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Evaluation of The Environment in Operating Theater and Delivery Unit and Neonatal Care Unit at Al-Zahra Hospital for Women and Children

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Abstract

The study aimed to assess the efficiency of the sterilization process and the process of controlling contamination within the environment in AL- Zahra Hospital for women and children in AL- Muqdadiya located at Diyala province- Iraq, which extends at latitudes (-3.33 and -36.6) north and longitudes (-44.22 and 45.56) east, during the period from 25 December 2021 to 19 February 2022 due to deficiency of studies that are interested in this field. One hundred ninety - two of air sample was taken distributed to the hospital halls such as the surgical hall and its corridor that leads to it, the delivery hall and its corridor that leads to it, the sterile preterm unit and its corridor leds to it, the main hall of the units, and the air outside the hospital environment, where the samples were divided into two groups, the first one includes 96 samples collected in the morning before the beginning of work at 8 :00am and the second include 96 samples collected during the work at peak time 12:00 noon. The result was expressed by colony forming unit (CFU/m^3). Bacterial microbial loads in hospital air ranged between 2-131 CFU/m3. Air bacterial loads in surgical hall ranged between 5-40, in a range 19.04 CFU/m3 and in the delivery hall ranged between 19-55.5, in a range 35.8 CFU/m3 and in the preterm infant hall 23.5-41.5, in a range30.5 CFU/m3 and in the main hall ranged between 34.5-89, in a range 60.4 CFU/m3 and in the outside air environment ranged between 39.5-115.5, in a range75.6 CFU/m3.

The variations between the two working groups was so that the rate was higher at noon compared to the morning group samples, with the rate of microbial load in the surgical unit in the morning 14.8 and evening 23.08, its corridor that leads to it in the morning 43.91 and evening 53.66 and the sterile preterm unit 22.91 evening 36.75, corridor that leads to it in the morning 27.5 and evening 40.8 the maternity hall in the morning 23 and evening 48.66, its corridor that leads to it in the morning 30.5 and evening 45.75. Main corridor hall in the morning 52.83 and evening 68.25 and air outside hospital environment in the morning 66.33 and evening 85 CFU/m3. Bacterial species isolated during the study were negative and positive bacteria for the gram stain, *Staphyllococcus* positive for gram stain recorded the highest isolation rate with 66 isolation rate 38%, and *Staphylococcus* epidermidis 54 isolation rate 31%. The negative bacteria of gram stain were isolated as follows, *K.aerogens* 24 isolation rate 14%, *E. coli* 16 isolation rate 9%, and *K. pneumonia* 8 isolations with isolation rate 5%, and the lowest isolation rate was *Proteus* species 4 isolations rate 2%. Contamination control swabs reached 100 swabs from non-living surfaces including the cesarean and delivery bed, flooring, ventilation outlets, anesthesia device, fluid withdrawal device, preterm incubators, ventilator and bandage cart, researcher was obtained the intestinal bacterial species, *E. coli* and *K.aerogens* 10 isolates in 38.5%, *Pseudomonas* 4 isolates in 15.4%, *K. pneumonia* 2 isolates in 7.7%.

Keywords: Nosocomial infection, Hospitals ventilation, contamination control, Air microbial load

تقييم بيئة صالات العمليات الولادة ورعاية حديثي الولادة في مستشفى الزهراء للنسائية والأطفال

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الخلاصة

Academic Science Journal

هدفت الدراسة إلى تقييم كفاءة عملية التعقيم وعملية السيطرة على التلوث داخل البيئة في مستشفى الزهراء للنسائية والأطفال في قضاء المقدادية في محافظة ديالى – العراق، خلال الفترة من 25 كانون الاول 2021 إلى 19 شباط2022 في ظل عدم وجود دراسات تهتم بهذا الجانب اذ تم أخذ 192 عينة هواء موزعة على صالات المستشفى مثل قاعة الجراحة وممرها المؤدي إليها، وقاعة الولادة وممرها المؤدي إليها، ووحدة الخدج المعقم وممرها المؤدي إليها، والقاعة الرئيسية للوحدات، والهواء خارج بيئة المستشفى، حيث توزعت العينات إلى مجموعتين الأولى شملت 96عينة تم جمعها في الصباح قبل بدء العمل عند 8 صباحا والثانية شملت 96 عينة تم جمعها أثناء العمل (وقت الظهيرة) عند 12 ظهرا. تراوح الحمل المكروبي البكتيري في هواء بيئة المستشفى بين 2- 131، حيث تراوح الحمل البكتيري في هواء الصالة الجراحية بين 5-40بمعدل 19,04، وفي صالة الولادة تراوح بين 19-55,5 بمعدل 35,8، وفي صالة الخدج المعقم تراوح بين 23,5-41,5 بمعدل 30,5، وفي الصالة الرئيسية تراوح بين 34,5-89 بمعدل 60,4، وتراوح الحمل المكروبي البكتيري في الهواء الجوي خارج بيئة المستشفى 39,5-115,5 بمعدل 75,6 .CFU/m3.

تغاير الحمل المكروبي البكتيري حسب وقت جمع العينة اذ كان وقت الجمع عند الظهيرة اعلى عند مقارنته مع وقت الجمع صباحا فكان معدل الحمل الميكروبي في الصالة الجراحية في الصباح 14.8وعند الظهيرة23.08، وممرها المؤدي إليها في الصباح 43.91 وعند الظهيرة 53,66، وفي صالة الولادة في الصباح 23 وعند الظهيرة 48,66،وممرها المؤدي اليها في الصباح 30,5 وعند الظهيرة 45,75،وفي صالة الخدج المعقم في الصباح 22,91،وعند الظهيرة 36,75،وممره المؤدي اليه في الصباح 27,5،وعند الظهيرة40,8، بينما سجل الحمل المكروبي في الصالة الرئيسية للمستشفى صباحا 52,83 وعند الظهيرة 68,25،وسجل المكروبي في الهواء الجوي خارج بيئة المستشفى في الصباح 66,33،وعند الظهيرة.CFU/m385 تم خلال الدراسة عزل وتشخيص انواع بكتيرية سالبة وموجبة لصبغة كرام حيث سجلت بكتريا المكورات العنقودية الموجبة لصبغة كرام اعلى نسبة عزل حيث تم الحصول على 66 عزلة بنسبة عزل 38%، بكتريا المكورات البشرية الموجبة لصبغة كرام 54 عزلة بنسبة عزل 31%، بينما سجلت البكتريا السالبة لصبغة كرام عزلات لبكتريا الكليبسيلا المعوية 24 عزلة بنسبة 14%، والاشريشية القولونية 16 عزلة بنسبة 9%، والكليبسيلا الرئوية 8 عزلات بنسبة 5%، واقل نسبة عزل كانت لبكتريا المتقلبات حيث حصلت الباحثة على 4 عزلات بنسبة 2%، بلغت مسحات السيطرة على التلوث 100 مسحة من الأسطح الغير حية حيث شملت سرير الولادة القيصرية الطبيعية والأرضيات ومنافذ التهوية وجهاز التخدير وجهاز سحب السوائل والحاضنات في الخدج وجهاز التنفس الصناعي وعربة الضماد تم زرع العينات وفحصها وتشخيصها حيث تم الحصول على الانواع البكتيرية المعوية حيث شكلت بكتريا الاشريشية القولونية والكليبسيلا المعوية 10 عزلات بنسبة عزل 38,5%، وبكتريا الزائفة الزنجارية 4 عزلات بنسبة 15,4%، وبكتريا الكليبسيلا الرئوية 2 عزلة بنسبة 7.7%.

الكلمات المفتاحية: اصابات المستشفيات، تهوية المستشفيات، السيطرة على التلوث، الحمل المكروبي للهواء.

Introduction

Nosocomial infection was defined as the infections that the patient acquires during his stay in the hospital, whether those infections have an exogenous source, Among the most important external sources of infection in hospitals, air, medical staff, devices and equipment, floors, walls, disinfectant and cleaning powders, constructing and design of halls, In addition to other factors such as wash basins, waste baskets, lamp and other source of the contamination, which are among the most important sources of infection and transmission of infection [1]. or they are endogenous sources, which means the existing microorganism in or on the body of the normal flora, where the problem of nosocomial infection has been one of the most important and most dangerous health problems that still face the whole world as more than 50% of patients who have asleep in the hospitals dies from these infections [2].

The importance of aerobic environmental control in hospitals has increased since 2003 with the onset of acute pulmonary infection (Severe acute respiratory syndrome (SARS), and therefore air conditioning has been used extensively and most of this use air conditioners, which leds to an increase in the use of recycled air with reduced air change rates to save money and fuel, as air quality in hospitals is amajor risk factor as well as it has health consequences for both the working staff and the patients and therefore there are efforts to search for alternatives to mechanical ventilation that help to prevent transmission, especially in developing countries [3].

After improvements in living conditions and infection control strategies, especially for tuberculosis and smallpox diseases and the emergence of antibiotics, airborne diseases (infections) has become less a threat to public health and thus weak the role of ventilation as a strategy to fight infection, but with the emergence of acute respiratory syndrome (SARS) between 2002-2003 and the emergence of Corona virus causing Middle East Respiratory Syndrome (COVID-1) 2018-2019, it recalled the seriousness of airborne diseases on human health as infection prevention and control became a vital part of the clinical therapeutic of patients, which are applied immediately after the patient's admission to the hospital and include typical personal precautions hand hygiene.

The use of personal protection equipment to avoid direct mixing with the blood of patients and fluids or their physical secretions including respiratory secretions or improper parts of the skin, safe waste management, cleaning of equipment and cleaning of the surrounding environment in addition to ensuring that personal care providers apply pollution control measures where they wear personal protection equipment (long-sleeved gloves, eye protection masks, appropriately tested breathing masks, tight and non-implementable particles compatible with N95 masks or their equivalent), and whenever well-ventilated individual rooms can be used for patients in the sense of working in rooms with negative pressure with air change at least 12 times per hour or at least 160 liters/second for the patient in rooms with natural ventilation in addition to avoiding the presence of people not to be present they need to be in the room [4].

Many factors affect patients entering health care institutions who are usually in poor health with poor defenses against bacteria and other infection factors, including advanced age, incomplete birth or immunodeficiency (due to medications, disease, radiation) as well as chronic obstructive pulmonary disease that increases the risk of respiratory infection, as these factors have been associated with an increased risk of health care-related infections including malignant diseases, immunodeficiency viruses, severe burns and some skin diseases, severe malnutrition, diabetes, bronchial disease, lethargy of the circulatory system, open wound, shock (5). In addition to environmental factors related to infection related to health care, which includes the mobile and non-mobile environment of patients where mobile environment includes health care staff, other patients in the same unit accompanying patients and visitors, the non-mobile environment refers to medical devices, environmental machinery and surfaces, and other risk factors associated with the health care environment ventilation, heat and humidity, therapeutic and diagnostic interference [6].

This study is one of the first studies at the level of Diyala province /Iraq to study the air microbial load of hospitals halls effectively (Active sampling). The method used in Iraqi hospitals depends on the principle of depositing air particles on surfaces or surfaces of dishes placed in spaces (passive sampling) which gives quality values only, and on the other hand there are no environmental standards in Iraq for microbial load levels in the air can be adopted for comparison purposes.

The research problem lies in the fact that hospitals, as they are places of the hospitalization but at the same time they are an incubator environment for many risks to the public health of the patients as despite the efforts to make the closed environments protected, it can become contaminated with microorganisms forming different risks, and some times more dangerous when their concentrations exceeds the permissible limits for human living in (1000) air born biological units that can cause air contamination [7]. One of the most important bacterial species that cause hospital infection are *Pseudomonas spp., Klebsiella spp., Escherichia coli, Staphyllococcus aureus, Haemophilus influenzae, Enterobacter spp., Proteus spp., Serratia spp., Enterococcus spp.* [8]. So because of aggravation of the problems of nosocomial infections and the suffering of many patients from delayed recovery after surgical interventions, in addition to the lack studies in Diyala governorate in this field and the importance of the clinically isolated pathogen was designed this study is at the level of AL-Muqdadiya district hospitals and which aims to:

Evaluating the degree of microbial load in the operating theaters, preterm infants and child birth, by measuring microbial load from selected places and identifying the most common bacterial species, sample taking by air sampling device and diagnosing them using the available biochemical testes. Evaluate method of taking swabs for non-living surfaces and compare them with the method of taking swabs used in hospital used to monitor contaminants in the operating room, birth and preterm infants' halls. Monitoring isolated bacterial species and observing their proportions, whether they are isolated from the air microbial load or from non-living surfaces.

Materials and methods

Air bacterial load of the environment of the operating theater, sterile preterm infant units, maternity hall and their corridors, as well as the air of outer environment of the hospital have been estimated at AL- Zahra Hospital for women and children in AL- Muqdadiya located at Diyala province, Iraq, which extends at latitudes (-3.33 and -36.6) north and longitudes (-44.22 and 45.56) east, during the period from 25 December 2021 to 19 February 2022.

Samples collecting

The air sample was collected twice a day in the morning at 8:00 am. (the start of work) and at 12:00 p.m.) Using the SAS100 sample collection device (International pbi spa Melon / Italy).

The device is programmed to pull different volumes of air into standard mode chosen by the operator, or to choose the programmable size (User Mode).

The following amounts of air are suggested by the nature of the inspection site:

1. Contaminated areas (communities, treatment rooms, etc.) 10-200 liters of air.
2. Natural areas (laboratory seats, houses, etc.) 200-500 liters of air.
3. Sterile or high-risk areas (clean rooms, operating theatres, etc.) 500-1000 liters of air.

In parallel pollution control swabs were collected (100 swabs) from surfaces of the same places, including the anesthesia cart, the patient's bed, fluid pullout device, ventilation outlets, walls and floors, and surgical machines.

Contamination control swabs

The total number of surface swabs (controlled on contamination) reached 100 from different places, including the natural cesarean and delivery bed, flooring, ventilation outlets, anesthesia device, fluid withdrawal device, preterm incubators, ventilator and bandage cart.

Samples cultures

Planting of air samples and pollution control swabs was implanted directly on blood, MacConkey and mannitol agar dishes. All dishes were incubated at 37° C temperature for 24 hours, after which biochemical and apparent diagnostic tests were conducted for isolated bacteria in laboratories of AL-Zahra hospital.

Diagnosis of bacterial isolates:

Isolated bacterial species were studied by observing the general characteristics of their growth on the blood, MacConkey and mannitol agar the colonies were identified and studied on the basis of color, size, textures and shape in addition to other general characteristics such as the ability of bacteria to produce catalase enzyme, presence of blood hemolysis on the blood agar or not.

Microscopic examination

Microscopic examination of bacterial cells after they were staining with gram stains and examined under the oil lens of the optical microscope.

Biochemical diagnostic tests

Oxidase, Catalase, Methyl red, Vox proscauer, Citrate utilization, Urease tests.

Calculating the results

The number of colony forming units observed on plates was calculated in cubic meters of halls and their corridors and outer air environment, the values of the constituent units of the colonies from 500 liters of hall air, which was prepared according to the statistical equation of the work done by J. Maker (8) Which was expressed by the statistical probability of passing several particles through the same hole on the surface of the counting dish, the potential number Pr is then used to calculate the number of colony units of CFU per cubic meter of the air sample according to the equation x = (pr x 1000) / v, where pr = cfu per dish, V = 500 liters of air.

Statistical analysis

The data were statistically analyzed using the Spss "Version 20" program, and chi square

Results and Discussion

There are two types methods of monitoring air quality within hospitals:

Ineffective method: In which the method of deposition is used on petri container dishes that contain suitable media for growth of the microbes and after the completion of the collection process is incubated under appropriate conditions, the results of this method are qualitative because only the vital particles deposited on the surface exposed to the air are monitored.

Effective method: Effective monitoring differs from ineffective monitoring in that it requires the use of modeling devices to draw microbial air samples, and to draw a known volume of air such as the SAS. sampler device used in the study [9].

Assessing of microbial load in the hospital halls and their corridors, outer air environment

The bacterial load in the air samples of the sites included in the study ranged between 2-131 units of colonies per cubic meter, where the results showed the variations of the bacterial load by location, by time of collection and as detailed below.

The bacterial microbial load ranged in one cubic meter. From the air of the surgical procedure hall between 5-40 at a rate of 19.04 CFU/m3, and variable depending on the time of collection of the model, in the morning at the start of work ranged between 2-39 (average 14.8) and at noon in the range of 6-41 in a rate of 23.08 CFU/m3, and the differences between the times were statistically significant at a significant level $P \leq 0.05$. (Table 1).

The bacterial microbial loads outside the surgical hall in the corridor leading to it ranged from 28 to 75.5, at a rate of 50.3 CFU/m3. It was also variable depending on the time the model was collected (it was morning at the start of work between 20-81, at a rate of 43.9, and at noon at 43-82, at a rate of 53.6 CFU/m3. The Mann-Whitney test showed that the differences in bacterial air load between the surgical procedure hall and outside the hall in the corridor leading to it were statistically significant (the calculated value was 4 and the p-value was lower than the significance level of 0.05).

In the delivery hall, the bacterial loads in the air ranged from 19-55, with an average of 35.8, CFU/m3. The bacterial loads outside the hall (in the corridor leading to it) ranged from 18 to 65.5, at a rate of 38.9, CFU/m3. The difference between inside and outside the hall were not statistically significant at a significant level of P≤0.05 (between the Man test and the calculated value of 69.5 and the error ratio P-Value) (greater than the significance level of 0.05).

Table 1: Microbial load measuring CFU/m^3 inside surgical hall and their corridor that leading to it in al-Zahra hospital for woman and children from 25Dec2021 to 19feb2022

Sample NO.	Collection day	Surgical unit ^{3}CFU/m AM	PM	Daily rates	Their corridor that leading to it ^{3}CFU/m PM	AM	Daily rates	Mann-whitney test value between inside and out side the ha
1	25-DEC	2	20	11	27	45	36	4,00
2	27-DEC	16	30	23	30	54	42	
3	29-DEC	10	18	14	20	38	29	
4	01-JUN	13	31	22	38	66	52	
5	03-JUN	14	22	18	44	40	42	
6	05-JUN	20	32	26	53	82	67.5	
7	08-JUN	4	6	5	81	58	69.5	
8	10-JUN	11	7	9	42	73	75.5	
9	12-JUN	20	29	24.5	25	38	31.5	
10	15-JUN	39	41	40	81	52	66.5	
11	17-JUN	11	18	14.5	64	64	64	
12	19-JUN	18	23	20.5	22	34	28	p-value to compare between pm and am Daily rates
Total		14.8	23.5	19.1	43.9	53.6	50.3	0.05

The bacterial loads inside the hall was variable depending on the time the model was collected, in the morning at the start of work it ranged from 13-39, at the rate of 23 CFU/m3, at noon at about 2-76, at a rate of 48.6, CFU/m3. It was also variable outside the hall in the corridor to it depending on the time the model was collected, in the morning at the start of work it was between 10-58, at a rate of 30.5 CFU/m3, and at noon at about 20-73, at a rate of 45.7 CFU/m3. However, the differences between the time the model was collected were not statistically significant (between the Mann-Whitney test that the calculated value (69,500) and the P-value error ratio was greater than the significance level of 0.05). As shown in Table 2.

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Table 2: Microbial load measuring CFU/m3 inside delivery hall and their corridor that leading to it in al-Zahra hospital for women and children from 25Dec2021 to 19feb2022

Sample NO.	Collection day	Delivery unit ^{3}CFU/m AM	PM	Daily rates	Their corridor that leading to it ^{3}CFU/m PM	AM	Daily rates	Mann-whitney test value between in and out the hall
1	25-DEC	29	51	40	25	34	39	69,500
2	27-DEC	18	29	23.5	30	42	36	
3	29-DEC	20	61	40.5	58	73	65.5	
4	01-JUN	24	56	40	40	53	46.5	
5	03-JUN	35	76	55.5	49	58	53.5	
6	05-JUN	13	25	19	13	28	20.5	
7	08-JUN	10	38	24	25	38	31.5	
8	10-JUN	19	53	36	15	21	18	
9	12-JUN	39	55	47	29	68	48.5	
10	15-JUN	21	60	40.5	10	41	25.5	
11	17-JUN	23	32	27.5	16	20	18	
12	19-JUN	25	48	36.5	56	73	64.5	p-value to compare between pm and am Daily rates
Totale		23	48.6	35,8	30.5	45.7	38.9	0.05

The bacterial load in the sterile preterm infant hall air ranged from 23.5 to 41.5, at a rate of 30.5 CFU/m3. It was variable inside the hall depending on the time the model was collected, in the morning when work began at 15-34 at a rate of 22.9 and at noon at 25-58 at a rate of 36.7 CFU/m3. The differences were statistically significant at a significant level $P \leq 0.05$.

The bacterial microbial load outside the sterile preterm infant hall (in the corridor leading to it) ranged from 19 to 52.5 at a rate of 34.1 CFU/m3. It was variable depending on the time the model was collected, in the morning at the start of work at 10-44, at a rate of 27.5, and at noon at 24-65, at a rate of 40.8, CFU/m3. The Man Whitney test showed that there was a statistically significant difference between the sterile preterm infant's hall and outside the hall in the corridor leading to it in bacterial microbial load (calculated value 60 and P-Value error ratio below the significance level of 0.05) as in the table 3.

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Table 3: Microbial load measuring CFU/m3 inside neonatal care hall and their corridor that leading to it in al-Zahra hospital for women and children from 25Dec2021 to 19feb2022

Sample NO.	Collection day	Neonatal care unit ^{3}CFU/m AM PM		Daily rates	Their corridor that leading to it ^{3}CFU/m PM AM		Daily rates	Mann-whitney test value between inside and outside the hall
1	25-DEC	15	45	30	29	41	35	60.00
2	27-DEC	20	35	27.5	42	53	47.5	
3	29-DEC	19	28	23.5	35	56	45.5	
4	01-JUN	23	25	24	25	39	32	
5	03-JUN	25	58	41.5	40	65	52.5	
6	05-JUN	34	42	38	44	58	51	
7	08-JUN	30	35	32.5	30	37	33.6	
8	10-JUN	19	35	27	18	31	24.5	
9	12-JUN	31	38	34.5	10	28	19	
10	15-JUN	15	39	27	16	24	20	
11	17-JUN	28	28	28	19	24	21.5	
12	19-JUN	16	33	24.5	22	34	28	p-value to compare between pm and am Daily rates
Total		22.9	36.7	30.5	27.5	40.8	34.1	0.05

The bacterial loads in the air of the main hall of the hospital was estimated in order to compare it with the air of the sterile halls, the bacterial loads in the air of the main hall of the hospital ranged between 34.5 – 89 at the rate of 60.4 CFU/m3, and was also variable depending on the time of collection of the model, in the morning at the start of work between 20 – 88 at the rate of 52.8 CFU/m3, and at noon in the range of 39 – 99 at the rate of 68.2 CFU/m3. The differences were not statistically significant.

While the bacterial microbial load outside the hospital environment (air in the garden) ranged from 39.5 to 115.5 at a rate of 75.6 CFU/m3 and was also variation depending on the time of collection of the model, in the morning between 26 – 100, at a rate of 66.3 CFU/m3 and at noon between 53 – 131 at a rate of 85 CFU/m3, The Man Whitney test showed that the differences were not statistically significant (the calculated value of 44 and the P-value error ratio was greater than the significance level of 0.05, as in Table 4.

Table 4: Microbial load measuring CFU/m3 inside main hall and outside air environment to in al-Zahra hospital for women and children from 25Dec2021 to 19feb2022

Sample NO.	Collection day	Main hall ^{3}CFU/m AM	PM	Daily rates	Outside air environment ^{3}CFU/m PM	AM	Daily rates	Mann-whitney test value between main hall and outside air
1	25-DEC	39	43	41	43	69	56	
2	27-DEC	36	79	57.5	32	85	58.5	
3	29-DEC	88	81	84	73	91	82	
4	01-JUN	78	92	85	100	131	115.5	
5	03-JUN	80	99	89.5	94	90	92	
6	05-JUN	44	59	51.5	99	97	98	44.00
7	08-JUN	57	71	64	75	83	79	
8	10-JUN	20	66	43	73	80	76.5	
9	12-JUN	71	86	78.5	92	101	96.5	
10	15-JUN	50	59	54.5	52	84	68	
11	17-JUN	30	39	34.5	26	53	39.5	
12	19-JUN	41	45	43	37	56	46.5	p-value to compare beteween pm and am. Daily rates
Total		52.83	68.25	60.4	66.33	85	75.6	0.05

The analysis tests the binary variance showed in the morning bacterial microbial load in the main hall of the hospital of 52.8 and the atmospheric air outside the hospital that recorded a load rate of 66.3 CFU/m3 that there was a statistically significant difference (P-Value) below the level of significance, as it shows in table 5 below:

Table 5: AM and PM daily rates by CFU/m3 comparing with main hall and outside air environment

Corridor leading to surgical hall Am	Pm	Outside air environment Am	pm	Main hall Am	PM	P-value
43.9	53.6	66.3	85	52.8	68.2	0.029
Corridor leading to delivery hall Am	Pm	Outside air environment Am	Pm	Main hall Am	PM	P-value
30.5	45.7	66.3	85	52.8	68.2	0.003
Corridor leading to preterm infant hall Am	Pm	Outside air environment Am	Pm	Main hall Am	PM	P-value
27.5	40.8	66.3	85	52.8	68.2	0.005

The process of sterilization and disposal of all pathogens may be difficult, but contamination and infection control programs must work to reduce the level of their occurrence, it is not possible to prevent all types of bacteria, but it is important to make the utmost effort to prevent infection with pathological bacteria and their transmission, as during the surgical procedure can occur spontaneous contamination which affects the patient's health inside the hall. In order to reduce contamination with pathogenic bacteria in the air, additional steps must be taken that take into account ensuring the quality of air inside the clean halls of the hospital by determining the amount of sterilization of the total environment inside the operating theatres. Super-filter ventilation systems and environmental change through humidity and temperature control, because adapting the microbes emerging in the air to the new environment inside the halls is a possibility [10].

Providing proper ventilation is only one aspect of a complex strategy to reduce the risk of infection during surgical interventions, as procedural or behavioral factors may have a negative impact on surgical outcomes including the risk of microbial contamination [11].

The effect of the time of collection of the sample from the halls was tested on the types and numbers of isolated bacteria (morning collection at the start of work compared to the collection at noon, peak work). As expected, there was an increase in the number of isolates from the air of the hall (9 in the morning and 14 in the afternoon) and outside (10 in the morning and 12 in the afternoon) with the use of the hall and the movement of its employees and in and out. There was also an influence on isolated species, as some species were present in isolation at various times such as *S. aureus, S.epidermids, E. coli* and *K. aerogens*. Other types were only occasionally present, such as *K. pneumonia* and *Proteus*. as in table 6:

Table 6: Percentages of bacterial isolates from air sampling

	Outside clean room				preterm infant hall				Delivery hall				Surgical hall			
	Outside air		Main hall		Out		In		Out		In		Out		In	
	am	pm	am	pm	am	pm	Am	pm	am	pm	am	pm	am	pm	Am	pm
S.aureus	4	6	2	4	1	3	5	7	3	7	6	6	1	3	3	5
S.epidermids	3	3	4	6	2	4	2	4	2	4	3	3	4	4	3	5
K.pneumonia	1	1	0	0	1	1	0	1	1	1	0	0	2	0	0	0
K.aerogens	1	1	2	0	3	5	2	1	1	1	0	0	1	3	1	1
E.coli	0	0	0	2	1	1	1	1	1	1	0	0	2	2	2	1
Proteus	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
Total	9	11	8	12	8	14	11	14	8	14	9	9	10	12	9	14

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Bacterial isolates from contamination control swabs

The total number of surface swabs (contamination control) reached 100 swabs from different places including a natural birth bed, caesarean section, floors, ventilation outlets, anesthesia device, fluid withdrawal device, incubators for preterm infants, ventilator and bandage cart.Where 26 different bacterial isolates were obtained with a growth rate of 26%, where the bacteria E. coli and *K. aerogens* came with equal isolation ratios, where (10 isolations) were obtained with an isolation rate of 38.5%, followed by the bacteria *Pseudomonas aeruginosa* (4 isolations) with an isolation rate of 15.4%, to come the bacterium *K. pneumonia* with the lowest isolation rate where (2 isolations) were obtained with an isolation rate of 7.7% and as shown by the number of isolates and their percentage in the table 7:

Table 7: Number and percentages from pollution control swabs

Bacteria	count	%
E. coli	10	38.5
K.pneumonia	2	7,7
K.aerogens	10	38.5
Pseudomonas	4	15.4
Total	26	100

The 1996 French Guidelines for Air Pollution Reduction for Surface Pollution, which it affirmed in 2016, suggested that the limits >5 and ≥ 15 colony units per plate are acceptable values for samples collected from manual touch sites in clean rooms inside the hospital [12].

Local studies in this field are very few and depend on the principle of the deposition of air particles on the surfaces of dishes placed in the halls in an inefficient way (Passive sampling) which gives only qualitative values, in addition to that there are no specific environmental standards in Iraq for the levels of microbial load in the air that can be adopted for comparison, where the microbial load in the air of hospital halls is one of the forgotten factors that are not monitored and audited periodically, and the efficiency of ventilation systems in the air is not followed.

Conclusions

1. Study conducted shows the inefficiency of the Contamination control process used in AL-Zahra hospital.
2. Variation of the microbial load in the halls and sites from which samples were withdrawn (morning and at peak time) per cubic meter, indicates need to monitor ventilation systems and halls air filter that which aims to reduce the rate of microbial load in hospitals.
3. Use of modern modeling devices in air sampling to evaluation of microbial loads of hospitals air to give an accurate picture of the sources of inflammation within hospitals.

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