

The Investigation of Acoustical Environments in Elderly Mental Hospital

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Abstract. Acoustic conditions in hospitals have been shown to influence a patient's physical and psychological health. Noise levels in Beitou Armed Forces Hospital were measured among various times. Sound pressure levels were logged every 30-seconds over a period in different locations: at the nurses' station, in the hallway, and in a patient's room. Results show that current noise level guidelines were exceeded regularly; despite this the surveys showed most patients were not very annoyed with the noise. Additionally, no relationships were found between a patient's gender or age to various noise responses. Overall this study did not find very large changes in sound levels in various time periods and overall patient noise perception will be discussed in the further work.

Keywords: Elderly mental hospital, Acoustical environments, Subjective evaluation.

1 Introduction

The current aging society in Taiwan for the elderly health care environment is becoming attention, noise control has also become the primary research. For all the countries of the world, it have been built for hospitals interior noise value and sound quality criteria of the proposed classification system which develop autonomy ways to improve hospital noise. Department of Health Science and Technology Research of Taiwan proposed the related research project which is noise hazards in hospital environments cause in the level of anxiety [1]. Physiological and psychological effects of noise for patients has been a considerable number of researches for the reference. Researches of noise effects for medical space are from the beginning of the 1960s. With the constantly increasing medical equipment unit, high-decibel noise levels is main factor for resulting in high-impact physical and mental health of the patient [2].

In the U.S. study survey found that the average noise hospital space is about 55 dB (A) [3] [4]. 150 patients after surgery for investigation, averaged result is up to 95% correlation between the amount of noise and the patient's anxiety [5]. In addition, many studies found that noise is the main factor which cause patient "psychological pressure" [6]-[11]. The prolonged exposure to high noise environment led into the

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patient's psychological stress and physical pain with a direct impact on wound healing and lead to slow growth in time to stay in the hospital treatment [12], serious noise environments cause physical and psychological concurrency problems [13]. In this study, elderly who stay in mental hospital and have medical treatment for insomnia, anxiety, emotional disorders and other mental disorders are the object, sound measurements in Beitou Armed Forces Hospital is be taken. In order to understand the correlation between objective sound distribution of the ward unit noise and subjective test, patient questionnaires are also made to comprehend subjective feelings of the psychological impact by noise sound. The purpose of this study is as follows:

- (1). Understand the current environmental conditions of care for Geriatric Psychiatry.
- (2). For elderly patients to provide the relationship between the noise impact and subjective psychology.
- (3). Enhance care unit nurses noise control attention, improve noise control standards.
- (4) Finally, expect to improve the noise environment in the development of psychiatric care space and to create a truly high-quality quiet environment of treatment.

2 Methods

To understand the correlation between with the noise frequency characteristics of the ward nursing unit and subjective with a tolerance of feeling, acoustical measurements of Geriatric Psychiatry Medical Center of Beitou Armed Forces Hospital as a foundation may be taken, questionnaires assessment may also conduct to realize the patients' psychological impact of noise. The main structure and content of the steps of this study described below:

2.1 Objective Evaluation

Measurement location is at Geriatric Psychiatry Medical Center of Beitou Armed Forces Hospital for monitoring the status of field sound environmental conditions. Elderly psychiatric hospital offer a treatment for elderly who are suffering from insomnia, anxiety, mood disorders and other mental disorders, and the recuperation space and related service space are the target spaces for monitoring indoor noise distribution prone shown in Fig. 1.

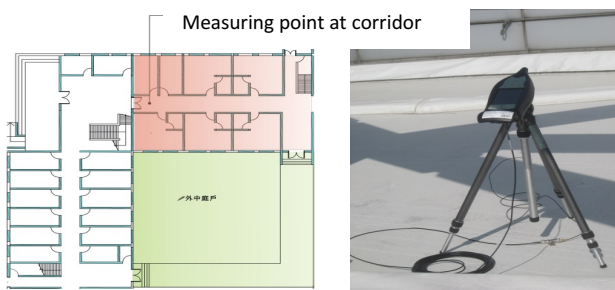


Fig. 1. Plane for location of indoor sound measuring points with sound meter de vice in Beitou Armed Forces Hospital

The main noise sources including hospital space monitoring mobile source - wheelchairs, hospital beds, medical carts, voice chat and other health care workers communication etc. Stationary noise including, pantry and indoor air-conditioning (machine) between devices, such as background noise in the ward. Measuring equipment for the requirements of IEC TYPE 1 decibel meter as a measuring instrument (Shown in Figure 2) is used, mobile noise assessment parameters is based on LAeq (10min), stationary noise is on NC value.

2.2 Indoor Sound Environment Measurement

Measuring height from the floor is 1.2 ~ 1.5-m and is away from windows 1.5-m. Every three minutes the is recorded by equivalent sound level (LAeq). Referring to the CNS 7183 noise level measurement method, 30 seconds integration of sound pressure level in 1/3 octave band for 20 Hz to 20000Hz is calculated by real time analyzer (Comply with requirement of Type 1, IEC standard).

$$\bar{Lp} = 10 \log_{10} \frac{1}{N} \left(\sum_{i=1}^N 10^{Li/10} \right) \quad (1)$$

2.3 Measurement Configuration and Space Description

Measuring targets are physical and mental wards space in Beitou Armed Forces Hospital Medical Center, spatial arrangement at physical and mental center, such as the entrance, physical and mental wards, nursing stations, group therapy rooms and pantries etc are selected. Spatial distribution of the measuring point sources for mobile noise set are walkways, public telephone areas, pantries and other indoor spaces and for stationary noise set are the ward, consulting space, equipment and service space.

2.4 Subjective Evaluation

Based on data quantities of measurements, subjective questionnaire will be applied for patients to understand the actual subjective feelings in order to assess consistency for the psychological impact of noise and objective discussion of the space condition. Finally, to provide space planning optimization of the design proposals.

2.5 Measurement Results of Mobile Noise

The assessment of the noise sources are stationary and mobile noise, Mobile Indoor noise, compared with mechanical carts, noisy sound and the sound of conversation are set in the open aisle space and administrative space. Measuring height from the floor is 1.2 ~ 1.5-m and is away from windows 1.5-m. Every three minutes the is recorded by equivalent sound level (Leq). The results is shown in Table 1.

Table 1. Measurement results of mobile noise

Measurement location	Leq dB(A)	L _{max} dB(A)	L ₉₉ dB(A)	Leq _{20-200Hz} dB(A)
Ward corridor A (with activity)	58.7	62.4	56.3	50.6
Ward corridor B (with activity)	54.1	60.3	53.4	46.4
Subject within group	49.8	58.8	47.4	40.1

2.6 Measurement Results of Stationery Noise

The 30 seconds integration of sound pressure level in 1/3 octave band for 20 Hz to 20000Hz is calculated by real time analyzer. Referring to the CNS 7183 noise level measurement method, 30 seconds integration of sound pressure level in 1/3 octave band for 20 Hz to 20000Hz is calculated by real time analyzer. The results is shown in Table 2.

Table 2. SPL values of 1/3 octave band in 63 Hz to 4000Hz and NC value

Frequency Location	63 Hz	125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	NC
Group therapy room	47.4	42.8	44.8	28.1	22.9	24.7	19.9	35
Meeting room	30.7	32.0	31.8	28.6	21.2	18.9	16.2	25
Psychology Assess- ment Room	36.1	39.3	39.2	36.0	28.6	25.7	23.4	35
Head nurse office	30.6	43.9	38.8	36.9	28.7	28.1	25.7	35
Ward (old air- conditioning)	52.1	53.3	47.4	41.7	34.2	27.9	24.1	40
Ward (renwe air- conditioning)	45.4	47.8	44.8	41.0	33.6	27.4	22.6	35

2.7 Subjective Evaluation

Thirty patients who made evaluations at the hospital. They were all have healthy hearing and asked about the air conditioner, hospital beds, medical carts, voice chat and other health care workers communication for mobile noise, and indoor air-conditioning (machine) between devices, such as background noise in the ward is for stationary source. A questionnaire was used that consisted of 5-point semantic scales with verbal descriptors defining the extremes at each end. The 3 point in each scale implied the unpleasant of perception. The results is shown in Fig. 2.

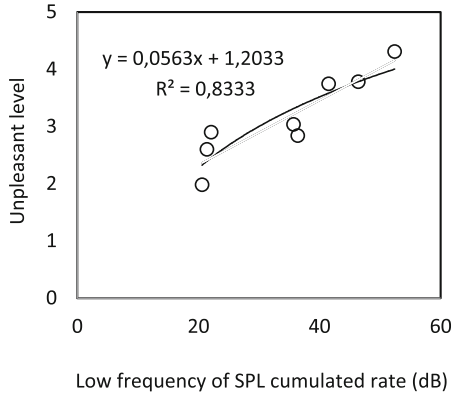
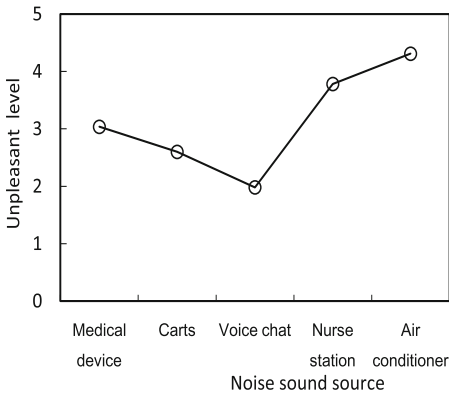


Fig. 2. Unpleasant level as a function of noise sound source **Fig. 3.** Unpleasant level as a function of low frequency of SPL cumulated rate (dB)

Subjective questionnaire applied for patients to understand the actual subjective feelings in order to assess consistency for the psychological impact of noise and objective discussion of the space condition. The results show the highly positive correlation between Unpleasant level and Low frequency of SPL cumulated rate ($r = 0.90$, $R^2 = 0.83$) (shown in Fig. 3).

3 Discussion

From results of Indoor mobile noise measurement, a semi-open space such as walkways, public telephone areas and other public spaces was a targets of investigation. The averaged 50dB (A) Leq dB (A) is calculated, far exceeding the Noise Control Act standard 40dB (A) (the hospital is the first level of standard), in particular during certain hours of the aisle of the sound level can reach 58.7dB (A). Hospital need a quiet place for spiritual space should raise standards and precisely control. Recommendations are as follows:

- (1). Installation of sound-absorbing material of the ceiling and walls to reduce the noise of the distribution and diffusion in the public space.
- (2). For ease of management and assistance needs of patients, the nursing station staff voice conversations are self-control and easily generated noise of space, such as group activity room of zoning to reduce noise interference to each other sounds.

Measurement results of the stationary sources (background noise) was found, such as ward space due to the adoption centralized air conditioning system, air-conditioning machinery and equipment for self-generated noise averaged NC35, in

particularly, old air conditioned system in the some wards produce higher noise levels (NC40). Recommendations are as follows:

- (1.) Sound isolation doors and windows in ward space will be considered to replacement in the future.
- (2.) Central air conditioning system should be re-round reviewed of the plan in order to facilitate the future to achieve a comfortable acoustical environment.

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