

# ASSESSMENT OF AUDITORY AND NON AUDITORY IMPACT OF NOISE IN HOSPITALS AND MITIGATION MEASURES TO PROVIDE SUSTAINABLE HOSPITAL ENVIRONMENT

<sup>1</sup>Rajeev Upadhyay, <sup>2</sup>Dr A.K. Shukla

<sup>1</sup>M.Tech Student, Environmental Engg, Institute of Engineering & Technology, IET, Lucknow.

<sup>2</sup>Professor, Department Of Civil Engg, Institute of Engineering & Technology, IET, Lucknow.

**ABSTRACT**-Noise is pervasive in everyday life and can cause both auditory and non-auditory health effects. Noise-induced hearing loss remains highly prevalent in occupational settings. In present paper a study was carried out to assess the effect of noise on auditory system. Five hospitals in Lucknow city namely King George Medical College, Veerangana Jhalkaribai Women & Child Hospital, DrShayama Prasad Mukherjee Civil Hospital, Balrampur Hospital & Sahara Hospital are monitored for evaluating noise pollution level (Leq) at outdoor locations of outpatient department (OPD) in day time. It was observed that noise level in every hospital has exceeded the permissible limit of 50 decibel (db). Employees working outside OPD were surveyed and a pure tone audiometry test was conducted for evaluating non auditory impact and auditory impact respectively. Survey revealed the prevalence of non-auditory impact namely annoyance, sleeplessness, stress till first period of 1-2 weeks from timing of starting job and impacts get diminishes with later continuation of job and now employees become susceptible in working in noisy environment. Results of pure tone audiometry revealed absence of noise induced hearing loss (NIHL) but mild hearing loss is observed in King George Medical College which was highly noisy among the five hospitals. Some measures have been suggested for creating sustainable hospital environment and preventing the occurrence of NIHL in future.

**Keywords :** Hospitals, Employee outside OPD, auditory & non auditory impact, sustainable noise mitigation measures.

## I. INTRODUCTION

In present scenario of rapid urbanization, environment degradation and maintenance of its quality is major concern for policy makers. Noise pollution in urban environment is emerging as a threat to quality of life impacting the peace of outside working environment. In urban environment Hospitals which are categorized under silence zones, are getting noisier. Employees working in these environment are prone to noise effecting their quality of life. The effect of noise on these employees is studied in terms of auditory and non auditory impact. Auditory and non auditory impact are long term and short term consequences of exposure on ears to noisy environment. In auditory impact hearing loss of employee is examined to check by how much threshold their hearing capacity is being effected working in noisy environment. In non auditory impact, sleeplessness, annoyance and stress of employee is evaluated. So, on these parameters quality of life of employee working in noisy hospitals areas are assessed.

Sustainable hospital environment is without effecting the source of origin of noise creating peaceful environment within hospital premises. Sustainable hospital environment is created by adopting optimal and suitable noise mitigation measures which best suit the present working environment without effecting functioning of noise originating activities.

## II. LITERATURE REVIEW

Preeti Srivastava et al 2016 studied noise level around ten hospitals of Jaipur city in Rajasthan, India & observed that hospitals were exposed to higher noise level as compared to ambient noise standard level by Central pollution control Board (CPCB).

According to CPCB standards, on the basis of noise pollution level, permissible noise level are set for four major zones as classified (Table No. 1).

Table no 1. Standards for noise pollution level by CPCB

Area code	Category of Area	Limits in db(A) Leq	
		Day	Night
<b>I</b>	Industrial area	75	70
<b>C</b>	Commercial area	65	55
<b>R</b>	Residential area	55	45
<b>S</b>	<b>Silence area</b>	<b>50</b>	<b>40</b>

According to Noise Pollution (Regulation and Control) Rules, 2000, Silence zone is an area comprising not less than 100 meters around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority.

For Silence Zones, permissible limit for noise level is 50 db (A) and for night time, permissible limit is 40 db (A). "Hospital" means an institution for the reception and care of sick, wounded, infirm or aged persons, and includes government or private hospitals, nursing homes and clinics.

Sanjith Saseedharan et al 2015 worked at ICU of S.L. Raheja Hospital (A Fortis Associate) Raheja Rugnalaya Marg, Mahim West, Mumbai. Noise levels in the ICU were found to be higher than the guideline values in accordance with most recent studies.

Ahsan Md. Quamrul et al 2015 conducted study to determine noise pollution in different zone of the Jamalpursadar municipal area Bangladesh in the year of 2014. The proper utilization of traffic enforcement laws was suggested by most of the respondents, driver and public awareness on noise pollution.

Tim Robinson et al 2015 objective was to describe the prevalence of occupational NIHL among woodworkers in Nepal and measure noise levels at workplaces. The woodworking industry represented an important cause of occupational noise-induced hearing loss (NIHL), a significant yet underappreciated problem in many developing countries. They observed that Woodworkers in Nepal were at risk of occupational NIHL.

Noise-induced hearing loss (NIHL) is hearing impairment due to exposure of loud sound above 85 db(A). In NIHL, a loss of perception of a narrow range of frequencies, impaired cognitive perception of sound including sensitivity to sound or ringing in the ears. Exposure to noise occurring at work and its association with hearing loss in such working environment, it is referred to as occupational hearing loss.

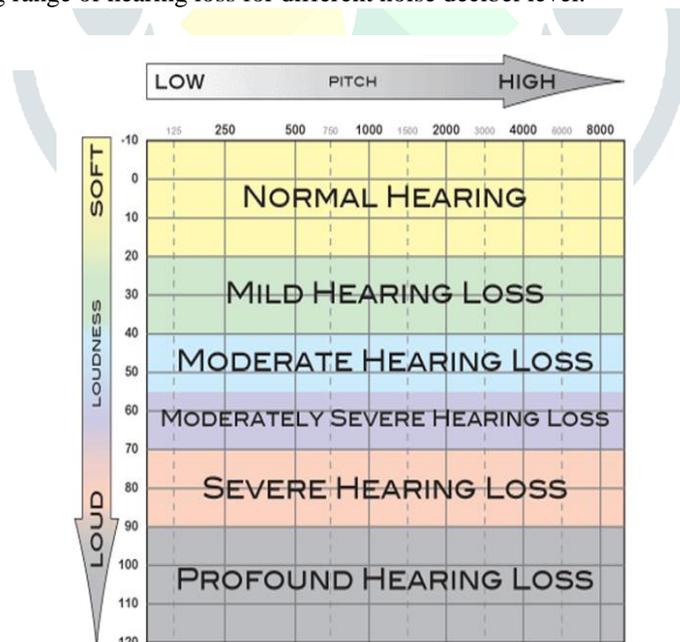
Hearing loss is classified as temporary and permanent hearing changes. PTS (Permanent Threshold Shift) is a permanent change of the hearing threshold (the intensity necessary for one to detect a sound) following an event, which will never recover. PTS is measured in decibels. TTS (Temporary Threshold Shift) is a temporary change of the hearing threshold the hearing loss that will be recovered after a few hours to couple of days. Also called auditory fatigue. TTS is also measured in decibels.

To measure the hearing loss, Pure tone audiometry (PTA) which is a hearing test is used to identify hearing threshold levels of an individual, enabling determination of the degree, type and configuration of a hearing loss. PTA is a subjective, behavioural measurement of a hearing threshold, as it relies on patient responses to pure tone stimuli.

Hearing loss data obtained from the pure tone audiometry test is an audiogram. An audiogram is a graph (fig no 1) that shows the audible threshold for standardized frequencies as measured by an audiometer. The Y axis represents intensity measured in decibels and the X axis represents frequency measured in hertz.

In the fig no.1, hearing loss obtained in an audiogram is classified as normal hearing (-10 to 20db), mild hearing loss (20 to 40 db), moderate hearing loss (40 to 55 db), moderately severe hearing loss (55 to 70 db), severely hearing loss (70 to 90 db) & profound hearing loss (90 to 120 db).

Fig no .1 Audiogram showing range of hearing loss for different noise decibel level.



Bhabananda Phukan et al 2013 carried out noise level measurement  $L_{10}, L_{50}, L_{90}, L_{eq}$  to assess the traffic generated noise in Guwahati University Campus, Assam during the month of April-May 2012. This study revealed that the noise levels exceeded the prescribed noise standard set by the Central Pollution Control Board, India (CPCB, 1998). The results of the analysis revealed that the maximum equivalent noise level  $L_{eq}$  was in the morning during 9-11 am and minimum in the midday at 12-2 pm.

.  $L_{10}$  is the level exceeded for 10% of the time. For 10% of the time, the sound or noise has a sound pressure level above  $L_{10}$ . For the rest of the time, the sound or noise has a sound pressure level at or below  $L_{10}$ . These higher sound pressure levels are probably due to sporadic or intermittent events.  $L_{50}$  is the level exceeded for 50% of the time. It is statistically the mid-point of the noise readings. It represents the median of the fluctuating noise levels.  $L_{90}$  is the level exceeded for 90% of the time. For 90% of the time, the noise level is above this level. It is generally considered to be representing the background or ambient level of a noise environment.  $L_{eq}$  is the preferred method to describe sound levels that vary over time, resulting in a single decibel value which takes into account the total sound energy over the period of time of interest.  $L_{eq}$  is calculated using the equation

$$L_{eq} = L_{50} + ((L_{10} - L_{90})^2 / 60)^{0.5}$$

Mathias Basner et al 2013 conducted observational and experimental studies which showed that noise exposure leads to annoyance, disturbs sleep and caused daytime sleepiness, affects patient outcomes and staff performance in hospitals, increases the occurrence of hypertension and cardiovascular disease, and impairs cognitive performance in schoolchildren. In this paper, they stressed on the importance of adequate noise prevention and mitigation strategies for public health.

**III. METHODOLOGY**

**I. Study area**

In Lucknow , capital city of Uttar Pradesh , five hospital namely King George Medical College, VeeranganaJhalkaribai Women & Child Hospital, DrShayama Prasad Mukherjee Civil Hospital, Balrampur Hospital & Sahara Hospital are selected for study. In outdoor environment, location outside opd are selected for noise monitoring.

**II. Data collection**

For measuring noise in given environment, following parameter  $L_{10}, L_{50}, L_{90}, L_{eq}$  are cacluated

Noise data in Hospitals are taken using Lutron SL-4010 Sound Level meter in day time from 10:00 am to 2:00 pm which is working hours for general opd. The recorded data is worked out in a excel sheet to calculate  $L_{10}, L_{50}, L_{90}, L_{eq}$  for every hospitals which is represented in the table no.2

Table no 2.  $L_{10}, L_{50}, L_{90}, L_{eq}$  for five hospitals in Lucknow city.

S.No	Name of Hospitals	$L_{10}$	$L_{50}$	$L_{90}$	$L_{eq}$
1.	King George Medical College	83.48	82.30	73.44	83.98
2.	VeeranganaJhalkaribai Women & Child Hospital	84.73	80.22	75.24	81.72
3.	DrShayama Prasad Mukherjee Civil Hospital	82.68	81.44	73.02	82.99
4.	Balrampur Hospital	73.50	71.98	70.57	72.12
5.	Sahara Hospital	81.47	80.15	76.45	80.57

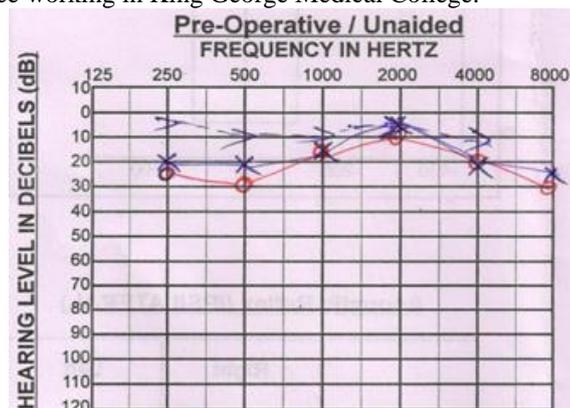
Employees working outside opd were surveyed and get conducted a Pure Tone Audiometry in ENT department of their respective hospital in which they are employed. Employees participated in the study were in the working age group from 26 to 40 years. In Questionnaire used in the survey, questionwere taken from WHOQOL-1995, Division of mental health , WHO, Geneva.

**IV. RESULT AND DISCUSSIONS**

**I. Auditory impact**

Series of audiogram obtained in Pure tone audiometry of employees revealed the absence of NIHL among five Hospitals despite of being working in noisy environment though mild hearing loss has been observed at King George Medical College. In Fig.no 2, at 250 Hz, 500 Hz & at 8000 Hz, hearing loss is observed at these frequencies.

Fig no 2. Audiogram of the employee working in King George Medical College.



## II. Non auditory impact

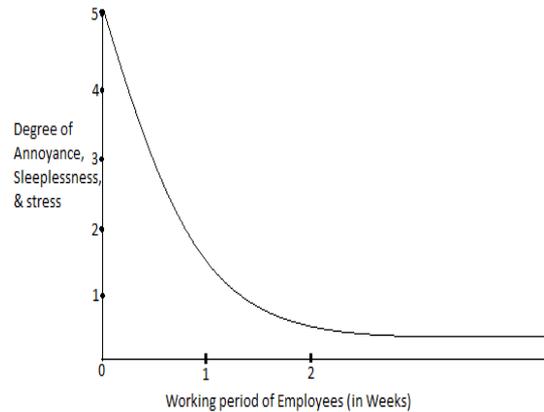


Fig no.3 Variation of Degree of Annoyance ,Sleeplessness & Stress with the working period( in weeks)

Survey done in the study revealed that working in noisy environment was leading to annoyance, sleeplessness & stress only in the earlier working period of 1-2 weeks and later with advent in working periods made them habitual and adaptable to work in such noisy environment.

## V. RECOMMENDATIONS

At King George Medical College ,outside New opd, there lies two intersection which get heavily congested .Both these intersection should be operated by signaled traffic to regulatetraffic flow and control noise. A Cantilever noise barrier sheet should be installed at boundary wall . For VeeranganaJhalkaribai Women & Child Hospital and DrShayama Prasad Mukherjee Civil Hospital Traffic route diversion should be done in morning hours . A vertical noise barrier should be installed at both the hospital's boundary wall.

## VI. REFERENCES:

1. Ahsan Md. Quamrul, Hossen Md. Shahadat and Islam Md. Azharul “Noise Pollution Assessment in Jamalpur Municipal Area, Bangladesh” International Research Journal of Environment Sciences Vol. 4(6), 52-58, June (2015).
2. Bhabananda Phukan, KalyanKalita “An experimental study of noise pollution in Gauhati University campus, Guwahati, Assam, India” International Journal Of Environmental Sciences Volume 3, No 5, 2013.
3. <https://www.castlegroup.co.uk/guidance/environmental-noise/percentile-levels>.
4. [https://www.epd.gov.hk/epd/noise\\_education/web/ENG\\_EPD\\_HTML/m4/mitigation\\_2.html](https://www.epd.gov.hk/epd/noise_education/web/ENG_EPD_HTML/m4/mitigation_2.html)
5. [http://www.epd.gov.hk/epd/noise\\_education/web/ENG\\_EPD\\_HTML/m2/types\\_3.html](http://www.epd.gov.hk/epd/noise_education/web/ENG_EPD_HTML/m2/types_3.html).
6. Mathias Basner, Wolfgang Babisch, Adrian Davis, Mark Brink, Charlotte Clark, Sabine Janssen, Stephen Stansfeld “Auditory and non-auditory effects of noise on health” Published online [http://dx.doi.org/10.1016/S0140-6736\(13\)61613-X](http://dx.doi.org/10.1016/S0140-6736(13)61613-X), October 30, 2013
7. Preeti Srivastava, YashodaSaini, Shipra Sharma, Rajesh Yadav, ShaliniRawat “Assessment of Noise Level around the Hospitals of the Jaipur City and its impact on health” SSRG International Journal of Civil Engineering (SSRG-IJCE) –volume 3 Issue 5 – May 2016.
8. Sanjith Saseedharan , Edwin Pathrose, RoonamChaddha, DeepaliDahale “Statistical Study of Noise Levels in an Adult ICU – A Case from India” International Journal of Biomedical Research 2015.
9. Tim Robinson, Joshua Whittaker, AanandAcharya, DeveshSingh, Michael Smith “Prevalence of noise-induced hearing loss among woodworkers in Nepal: a pilot study” International Journal of Occupational and Environmental Health vol. 21 no. 1, 2015.