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Noise Levels at Mosul City's Academic Medical Centers

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ABSTRACT
The following institutions are prone to noise pollution: hospitals, medical suites, and elderly care homes.Hospitals with excessive noise levels may have an adverse effect on patient care,doctor-patient interaction, and medical education.
Aim: this study is to quantify the noise levels at Mosul City's teaching hospitals, break those levels down by time of day and night, and compare the noise levels on weekdays and weekends. We used digital sound level meters to assess the noise levels at the Iben-Sena, Aljamhory, Alkhansa'a, and Alsalam Teaching Hospitals. Material and methods: We measured and categorized the noise levels in each hospital at nine in the morning, eleven in the afternoon, two in the evening, five in the evening, and seven in the evening. The medical ward is involved in all hospitals, but Aljamhory Teaching Hospital adds the important areas to that future research may use it as a baseline.
Results: The study included a total of 556 readings obtained from all participating hospitals. We calculate the average of all measurements after selecting a parameter, the equivalent sound level (Leq) in decibels (dBA). Plus, you can see how much noise there is on weekdays (Sunday through Thursday) compared to weekend days (Friday and Saturday). Acurrent experiment is investigating the origin of background, noise at academic medical centers.
Findings: Iben-Sena, Aljamhory, Alkhansa'a, and Alsalam Teaching Hospitals had mean Leq sound levels of 73.2 BA, 74.4 dBA, 73.8 dBA, and 69.2 dBA, respectively.
Conclusion: After looking at the Leq sound levels throughout the week and on weekends at each teaching hospital, we find that Ibensena, Aljamhory, and Alkhansa'a all had levels of 73.6 dBA, 71.5 dBA, and 73.9 dBA,respectively.In addition, the measurements taken on both weekdays and weekends by Alsalam were 69.6 and 67.3 dBA, respectively, indicating that there is no statistically significant difference (P > 0.5).The majority of hospital noise comes from visits (61.3%), followed by conversations (10.6%), and then the teaching process (9.36%).Results showed that across the board, the four teaching hospitals' noise levels were higher than the World Health Organization's recommended threshold for healthcare facilities.Even though the noise level at Alsalam Teaching Hospital was far lower than that of other hospitals, it was still too high.
KEYWORDS Noise, Mosul City's, Levels, pollution, TIME.

Introduction:

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A noise is a sound that is clearly unpleasant, undesirable, or distracting because it does not have a nice musical character. Noise pollution is when disturbing or dangerous sounds are heard in a specific area. Noise levels surpassing 40–50 dB are known to induce a variety of negative reactions, including discomfort, disturbed sleep, psychosis, hypertension, tachycardia, and possibly IHD. Environmental stresses often trigger acute and persistent increases in catecholamine levels (fight-or-flight reaction) and cortisol levels (defeat reaction) at noise levels of 55 to 60 dB (1,2). Excessive noise levels in hospitals can negatively impact medical education, doctor-patient interaction, and patient care (3).

Many times, the noise level in a hospital operating room is higher than that of a highway, and even more often, it is comparable to the noise level of a kitchen with a food mixer running, a train, or a truck. The US Federal Occupational Safety and Health Act sets an eight-hour limit of 90 dB(Ascale) for surgical room noise levels in (4). In order to lessen the negative health impacts of noise exposure, the World Health Organization (WHO) has developed standards to support community noise control plans. The suggested noise levels in hospital areas during the day should be 35–40 dBA, while in the evening they should be 30–40 dBA. To prevent sleep problems, keep indoor spaces (dwellings) at an acceptable 35 dBA, and keep bedrooms at a limit of 30dBA.

Hospitals should maintain noise levels below 45 dBA during the day and 35 dBA at night, according to the Environmental Protection Agency (EPA) (5). Due to the risk of long-term hearing damage, the Occupational Safety and Health Administration (OSHA) suggests that workers wear earplugs if they are required to be near noise levels above 85 dB for eight hours or more (6). The American Family Physician published a study in 2001 that lists frequent causes of noise (7). A quiet dwelling is around 40 dBA, a private office is about 50 dBA, conversational discourse is about 60 dBA, a vacuum cleaner is about 70 dBA, heavy traffic is about 80 dBA, a pneumatic hammer is about 100 dBA, and a jet aircraft is about 120 dBA, to name a few examples of approximate sound levels (8). These are simply rough estimates, though, because hearing is a complicated process. According to Ulrich and Zimring (10), several studies have found that the majority of American hospitals have very high noise levels. After reading these papers, they summarized two common causes of noise in healthcare facilities.

First, there are the sounds made by things like paging systems, alarms, bedrails, phones, employees' voices, ice makers, pneumatic tubes, delivery people, and housemates.

The second contributing factor is the fact that most hospital flooring, walls, and ceilings are hard and reflect sound instead of absorbing it. The bustle of the sluice and service rooms, the chatter of visitors, the tapping of nurses' and physicians' heels, and the snores, moans, or flatus of patients are among the background noises (4). Although it is impossible to escape the noise in a public hospital, there are numerous negative physical and psychological effects of long-term noise exposure that pose a health risk. These effects include sleep disturbance (12), cardiovascular manifestation (13,14), psychological and central nervous system manifestation (15), gastrointestinal manifestation (16), and noise, induced hearing loss (NIHL) (17,18). The Mosul City Teaching Hospitals of Iben-Sena, Aljamhory, Alkhansa'a, and Alsalam will have their noise levels measured. Also, find out how satisfied patients and staff are with the noise level, and figure out where the noise might be coming from.

MATERIALS AND METHODS

All participating teaching hospitals and the College of Medicine/University of Mosul gave their administrative and ethical approvals before data collection began, and the Nineveh Directorate of Health also gave their stamp of approval Environments for research, this research takes into account the Iben-Sena, Aljamhory, Alkhansa'a, and Alsalam Teaching Hospitals in Mosul. Data gathering technique:

This research made use of a QMEST Technology Digital Sound Level Meter (DSLM) Model 2900. A portable sound level meter is one way to measure the decibel level in a healthcare facility. When you install noise warning signs, you eliminate the need to rely on a single person's perception of the noise levels. We set up the sound level meter one meter from the ground, one and a half meters from any walls or windows, and carried out the measurement for around five minutes while the crew, remained, oblivious. Decibel (dB) noise level is

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the primary outcome measure; it is the mean of readings taken at the same location and time but on various days to determine the overall sound level. This research focuses on reading at the equivalent sound level (Leq). We chose the following times on weekdays (Sunday through Thursday) and weekends (Friday and Saturday) to diagnose the time-pattern difference: 9:00 AM, 11:00 AM, 2:00 PM, 5:00 PM, and 7:00 PM. The study collected a total of 556 readings from various locations within teaching hospitals.These included the medical wards on the fourth floor of Iben-Sena Teaching Hospital, the pediatric wards on the first, second, and third floors of Alkhansa'a Teaching Hospital, the medical wards on the fourth floor of Alsalam Teaching Hospital, and the main areas such as the hospital facet, corridors, intensive care unit, theaters, kitchen, laundry, and administrative department at Aljamhory Teaching Hospital. The hospital closed the last three locations after 2:00 PM, marking the end of the first shift. We attempted to identify the potential noise source during data collection, not during the measurements themselves. Statistical Testing and Data Analysis: We used Excel 2007 for data tabulation and coding. We conducted both descriptive and analytical statistics using the statistical application. Minitab version16. When comparing more than two means, an analysis of variance (ANOVA) with Tukey's pair wise comparison or an independent T-test for differences between two means are both part of the statistical toolbox. Statis We maintained statistical significance throughout the data analysis for p-values less than or equal to 0.05.tcome According to the temporal pattern, the highest mean Leq sound level in patient bedrooms at Iben-Sena Teaching Hospital is at 5:00 PM (74.3 dBA), and the lowest at 2:00 PM (71.9 dBA) (Table 1).

According to Table 2, the Leq sound levels in patients' bedrooms vary between 70 and 74 dBA during the first shift (9:00AM – 2:00PM) and then drop to 67 to 68 dBA during the second shift. Even in the intensive care unit, with somewhat lower measurements, the disparities are discernible. At 9:00 and 11:00 AM, the level remains constant at 80 dBA in cinemas;however,there is a decrease in reading at 2:00 PM, reaching 66. 6 dBA. Also, the noise level in the laundry room has steadily increased from 80.7 dBA to 96 dBA over the past few years.

RESULTS

The loudest recorded Leq level was 99.3 dBA in the laundry room at 2:00 PM, while the quietest recorded at 7:00 PM in the patients' bedroom was 50.7 dBA. Table 3 displays the average Leq sound level in the bedrooms of Alkhansa'a Teaching Hospital patients. At 11:00 AM, the mean was 74.7 dBA, and at 5:00 PM, it was 72.0 dBA, the lowest recorded. Data from the guestrooms of Alsalam Teaching Hospital demonstrate that the mean Leq sound level is greater during the day than at night, regardless of the lowest or maximum values (see Table 4).

Table 5 demonstrates that there is no significant variation ($P < 0.05$) in the Leq sound level between workdays and weekend days at each teaching hospital.

Table 6 shows the potential sources of noise in teaching hospitals: visitors make the most noise, followed by conversations, and finally the teaching process.

The study's inclusion of the intensive care unit, the theater, and the laundry makes machine noise the second most significant element at Aljamhory Teaching Hospital, behind only visitors and medical devices.

Table 1: Leq sound levels in the bedrooms of Iben-sena Teaching Hospital patients, with their respective means and standard deviations.

Time	No. of readings	Mean ± S.D	Minimum	Maximum
9:00 AM	23	72.9 ± 3.4	67.9	80.0
11:00 AM	20	73.9 ± 4.1	63.9	80.6
2:00 PM	14	71.9 ± 5.7	63.5	81.4
5:00 PM	12	74.3 ± 5.2	68.2	85.6
7:00 PM	18	72.7 ± 5.8	61.6	85.6

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Table 2. Aljamhory Teaching Hospital's Leq sound level distribution throughout time, with standard deviation and mean values shown in**.**

Time	Location	No. of reading	Mean ± S.D	Minimum	Maximum
9:00 AM	Hospital facet	4	81.1 ± 3.09	78.2	84.2
	Corridors	8	79.5 ± 5.1	72.8	88.6
	ICU	8	72.4 ± 5.4	67.4	83.3
	Patient bedroom	24	74.4 ± 4.2	62.4	84.7
	Theaters	6	80.7 ± 3.8	75.8	87.0
	Kitchen	7	81.7± 3.5	77.8	87.8
	Laundry	7	85.1 ± 4.7	79.1	92.8
	Adm.Dep.	7	78.6 ± 6.1	71.8	86.9
11:00 AM	Hospital facet	4	81.2 ± 4.8	76.7	87.6
	Corridors	7	78.1 ± 6.3	70.2	86.9
	ICU	7	71.6 ± 7.2	58.1	79.9
	Patient bedroom	21	70.9 ± 7.8	51.8	82.5
	Theaters	6	80.8 ± 6.8	69.1	89.9
	Kitchen	6	83.2± 9.4	68.8	97.7
	Laundry	6	88.4 ± 5.9	77.7	94.7
	Adm.Dep.	6	75.5 ± 2.9	72.4	79.8
2:00 PM	Hospital facet	2	74.4 ± 3.8	71.7	77.1
	Corridors	5	77.7 ± 6.3	68.7	83.5
	ICU	5	70.6 ± 4.3	67.5	78.2
	Patient bedroom	15	72.8 ± 5.5	62.4	83.4
	Theaters	5	66.6 ± 5.5	58.2	71.8
	Kitchen	5	85.5 ± 1.1	84.6	87.4
	Laundry	5	96.0 ± 2.7	92.6	99.3
	Adm.Dep.	5	83.8 ± 2.9	80.5	88.1
5:00 PM	Hospital facet	7	74.1 ± 4.1	66.6	78.7
	Corridors	7	71.9 ± 3.1	66.3	75.8
	ICU	7	65.4 ± 2.4	62.2	68.8
	Patient bedroom	21	68.5 ± 6.5	57.9	78.2
	Theaters*	0	*	*	*
	Kitchen	6	81.5 ± 2.9	78.1	84.5
	Laundry*	0	*	*	*
	Adm.Dep.*	0	*	*	*
7:00 PM	Hospital facet	8	73.0 ± 6.38	60.1	80.6
	Corridors	8	73.19 ± 5.8	64.4	79.5
	ICU	8	67.8 ± 3.4	62.4	72.0
	Patient bedroom	24	67.4 ± 7.3	50.7	81.2
	Theaters	0	*	*	*
	Kitchen	6	78.3 ± 6.7	65.0	83.9
	Laundry	0	*	*	*
	Adm.Dep.	0	*	*	*

*Theaters, laundry and administrative department are closed after 2:00 PM.

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Table 3. At Alkhansa'a Teaching Hospital, the average and standard deviation of the Leq sound level in patient bedrooms are displayed in **.**

Time	No. of reading	Mean ± S.D	Minimum	Maximum
9:00 AM	25	74.1 ± 5.6	64.1	85.4
11:00 AM	25	74.7 ± 4.2	66.1	82.5
2:00 PM	18	73.8 ± 5.1	64.2	81.5
5:00 PM	10	72.0 ± 6.3	59.9	79.6
7:00 PM	11	73.4 ± 4.3	64.9	82.2

Table 4 shows the average decibel level (LEq) in the bedrooms of patients at Alsalam Teaching Hospital over a 24-hour period.

Time	No. of reading	Mean ± S.D	Minimum	Maximum
9:00 AM	27	69.6 ± 4.8	61.6	82.9
11:00AM	28	70.0 ± 5.4	58.4	78.6
2:00 PM	24	68.9 ± 5.0	56.6	78.1
5:00 PM	9	66.9 ± 4.1	62.6	75.4
7:00 PM	9	67.1 ± 4.1	59.4	72.9

Table 5 Leq sound levels on weekdays compared to weekends in academic medical centers.

Hospitals' name	Workdays Mean ± S.D	Weekend days Mean ± S.D	P-value*
Iben-sena	73.6 ± 4.6	71.5 ± 4.9	0.102
Aljamhory	75.3 ± 8.7	73.9 ± 7.2	0.152
Alkhansa'a	74.1 ± 5.3	73.6 ± 4.3	0.635
Alsalam	69.6 ± 4.8	67.3 ± 5.3	0.086

*independent t-test with two means

Table 6: Possible causes of noise in hospitals that provide medical education.

Name of hospital	Teaching process No. (%)	Visitors No. (%)	Conversation No. (%)	Medical devices No. (%)	Air condition No. (%)	Machine No. (%)	Total percent in each hospital
Iben-sena	6 (6.74%)	68 (76.4%)	11 (12.3%)	1 (1.12%)	3 (3.37%)	0 (0%)	89 100%
Aljamhory	7 (2.4%)	157 (53.95%)	32 (10.99%)	37 (12.7%)	11 (3.78%)	47 (16.15%)	291 100%

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Alkhansa'a	19 (21.34%)	56 (62.9%)	10 (11.23%)	4 (4.49%)	0 (0%)	0 (0%)	89 100%
Alsalam	21 (21.6%)	66 (68.04%)	7 (7.21%)	0 (0%)	3 (3.09%)	0 (0%)	97 100%
Total percent	53 (9.36%)	347 (61.3 %)	60 (10.6 %)	42 (7.42 %)	17 (3.0 %)	47 (8.3 %)	566 100%

DISCUSSION

At 5:00 PM, when the hospital is busiest with patients and their families, the Leq sound level in the medical wards was 74.3 dBA. At 11:00 a.m., when there was more staff and teaching activity, the Leq was slightly lower at 73.9 dBA. At 2:00 PM, when the first shift was ending, the Leq was lower at 71.9 dBA. The Leq sound level on the Iben-Sena hospital floor was 85.65 dBA in 2013, according to research on noise pollution in Mosul Medical City Center Teaching Hospitals conducted by Al-Zubeer et al. (19), which is lower than these findings.

In 2010, Juang et al. (20) measured the levels of noise pollution in several Taiwanese hospitals from 8:30 to 9:30, 11:30 to 12:30, and 16:00 to 17:00. The Leq sound levels in the hospital (A) were 57.3 dBA, 57.6 dBA, and 56.9 dBA, respectively. In hospital (B), the Leq sound levels were 46.0 dBA, 53.6 dBA, and 52.3 dBA, respectively. In the hospital (C), the Leq sound levels were 45.1 dBA, 53.8 dBA, and 52.1 dBA, respectively. Table 2 reveals that during the first shift at Aljamhory Teaching Hospital, the noise level in patients' bedrooms increased to above 70 dBA, and during the second shift, it decreased to just over 65 dBA. Darbyshire et al. (21) (2013) conducted research on five intensive care units in the United States, consistently reporting a Leq greater than 45 dBA. Additionally, in over half of the minutes examined, the Leq was between 52 and 59 dBA. The Aljamhory hospital floor had a greater noise level, according to Al-Zubeer et al. (19), with a Leq sound level of 91.84 dBA. The current study found that the noise level in the theaters dropped by approximately 14 degrees (66.6 dBA) due to the cessation of surgical procedures at 2:00 PM, reduced staff numbers, and the absence of patients and family. The noise level was 80 dBA at 9:00 and 11:00 AM.

Nevertheless, 2007 research by Kracht et al. (22) indicated a lower Leq of 66 dBA in the orthopedic surgery rooms at Johns Hopkins Hospital.

The first, second, and third medical foyers (patients' bedrooms) of Alkhansa'a Teaching Hospital had Leq so und levels exceeding 70 dBA.

Kulwa et al. (2011) found lower rates in pediatric wards at Bunda District Hospital in Tanzania's Lake Victo ria Zone, while our results are higher.

During the first shift, the Leq sound level is somewhat higher (68 to 70 dBA) at Alsalam Teaching Hospital, but it drops slightly (66 to 67 dBA) during the second shift.

Because the reception system restricts visitors and patients' relatives at all times, this little range is developin g. At 2:00 PM, the lowest recorded Leq sound level was 56.6 dBA. In 2007, Pai (24) discovered a lower measurement of 50.3 dBA for the wards' noise level. Bharathan et al. (25) found that the nursing home does not experience the most noisy times of day—58.9 dBA in the morning and 56.5 dBA in the afternoon—during the middle of the day. Since the reception systems and visitor control at each hospital are consistent throughout the week and staff activities do not vary, the Leq sound level reveals a slightly lower noise level on weekends compared to weekdays. Consequently, this difference is not statistically significant ($P \geq 0.05$).

While Bharathan et al. (25) found that noise levels were greater on weekdays (69.5 dBA) than on weekends (67.2 dBA) ($P < 0.001$), this result contradicts that. Similarly, in the intensive care unit (ICU), weekdays (64.7 dBA) had higher noise levels than weekends (63.3 dBA) ($P < 0.001$).

The difference between weekdays (63.7 dBA) and weekends (63.3 dBA) on the health floor and nursing faci lity did not follow this trend. According to this research, 76.4% of the noise at Iben-Sena Teaching Hosptal comes from patients and visitors.

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Visitors account for 53.95 percent of the hospital's noise, followed by laundry and culinary appliances at 16. 15 percent, and medical devices at 12.7 percent, all of which are a result of the hospital's theaters and intensi ve care units.

Similarly, visitors account for 62.9% and 68.04 percent of noise at Alkhansa'a instructional hospitals, respectively, while instructional processes account for 21.34 and 21.6% of noise during morning readings, re spectively. The results show that visitors are the main cause of the increased noise level in hospitals due to their heavy foot traffic, constant pounding on doors, and use of hospital furnishings. Because both staff and patients must raise their voices to be heard, even while using cell phones, conversation was the second source of noise.

CONCLUSIONS

In Alkhansa'a and Alsalam Teaching Hospitals, teaching procedures are the third most common source of no ise, whereas in Iben-Sena and Aljamhory Teaching Hospitals, they contribute very little. In 2002, Allaouchiche et al. (26) found that staff chat generated 56% of noises over 65 dB, with alarm, telephone, and nursing care accounting for the remaining 10%. IN THE END It was discovered that all noise measurements in the four academic medical centers were higher than the levels considered tolerable by the World Health Organization for healthcare facilities.

Though still inadequate, the standards at Alsalam Teaching Hospital were much lower than those at competi ng facilities. Even on weekends, when hospital congestion is lower than during the week, it is still rather high. Lastly, visitors, patient and nurse chatter, and the crowding of patients' relatives contribute significantly to the noise levels on wards. Thoughts Proposed

RECOMMENDATIONS

This study mostly suggests the following:

1.We will control each hospital's visitation count by activating a quiet time policy.
2. train employees to recognize and reduce the impact of noise.
3. Cover the walls, ceiling, and floor with soundproof material.
4. option is to use curtains to separate patients' beds in public rooms if individual isolation is not possible.
5. We will limit the use of loud devices, such as mobile phones and radios, in patients' bedrooms.
6. We will distribute posters to educate individuals on the importance of silence for patient well-being and staff efficiency.

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الخلاصة
مقدمه : المستشفيات وأجنحة المرضى ومراكز الرعاية الاولية جميعها معرضة للضوضاء. ارتفاع مستويات الضوضاء في المستشفيات قد يؤدي إلى التأثير على الخدمات الصحية المقدمة للمرضى وعلى علاقة الاطباء مع المرضى بالإضافة إلى فاعلية التعليم الطبي.
هدف الدراسة: قياس مستويات الضوضاء في المستشفيات التعليمية في مدينة الموصل و تحديد الاختلاف حسب الزمان والمكان و تعيين نمط الضوضاء اثناء النهار و الليل, علاوة على ذلك ايام العمل و ايام عطلة نهاية الاسبوع.
طريقة الدراسة: قياس مستوى الضوضاء في مستشفيات ابن سينا والجمهوري والخنساء والسلام التعليمية بواسطة مقياس مستوى الصوت الرقمي (Digital Sound Level Meter). في كل مستشفى كان هنالك تصنيف للوقت كما يلي : 9:00 صباحا و 11:00 صباحا و 2:00 بعد الظهر و 5:00 عصرا و 7:00 مساءا. كانت ردهات المرضى هي المشمولة بقياس مستوى الضوضاء في المستشفيات التعليمية ولكن في مستشفى الجمهوري تمت إضافة الاماكن الرئيسية فيها لتكون قاعدة بيانات لدراسة مستقبلية. تم أخذ 556 قراءة في المستشفيات التعليمية كافه بوحدة قياس الدسي بل و القراءة المستخدمة في هذه الدراسة هي معدل الصوت المكافئ (Leq). و من ثم أخذ معدل القراءات الكلي , بالإضافة

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, هنالك مقارنة مستويات الضوضاء بين أيام العمل (الأحد إلى الخميس) و أيام عطلة نهاية الاسبوع (الجمعة و السبت). تم القيام بتقدير مصدر الضوضاء المحتمل.
النتائج: معدل الصوت المكافئ في مستشفيات إبن سينا و الجمهوري و الخنساء و السلام كان .273 دسي بل 74.4 دسي بل 73.8 دسي بل 69.2 دسي بل على التوالي. بعد مقارنة معدل الصوت المكافئ بين أيام العمل و أيام عطلة نهاية الاسبوع نكتشف في مستشفى إبن سينا 73.6 دسي بل و 71.5 دسي بل وفي مستشفى الجمهوري 75.3 دسي بل و 73.9 دسي بل و في مستشفى الخنساء 74.1 دسي بل و 73.6 دسي بل و في مستشفى السلام 69.6 دسي بل و 67.3 دسي بل مع ملاحظة عدم وجود اختلاف هام (significant difference) في المستشفيات اعلاه. يساهم الزوار في مصدر الضوضاء الرئيسي (61.3 %) في المستشفيات يلي ذلك المحادثة (10.6 %) و من ثم التدريس (9.36 %).
الاستنتاجات: من هذه الدراسة يتبين أن مستويات الضوضاء في المستشفيات التعليمية الاربعة قد تعدت الحدود المقبولة من قبل منظمة الصحة العالمية (WHO) , على الرغم من ان مستوى الضوضاء في مستشفى السلام كان أقل من باقي المستشفيات ولكنه لا زال في الحدود الغير مقبولة.