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Noise pollution in wards and other areas in general hospital at Zakho city-Kurdistan region/Iraq

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ABSTRACT

Hospitals are places that allow patients to rest and recover, and therefore must be quiet inside and in the surrounding neighbourhood. General Zakho Hospital {Kurdistan region-Iraq} was chosen as a sample. The objectives of this study are to investigate the levels of noise pollution in this hospital. Sound levels were recorded in all wards in the hospital using a Digital Sound Level Meter. The results showed that the measured mean equivalent sound levels (Ls) and standard deviation were (53.77 ± 2.43 dBA, 52.1675 ± 2.27 dBA and 52.0462 ± 1.53 dBA) during the morning, afternoon and the evening measurements respectively. The highest mean Ls (55.6 dBA) and maximum (66.777 dBA) noise level during measurement time was observed in Nurse station room. The lowest mean Ls (50.9055dBA) and minimum Ls readings (43.03 dBA) were observed in the Female ward. These observed noise levels exceeded the recommended World Health Organization (30-40dBA) guidelines for hospitals. This study conclude that there is noise pollution problem in this hospital and the major source of noise inside the wards are talking of visitors or patient's family members, doors opening or closing and patients moaning or crying, whereas talking of visitors or patient's family members and children playing, Footsteps, renovation of hospitals, shouting of nursing staff and opening or closing are the five major noise sources outside the wards.

1. Introduction

Sound is defined as being caused by vibrations in the air or other medium which stimulate a sensation of hearing when they reach the ears (Peterson, 1980). The sound is called noise when it becomes the sound level exceeds 40 dB according to World Health Organization (30-40dBA) guidelines for hospitals, Noise is disturbing uncomfortable waves which has great negative effects on health. It has become a very important "stress factor" in the human environment as a result of technological and industrial progress. However the most common sources of noise pollution are factories and modern transportation of all forms (cars, trains, planes, trucks and buses). Other sources include the noise in workplace or even the noise of simultaneous conversations (Ahmad, 2011; WHO, 2010).

Hospitals are places that allow patients to rest and recover, and therefore must be quiet inside and in the surrounding neighbourhood. Not only can noise cause temporary and permanent hearing loss, it can also harm the endocrine, digestive, and cardiovascular systems. Noise can result in a decrease of worker productivity and an increase in human error. Noise has also been found to negatively affect the quality of the patients healing environment. Noise may elevate blood pressure, increase heart rate, stimulate the release of epinephrine (adrenaline), increase pain, and alter quality of sleep (Pai, 2007).

Being a major component of dynamic space, noise is one of the most invasive aspects of the hospital environment. Patients and their families are exposed to sounds overheard through walls and curtains. Effect of conversations among patients, staff and visitors, sounds of doors and phones make up the "sound environment" which is a risk to healthcare. Whether by accident or incident, the accumulation of noise and unwanted spaces distraction adds up to a negative physiological and psychological healthcare experience and also affects patients' performance especially on their sleep quality (Moshi et al., 2010).

There are many vulnerable groups of people who are most affected by noise pollution such as the young, elderly, and the hospitalized. Young children are unable to protect their hearing and rely on their parents to keep them from constant exposure (Ray and Levinson, 1992).

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Noise is described in terms of loudness (intensity) and pitch (frequency) and noise exposure is measured using a logarithmic decibel (dB) scale. The Occupational Safety and Health Administration (OSHA) recommend hearing protection in the workplaces where the exposure to noise becomes greater than 85 dB for eight hours or more. Under such circumstances, permanent hearing loss is a possibility. The health effects of noise pollution have been studied by many researchers in recent years: it was found that the sound in the post an aesthesia care unit exceeded the internationally recommended intensity (40 dBA), Conversation was the most common cause of excess noise, staff conversation caused 56 % of sounds greater than 65 dB and other noise sources (alarm, telephone, nursing care) were each less than 10 % of these sounds. Morrison et al. (2003) measured the average daytime sound level in a paediatric intensive care unit was 61 dB (A), night time 59 dB(A). Higher average sound levels significantly predicted higher heart rates (p =.014). Other significant predictors of tachycardia were higher caffeine intake, less nursing experience, and daytime shift. Analyses of measurements showed a large variability and were not significantly affected by noise levels. Higher average sound levels were also predictive of greater subjective stress (p =.021) and annoyance (p =.016) (Moshi et al., 2010).

Also studied the effects of noise pollution and concluded that there is noise pollution problem in Iringa regional hospital, the important contributor to baseline noise levels in wards are conversations of patients and nurses, overcrowding of patient's relatives, television and screaming of children. The peak noises were contributed to other sources, such as bin lids slamming and emotional outbursts.

2. Material and methods

2.1. Sampling

Zakho General Hospital {Kurdistan region-Iraq} (200 beds) (Fig. 1) is located in Bedar residential quarter, that was opened in 2012. Consists of (82 beds) for patients, (20 beds) emergency and (98 beds) separate rooms, doctors almost (20 rooms) for the reception of patients. 12 showrooms operations, including halls for emergency operations and Hall of burns and eight intensive care and catheters, delivery and premature, with the total artificial eight general surgery, and women's sections, x- rays. The hospital receives about 200 patients, almost daily.

2.2. Measured locations

The noise level was measured in the male ward interior, Male out ward, Female ward interior, Female out ward, Children ward interior, Nurse Station waiting area, Nurse station and room outpatient waiting areas, reception, imaging, Neurologist Clinic, Laboratory, paediatric and ophthalmology clinic and General Surgery during the measurement periods in the Hospital. The method of the measurement was taken in the middle of the corridor at high of 1.5 meters from the floor, and 1.5 meters away from the walls, and windows respectively as shown in Fig. 2.

Fig. 1: Zakho General Hospital

2.3. Measuring Instrument

Digital Hand-held sound level meter of type (AR824), was used for measuring sound level.

Fig. 2: The method of measurement

2.4. Measurement date and time

This study measured the sound levels in the patients' area at three time periods during the day: First, in the morning (9:00-11:00 am), second in the afternoon (1:00-3:00 pm.), and finally at Evening (6:00-8:00 pm.). The data measured the sound levels in the interval between November, 2013 and February, 2014.

3. Results and discussion

Table 1 shows mean equivalent continuous noise level, minimum and maximum reading for all individual locations considered during the measurement periods. Overlay as shown in Fig. 3, inside all monitored wards, the measured mean equivalent sound levels (Ls) and standard deviation showed the mean Ls measurements for each ward of (53.77 ± 2.43 dBA, 52.1675 ± 2.27 dBA and 52.0462 ± 1.53 dBA) during the morning, afternoon and the evening measurements respectively. The highest mean Ls (55.6 dBA) and maximum (66.777 dBA)

noise level during measurement time was observed in Nurse station waiting area and the lowest mean Ls (50.9055dBA) and minimum Ls readings (43.03 dBA) in the Female ward. The female's conversation, nurse's activities and ward cleaners might have contributed to the observed noise level on Nurse Station waiting area. Another reason for the high levels of noise in Nurse Station waiting area may be related to the fact that these nurses are busy all the time. The lowest noise level observed in the Female ward at evening was due to fewer visitors and reduction of general activity at this time.

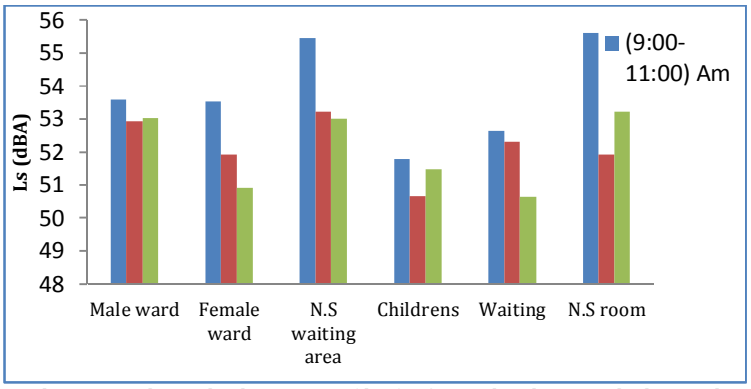

Fig. 3: Mean and associated Standard Deviation (dBA) of noise level on wards during the study period

Table 1: Mean and Standard Deviation, Minimum and Maximum Values (dBA) of Noise Levels on Wards in Zakho General Hospital

Places	(9:00-11:00) Am				(1:00-3:00) Pm				(6:00-8:00) Pm			
	Min (dBA)	Max (dBA)	Ls (dBA)	SD	Min (dBA)	Max (dBA)	Ls (dBA)	SD	Min (dBA)	Max (dBA)	Ls (dBA)	SD
Male ward	44.6666	62.5222	53.5944	2.049	43.4222	62.4555	52.9388	2.732	43.8333	62.2222	53.0277	1.93
Female ward	44.5555	62.5111	53.5333	2.083	43.0444	59.3333	51.9166	2.934	43.0333	58.7777	50.9055	0.8
N.S waiting area	44.7222	66.2	55.4611	3.03	43.3888	63.0777	53.2333	2.187	43.7888	62.2222	53.0055	1.66
Child	44.1444	59.4222	51.783	*1.27*	43.6666	57.6666	50.6666	*1.97*	43.8666	59.1111	51.4888	1.62
Waiting	44.1888	61.1111	52.65	*2.89*	43.4222	59.5555	52.3277	*2.43*	43.4888	57.7777	50.6333	1.44
N.S room	44.4222	66.7777	55.6	*3.26*	43.4	60.4444	51.9222	*1.41*	44.5444	61.8888	53.2166	1.73
Mean	44.449	63.09	53.77	2.43	43.39	60.422	52.167	2.277	43.759	60.333	52.046	1.53

The high noise levels observed at the Children ward interior at morning (51.783dBA) were due to children crying and activities of mothers inside the ward.

The high noise levels observed at the Male ward interior at morning (53.594 dBA) were due to its location near the road side.

The World Health Organization (WHO) guidelines state that, on hospital wards, noise shows levels should not exceed 35-40 dBA during the daytime (WHO, 2010). In the present study, and the mean noise levels observed on wards stands at much higher value than that recommended in WHO guidelines for hospitals. the major source of noise inside the wards are talking of visitors or patient's family members, doors opening or closing and patients moaning or crying ,whereas talking of visitors or patient's family members and children playing, Footsteps, renovation of hospitals, shouting of nursing staff and opening or closing are the five major noise sources outside the wards.

Table 2 shows that quiets time is in Evening (52.0462 dBA) which is high according to (WHO) and the loudest time is in Morning (53.77 dBA) because at the morning in addition to patients in hospital, patients visiting hospital for consultancy, also high turnover and conversations of visitors overcrowding on wards during the morning hours are the main reason to the observed noise levels. However, traffic and ward activities, mostly visitors visiting patients who are in the hospital during the afternoon hours are additional source of the increased noise levels at this time of the day (Fig. 4).

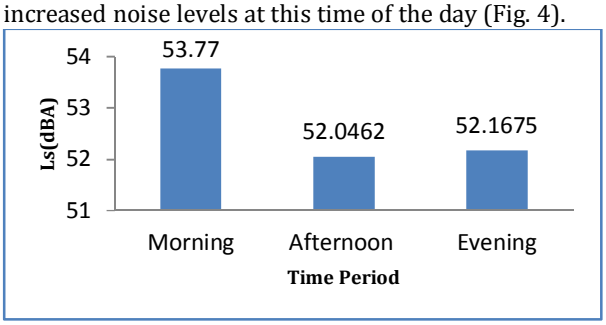

Fig. 4: Mean Ls (dBA) for each time period

Table 2: Mean Ls (dBA) for each Time Period

Time	General Hospital Ls (dBA)
Morning	53.77
Afternoon	52.1675
Evening	52.0462

Table 3 as well as Fig. 5 Show the Mean and Standard Deviation Values (dBA) of Noise Levels on reception, imaging, neurologist clinic, laboratory,

paediatric and ophthalmology clinic ,and general surgery at this hospital at morning (56.2±2.345dBA, 55.32± 1.861 dBA, 56.53 ± 1.85dBA, 56.66 ± 1.599 dBA,57.89 ± 1.883 dBA, and 56.36 ± 2.036 dBA) respectively. These values are clearly higher than WHO guidelines for hospitals for the same resins that we mentioned in the Table 2 at morning period.

Table 3: Mean and Standard Deviation, Minimum and Maximum Values (dBA) of Noise Levels on other areas in Zakho General Hospital at Morning

Places	(9:00-11:00) Am			
	Min (dBA)	Max (dBA)	Ls (dBA)	SD
Reception	42.95	69.44	56.2	2.345
imaging	43.43	67.22	55.32	1.861
Neurologist Clinic	44.27	68.78	56.53	1.85
Laboratory	43.8	68.77	56.66	1.599
paediatric and ophthalmology clinic	43.56	72.22	57.89	1.883
General Surgery	43.94	68.77	56.36	2.036
Mean	43.65833	69.2	56.49333	1.929

From the above we conclude that there is noise pollution problem in this hospital and the major source of noise inside the wards are talking of visitors or patient's family members, doors opening or closing and patients moaning or crying, whereas talking of visitors or patient's family members and children playing, Footsteps, renovation of hospitals, shouting of nursing staff and opening or closing are the five major noise sources outside the wards.

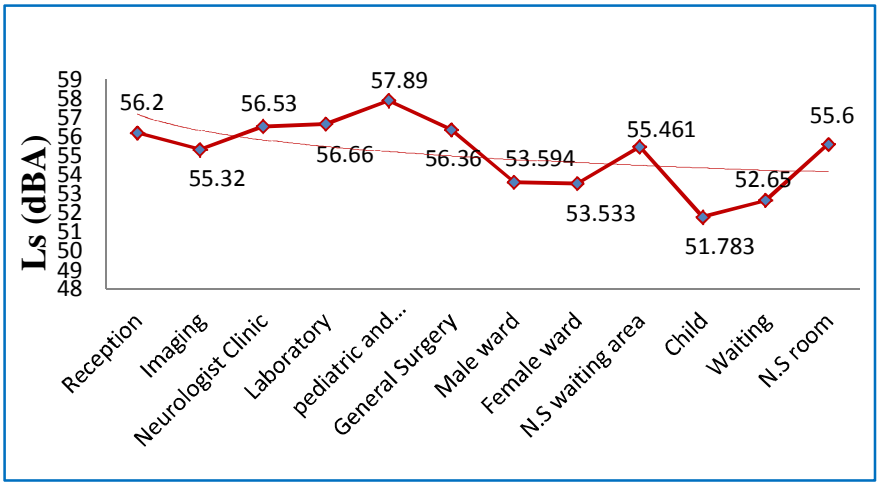

Fig. 5: Mean and associated Standard Deviation (dBA) of noise level on wards during the morning in Hospital B with equation on chart and R-Squared value on chart

Some suggestions to reduce this problem may include:

1- Advising the nursing staff to do their works as quite as possible.

2- Reduced the numbers of patient's family members or visitors to one person only.

3- Limited the visitors time to shorter periods.

4- Covering the walls and floors of the wards and corridors with voice insulating materials to reduce the sound that comes out from the footsteps of workers, patients moaning or crying, visitors and staff talking.

5- Putting sound level meter in each ward with alarm to announce the staff members that the sound level reach to pollution rang and they must reduce the voices in that point.

6- Make a periodic service to the doors, air condition systems and measure the sound level for each one.

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