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**Research Article**

# ENVIRONMENTAL NOISE LEVEL AND ITS CONTROL IN THE HEALTHCARE SETUP

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**ABSTRACT**

Noise is recognized as a source of hazard to the patient's environment. Studies have also shown that it has a direct impact on mortality and morbidity as a result of sleep deprivation which affects the immunity of critically ill patients. The aim of this study was to measure levels of environmental noise in different departments in three different time shifts in working days in three floors with basement area. On statistical analysis the result shows that there was significant difference in the noise level among all the floors across all the three time shifts except the basement area. The noise level was found to be higher than the standardised level. This needs to be taken care for the basic modification in construction of the area in hospital setup along with the usage of sound dampers in larger context to meet the standards. Further research in this area might focus on the noise level and other modifiable environmental stress factors in the hospital setup to explore its effect on physician, hospital staff and patients.



## INTRODUCTION

At intolerable levels, the environment noise pollution is common place today. In hospitals, technological developments have, as a consequence, potentially harmful noise levels. The control of exposure to environmental noise in the hospital is becoming a serious issue, particularly in areas where quiet is necessary. The recommended level of noise recommends that noise levels by world health organization(who)is that it should not exceed 35 decibels (db) during the night and 40 (db) during the day (Falk. *et al*, 1973). However, the american conference of governmental industrial hygienist (acgih) stipulates that noise levels in the work place should not go beyond 85 db (cincinnati: acgih signature publications, personal communication). whereas according to the india noise pollution rules (2000) the noise level has been standardized as 50 db a (in day time) and 40 db a for night time in the silent zone (bhati *et al*, 2016). Since 1960, average daytime hospital sound levels have risen from 57 decibels to 72 db, while average night time levels have jumped from 42 to 60 db-all far exceeding the world health organization's recommendation of 35 db as a top measure for sound levels in patient rooms. (johns hopkins university news release, november 21, 2005, personal communication), (cmiel, 2004).

The hospital setups have complex biomedical equipment for the continuous monitoring of patients who have serious physical conditions, to support their vital functions. This equipment is used by health professionals to give specialized treatment and care (kam, 1994). To give an idea of the magnitude of sounds that can be found in hospital environments, the decibel level of a portable x-ray machine is roughly equivalent to that of motorcycle; a bedside monitor alarm approaches the intensity of sound created by heavy truck traffic (hilton, 1985).

In some earlier studies, researchers showed that noise levels in icus ranged from 59-83 db which exceeds the level recommended by world health organization (who) and which can stimulate the cardiovascular and endocrine systems and disrupt sleep as result of noise induced stress modulation((kam, 1994), (hilton, 1985). Also the general outpatient departmental (opd) areas also produce the excessive noise due to presence of crowd especially in indian context leads to the psychological impact on physicians which ultimately develops stress and anxiety in them.

It is important to note that exposure to excessive noise levels in the hospital setup specially in icu is a contributing factor in the development of the condition known as 'icus delirium' characterized by delusions, hallucinations, disorientation, sleep

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deprivation and paranoia.(marshall and soucy, 2003), (borthwick, 2006).

Within patient rooms, monitoring and life-sustaining equipment continually beeps and whooshes around patients' beds, occasionally erupting into alarming warning signals (dana 2004). "these noises are concentrated around the patient's head, where caregivers naturally tend to position equipment so it's easier to use with the patient. (linda and miller, 2006, healthcare clinical consultant, phone interview, personal communication)

As for effects on critical care staff, studies have shown that prolonged exposure to excessive noise levels has a deleterious effect on the performance of cognitive tasks and altruistic behaviour (christensen, 2002). Study done by university of michigan researchers found a direct correlation between overall decibel levels and blood pressure levels. The study shows, increased blood pressure levels due to chronically high levels of sound lead to; (university of michigan news service,2005, personal communication)

The mental activities requiring a lot of working memory, such as paying attention to a variety of different cues or performing a complex analysis, are especially noise-sensitive (jasper, 2005). In many healthcare facilities the frequent interruptions and distractions noise causes often result in medication errors, one of today's most challenging issues in delivering care, can be costly and dangerous situation.( greenberg and miller, 2006)

Thus it is a prime need to have a noise check in healthcare setups in all levels and follow the recommended level in order to provide healthy environment for clinicians as well as the person with health issues.

### *Aim*

The aim of this study was to measure noise level in different departments of hospital in different time shifts of working days using calibrated sound level meter (SLM).

## METHODS

### *Instrumentation*

The noise level was measured using equinox sound level meter (slm) with the model eq-805 specified as iec 651 type ii. The low level intensity range for the slm was 30 to 100 db whereas the high level measurement range was 60 to 130 db. Both the ranges were used in slm while measurement to ensure the measurement of all level of noise exposure from 30 to 130 db. The frequency weighting network available was a and c, while measurement the weight network a has been used to correlate the noise levels more realistically and its impact on human physiology and psychology. The slm had the two time level for the measurement i.e. The slow, which measures the average of noise exposed in 6.4 seconds and the other time length given was 1.6 sec which shows the data for the immediate i.e. Within time frame mentioned, exposure of the noise and termed as fast. The 'slow' time has been used for measurement of noise to avoid any overlapping and rapidity while measurement. So the measurement was done at 'a' weighting network, in two levels (low and high) in slow time.

### *Procedure*

In ayush building aiims raipur chhattisgarh measurements of opd noise were taken using calibrated sound level meter during shifts of working days for fourteen days in the month of june 2016. Weekends and holidays were excluded from the study. The measurement was done in three shifts each day that was morning at 9: 00 am, afternoon at 12:00 pm and evening at 4:00 pm. All three floors including basement noise were measured using slm. The point of measurement and microphone placement for noise level detection for three floors and basement was choose the midpoint of the patient sitting area and in front of physicians room while data collection.

### *Statistical analysis*

The noise level for all the floors were compared across the time schedule/sifts i.e. 9:00 am, 12:00 pm and 3:00 pm. The comparison was done within floor as well as across floors. Descriptive statistics was used for average values followed by one sample t- test was used for within and across floor comparison among time shifts.

## RESULTS

Statistical analysis revealed that there were significant differences between noise levels in the morning, evening and night shifts of working days (p value =0.000) shown in table 1. However, the average levels of noise were found to be higher than stipulated international and national standards shown in table 1 for all the floors across time shift. Overall the basement area was found to have maximum level of noise compare to other floors (table 1).

**Table 1** Mean and Standard Deviation for Different Time Shifts among Floors

| Variables | N | Mean | Std. Deviation |
|---|---|---|---|
| FFNine | 70 | 62.5571 | 2.53461 |
| FFTwelve | 70 | 66.2571 | 2.11746 |
| FFFour | 70 | 61.4071 | 2.59740 |
| SFNine | 70 | 59.4114 | 3.91206 |
| SFTwelve | 70 | 64.6857 | 3.29929 |
| SFFour | 70 | 58.1286 | 3.54647 |
| TFNine | 14 | 61.4857 | 2.98892 |
| TFTwelve | 14 | 66.0714 | 3.58339 |
| TFFour | 14 | 61.2857 | 3.22081 |
| GFNine | 84 | 64.6429 | 3.03253 |
| GFTwelve | 84 | 67.8095 | 3.30926 |
| GFFour | 84 | 63.1631 | 2.70799 |
| BNine | 14 | 69.7714 | .79945 |
| BTwelve | 14 | 71.9286 | 1.54244 |
| BFour | 14 | 70.4286 | .93761 |
| Valid N (listwise) | 14 | | |

Note: FF: 1ST FLOOR, SS: 2ND FLOOR TF: 3RD FLOOR B: Basement, Nine: morning Twelve: afternoon, four: Evening,
N: numbers

There were significant difference among all the three floors across time shift (p value= 0.000) except the basement where there were no significant difference in morning and evening shift noise level compare to other floors among different time shift (p value= 0.111 and 0.304) for overall level of exposure in three shifts (p-value=0.71) depicted in table 2 below.

**Table 2** Mean comparison among floor across different time shifts

| Variables | Mean | Sig. (2-tailed) | Mean Difference |
|---|---|---|---|
| FFNine | 62.5571 | .000 | -7.44286 |
| FFTwelve | 66.2571 | .000 | -3.74286 |
| FFFour | 61.4071 | .000 | -8.59286 |
| SFNine | 59.4114 | .000 | -10.58857 |
| SFTwelve | 64.6857 | .000 | -5.31429 |
| SFFour | 58.1286 | .000 | -11.87143 |
| TFNine | 61.4857 | .000 | -8.51429 |
| TFTwelve | 66.0714 | .001 | -3.92857 |
| TFFour | 61.2857 | .000 | -8.71429 |
| GFNine | 64.6429 | .000 | -5.35714 |
| GFTwelve | 67.8095 | .000 | -2.19048 |
| GFFour | 63.1631 | .000 | -6.83690 |
| BNine | 69.7714 | .304* | -.22857 |
| BTwelve | 71.9286 | .000 | 1.92857 |
| BFour | 70.4286 | .111* | .42857 |

Note: FF: 1ST FLOOR, SS: 2ND FLOOR TF: 3RD FLOOR B: Basement, Nine: morning Twelve: afternoon, four: Evening,
* No significant difference.

## DISCUSSION

The result of the present study reflects the higher than the standardized level of noise in all the floors. This reflects the need of modifications in the hospital based setup to reduce the noise level.

There are different methods available that can be used to reduce the noise level like usage of curtains based on principle of acoustical dampers, different shrubs, plants which will improve the acoustical damping along with will be relaxing patient eyes for stress free healthcare environment. Nothing on its own is unmanageable. There are solutions to all of these noisemakers, however, doing so requires a will and determination so consistent that noise never again takes control of the patient experience or the quality of the hospital environment.

***There Are Different Management Strategies to Overcome From Excessive Surrounding Noise***

The environment built in the hospital itself is a major cause of. The sound emanating from all the machines and human beings working to monitor and promote patient health .to create a quieter environment in the hospital, we must understand and take control of the noise that occurs and define the acoustic ground zero.

It's necessary to reduce the level of noise that's created due to hard wall and floor of the setups. The noise floor results from heating, ventilation and air conditioning; ice machines these many technologies that continue at the same volume with or without people that are usually put in a place more convenient than soundproof along with walls and floors that amplify every sound that bounces off them. Hospital interiors and furnishings are typically made of hard, reflective materials that won't harbour infectious organisms and are easily cleaned. All these sound-reflecting surfaces propagate noise down hallways and into patient rooms, causing sounds to echo, overlap, and linger (Ulrich, 2004).

Once the human equation is added into a health care environment, the noise floor is multiplied many times. First is the people in motion-the sound of their feet on the floor-are noisy from the start. Second, people walking mean people talking. A continuous and consistent noise floor ranging between 42 and 48 dBA can help preserve speech privacy and protect concentration. (Mazer, 2005) patients and visitors add their own sound environment. Elderly patients speak and are spoken to in raised voices. The sound of laughter may be more disturbing at the wrong time or place than the louder but more appropriate sound of an infusion pump or heart monitor. (Moeller, 2005)

In present scenario there are multiple sources that are in use like phones ringing plus cell phones, personal pagers and people who respond to these devices where they are standing or walking, away from an appropriate place to talk. Traditional telephones have a microphone that feeds us back our own voice. Mobile phones do not. So, people talk really loudly when we cannot hear-no matter where we are and who else is around. With the limited or restricted use of these inter and intra personal communication devices can lead to reduction in good amount of noise reduction in hospital setups.

## CONCLUSION

In the analysed sectors in hospital at all floors, the sound level was considerably above the recommended maximum. The hospital staff should be aware of this noise level and its effects, so that they may act in a more efficient way in order to reduce this noise pollution; thus benefiting the professionals and patient recovery. The present study also reflects the need of further research to focus on the impact of high level noise in healthcare setups and to establish a strong step in order to have control on such variance for healthier environment for both healthcare providers and health care seekers.

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