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Evaluation of medical staff knowledge toward bacterial contamination at the indoor air of hospitals in Najaf City, Iraq

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ABSTRACT

The investigation evaluates the expertise of healthcare personnel regarding the contamination of hospital ambient air with bacteria. The objective of the investigation is to establish a correlation between participant knowledge and both independent and dependent factors. Cross-sectional analytical research was conducted by three institutions in Najaf City from mid-December 2023 to May 10, 2024. Data from 515 health professionals who completed a random self-reporting questionnaire were analyzed using a statistical instrument. The primary findings suggest that the majority of participants are women, with 51.8% of them falling within the 20–29 age range. Of these women, half have bachelor's degrees (54.6%), and 44.5% have less than five years of experience. 27.0% of the professions were in a laboratory setting, and 30.1% had received training. The data indicates that 13.4% of individuals possessed a high level of general knowledge. We discovered substantial correlations between all sociodemographic factors and knowledge, with the exception of sex, which did not exhibit a significant correlation with knowledge. The survey revealed that the majority of health professionals (68.0%) possessed only middling levels of knowledge. Consequently, it is imperative that local authorities provide ongoing training to health personnel regarding bacterial indoor air pollution in order to elevate these levels. We arrived at the conclusion that there is a substantial correlation between knowledge and training programs. Additionally, we identified a statistically significant correlation between the educational attainment of the preponderance of youthful healthcare professionals.

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Introduction

WHO estimates that indoor air pollution (IAP) causes 3.8 million deaths per year (WHO 2020). Capolongo (2014) argues that healthcare facilities should be intricate architecture that advances health and wellness. Indoor air quality (IAQ) is critical for patient safety and occupational health in healthcare environments because employees, clients, and staff spend more than thirty per cent of their working hours indoors (Weikl et al. 2016).

Hospital indoor air quality is more complex and has unique characteristics than those of homes and workplaces. In addition to infectious agents, there are constant sources of biological, chemical, and other pollutants because the hospital is open seven days a week, twenty-four hours a day (Ibrahim et al. 2022). In order to develop strategies for improving indoor air quality (IAQ) in hospitals, it is essential to identify the primary sources of indoor pollutants. Various factors can contribute to the production of poor indoor air quality (IAQ) due to the

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complex interactions between humans, microorganisms, the physical environment, and architecture in indoor settings (Adams et al. 2016).

The indoor air pollutants in each healthcare department's and room's specific indoor air environment will depend on how those departments and rooms are used (Śmiełowska et al. 2017; Lee et al. 2020). Ventilation equipment are particularly specialized for many hospital areas and procedures (Gola et al. 2019). The primary factors influencing hospital indoor air quality (IAQ) can be broadly categorized into four groups. These include (1) macro-level contextual factors like season and climatic conditions; (2) micro-level contextual factors like regional temperature; (3) occupant factors like occupant health status, behavior, and activities and (4) building operation factors like management and maintenance activities for ventilation and hygiene; (Gola et al. 2019; Nasir et al. 2016; Korsavi et al. 2020).

The airborne biological particles which are comprised of fungal spores, bacterial cells, viruses may be defined as bio-aerosols (Roca-Barcelo et al. 2020). Skin contact, the release of skin scale, or patient-generated bio-aerosols via breathing, talking, coughing or sneezing can all contaminate medical environments that receive patients. These bio-aerosols can then settle on surfaces and contaminate the interior air (Zemouri et al. 2017).

Potentially pathogenic bio-aerosols may lead to hospital-acquired infections (HAIs), most notably in hospital environments with natural ventilation, where bio-aerosol concentrations reach approximately 201 CFU/m^3. (Stockwell et al. 2019). Since the usual individual breath in about 10 m^3 of air each day, it is estimated that 20% of HAIs are produced by contact of patients with airborne contaminations (López-Cerero 2014; Montagna et al. 2016). Healthcare facilities are at higher risk of microbiological contamination, in line with the infective nature of the patients and interventions (Zemouri et al. 2017). To develop and implement effective biological safety programs, reducing the imbalances and diseases that the working staff may be infected with during working hours, it is imperative that knowledge regarding bacterial contamination of hospital indoor air become more comprehensive.

Materials and Methods

Three hospitals in Najaf City (Al-Sadr Teaching Hospital, Al Zahra Gynecology Obstetric and Pediatrics Hospital, and Al-Hakim General Hospital) conducted a cross-sectional study from December 24, 2023, to March 20, 2024, to achieve the study's objectives. The sample collection process took about six days a week using a self-questionnaire on 515 health workers (sample size). The data was collected and analyzed using a statistical program.

Data Collection

We collected the data randomly using a self-administered questionnaire. The sample size consisted of 515 individuals and included all divisions of the hospital.

Questionnaire preparation

Based on the supervisors' input, a team of ten specialists from various fields collaborated to improve the questionnaire. We then tested the updated questionnaire to evaluate its validity, applicability, and the significance of specific items.

We divided the questionnaire into two sections, the first portion of the study focuses on sociological and demographic variables, which includes six paragraphs covering age, sex, educational attainment and specialization, years of experience, and participation in training courses relevant to biological and chemical safety. The second part, which consists of 18 questions with yes, no, or I'm not sure answers, evaluates health workers' knowledge about bacterial contamination in indoor air.

Assessing and assigning numerical values

The second part of the questionnaire focused on the knowledge of health employees regarding bacterial contamination in indoor air, consisting of 18 questions. Each question used a three-point Likert scale scoring technique, offering response options of "yes," "no," and "I am not certain." The scoring scale ranged from 1 (representing a low score) to 3 (representing a high score). Based on the mean score for each question, a correct answer received 3, while a false answer received We assigned a value of 2 to responses indicating uncertainty. According to Table 1, we determined the final assessment for these questions.

Table 1 Assessment the mean of Score according the cut-off point.

Assessment	Range
Low	1.00-1.66
Moderate	1.67-2.23
High	2.24-3.00

Limitation

On some days, there was overcrowding in certain units. Some healthcare professionals declined to complete the questionnaire because they lacked the necessary time to work at the hospital or because they were afraid that providing information would cause friction with supervision.

Ethical approval

We submitted a research proposal to the Al-Najaf Al-Ashraf Health Department. Prior to commencing data collection, we obtained authorization. A consent form was affixed to a cover letter that provided an information sheet delineating the study's objectives and the required time to complete the questionnaire. This letter was sent to all three primary hospitals in Al-Najaf city. In order to obtain their oral consent for data collection, we provided each healthcare professional with a comprehensive explanation of the study's objectives, methodologies, and prospective advantages for their field.

Results and Discussion

The sample of this study included 515 health personnel, ages 20–59, with a mean age of 31.06± 8.480 yrs., and the data were normally dispersed.

Result of the table 2 reveals that the age group of 20–59 years old represents the highest percentage (58.6%), and ≥50 years old represents the lowest percentage (6.8%). The mean ± SD (31.06± 8.480 yrs.) and findings of our study were in line with another study carried out in Accra, Ghana, that showed 45.4 percent of participants in the age group ≤29, and the age group ≥60 had the lowest percent (2.9%) (Odonkor & Mahami, 2020).

In addition, the findings of the study conducted in Najaf (Fadiel et al. 2021) come into line with our own study, showing that the age group with the largest proportion (63.8%) was 20–26 years old. Ayed's (2015) study in Palestine also found that individuals aged 20–30 accounted for the highest percentage (64.2%). Each year, the Ministry of Health employs thousands of graduates from private medical colleges and institutes to work in the public sector, which explains the prevalence of this young age group among the study samples.

Table 2 Distribution of the participants according to the age groups

Socio-demographic	Groups	No.	Percent
	20-29	302	58.6
	30-39	120	23.3
	40-49	58	11.3
	50 and older	35	6.8
Mean ± SD	31.06± 8.480 yrs.		

According to gender, most health employees (51.8%) were female, while 48.2% were male (table 3). This result was related to another study conducted in Nigeria (Olatade et al. 2021), which revealed that most participants were females (69.0%) and males (31.0%).

Another study in Manicaland confirms the results of this one, showing that 86.2 percent of participants were female and 13.8% were male (Gasaba et al. 2020).

The researcher attributed the higher number of females than males to the random selection process and the absence of females who refused to participate in the questionnaire.

Table 3 Distribution of the participants according to the gender

Socio-demographic	Groups	No.	Percent
Sex	Male	248	48.2
	Female	267	51.8

Table 4 shows the health personnel with different educational levels, such as 54.6% with a bachelor's degree, 33.6% with a diploma, 4.1% with a high school education, and 7.8% with a post-graduate degree. These findings were in line with those of another study carried out in Najaf City, which revealed that the majority of contributors (50%) had bachelor's degrees, while the lowest percentage (4.7%) belonged to participants with only a high school education (Alshamarti et al., 2022).

The study claims that the high results about bachelor's degrees among health employees are due to the abundance of private and public health and medical group faculties. The number of people holding bachelor's degrees is increasing annually due to the presence of four private and three public institutions in Najaf alone, in addition to a significant number in neighboring governorates (Ministry of Higher Education and Scientific Research, 2019).

The Ministry of Health also permits employees with diplomas from institutions to pursue a bachelor's degree in the same field of study as the recipients of their diplomas.

Table 4 Distribution of the participants according to the Level of Education

Socio-demographic	Groups	No.	Percent
Level of Education	High school	21	4.1
	Diploma	173	33.6
	Bachelors	281	54.6
	Postgraduate	40	7.8

In terms of professional levels, lab technicians had the highest percentage (27.0%), while dentists had the lowest (1.9%). The study found that the participation rates of various specialties, including physicians, nurses, pharmacists, biologists, and others, were 3.3, 19.4, 26.4, 8.0, and 14.0, respectively (table 5).

The researcher suggests that the stochastic selection of medical staff and the unequal distribution of healthcare workers among hospitals could be the cause of the

discrepancies in sample sizes and variances observed in the studies.

Table 5 Distribution of the participants according to specialty

Socio-demographic	Groups	No.	Percent
Specialty	Physician	17	3.3
	Dentist	10	1.9
	Pharmacy	100	19.4
	Nurses	136	26.4
	Laboratory	139	27.0
	Biology	41	8.0
	others	72	14.0

The majority of health workers in this survey (44.5%) had between one and four years of experience, with the lowest percentage among those with less than one year of experience, as indicated by their experience, this is fact manifests in table 6.

This finding was in agreement with another study conducted in Najaf, which determined that the majority of contributors (66.4%) had prior experience of less than five years. (Alshamarti et al., 2022). The interpretation of the brief years of experience of health workers may be influenced by the fact that a significant number of youthful employees are employed, as well as the fact that a significant number of graduates from medical and health group colleges entered the workforce in the final year of 2023, primarily in hospitals.

Table 6 Distribution of the participants according to experience years.

Socio-demographic	Groups	No.	Percent
Experience	<1	41	8.0
	1-4	229	44.5
	5-9	120	23.3
	10-14	59	11.5
	≥15	66	12.8
	M± SD	6.68±7.865	

Conversely, in terms of instruction regarding biological safety, 69.9% of health workers did not enroll in or participate in training programs, as indicated by their comments. Conversely, 30.1% of respondents reported that they were enrolling in or had enrolled in courses as mentioned in table 7. Al-Ghamdi and Kabbash (2011) conducted a study in Western Saudi Arabia and found that 72.3% of medical professionals did not attend biological safety courses. The results of this study are comparable to those of our own. This aligns with a study from the Al Hilla Teaching Hospitals in Iraq, revealing that 57.5% of the participants declined to attend the training modules (Sekab & Abd 2021).

Table 7 Distribution of the participants according to training

Socio-demographic	Groups	No.	Percent
Training	Yes	155	30.1
	No	360	69.9

Bacterial indoor air pollution is generally understood by 13.4% of health professionals. Conversely, 85.2% of them demonstrated reasonable comprehension, while 1.4% possessed inadequate knowledge (table 8). Their average level of expertise may not be adequate, given their frequent exposure to biological and chemical pollutants and their critical function in the hospital. This is a result of the absence of sufficient training programmes for control, prevention, and continuing education, as well as evaluations that guarantee health workers have access to high-quality information. Furthermore, there are either insufficient or nonexistent policies and programmes that address the biological hazards of indoor air.

We limited our study to results from studies conducted in the Governmental Hospital in Palestine (Ayed, 2015), the Western Development Region of Nepal (Timilshina et al., 2011), and regional hospitals in Trinidad and Tobago (Unakal et al., 2017). These studies reported rates of 28%, 20%, and 18%, respectively. According to an Irish survey, 35% and 66% of participants, respectively, were aware of the negative impacts of air pollution on local and national health. Furthermore, there were noteworthy correlations between awareness of air pollution and sociodemographic traits. According to the results of another survey done in Turkey, which assessed the knowledge of healthcare professionals, 28.4% of respondents rated their knowledge as "good," 59.5% as "moderate," 10.8% as "insufficient," and 1.4% as having "no idea" (Yüksek et al., 2023).

The high level of knowledge among health personnel is demonstrated in another study conducted in Erbil and Al-Amara (Ronak, 2016; Al-Hraishawi & Fraaj, 2021), with scores of 54.0% and 60.0%, respectively. According to a survey conducted in Poland, 65.98% of healthcare personnel possess a sufficient level of knowledge, while 34.02% possess an insufficient level (Fortunka et al., 2024).

Studies conducted at Tehran, Iran's Dobti Referral Hospital (Ronak 2016) and Ethiopia's Dobti Referral Hospital (Jemal et al. 2019) led to additional research findings. Furthermore, according to a study conducted in Al-Hassa, Saudi Arabia (Amin & Al Wehedy 2009), health care personnel possess a moderate level of knowledge (57%, 50.5%, and 61%, respectively).

Table 8 The Overall Knowledge of study participants

Scale	M ± SD	Score	No.	%	Ass.
Overall Knowledge 18 Q	38.71±3.972	Poor	7	1.4	Fair
		Fair	439	85.2	
		Good	69	13.4	
		Total	515	100.0	

M: Mean for total score, SD=Standard Deviation for total score

Table 9 Association between participant's knowledge and socio-demographic characteristics

Variables	Unstandardized Coefficients		*Sig.*
	B	Std. Error	
Age	.015	.005	.002
Gender	-.011-	.030	.722
Level of Education	.077	.022	.001
Specialty	-.053-	.010	.000
Experience	.039	.005	.041
Training	-.087-	.036	.015

The results of table 9 demonstrates that healthcare workers age (β= 0.347; p.002), education level (β= 0.153; p.001), specialty (β= -0.226; p.000), years of experience (β= 0.200; p.041), and training courses (β= -0.110; p.015) are predicted factors influencing their knowledge about bacterial contaminants in hospital environments.

Several factors considerably influence the knowledge of healthcare personnel regarding bacterial contaminants in hospital environments, according to the results. These factors include age (β = 0.347; p =.002), which implies that senior employees possess more knowledge. Furthermore, education level (β = 0.153; p =.001) has a positive impact on knowledge, suggesting that individuals with higher levels of education tend to have a greater knowledge base in this field. Interestingly, labourers in specific specialisations may have a lower level of comprehension regarding bacterial contaminants (β = -0.226; p =.000). Nevertheless, the knowledge of healthcare workers is positively influenced by their years of experience (β = 0.200; p =.041), suggesting that they have a greater understanding of this field and are more knowledgeable. Furthermore, participation in training courses (β= -0.110; p= .015) is found to have a positive association with knowledge, implying that the effectiveness or relevance of the training may vary between the trained people and non-trained.

The existence of a statistically significant difference (P< 0.05) between training and non-training personnel was confirmed in another study conducted in Al-Amarah and Al-Kut, Iraq (al-Hraishawi & Naji, 2015; Khyoosh et al., 2021). It is imperative that health professionals participate in training courses and ongoing education to enhance their knowledge and remain informed about the latest scientific and technological developments. Training courses that are both theoretical and practical are essential for the prevention and management of disease outbreaks. Researchers attribute this to the random selection of the sample. In contrast, investigations conducted in Saudi Arabia in Qassim hospitals and Fayoum Governorate in Egypt have revealed a strong correlation (Khan et al., 2014; Abdel Wahed et al., 2020).

The discrepancy between studies may be attributed to variations in the timing of the investigations, as well as disparities in community routines and interactions across different nations. By taking into account the impact of both sociodemographic and knowledge variables, we can account for this discrepancy.

Conclusion

Our current study's results indicate that a quarter of health workers possess a good understanding of bacterial contamination in hospital indoor air, necessitating ongoing biological safety training to raise these standards. We also found a strong correlation between training programs and knowledge. In addition, a considerable proportion of health specialists are young and have recently joined the profession. Studies have demonstrated a statistically significant correlation between their level of education and years of experience. Furthermore, the majority of them are under the age of thirty and do not participate in training sessions. The degree of knowledge regarding bacterial contamination is not influenced by the sociodemographic characteristics of gender alone.

Conflict of interest

The authors declare that they have no conflict of interest.

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