

## NOISE POLLUTION IN GOLESTAN HOSPITAL'S WARDS, AHVAZ, IRAN, 2014

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### ABSTRACT

**Introduction:** Hospitals are centers that restore physical and mental health of patients, and are places that allow patients rest and recover. It needs a quiet Environment for both patients and personnel involved. We aimed to assess the wards environmental noise pollution and evaluate their noise levels with recommended standard values. **Methods:** This cross-sectional study was carried out in Golestan Hospital, Ahwaz, Iran. The study aimed to measure noise levels in ten wards, at four time periods in a day: morning (8-10), afternoon (12-15), meeting time (15-17) and at night (20-22). **Results:** The wards noise levels measured in 320 sections at different times. The mean noise levels in wards of Golestan Hospital were about 55, 55.5, 55 and 66 dB in morning, noon, afternoon and meeting time respectively.

Most mean noise level differentiation (8.94 dB) was seen between dialyze and gynecology.

**Conclusion:** The World Health Organization guidelines state that mean noise levels on hospital wards should not exceed 30 dB (day and night) and that peak noise levels at night should not exceed 40 dB. Our results showed that mean noise levels in all Golestan Hospital Wards are more than theses recommended levels. It needs an educational program for both personnel and visitors and even patients.

**KEYWORDS:** Noise Level, Noise Pollution, Hospital Wards.

## INTRODUCTION

Sound waves are considered as a vital factor of human life; however, in some cases, hearing these waves is not pleasant. The unsolicited and irritating group of sound waves that spreads in the environment is called noise or noise pollution.<sup>[1, 2]</sup>

Human exposure to noise can lead to known effects and side-effects, including temporary and permanently hearing loss and undesirable physiological and mental-psychological side-effects. The World Health Organization has estimated that about 278 million people around the world suffer average to intense hearing disorders.<sup>[3]</sup>

There is sufficient scientific evidence that noise can cause hearing problems, blood pressure, heart diseases, irritation, sleep disturbance, and a decrease in learning of students.<sup>[4]</sup> A review of 130 scientific articles regarding noise pollution at hospitals has reported that noise pollution is a considerable factor of stress for hospital employees and patients. Findings of this review showed that at medical centers, reducing noise pollution improves the satisfaction of patients of provided services, as well as the quality of their sleep and also reduces their blood pressure; moreover, employees performed at a higher rate of efficiency and effectiveness.<sup>[5]</sup>

noise pollution at hospitals is caused by patients, employees, and visitors and may be a result of the air conditioning system, transportation inside the hospital, hospital speakers and sound systems, and external sources including traffic in adjacent streets, the noise of entering and exiting the hospital, ambulances, car horns, etc. therefore, hospitals are one of the most important service environments whose noise can have a significant effect on the health of society.<sup>[6-8]</sup>

In order to prevent any interference in providing optimal services, The Environmental Protection Agency (EPA) of the United States has recommended that the sound level of hospitals should be about 45 Db inside and 55 Db outside.<sup>[9]</sup> According to the recommendation of the World Health Organization, the maximum background noise of the patient room must not be higher than 35 Db during the day and 70 DB during the night. While, various studies have shown that the sound of the environment surrounding most hospitals has been about 65 Db in average during the day and reduced to 45 Db during the night.<sup>[10,11]</sup>

The national standard of the permitted sound limit at the environment around and inside hospitals during the day, from 7 to 22, must be respectively equal to 55 and 45 Db and during the night, from 22 to 7 respectively 45 and 35 Db. The study of Lee and Cabrera in the United States has shown that the increase in noise pollution at hospital rooms causes an increase in the pain and distress of the patients.<sup>[12]</sup>

Hospitals play a significant role in recovering the mental and physical health of the patients. Creating a calm and tranquil environment at hospitals is considerably important. The increase in harmful factors, e.g. noise, at the hospital negatively affects the hospital staff and employees in providing appropriate service to the patients. Therefore, in this paper, the degree of noise pollution in Golestan hospital and the surrounding environment is determined, so that identifying the degree of noise pollution, comparing it with the Environmental Protection Agency standards in Iran, and providing results to the authority allows a starting point to control noise pollution at hospitals.

### **Methodology**

This study is a descriptive-analysis research. Since Golestan educational hospital is the most important and largest hospital of Ahvaz, it was selected as the subject location of the research. In order to measure the sound intensity level based on Db, a HARRIS SOUND LEVEL INDICATOR audiometer, made by SHERSTON in England, was used that was previously calibrated by an expert.

Audiometry in hospital wards, including dialysis, ICU, CCU, pediatrics, surgery, maternity, neurology, cardiology, and pediatric cardiology during two periods of two weeks. Four stations (the beginning and the end of the corridor, room, and nurse station) were selected at each ward as audiometric locations. Before beginning measurements, the audiometer was calibrated using a calibrator device. Due to the different levels of noise at different hours of the day, measurements were performed four time during the day, at the first hours of the day, at noon, at visiting time, and finally during the night. Due to noise variations of different sources, in order to determine the noise baseline, the measurement intervals were considered 15 minutes. Each 10 minutes, the noise of all wards was measured, the numbers shown by the chronometer during one minute were recorded, and after one minute, the average of these number during the corresponding time was calculated (the count of the recorded numbers divided by their count was considered as the current amount). Based on the hearing height

baseline, the height of measuring sound was about 1.5 meters at different wards and 1 meter at patient rooms.

## RESULTS

During this research, 320 audio measures were recorded at four stations (at the beginning and the end of the corridor, patient room, and nurse station) for 10 selected intervals during 4 periods (morning, noon, visiting hours, and night) at two different times. Findings of this research shows that the mean of 320 sound measures at clinical wards was equal to  $57.8 \pm 7.8$  and the highest mean of all four stations belonged to the dialysis unit with 62.18 Db and the lowest belonged to the neurosurgical unit with 53.87 Db.

During measurements at clinical wards, the average measured noise was 54.85, 55.41, 54.92, and 66 Db respectively during morning, noon, night, and visiting hours. The most and the least amount of noise in the morning respectively belonged to dialysis and neurology with means of 63 and 49.12 Db, at noon, respectively dialysis and cardiology with means of 63.75 and 51.5137 Db, during visiting hours respectively maternity and dialysis with means of 75.25 and 60.25 Db, and at night, respectively dialysis and neurology with means of 64.25 and 46.0 Db (table 1).

**Table 1: The average noise pollution at clinical wards during four periods**

Ward	Morning	Afternoon	visiting time	night	Total
Pediatrics	53.37	55.37	67.25	46.25	55.65
Surgery	54.75	55.25	65.62	61.37	59.25
Cardiology	50.12	51.37	65.25	52.12	54.71
pediatric cardiology	58.5	59.37	65.75	62.12	61.43
ICU	55.87	57.25	60.75	58.0	57.96
CCU	51.5	53.37	65.37	51.5	55.43
Dialysis	63.0	63.75	60.25	64.25	62.81
Internal	51.12	52.87	64.62	55.12	55.93
Maternity	61.12	55.0	75.25	52.5	60.96
neurology	49.12	55.5	69.87	46.0	53.87
Total	54.8	55.41	66.0	54.92	57.79

Regarding the audiometry stations selected inside all 10 clinical wards, the nurse stations and the end of the corridor had respectively the most and the least amount of noise with means of 61.1 and 55.11 Db. (Table2)

**Table 1: The average noise pollution at clinical wards during four stations**

Ward	Beginning and the corridor	Room	Nurse station	End of the corridor
Pediatrics	56.12	54.25	59.62	52.25
Surgery	58.0	57.37	63.0	58.62
Cardiology	55.5	55.62	59.37	48.37
pediatric cardiology	61.0	59.0	64.75	61.0
ICU	55.75	59.25	61.87	55.0
CCU	57.25	54.0	57.25	53.25
Dialysis	61.37	63.5	62.75	63.62
Internal	56.75	55.5	60.87	50.62
Maternity	59.5	60.12	65.62	58.62
Neurology	58.62	52.12	55.0	49.75
Total	57.98	57.07	61.01	55.11

Statistical findings showed that the most mean noise pollution difference at all four stations during four periods of time during the day and the date of measurements was between dialysis and maternity for 8.94 Db.

Regarding time dimension, the most and the least mean noise pollution at all clinical wards were respectively 66.0 Db for visiting hours and 54.85 in the morning, which shows a difference of about 11.15 Db.

The mean noise pollution of each individual station at all clinical wards indicated that the most mean noise pollution difference belonged to the nurse station and the end of the corridor for 5.89 Db and there was a significant relationship with  $P=0.000$ .

## CONCLUSIONS

The sources of noise pollution inside hospitals are employees, patients, and visitors, air conditioning systems, transportation inside the hospital, speakers, and hospital sound systems and the external sources are the traffic in adjacent streets, the noise of entering and exiting the hospital, ambulances, car horns, etc.

Based on the conducted sound measurements, noise pollution of 10 studied hospital wards was  $57.8 \pm 8.7$  DB, which exceeds the national sound limit in the environment inside and surrounding the hospital from 7 to 22 respectively equal to 45 Db and 55 Db and is in line with the study of Golmohammadi, Hamedan, which measured the average noise pollution inside and around the hospital for about 57 and 54 Db.<sup>[13]</sup> Moreover, results are in line with findings of hospitals in Taiwan<sup>[14]</sup>, Tanzania<sup>[15]</sup>, Chamran, Azahra, and Kashani Isfahan.<sup>[16]</sup>

The strongest sources of noise pollution inside hospitals are the sound of visitors or patients' family members, shouting of nurses, or opening and closing of the doors which are all mostly a result of behavioral factors.

The highest and the lowest mean sound at the four selected points were respectively 62.81 Db in the dialysis unit and 53.87 Db in neurology. Statistical findings indicate that the highest mean noise pollution difference in all four stations during four periods and two dates was 8.94 between dialysis and maternity. Observations showed that the major part of the noise pollution in dialysis is related to the number of machines in that unit. The one-sided variance analysis showed that there was a significant difference between noise pollution at different hospital wards ( $P=0.004$ ). According to the recommendation of the World Health Organization, the mean noise level must not exceed 65 Db during the day and 45 Db at night.<sup>[17-19]</sup> Regarding the time dimension, based on the recommendation of the World Health Organization, the maximum background noise in patient rooms should not be higher than 35 Db during the day and 30 Db at night; this mean level of sound in general wards (ICU and CCU) should not be higher than 65 Db during the day and 45 Db at night (9.1017). In this study, the mean sound at various wards was measured as 54.85 in the morning, 55.41 at noon, 54.92 at night, and 66 at visiting hours. Using one-sided variance analysis, it was shown that there is a significant difference in the mean noise pollution between various times of the day ( $P=0.000$ ). The maximum mean noise pollution belonged to the visiting hours, due to the large number of visits, and the noise of patients' family members at different wards which is in line with the study of Feiz hospital.<sup>[20]</sup> The amount of noise pollution inside corridors, around the hospital, and hospital pagers was also recorded during two different days and four different time periods as 75.5 Db around the hospital and 79.3 Db for mean number of pages, which was not in line with the study of Golmohammadi, 54 and 57 Db (13). The amount of noise pollution inside corridors, around the hospital, and hospital pagers was also recorded during two different days and four different time periods as 75.5 DB around the hospital and 79.3 Db for mean number of pages, which was not in line with the study of Golmohammadi, Hamedan, in which the mean sound in the environments around and inside educational and non-educational hospitals during the day was respectively equal to 54 and 57 Db (13). The baseline of sound around the hospital was affected by the traffic, the wrong tradition of gathering around the patient outside Golestan hospital (even with full picnic equipment during the treatment of a family member).

Based on the selected audiometry stations inside 10 clinical wards, the highest and the lowest mean sound were respectively in the nurse station, 61.01 Db, and the end of the corridor, 55.11 Db. The mean sound at the nurse station and the end of the corridor had a significant difference equal to 5.89 Db ( $P=0.007$ ). One of the factors of high noise pollution in nurse stations is the gathering of nurses and visitors at those locations. Finally, we must note that due to the lack of internal standards and resources for some of the studies wards, authentic international standards were generally used, which required careful generalization. Considering native specifications, due to the lack of domestic and internal research resources in this context, cases like noise pollution reduction methods, acoustic needs of various hospital wards, and approaches to creating enhanced acoustic environment can prove to be useful in improving the quality of medical centers in Iran.

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