

RESEARCH ARTICLE

Bacterial Profiles and Antimicrobial Susceptibility Pattern of Isolates from Inanimate Hospital Environments

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Received: 17th February, 2022; Revised: 08th April, 2022; Accepted: 16th May, 2022; Available Online: 25th June, 2022

ABSTRACT

The spread of healthcare-associated illnesses (HCAIs) is aided by microbial contamination of the hospital environment. Bacterial contamination, bacterial profiles, and antibiotic susceptibility patterns of bacterial isolates from ambient surfaces and medical equipment were investigated in this study.

At Al-Hilla, a general teaching hospital in Babylon, Iraq, cross-sectional research was done. The operating room theater (ORT), the intensive care unit (ICU), and the material and sterilizing center all have a total of 120 inanimate surfaces (MSC). Routine bacterial culture, gram staining, and a battery of biochemical testing were used to identify all isolates. The Kirby–Bauer disk diffusion technique was used to establish antibiogram profiles for each detected bacterium, according to the Clinical and Laboratory Standards Institute’s criteria (CLS).

The study’s findings revealed that 120 bacterial isolates had favorable bacterial microscopy results. The isolates came from six different species, four of which were Gram-negative and two of which were Gram-positive. When tested for antibiotic susceptibility, all bacterial isolates were found to be MDR bacteria.

Keywords: Healthcare-associated infections, Inanimate environments, Intensive care unit, Multidrug-resistant.

International Journal of Pharmaceutical Quality Assurance (2022); DOI: 10.25258/ijpqa.13.2.9

How to cite this article: Jabr HS, Kadhim AJ, Issa AH, Hameed AH, Hasan SY, Hamad DA, Mohammad MF. Bacterial Profiles and Antimicrobial Susceptibility Pattern of Isolates from Inanimate Hospital Environments. International Journal of Pharmaceutical Quality Assurance. 2022;13(2):145-148.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

To safeguard patients and staff from hospital infections and occupational illnesses, the hospital environment must be regularly monitored.¹⁻³ Medically important nosocomial pathogens, antibiotic-resistant microorganisms, and reservoirs of resistance genes, which have previously been found on various surfaces within hospitals (e.g., medical equipment, housekeeping surfaces, workplaces, and lobby (furniture), now have a new ecological home in the hospital environment.^{4,5} Pathogens were found in all hospital units, according to studies, although the focus was mainly on critical care and surgery units, due to the susceptibility of patients in these units.⁶ These facilities also use a lot of antibiotics and perform invasive procedures.⁴

Humans may be the source of microorganisms responsible for HI outbreaks, such as hands and uniforms,⁷ climatization systems,⁸ ineffective sterilization/cleaning procedures,⁹ humidity infiltration,¹⁰ and external microbial load,¹¹ and these factors must be linked to favorable conditions for microbial growth.¹²

Bacterial and viral cross-contamination is a significant factor in spreading HCAIs and resistant strains.^{4,13} Although the majority of HCAIs are thought to be spread directly from patient to patient, growing data suggests that medical workers, as well as the clinical environment (i.e., surfaces and equipment), are frequently sources of infections.¹⁴ The major focus of hospital design and hygiene measures is to control nosocomial germs and resistant strains polluting air, hands, equipment, and surfaces.¹⁵ A deeper knowledge of how bacteria

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cross-contaminate can lead to the creation of evidence-based prevention strategies.¹³

The rise of multidrug-resistant (MDR) strains in a hospital setting, particularly in developing countries, is becoming a growing concern that poses a challenge to managing HCAs.¹⁶⁻¹⁸ In developing countries, studies have revealed a high prevalence of HCAs, primarily due to MDR pathogens, in some of the country's largest tertiary referral hospitals,¹⁹⁻²¹ highlighting the urgent need to reconsider the role of the inanimate environment in the transmission of nosocomial infections.^{15,16}

The effects of bacterial contamination in hospital wards have been studied. High bacterial load and multidrug-resistant

(MDR) strains were found in Al-Hilla, a general teaching hospital in Babylon, Iraq.^{17,18} However, there are insufficient data on bacterial contamination of the hospital environment in the hospital under study. As a result, the goal of this study was to determine bacterial contamination, detect potential pathogenic bacteria, and determine antimicrobial susceptibility patterns in three hospital environments: the operating room theater (ORT); the intensive care unit (ICU); and the material and sterilization center (MSC) in Al-Hilla, General Teaching Hospital in Babylon, Iraq.

MATERIALS AND METHODS

Samples Collection

The samples were taken from patients admitted to various wards of the hospital. Standard microbiological methods were used to identify the bacterial species in these samples. Specimens were collected from three different hospital locations: the ORT, the ICU, and the MSC, and inoculated on standard culture media such as blood agar and McConkey agar. Lactose non-fermenting pale colonies with oxidase-positive colonies were found on Macconkey agar.

Confirmation of Bacteria

The primary identification of bacteria species was made using a combination of colonial morphology, gram stain characteristics, motility test pigmentation, oxidation formation test, catalase

Table 1: Number of isolates and percentage of bacteria isolated from the environments in Al-Hilla, General teaching hospital, in Babylon, Iraq.

Isolated bacteria	Gram stain	Isolate no.	Percentage %
<i>E. coli</i>	G -ve	24	20
<i>Klebsiella spp.</i>	G -ve	18	15
<i>Acinetobacter spp.</i>	G -ve	21	17.5
<i>Pseudomonas spp.</i>	G -ve	30	25
<i>Staphylococcus spp.</i>	G +ve	15	12.5
<i>Streptococcus spp.</i>	G +ve	12	10
Total	120		

Table 2: Antibacterial susceptibility pattern from the hospital environment.

Bacterial Isolates	Ptm	C	DO	CN	ATM	AK	NEXT	CLIP	KF	FOX	VAN
<i>E. coli</i>	R	22 91.66%	18 75%	20 83.33%	5 20.83%	21 87.5%	15 62.5%	16 66.66%	19 79.16%	21 87.5%	17 70.83%
	S	2 8.33%	6 25%	4 16.66%	19 79.16%	3 75%	9 37.5%	8 33.33%	5 20.83%	3 75%	7 29.16%
<i>Klebsiella spp.</i>	R	17 94.44%	16 88.88%	10 55.55%	6 33.33%	15 83.33%	11 61.11%	10 55.55%	15 83.33%	18 100%	17 94.44%
	S	1 5.55%	2 11.11%	8 44.44%	12 66.66%	3 16.66%	7 38.88%	8 44.44%	3 16.66%	0 0%	1 5.55%
<i>Acinetobacter spp.</i>	R	18 85.71%	19 90.47%	13 61.9%	3 14.28%	20 95.23%	10 47.61%	18 85.71%	17 80.95%	4 19.04%	11 52.38%
	S	3 14.28%	2 9.52%	8 38.09%	18 60%	1 4.76%	11 52.38%	3 14.28%	4 19.04%	17 80.95%	10 47.61%
<i>Pseudomonas spp.</i>	R	26 86.66%	25 83.33%	18 60%	5 16.66%	6 20%	27 90%	24 80%	8 26.66%	21 70%	16 53.33%
	S	4 13.33%	5 16.66%	12 40%	25 83.33%	24 80%	3 10%	6 20%	22 73.33%	9 30%	14 46.66%
<i>Staphylococcus spp.</i>	R	5 33.33%	8 53.33%	11 36.66%	3 20%	2 6.66%	13 43.33%	10 66.66%	6 40%	15 100%	9 60%
	S	10 66.66%	7 46.66%	4 26.66%	12 80%	13 43.33%	2 6.66%	5 33.33%	9 60%	0 0%	6 40%
<i>Streptococcus spp.</i>	R	2 16.66%	10 83.33%	8 66.66%	3 25%	1 8.33%	10 83.33%	8 66.66%	5 41.66%	12 100%	3 25%
	S	10 83.33%	2 16.66%	4 33.33%	9 75%	11 91.66%	2 16.66%	4 33.33%	7 58.33%	0 0%	9 75%

Abbreviations: R, resistant and S, sensitive
 C = Chloramphenicol, DO = Doxycycline, CN= Gentamicin, ATM = Aztreonam, AK = Amicacin, SXT = Trimethoprine Sulphamethoxazole, CIP= Ciprofloxacin, KF = Cephalothin, FOX = Cefoxitin, VAN = Vancomycin

and oxidase activity test, and pyocyanin production, which was then confirmed using the Viteck2 compact system.^{22,23}

Antimicrobial Susceptibility

Disk diffusion was used to assess antimicrobial susceptibility for the pathogens included in the Clinical and Laboratory Standards Institute recommendations CLSI, (2020).²⁴

RESULTS AND DISCUSSION

The findings revealed that 120 samples were positive for bacterial microscopy at Al-Hilla, General Teaching Hospital in Babylon, Iraq, with 93 (77.5%) isolates Gram-negative and 27 (60%) Gram-positive. *E. coli*,²⁴ *K. spp.*,¹⁸ *Acinetobacter spp.*,²¹ *Pseudomonas spp.*,³⁰ *Staphylococcus spp.*,¹⁵ and *Streptococcus spp.*¹⁵ were among the isolates.¹² *Pseudomonas spp.* was the most prevalent bacterial isolate, as seen in the Table 1.

The study's findings obtained from the settings at Al-Hilla, General Teaching Hospital in Babylon, Iraq, clearly reveal that *Pseudomonas* bacterium was the most prevalent. *E. coli* and *Klebsiella spp.* bacteria came in second and third, respectively, while *Streptococcus spp.* came in last. The findings of this investigation are compatible with those of 25, 26 which indicated that *Pseudomonas* bacteria were isolated in the greatest proportion from Al-Hilla, General Teaching Hospital in Babylon, Iraq. The high prevalence of *Pseudomonas* bacteria may be due to resistance to antimicrobials and antiseptics used in hospitals,²⁷ or the presence of pigments that play an important role in the bacterial colonization process of the host. If they work to allow these bacteria to compete with other bacterial species in the area where they have settled, if these pigments act similarly to antibiotics, inhibiting another genus with it and having the opportunity to colonize the host.²⁸

Antibiogram Profile for Bacterial Isolates

The CLSI, the European Committee on Antimicrobial Susceptibility Testing (EUCAST), and the US Food and Drug Administration (FDA) provided documentation and breakpoints for the creation of antibiotic susceptibility test lists. The antibiotic sensitivity of the sample bacteria was investigated, and ten antibiotics were chosen for susceptibility testing of the isolated bacteria: Chloramphenicol, doxycycline, gentamicin, aztreonam, amikacin, trimethoprine sulphamethoxazole, ciprofloxacin, cephalothin, ceftiofloxacin, and vancomycin, as in Table 2.

The results of this study's investigation of bacterial isolate susceptibility patterns were classed as MDR when showing significantly high resistance to most of the tested antibiotics since acquired non-susceptibility to at least one agent in three or more antimicrobial classes was defined as resistance to more than one kind of antibiotic. The accumulation of resistant R plasmids or gene transposons, each of which codes for a distinct agent, or the action of multidrug efflux pumps, each of which may pump out numerous drugs.^{29,30}

CONCLUSION

Inanimate surfaces and frequently handled medical equipment in OTs and ICUs are possible reservoirs of pathogenic germs

that might predispose critically sick patients to HCAs. The percentage of isolates with antimicrobial resistance profiles is substantially greater in clean inanimate settings.

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