualities of coconut fiber-reinforced concrete.A digital sound level metre was used to determine the sound frequency. The data was gathered from the Nigerian states of Lagos and Ogun. While converting trash to riches and analyzing the acoustic behavior of coconut fibers as a construction material, acoustic behaviour will be taken into account in this data presentation. The slum values of fibre treated with water, chemical, and control, as well as the sound absorption value of 0.25–0.75 percent CFRC.



The findings of this study address the problem of noise pollution in buildings in both urban and rural locations. In comparison to importing sound absorbing materials, the findings reported.This research proposes a cost-effective and functional alternative to sound-proofing materials.

- The goal of this study was to assess the influence of a sound absorption panel (SAP) on the level of noise inside the Isolate and to quantify a busy newborn intensive care unit's noise level (NICU). Background noise, baby screaming, alarms, and the closing of doors are all examples of sound pressure levels (SPL).A 2235-Bru el&Kjaer Sound Level Meter was used to measure

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Isolate's door/portholes. Readings were repeated after sound absorption panels (3D pyramidal shaped open cell polyurethane foam) were installed on the isolate's three lateral walls and roof.Inside the NICU, the median SPL of background noise was 56 dB, while inside the isolation, it was 47 dB.Indoor the separation the average SPL of monitor alerts, and the average SPL of baby monitor alarms screaming was not different from Under the radiant warmer, the SPL was measured ($p > 0.05$). Temperature alert fell from 82 to 72 decibels, monitor alarm from 64 to 56 decibels, porthole shutting from 81 to 74 decibels, and isolating door closing from 80 to 68 decibels (p 0.01). The noise produced by baby crying was greatly reduced when SAP was used in the separate (79 dB to 69 dB, respectively) (p 0.0001). The panel had a significant dampening effect on the ambient noise as well.

➢ *Noise levels within the isolette, with or without a sound dampening panel.*

Measurement Devices	sound level (dBA)		p
	Isolette withsound absorbing panels (25–75 IQR) Median	Isolette with sound pressure level (25–75 IQR) Median	
Monitor alarm	82(80-83)	77(76-78)	<0.0001
Port h0le closing	80(69-87)	68(61-79)	0.015
Surrounding noise	47(44-49)	43(31-46)	0.001
Temperature alert	79(74-81)	69(65-73)	<0.0001
Baby crying	81(73-88)	74(63-79)	0.005

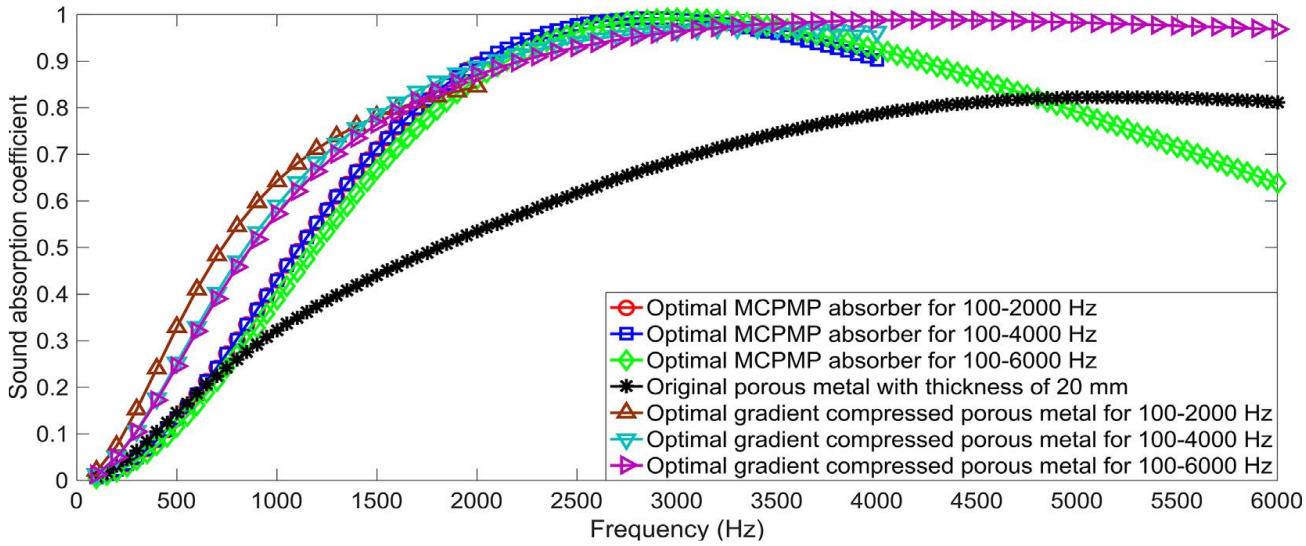
After putting soundthe isolate's three lateral walls and ceiling include absorption panels (3D pyramidal shaped open cell polyurethane foam) with absorptive surfaces. Measurements of each category were redone. SAP had a maximum thickness of 6 cm and a minimum thickness of 2 cm.

- The micro perforated compressed porous metal panel (MCPMP) absorber was offered as a way to create a new sound absorber with better sound absorption, fewer materials, and a lighter weight. Finite element simulation method, sound absorption model, and cuckoo search optimization algorithm.

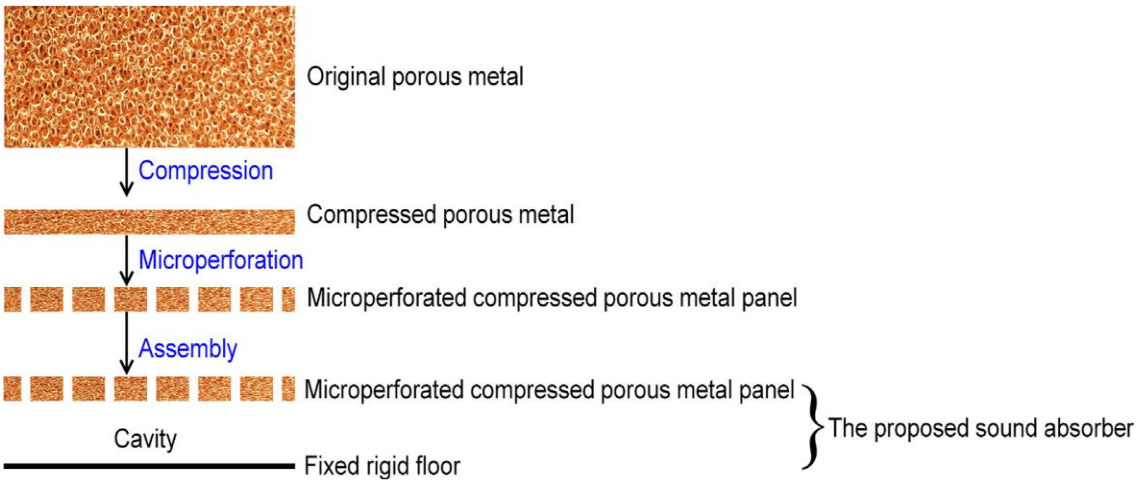
The actual average sound absorption coefficients of the best MCPMP absorbers with a limited total thickness of 20 mm were 0.4679, 0.7069, and 0.7299, respectively, when the target frequency ranges were 100–2000 Hz, 100–4000 Hz, and 100–6000 Hz. That usefulness and practicality of the optimal MCPMP absorber were demonstrated by comparing comparing the original porous metal's sound absorption capability to that of the 10-layer gradient compressed porous metal. The MCPMP absorber produced was beneficial in enriching sound absorption theory and promoting its practical use.

The optimum MCPMP absorber was found to be in the frequency range of 100–2000 Hz.

➢ *The theoretical sound absorption coefficients of the sound absorbers under investigation are compared.*

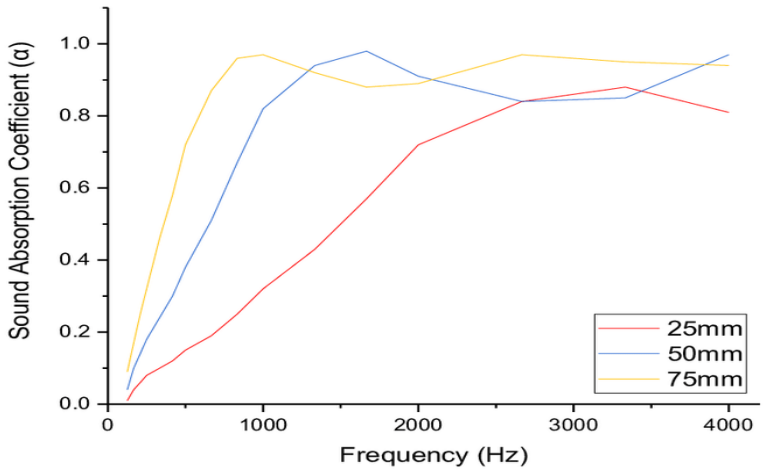


➢ *The MCPMP absorber's production process is depicted in a flow chart.*



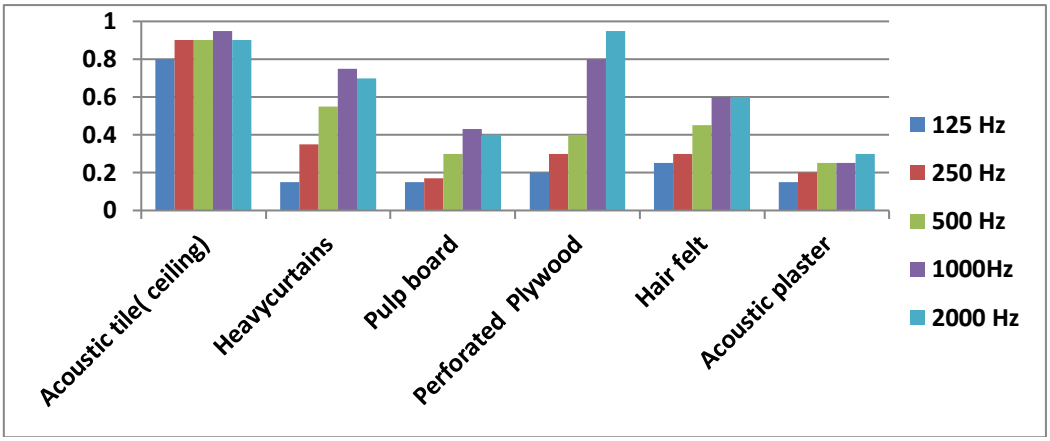
- This research includes a preliminary investigation on the ability of bamboo's hollow structure to absorb sound energy. With a 2 cm long Bamboo sample, the outcome reveals. At frequencies above 3000 Hz, there is good sound absorption. It is possible to improve the absorption coefficient at lower frequencies.The air gap at the back of the sample was increased to achieve thisIncreasing the air gap at the back of the sample can improve the absorption coefficient at lower frequencies. The addition of micro-holes has a negligible effect on the acoustic performance. Lower frequency improvement is possible.For samples with a longer structure, this is to be expected. Bamboo framework arranged horizontally.The future work will also be interested in direction.

➢ *This chart shows between in sound absorption coefficient & Frequency (Hz).*



Bamboo is a natural material with a hollow structure that can be used as a sound absorber. The hollow route in an Impedance tube test is oriented toward the sound incidence. Bamboo with a At 2 cm in length, the average absorption coefficient is 0.95 frequencies over **3 kHz**, according to the results. The air gap behind the device can be used to influence performance at lower frequencies. The placement of micro-holes along the body has little effect on sound absorption.This all materials fully analyzed based on previous research papers and study. It materials are explained by graphs mostly materials are easily available in India .this materials are very effective for sound absorption. Therefore this material used in hospitals and maximum energy sound absorbed.

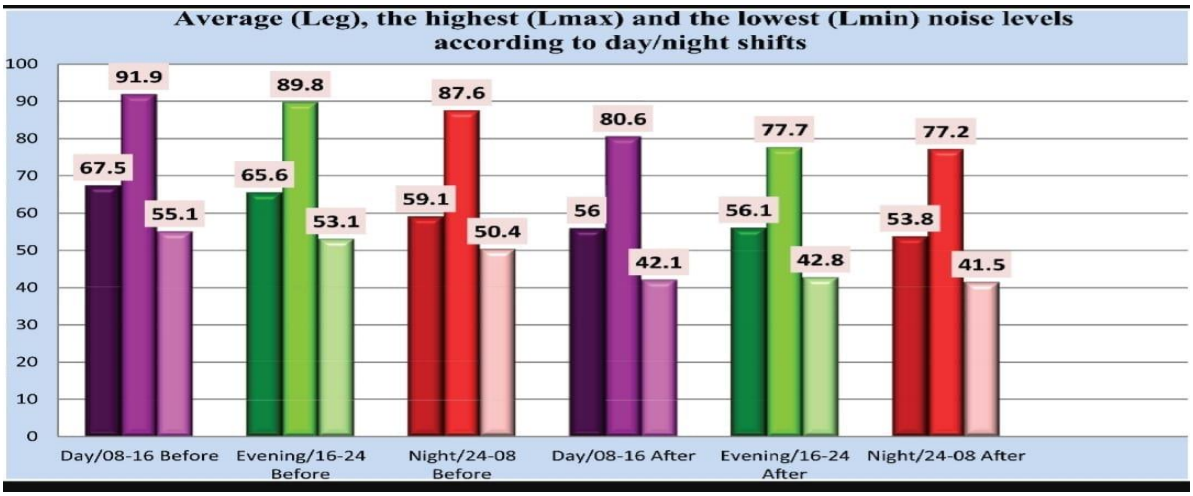
➢ *This chart compare between frequency and absorption coefficient, noise absorbing materials.*



Materials	Absorption coefficient by frequency(Hz)				
	125Hz	250Hz	500Hz	1,000Hz	2,000Hz
Acoustic tile (ceiling)	.80	.90	.90	.95	.90
Brick	.03	.03	.03	.05	.05
Heavy curtains	.15	.35	.55	.75	.70
Carpet over concrete	.08	.25	.60	.70	.72
Painted concrete	.10	.05	.06	.07	.09
Plaster on concrete	.10	.10	.08	.05	.05
Marble	.01	.01	.01	.01	.02
Smooth concrete	.01	.01	.01	.02	.02
Plywood on studs	.30	.20	15	.10	.09

IV. RESULT

The results were statistically significant when noise levels were evaluated before and after noise reduction measures. Data showed that on weekdays when procedures were performed and a larger number of patients attended, noise levels were greater than on weekdays when no procedures were conducted and a lower number of patients arrived Because a machine was used to wash the floors on Saturdays between 9:00 and 11:00 a.m., the noise level was comparable to that of surgery days. The hospital was noticeably noisier than usual, particularly throughout the day.



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V. CONCLUSION

Sleep disturbance, annoyance, discomfort, nervousness, anxiety, impaired concentration, headache, stress, and physiological and psychological effects caused by Noise (monitors, infusion pumps, and other equipments), Sum Score of Environmental Comfort, and physiological and psychological effects caused by Noise (sleep disturbance, annoyance, discomfort, nervousness, anxiety, impaired concentration, headache, stress, and others and so on) were all statistically linked.(Among other things).

After this study and research papers many materials used in hospitals different- different places in ICU, General wards receptions, corridors ,Parking areas showed can more noise absorbed uses these materials. Due to many patients being fast recovery own diseases. All fitnessexperts, especially This is something clinical psychologists should be aware of issue or inform furtherworkersof hospitals as well as further people/guests about the physical and mental health risks that noise poses. When establishing long-term noise reduction initiatives, it is important to consider the experiences and perspectives of ICU staff. This could also help healthcare workers in intensive care units enhance their mental health, well-being, resilience, and coping skills are all important factors to consider.

Otherwise, different types material discuss that report like acoustic tiles can used in floor, Noise absorbing curtains can used in ICU windows , carpets can used in ICU floor and corridors, etc this materials used very effected helps too much absorbed noise . More chances come to under WHO noise range in hospital.

Furthermore, it was discovered that any noise-reduction measures adopted were ineffective. In order to better manage noise in intensive care units, a team approach should be adopted.

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