


ORIGINAL ARTICLE

Are emergency care departments too noisy?

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ABSTRACT

Background: Noise pollution is a serious issue that faces healthcare centers. It is associated with detrimental effects on both the patient's and the healthcare provider's mental and physical well-being. It could also negatively impact the physician's decision-making.

Aim: There are no similar studies conducted in the past 5 years in Saudi Arabia. This is the first study to measure noise levels and deem them pollutants in an emergency care center in Saudi Arabia.

Method: This cross-sectional study was conducted in the emergency department (ED) of a tertiary care hospital to assess the level of noise pollution. Noise levels were evaluated in the ED by using a calibrated decibel meter device in three selected units including resuscitation, acute care, and pediatrics unit. Noise levels were only measured during weekdays. In each unit, readings were obtained over 24 hours.

Results: Over 24 hours, measurements of all assessed units showed that noise levels exceeded WHO guidelines for hospitals, which recommend sound levels below 40 decibels (dB). Among all clinical areas, the pediatric unit exhibited the highest noise spike (97.3 dB), followed by the resuscitation unit (88.5 dB), and the acute care unit (87.3 dB).

Conclusion: Noise levels were high in all the assessed units, which places the patient's well-being and recovery at risk. Moreover, high noise levels could contribute to adverse outcomes for the healthcare provider. More studies should focus on assessing the noise levels in other departments and the efficacy of different intervention methods.

Keywords: Hospital, emergency care, noise, pollution, sound, noise control, noise prevention.

Background

Noise is "an accidental sound wave without any rhythm or harmony that can interfere with hearing" [1]. According to the Centers for Disease Control and Prevention (CDC), prolonged exposure to noise exceeding 70 dBA can cause hearing damage [2] and is considered noise pollution. Noise pollution is an ignored yet serious issue facing medical facilities and is associated with detrimental effects on patients and healthcare providers.

High noise levels can lead to miscommunication as patients cannot adequately vocalize their complaints [3]. High noise levels can also lead to physical damage, such as inner ear hearing damage [4] or sleep disturbances in the intensive care unit (ICU) [3]. Based on prior studies, the continued presence of unwanted sounds may cause an increase in blood pressure and heart rate, and an increase in mortality in patients with myocardial infarction [3,4]. Moreover, noise levels can affect a patient's sleep, which negatively affects their recovery [3]. Mental health damage has been reported

in studies related to noise levels. In fact, some patients are more likely to use tranquilizers and request more pain medications owing to high noise [4]. In medical facilities, optimum care should be provided to patients whose conditions might worsen with high noise levels, such as those with migraine headaches or older patients with delirium. The adverse effects of noise not only affect patients but also healthcare providers. Studies have revealed a decrease in patient safety measures and an increase in medical errors associated with noise levels [5].

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According to prior evidence, noise levels in hospitals have exceeded the recommended level, mainly in the emergency department (ED) and ICU. The World Health Organization (WHO) recommends a noise level of 40 decibels (dB) outside bedrooms to prevent adverse health outcomes [6]. A study measured noise levels in six areas of the ED in Australia: triage, acute care, short stay, resuscitation, pediatrics, and cubicles. All areas had averages above 50 dB over 24 hours [7]. Additionally, studies at John Hopkins in the United States found noise levels reaching averages between 50 and 60 dB [8], and 60 and 65 dB [9]. Another study that evaluated noise in the ED revealed that the average sound levels peaked approximately 25 times over 12 hours, with individual peak levels measuring 94-117 dB every minute [10]. Notably, the noise levels exceeded the recommended level of 40 dB in the above studies. The high noise levels in the ED could be attributed to the increased usage of different medical equipment that has a beeping sound, such as monitors. Moreover, the high noise level could be related to regular visits from medical professionals belonging to other specialties, conversations between medical teams, and the constant movement of people.

In our search for similar research performed in the Kingdom of Saudi Arabia, we found that no such studies have been conducted in Riyadh in the past 5 years. Accordingly, this study aimed to measure the noise levels in a tertiary healthcare center's ED in Riyadh, Saudi Arabia, and determine whether the noise levels exceed the WHO's recommended level of 40 dB.

Materials and Methods

Study setting and design

This cross-sectional analysis was conducted to assess noise pollution levels in the ED of a tertiary care hospital, whose name remains confidential. This hospital was considered an advanced trauma center. Notably, the main clinical area of the ED is divided into several units, including acute care, resuscitation, and pediatrics units.

Data collection process

In this study, noise levels in the ED were evaluated in three units: resuscitation, acute care, and pediatrics, using a decibel meter device. For each unit, the device was placed at the nurse station, specifically in the middle of the unit, to better approximate the noise level. Noise levels were only measured on weekdays; accordingly, no recordings were obtained on holidays and weekends. At each unit, readings were obtained over 24 hours, and the average was calculated. Before each measurement, the device was calibrated per factory guidelines to ensure accuracy. The instrument measured the noise level in dB in a single second, with an accuracy of +1.5 dB and a sensitivity range of 30 to 130 dB. A total of 259,200 sound samples were obtained.

Analysis

Data from the noise meter device were electronically downloaded and analyzed using SPSS (IBM Corp. Released 2013. IBM SPSS Statistics for Windows,

Version 22.0). Descriptive statistics were used for the quantitative analysis. Numerical variables are presented as means and SDs. The average sound pressure level was calculated for each unit and compared with the WHO noise pollution standard. The results from the three units were also compared. According to the CDC, noise above 70 dB is "irritating" and can damage hearing over time. Thus, readings above 70 dB/second indicated noise pollution. The period where noise level readings exceeded 70 dB in one second was summed and then divided by 60 to obtain the total number of minutes of noise pollution.

Results

A total of 259,200 sound samples were recorded and analyzed. The average noise level over 24 hours in all clinical areas was 62 dB, with acute care and resuscitation areas reporting the highest average levels of 63.4 and 62.8 dB, respectively. Among all clinical areas, the pediatrics unit had the highest noise spike (97.3 dB), followed by the resuscitation unit (RU) (88.5 dB) and acute care unit (ACU) (87.3 dB). Figure 1 shows the highest and lowest sound pressure levels over 24 hours in each unit.

Noise levels in all clinical areas fluctuated over time. The pediatrics unit had the highest level of noise between 21:00 and 23:00, with 23:00 recorded as the noisiest hour. Two additional noise spikes were recorded in the ACU; the first spike occurred between 6:00 and 8:00, and the second spike occurred between 9:00 and 13:00. RU noise levels were the highest between 12:00 and 16:30, with 12:00 recorded as the noisiest. Figure 2 shows the average of the highest and lowest peaks of noise per hour in each unit.

A lower level of noise was observed in the ACU between 6:00 and 9:00, with 7:00 recorded as the quietest hour. In addition, noise levels decreased in the RU between 2:00 and 5:00, and in the pediatrics unit between 13:00 and 14:00, and 19:00 and 20:00. Notably, even in the quiet periods, the sound levels frequently exceeded 40 dB.

The ACU was found to have the longest period of noise pollution, with 103 minutes. The shortest period of noise pollution was recorded in the RU, with only 67 minutes. The noise pollution period in each unit is shown in Table 1.

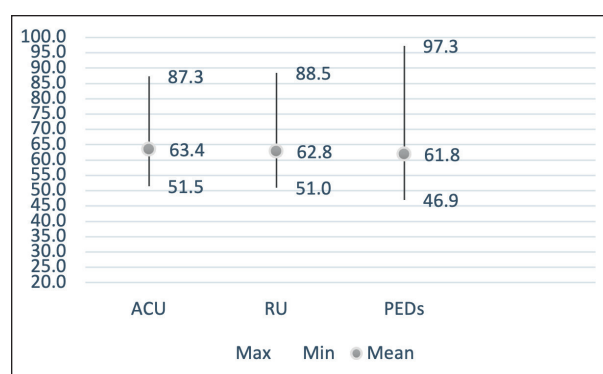


Figure 1. Highest and lowest sound pressure levels over 24 hours in each unit.

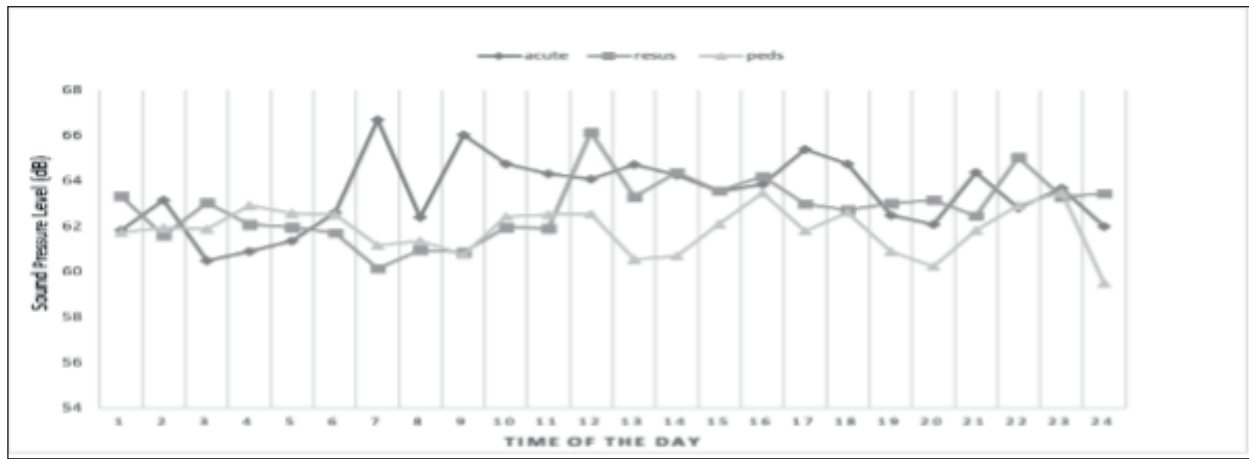


Figure 2. Averages of the highest and lowest peaks of noise per hour in each unit.

Table 1. Period of noise pollution over 24 hours in each unit.

Unit	Period of noise pollution
Acute Care	103 minutes
Resuscitation	67 minutes
Pediatrics Unit	77 minutes

Discussion

An increase in noise levels beyond the recommended range has been revealed to have a direct negative impact on the safety and health of patients and healthcare providers [6]. Based on previous studies, increased noise levels adversely affect cardiovascular and physiological functions [3,4].

Headache, anxiety, increased stress levels, and burnout are potential psychological effects of high noise levels [11-17]. High noise levels are also potential contributors to physician-and nursing-related errors [18-20].

To our knowledge, this study is the first to measure noise across multiple units in the ED of a tertiary care hospital in Saudi Arabia, including the adult ACU, RU, and pediatrics unit. Over the 24-hour period, measurements of all areas indicated that noise levels were above the WHO guidelines for hospitals, which recommend equivalent sound levels below 40 dB. The highest level of noise in the pediatric unit was recorded between 21:00 and 23:00, with 23:00 being the noisiest hour. In the ACU, the first noise spike occurred from 6:00 to 8:00 while the second noise spike occurred from 9:00 to 13:00. In the RU, noise levels were highest between 12:00 and 16:30, with 12:00 being the noisiest hour. Notably, sound levels frequently exceeded the recommended range of 40 dB even during periods of low noise, including at night. As a result, patients' recovery could be negatively impacted as the necessary rest and sleep may not be attained. This finding could be attributed to the overcrowding of patients in the ED, secondary to the lack of a sufficient number of inpatient beds [7,21].

The pediatrics unit had the highest noise level of 97.30 dB, with a noise pollution duration of 77 minutes in 24 hours. Such a finding could be attributed to multiple

reasons. For instance, children are more likely to display feelings of stress in public and are less likely to vocalize their pain, ultimately resorting to crying [22]. The pediatric ED had a period of dips in noise, with levels reaching 46.9 dB. Such a result could be attributed to the isolation rooms in which patients reside after admission.

The second-highest noise pollution reading was recorded in the resuscitation area. Noise levels reached a peak of 88.5 dB, and the duration of noise pollution was 67 minutes over 24 hours. This value was higher than that reported by Short et al. [7] in Australia, where the highest noise level over 24 hours was 57.4 dB in the RU. Of note, the peak of 88.5 dB was lower than that found in a study conducted in a large ED in Los Angeles, where individual peaks of 90.1 and 127.2 dB were measured over 12 hours [10]. Such variations in noise peaks could be attributed to multiple factors, including the varying structures and floor planning in EDs across different hospitals worldwide, patient flow, and loud technological equipment [4,7,23]. High noise levels are due to the chaotic nature and constant stress in the resuscitation area, which is caused by the simultaneous presence of multiple specialized teams comprising attending consultants, residents, nurses, and other healthcare professionals.

The ACU had the highest period of noise pollution in this study, with 103 minutes over 24 hours. The acute care area also had a noise spike of 87.3 dB, which exceeds the desired range. Notably, this value was significantly higher than that reported by Short et al. [7] as their highest reading was 64.9 dB over 24 hours. The factors that contribute to increased noise include the overcrowding of patients in the ED, patients waiting for beds, multiple sitters accompanying patients, and ongoing multidisciplinary patient rounds. Increased levels of noise pollution can lead to a decrease in the quality of care delivered to patients, and serve as an important factor for patients leaving the ED before appropriate medical checkups and evaluation [24]. Moreover, high noise peaks could decrease the physician's ability to listen and assess heart and lung sounds, ultimately increasing their chances of missing critical conditions [25]. A study that sought to determine the quality of auscultating heart and lung sounds in the ED found that 3.8% of the tested staff could not auscultate a heart sound, and 8.7% could not

distinguish between different lung sounds owing to the high noise levels in the ED [25].

Although noise in the ED is unavoidable, and peace and silence may be difficult to achieve, different measures can be implemented to reduce noise. Simple methods, such as closing doors and lowering voices when speaking, should be encouraged. Other measures include dividing the ED into small units, arranging beds in a cubicle format instead of placing stretchers next to each other, separating the beds with soundproof walls and glass doors instead of curtains, limiting the number of sitters to one per patient, limiting access between waiting and management areas, and regularly measuring the level of alarm sounds.

Limitations

The study was conducted on weekdays, and not on weekends. Further, noise levels were not measured on public holidays, and were only measured in the ED. Accordingly, ICUs, medical wards, surgical wards, and clinics were excluded.

Conclusion

To our knowledge, this is the first study to focus on noise pollution levels in different units in the ED in Saudi Arabia. Noise levels were dangerously high in the assessed units, which poses a risk to the patients' well-being and recovery, and could contribute to adverse outcomes for the healthcare provider. Future studies should assess noise levels in other departments, including on weekends and holidays. Additional studies should also evaluate the effectiveness of different interventions in lowering noise levels. Finally, incorporating a set of guidelines in the healthcare setting is vital for monitoring noise levels and maintaining them at the standard level.

List of Abbreviations

ACU	Acute care unit
CDC	Centers for disease control and prevention
ED	Emergency department
ICU	Intensive care unit
RU	Resuscitation unit
WHO	World Health Organization

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None.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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Ethical approval

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