Print ISSN: 0375-9237
Online ISSN: 2357-0350

EGYPTIAN JOURNAL OF BOTANY (EJBO)

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PUBLISHED BY
THE EGYPTIAN
BOTANICAL SOCIETY

An investigation of bacterial nosocomial infections and an assessment of the knowledge of medical students concerning the prevention and control of these infections in Najaf Province

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Background: Nosocomial infections represent a major problem worldwide. Because it causes illness and death, it is considered a major burden to patients, and healthcare workers. Although nosocomial infections occur worldwide and affect all countries, healthcare-associated infections can however be prevented through some inexpensive strategies. Aims: This study aims to investigate the bacteria causing hospital infections in different settings of healthcare centers, and to evaluate medical students' knowledge about preventing and controlling infections in hospitals. Students' knowledge of nosocomial infection prevention and control was assessed through a cross-sectional descriptive study. In addition, this study was conducted amongst medical students for the period between December 27th, 2022, and July 15th, 2023. The Practical Part: The non-probability specimens were composed of 608 students. A questionnaire and an interview were used as methods of data collection. The questionnaire consists of two parts: one was the demographic characteristics of the students, and the other was the students' knowledge of infection control. In addition, experts evaluated the validity and reliability of the questionnaire separately using Cronbach's alpha. The Results: The results arrived in this study showed that more than two-thirds of the specimens had an intermediate level of knowledge. The survey results also showed that the most popular proportions of students were those between 18 and 22 years old (69.85%), females (68.86%), students from urban areas (78.58%), and students with sufficient income (60.96%). The results also showed that students have a moderate level of knowledge on the prevention and control of hospital infections. They also suggested encouraging students to set examples for better infection control. Overall, 1628 swabs were taken from different surgical theater locations. Eighty-three (5.1%) were positive for bacteria and isolated for the purpose of this study. The walls and floors of the theater had the highest isolation rate (14.2%), followed by the patients' beds (7.4%) and ventilation outlets (7.5%). On the other hand, no bacterial isolation was found in the sterilized gauze or disinfection solution.

Keywords: Bacterial contamination, Operating theatre, nosocomial infections

ARTICLE HISTORY
Submitted: June 06, 2024
Accepted: March 05, 2025

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DOI: 10.21608/ejbo.2025.295893.2878

EDITED BY: M. Ibrahim

INTRODUCTION

The essence of the hospitals' operation involves the containment of disease cases, the majority of which may be contagious, making them an ideal habitat for diseases. Hospital infections represent a significant concern for healthcare organizations and personnel as they can potentially spread diseases and result in fatalities. Additionally, hospital infections put students' lives at risk as they meet bodily fluids like blood. Moreover, due to their ongoing exposure to microorganisms, medical professionals, students, and patients are not the only ones who can contract this infection. Accidental exposure to blood-borne viruses such as the hepatitis B virus (HBV), hepatitis C virus (HCV), and the human immunodeficiency virus (HIV) can result in infection just as body fluids like blood can transport diseases (Murphy et al., 2020, Radhi, 2020). When it comes to the study and treatment of critical illness, the first 70 years of critical care might be viewed as a time of "industrial revolution-like" progress. Unfortunately, just as the industrial revolution's effects on the environment, the increasing complexity and overall burden of nosocomial infections in modern ICUs can be attributed to advances in the treatment of older, immunosuppressed, and disabled patients (Kollef et al., 2021). Research has shown that healthcare-associated infections (HAIs) represent a significant risk to patients' safety in hospitals worldwide, impacting 5–10% of admitted patients and having the potential to be fatal. An estimated 100,000 patients are thought to pass away from HAI each year, at a cost of between 17 and 29 billion dollars (Gaid et al., 2018). This is the infection that the patient contracts after being admitted to the hospital because of bacterial transmission and inadequate sanitation practices. The hospital serves as a hub for the spread of several illnesses, the majority of which have the potential to be quite hazardous (Gawad, 2017). Nosocomial infections, also known as healthcare-associated infections (HAI), are illnesses that you get while getting medical care but were not present when you were in. These can impact both patients and medical staff and happen in many types of care units (Sikora and Zahra;2021) Among the measures to control or prevent nosocomial infections are the following: Asepsis during surgery and the care of wounds and lines, proper antibiotic prophylaxis, safe disposal of needles and other sharp objects, prophylactic use of antibiotics to minimize selection of resistance, sterilization of surgical instruments, decontamination of endoscopes, basic hygiene and handwashing by all staff (and provision of adequate sinks), and appropriate isolation of infectious patients (Breathnach,2005).

The fundamentals of infection prevention and control which apply to all patients - adults, children, and neonates alike, must be well understood by students in the medical group. These safety measures include following the guidelines for sterilization and the

secure disposal of sharps, maintaining appropriate hand hygiene, using personal protective equipment as directed, and maintaining hospital hygiene (Mukasine, 2017). The responsible pathogens originate from a variety of various sources, and they are represented by several types of HAI. The Centers for Disease Control and Prevention broadly categorize the types of HAI as follows: Central line-associated bloodstream infections (CLABSI), Catheter-Associated Urinary Tract Infections (CAUTI), Surgical Site Infections (SSI), as well as Ventilator-Associated Pneumonia (VAP) (Al-Zuharri, 2011). Non-ventilator-associated hospital-acquired Pneumonia (NV-HAP), gastrointestinal tract infections (including *Clostridium difficile*), other primary bloodstream infections not related to central catheter use, and other urinary tract infections not related to catheter use are among the other types of Healthcare-Associated Infections (HAI). Affected systems such as infections of the ear, eye, nose, and throat, infections of the skin and soft tissues, infections of the cardiovascular system, infections of the bones and joints, infections of the central nervous system, infections of the reproductive system, and infections of the lower respiratory tract (including bronchitis, tracheobronchitis, bronchiolitis, tracheitis, lung abscess or empyema without evidence of pneumonia) can also be combined to form HAI (Sikora and Zahra;2023). Point prevalence surveys conducted in 2011 revealed that the most prevalent illnesses were pneumonia (21.8%) and SSI (21.8%), followed by gastrointestinal (17.1%), urinary tract (12.9%), bloodstream (9.9%), and other infections. Since then, the prevalence of these infections has altered (Magill et al., 2014).

According to a point-prevalence survey conducted in the United States in 2015, pneumonia was the most prevalent HAI in acute hospital settings, followed by bloodstream infections, urinary tract infections, SSI, gastrointestinal infections, and other infections of the systems (van Duin and Paterson; 2016) Fascinatingly, the same study revealed that NV-HAP is the most prevalent form of HAI in the acute care context, which is in line with research from Europe (Suetens et al., 2018). Nosocomial infections are caused by bacteria, viruses, and fungi, among other pathogens. The location, setting, and patient population of a healthcare facility all influence the occurrence of illnesses caused by microorganisms. The overuse and carelessness of antibiotics have led to the emergence of resistant microorganisms. One of the side effects of HAI is the multidrug-resistant bacteria (MDR). Research indicates that over 20% of all bacteria that are reported were MDR(van Duin and Paterson; 2016). As a component of the normal flora, bacteria might have an external or endogenous origin. When the human immune system fails to operate properly, opportunistic bacterial infections happen. *Staphylococcus aureus*, coagulase-negative *Staphylococci*, *Streptococcus* species, and *Enterococcus* species, for example, *faecalis, and faecium*, are common Gram-positive organisms. In US hospitals, *C. difficile* was the most often reported pathogen among all HAI-associated pathogens (15 % of infections with a documented pathogen) (Magill et al., 2014; Magill et al., 2018).

In hospitalized patients, almost any pathogen has th e potential to cause infection,
although only a small number of most nosocomial infections are caused by bacteria, both Gram-positive and Gram-negative. The most common ones include *Enterococci*, *Pseudomonas aeruginosa*, *Escherichia coli*, and *Staphylococcus aureus* (Bereket et al., 2012). The most crucial component of infection prevention and control for healthcare-associated infections (HAIs) is hand hygiene. By practicing regular hand cleanliness, healthcare workers may easily eliminate pathogenic bacteria that are momentarily on them, hence reducing the potential of transmitting it to the patients. Additionally, practicing good hand hygiene keeps the workplace clean and avoids infections and colonization among healthcare personnel. Five instances have been highlighted by the World Health Organization for when hand hygiene should always be used (Mathai et al; 2010). Even with tremendous efforts to avoid nosocomial infections, more work must have been done to control them. Every day, one in every twenty-five hospital patients may get at least one nosocomial illness (Wattal;2014). This study seeks to examine the bacteria responsible for hospital-acquired infections across various healthcare settings and assess medical students' understanding of infection prevention and control in hospitals.

MATERIAL AND METHODS

Specimen's collection and identification

In the operating rooms of three hospitals in Najaf Province, which were Al-Hakeem General Hospital, Al-Zahraa Teaching Hospital, and Al-Sadr Medical City, cross-sectional research was conducted between December 27th, 2022, and July 15th, 2023. Throughout the surgical theater, a total of 1628 swabs were taken from various locations, such as the

floors and walls, sterilized gauze, ventilation outlets, disinfection solutions, patient's beds, anesthesia trolley, surgical tools, and suckers. As quickly as feasible, swabs were cultured on culture media such as Blood agar and MacConkey agar, which were prepared following the manufacturing firms and incubated at 37°C for 24 to 48 hours. According to general biochemical parameters and colony appearance, bacterial isolates were identified (Cruickshank et al, 1975; MacFaddin, 2000). Furthermore, a standard procedure for examining Gram-stained film was used (Brooks et al.,1998).

The design of the study

A descriptive cross-sectional design study was used to evaluate a student's knowledge of the medical group regarding nosocomial infections. The study was conducted during the period (December 27, 2022, to July 15, 2023).

The setting of the study

The study was conducted in the Faculty of Medicine, the Faculty of Pharmacy, and the Faculty of Nursing and Dentistry of the University of Kufa. In addition to the Faculty of Medicine and the Faculty of Pharmacy of Jaber Bin Hayyan University, as well as the Al-Kafeel University medical group Faculties, Al-Tusi University medical group Faculties, Imam Al-Sadiq University medical group Faculty, and the Department of Pathological Analysis.

The specimen of the study

A convenient non-probable sampling technique was selected for representative and accurate data, from 1214 and the questionnaire was filled by the medical group of the University of Kufa (872), Jaber Ben Hayyan University (124), the Islamic University (54), the University of Al-Tusi (60), the Faculty of Medicine (118), the Faculty of Pharmacy (118), the Faculty of Nursing (728), the Faculty of Dentistry (124), and the Faculty of Technology (124) Sampling.

Statistical analysis

The following statistical data analysis approaches were used to analyze the data of the study by implementing the statistical package (SPSS) version. (22), and Microsoft Excel (2010).

RESULTS

A total of 1628 swabs were taken from different surgical theater locations. Eighty-three (5.1%) were positive for bacteria and isolated. The walls and floors of the theater had the highest isolation rate (14.2%), followed by the patients beds (7.4%) and ventilation outlets (7.5). On the other hand, no bacterial isolation was found in the sterilized gauze or disinfection solution. There was a statistically significant variation in the isolation rate between these sites ($p>0.05$) as shown in Table 1. The identification of bacterial isolates in Figure 1 shows that *Escherichia coli* (43.4%) was the most often occurring isolate, followed by *Klebsiella* spp (21.6%). However, this investigation found that *Pseudomonas* spp and *Staphylococcus aureus* had high rates (19.3 and 15.6%, respectively). To demonstrate possible sources of contamination, the distribution of bacterial isolates according to the operating theatre was examined. The results showed that most *Escherichia coli* isolates were from walls and floors (n=16) and that most *Staphylococcus aureus* isolates were from walls, floors, and patients' beds. In addition, the most *Pseudomonas* spp isolates were from suckers (n=6), while only two isolates from *Klebsiella* spp were from the patients' beds, these were from all the bacterial isolates (Figure 2).

Table 1. Bacterial isolation rate from different sites of the surgical theater

Surgical theater sites	No. examined	Positive for bacteria	
		No.	(%)
Walls and floors	211	30	14.2
Ventilation outlets	200	15	7.5
Sterilized gauzes	200	0	0
Disinfection solutions	206	0	0
Anesthesia trolleys	200	8	4
patients' beds	201	15	7.4
Suckers	210	10	4.7
Surgery instruments	200	5	2.5
Total	1628	83	5.1

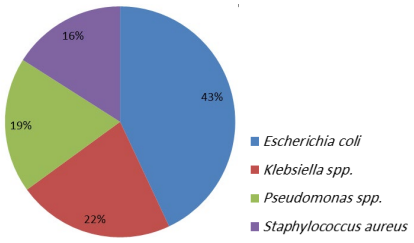

Figure 1. Contamination rates according to the bacterial species

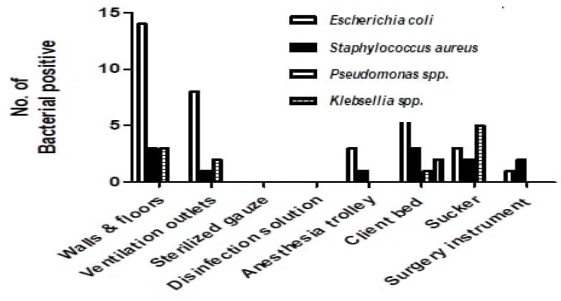

Figure 2. Number and type of isolates identified from various operating theaters

The students' favorable demographics include those who were between the ages of 18 and 22 (69.85%), females (68.86%), reside in cities (78.58%), with enough, to some extent, income (60.96%). The statistical distribution of research specimens according to their socio-demographic information is shown in Table 2. Table 3 displays the statistical distribution of the study specimens by their education characteristics; it states that the highest percentage of the university participants was from Kufa (71.83%), the Faculty of Nursing (59.97%) of the third class (32.78%) and those who got information from the university (32.78%).

Table 2. The Socio-demographic characteristics of the students (No.=1214)

Socio-demographic Data		Freq.	%
Age groups (Years)	18-22	848	69.85
	23-27	276	22.73
	28-32	42	3.46
	33-37	34	2.80
	38 and more	14	1.15
Gender	Males	378	31.14
	Females	836	68.86
Residence	Urban	954	78.58
	Rural	164	13.51
	student's dormitory	96	7.91
Income	Enough	454	37.40
	Enough to some extent	740	60.96
	Not enough	20	1.65
Total		1214	100%

Table 3. Education characteristics of the students (No.=1214)

Education characteristic		Freq.	%
Universities	Kufa	872	71.83
	Al-Forat Al-Awsat	124	10.21
	Jaber Ibn Haain	84	6.92
	the Islamic University	54	4.45
	Al-Tusi	60	4.94
	Basra	20	1.65
Faculties	Medicine	118	9.72
	Dental	124	10.21
	Pharmacy	118	9.72
	Nursing	728	59.97
	Technology	126	10.38
Class	First	190	15.65
	Second	250	20.59
	Third	398	32.78
	Fourth	312	25.70
	Fifth	48	3.95
	Sixth	16	1.32
Information source	Pharmacist in your family	278	22.90
	University	450	32.78
	Workshop	18	1.48
	Symposium	20	1.65
	Training, workshop, symposium	20	1.65
	interesting	354	29.16
	no source	74	6.10
Total		1214	100%

Table 4 shows the assessment (mean of scores) of knowledge among the students; it reveals that the assessment of the items no. 1, 3, 12,13,14, 18, 20, 21 and 22 was good, the assessment of the items no. 2, 4, 8, 9, 10, 11, 15, 23 and 24 was fair, and all other items were poor.

Table 4. The mean scores for assessment of knowledge according to each item of the scale among the students (No.=1214)

Items of scale		Freq.	%	MS	Assess.
Q1	Incorrect	316	26.03	0.74	Good
	Correct	898	73.97		
Q2	Incorrect	604	49.75	0.50	Fair
	Correct	610	50.25		
Q3	Incorrect	174	14.33	0.86	Good
	Correct	1040	85.67		
Q4	Incorrect	552	45.47	0.55	Fair
	Correct	662	54.53		
Q5	Incorrect	956	78.75	0.21	Poor
	Correct	258	21.25		
Q6	Incorrect	1052	86.66	0.13	Poor
	Correct	162	13.34		
Q7	Incorrect	938	77.27	0.23	Poor
	Correct	276	22.73		
Q8	Incorrect	532	43.82	0.56	Fair
	Correct	682	56.18		
Q9	Incorrect	484	39.87	0.60	Fair
	Correct	730	60.13		
Q10	Incorrect	468	38.55	0.61	Fair
	Correct	746	61.45		
Q11	Incorrect	652	53.71	0.46	Fair
	Correct	562	46.29		
Q12	Incorrect	242	19.93	0.80	Good
	Correct	972	80.07		
Q13	Incorrect	108	8.90	0.91	Good
	Correct	1106	91.10		
Q14	Incorrect	248	20.43	0.80	Good
	Correct	966	79.57		
Q15	Incorrect	484	39.87	0.60	Fair
	Correct	730	60.13		
Q16	Incorrect	956	78.75	0.21	Poor
	Correct	258	21.25		
Q17	Incorrect	918	75.62	0.24	Poor
	Correct	296	24.38		
Q18	Incorrect	266	21.91	0.78	Good
	Correct	948	78.09		
Q19	Incorrect	488	40.20	0.60	Fair
	Correct	726	59.80		
Q20	Incorrect	134	11.04	0.89	Good
	Correct	1080	88.96		
Q21	Incorrect	304	25.04	0.75	Good
	Correct	910	74.96		
Q22	Incorrect	108	8.90	0.91	Good
	Correct	1106	91.10		
Q23	Incorrect	644	53.05	0.47	Fair
	Correct	570	46.95		
Q24	Incorrect	712	58.65	0.41	Fair
	Correct	502	41.35		
Q25	Incorrect	1048	86.33	0.14	Poor
	Correct	166	13.67		
Total		1214	100%		

MS: Mean of Scores; Poor: MS =<0.33; Fair: MS = 0.34-0.67; Good: MS ≥ 0.68

This assessment is based on the statistical scoring system that indicates the total mean of scores (=<0.33) as poor, those between 0.34 and 0.67 as fair, and those with scores more than 0.68 as good. Table 5 shows the assessment of overall items (means of scores) of knowledge among the students; it reveals that the overall assessment of the items was fair. This assessment is based on the statistical scoring system that indicates the total mean of scores =<0.33 as poor; and those between 0.34 and 0.67 as fair, those with scores more than 0.68 as good. Table 6 shows that there is a significant mean difference only between the overall assessment of knowledge and age groups (p-value=0.011), while other data were statistically not significant. Table 7 shows that there is a significant mean difference only between overall assessment of knowledge with faculties class, and information sources (p-values were 0.010, 0.003, and 0.044) respectively, while for universities differences were statistically not significant.

DISCUSSION

As mentioned previously, knowledge of infection and evolving bacterial resistance have become major public health concerns in Iraqi hospitals (Radhi et al., 2022). Therefore, the main purpose of this study was to evaluate the incidence of bacterial contamination of operating theatres in the hospitals in Najaf Province/ Iraq and to identify the contaminating agents and their distribution within different theatres as well as to evaluate medical students' knowledge about preventing and controlling infections in hospitals.

During this study, a total of 1628 swabs were collected from different sites of surgical theaters. The results showed that the overall isolation rate of bacterial-positive from various sites of surgical theaters was 5.1%. The results of this study are in line with a previous observational study, which was conducted in Al-Imam Ali Hospital in Baghdad to address bacterial contamination in the surgical theaters; the contamination rate was found to be 3.7 % in 2001 and increased to 4.0 % in 2002 (Ensayef et al., 2009).

The most obvious finding to emerge from the analysis is that the highest isolation rate of bacteria from the theater's walls floors, patients' beds, and ventilation outlets seems logical. This result may be explained by the fact that these sites are exposed to contamination more than the other examined sites in the theater; moreover, the theater's staff is usually forced to clean the reachable sites with available antiseptics shortly before allowing the laboratory personnel to collect swabs. This result was consistent with Ensayef et al. (2009).

What is interesting in the data of this study is that *Escherichia coli*, *Klebsiella* spp and *Pseudomonas* spp were the commonest microorganisms reported for bacterial contaminating the operating theatres with percentage of 43, 22, and 19%, respectively. This result matches those observed in the earlier study. *Escherichia coli*, *Pseudomonas* spp, *Staphylococcus aureus* were the most common microorganisms reported by sixteen Iraqi health directorates during the first 6 months of 2018. Only a few health directorates have recorded fungal contaminations, and none have reported anaerobic microorganisms (Merdaw and Abdul-kareem; 2019).

Therefore, greater efforts are needed to ensure our programmers of infection control should be extended to target these microorganisms. Whether these microorganisms originated from the patients (endogenous risk factors) or procedure-related (external risk factors) such as staff, instruments, and consumers (Spagnolo et al., 2013, Mubarak et al 2020).

To evaluate medical students' knowledge about preventing and controlling infections in hospitals, this study found that the favorable percentage of the students of ages 18-22 was (69.85%). An explanation of this might be that the participating group consists of faculty students, whose ages range between 18 and 22.

Additionally, in this study, females represented 68.86% of the total students included in this study. For this result, we could have suggested the reason is due to the Ministry of Higher Education and Scientific Research admitting more Females than males in the Faculty of Nursing. This was an expected result since most of the specimens were from this faculty.

Also, the results of this study show another expected thing which is that the percentage of people living in urban areas (78.58%) was more than those who live in rural areas. We can suggest that urban residents are the ones who push and encourage their children to study more than those in the countryside. Another explanation for this is that cities are centers of knowledge and learning and have a greater chance of obtaining a better education. Moreover, it may be because of some backward cultures in addition to the difficulty of accessing learning centers, and the different requirements of life.

Table 5. Mean scores for assessment of knowledge according to overall items of the scale among the students (No.=1214)

Overall items of the scale		Freq.	%	MS	Assess.
Total Knowledge	Poor	70	5.77	0.56	Fair
	fair	906	74.63		
	Good	238	19.60		
Total		1214	100%		

MS: Mean of Scores; Poor: MS =<0.33; Fair: MS = 0.34-0.67; Good: MS ≥ 0.68.

Table 6. Mean difference between socio-demographic data and overall assessment of knowledge

Demographic Data		Freq.	MS	SD	F-Test	P-value (sig.)
Age groups (Years)	18-22	848	0.56 [b]	0.12	12.992 (4)	0.011 (S)
	23-27	276	0.55 [b]	0.12		
	28-32	42	0.59	0.06		
	33-37	34	0.61 [ab]	0.11		
	38 and more	14	0.60	0.10		
Gender	Males	378	0.55	0.11	1.683	0.092 (NS)
	Females	836	0.56	0.12		
Residence	Urban	954	0.56	0.12	1.098 (2)	0.578 (NS)
	Rural	164	0.56	0.12		
	student's dormitory	96	0.55	0.12		
Income	Enough	454	0.56	0.11	0.174 (2)	0.917 (NS)
	Enough to some extent	740	0.56	0.12		
	Not enough	20	0.55	0.12		

For multi-comparisons: LSD was shown in similar letters, P= probability value, S= significant, NS= non-significant

Table 7. Mean difference between socio-demographic data and overall domains of knowledge assessment

Education characteristic		Freq.	MS	SD	F-Test	P-value (sig.)
Universities	Kufa	872	0.56	0.12	10.53 (5)	0.062 (NS)
	Al-Forat Al-Awsat	124	0.55	0.11		
	Jaber Ibn Haain	84	0.55	0.11		
	Islamic University	54	0.55	0.10		
	Al-Tusi	60	0.55	0.11		
	Al-Basra	20	0.61	0.09		
Faculties	Medicine	118	0.58 [b]	0.12	13.256 (4)	0.010 (S)
	Dental	124	0.55	0.11		
	Pharmacy	118	0.54	0.12		
	Nursing	728	0.56	0.12		
	Technology	126	0.54 [a]	0.11		
Class	First	190	0.55 [c]	0.13	18.124 (5)	0.003 (HS)
	Second	250	0.55 [a]	0.11		
	Third	398	0.57	0.12		
	Fourth	312	0.55 [b]	0.11		
	Fifth	48	0.59	0.11		
	Sixth	16	0.63 [abc]	0.13		
Information source	Pharmacist in your family	278	0.55	0.12	12.950 (6)	0.044 (S)
	University	450	0.57	0.11		
	Workshop	18	0.56	0.13		
	Symposium	20	0.50 [b]	0.11		
	Training, workshop, symposium	20	0.55	0.12		
	interesting	354	0.56 [ab]	0.11		
	no source	74	0.53 [a]	0.12		

For multi-comparisons: LSD was shown in similar letters, P= probability value. S= significant, NS= non-significant, HS= highly significant

Furthermore, those who have enough, to some extent, income (60.96%) has been higher in our results. We suggest that those with enough income constitute most of society. Another important finding was that the highest percentage of participating students was from the University of Kufa (71.83%), explanation for that is that the University of Kufa contains most of the faculties of the medical group, such as dentistry, pharmacy, nursing, etc. Moreover, the participating students from the Faculty of Nursing

(59.97%) were more compared to other faculties which could be because it has a close connection with our specialty, i.e., nursing, (32.78%) in the third stage, and those who got information from university (32.78%). Naturally, students continue to obtain and learn academic information from the faculty because the participating group was mostly faculty students whose ages range between 18 and 22.

The most interesting finding was that most of the study specimen knowledge regarding the prevention and control of nosocomial infection was of a moderate level of knowledge. These results came in line with a study conducted by Althiyabi et al. (2024) on nursing staff in medical education hospitals to identify and monitor their knowledge and practices regarding prevention and control of nosocomial infection. In this study, they found that most of the study specimen knowledge regarding prevention and control of nosocomial infection was of a moderate level (61.34%) while about 30% of the study specimens had a good level of knowledge, whereas only about 8% of the study participants had poor knowledge. These results mean that there is a low level of knowledge regarding the prevention of nosocomial infection, and this is due to their lack of follow-up and awareness of such critical issues. Accordingly, we suggest studying the subject of infection control completely; this may increase the percentage of the students' knowledge and of the hospital's staff.

The most important finding was that significant difference between the overall assessment of knowledge and age groups (p-value=0.011), while other data were statistically not significant. Through the statistical data, it is clear to us that the percentage of knowledge was higher in the older age groups, and this may be because the largest groups of students were from the Faculty of Nursing, especially evening studies, so most of them are employees in health institutions and already have knowledge of infection control. So, the younger group is lacking information about infection control. These results came close to two studies conducted by Tafere, et al (2024)., and Alsolami, and Tayyib (2024). stating that nursing staff know and monitor their practices in medical education hospitals.

The results also show that there is a significant mean difference only between the overall assessments of knowledge with the faculties. Through the statistical data, the highest levels of knowledge were among the students of the Faculties of Nursing and Medicine. We suggest that this is because the students of the Faculty of Medicine have a practical application at a high level, but they represent the top of the medical pyramid, which is logical, and they study infection control as a full course. Likewise, the students of the Faculty of Nursing are in direct contact with the cases, so they must pay attention to the issue of infection control, and because they are evening students working in health institutions, they already have skills in that field. As compared to the rest of the faculties and classes, it also became clear that the increase in knowledge in the fifth and sixth stages was high, because they studied and learned more within the health institution, so they have more information. As for the third stage, their percentages were also high, and this is due to the large considerable number of participants from this stage and the Information Source. We suggest that increasing interest has a significant role in knowledge in general and the topic of infection control in particular, so the results were clear through the results of the questionnaire itself, and the workshops also had a role in increasing knowledge of the topic of infection control. These results were consistent in all Faculties (Mba,et al 2022).

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