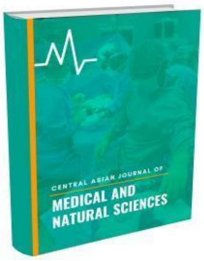

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Article

Prevalence of Bacterial Contamination of Tikrit Teaching Hospital Surfaces and Equipment in Different Units

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Abstract: General Background: Hospital environments serve as potential reservoirs for pathogenic bacteria, contributing to the spread of healthcare-associated infections (HAIs). Contaminated surfaces and medical equipment pose a risk to patient safety and increase morbidity rates. Specific Background: The Tikrit Teaching Hospital in Iraq is a key medical facility where the presence of bacterial contamination on hospital surfaces and equipment requires systematic investigation. This study aimed to assess the bacterial contamination levels in various hospital units, focusing on environmental surfaces, surgical instruments, patient beds, and air quality. Knowledge Gap: Despite existing research on HAIs, limited studies have comprehensively analyzed bacterial contamination on multiple hospital surfaces, particularly in Tikrit Teaching Hospital. Aims: The objective of this study was to identify and quantify bacterial contamination across different hospital units, highlighting potential risks to patients and healthcare workers. Results: A total of 147 samples were collected, with 60.4% testing positive for bacterial growth. The most prevalent bacterial species included E. coli (32.9%) and S. aureus (22.4%), while Leuconostoc pseudomesenteroides was the least frequent isolate (1.2%). Hospital floors were found to be the most contaminated (51.8%), while surgical instruments exhibited the least contamination (1.2%). Novelty: This study provides a detailed assessment of bacterial contamination across various hospital surfaces, offering insight into the distribution and prevalence of pathogenic bacteria in Tikrit Teaching Hospital. Implications: The findings underscore the necessity for improved infection control measures, including enhanced disinfection protocols and routine microbial monitoring, to mitigate the risks of HAIs and improve hospital hygiene standards.

Keywords: Bacterial Contamination, Hospital Surfaces, Healthcare-Associated Infections, E. Coli, S. Aureus, Infection Control, Tikrit Teaching Hospital

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1. Introduction

Environmental contamination on the surface was thought to play a minor influence in the endemic spread of healthcare-associated illnesses [1], [2]. Healthcare-acquired infections continue to jeopardize patient care quality and are regarded as a major source of morbidity worldwide [3]. In USA, it is estimated that roughly 1.7 million individuals suffer nosocomial infections each year, with approximately 99,000 dying [4]. Nosocomial pathogens are disease-causing organisms that are obtained from hospital and health care setting within a short period of admission and serve as the cause for nosocomial infections being common [5]. While an endogenous bacterial flora is thought to be the primary source of nosocomial infections, cross-contamination accounts for 20 to 40% of nosocomial infections [6]. Despite significant improvements in infection control techniques, HAIs continue to be a major public health issue and a concern to patient safety globally [7]. For decades, environment surfaces were thought to play little or no influence in the spread of HAIs. A increasing physical appearance of evidence indicates that dirty surfaces may lead to the development of HAI infections [8]. Based to the study, in addition to personal hygiene and medical equipment reprocessing, disinfection and cleaning of surfaces is a significant factor in preventing germ transmission and, as a result, illnesses [9], [10]. As a result, washing and disinfecting surfaces like floors and beds in patient care spaces is increasingly acknowledged as an essential component of infection control programs [11], [12]. Furthermore, sterilization of surgical tools is a traditional and important approach for preventing surgical site infections (SSI) [13]. the microorganism from infected individuals, as well as health personnel' hands, may directly infect surfaces [14]. Common bacteria from the hand microbiota can contaminate highly handled surfaces [15]. The current study intended to determine the bacteria contamination of Tikrit Teaching Hospital equipment and surfaces in various units.

2. Materials and Methods

The specimens for this investigation had been obtained from April to July 2024 from Tikrit Teaching Hospital.

Sample Collection

One hundred forty-seven samples were taken from environmental sources (surgical instruments, air of the patient rooms, beds, and floors). The environmental samples collected from Tikrit Teaching Hospital in Tikrit city from April to July 2024. Environmental samples were analyzed to establish, ventilation, illumination, and humidity. In the table (1), some properties relating to the building that have been documented throughout the collection of swabs.

Table 1. Certain of the characteristics associated to the buildings.

Properties	Class
Ventilation of hospital	Poor level
	Intermediate level
	Good level
Lighting of hospital	Poor level
	Intermediate level
	Good level
Building restoration	Yes
	No
Temperature	<15 (low)
	15≥-20 (medium)
	20> (high)
Humidity	%65-%80 (high)
	%50-%65 (medium)
	<%50 (low)
Room size	25 m
	30 m
	40 m

Passive air sampling

The specimens have been collected using the passive air sampling method. The opened petri dishes containing various media (nutrient, blood, MacConky agars) were put at 1m height in the center of the room and for an hour at the sample collection sites. Petri dishes were brought directly to the lab and put into an incubator at 37°C for 48 hrs. After the incubation period, the number of colonies for each isolate is determined as (CFU) Colony Forming Unit [16].

Identification of Morphological characteristics

Colonies of isolated bacterial strains cultured on blood and MacConky agars have been described based to their morphologies, color, size, odor, and other features (microscopy and biochemical testing) [17].

Cultural characteristics:

The morphological properties of isolated colonies of bacteria were extensively investigated using a 10X magnification.

Identification of bacteria isolates via VITEK2

VITEK 2 is the next version of the gold standard for microbiological detection, incorporating improved colorimetric technique. Method All of the following processes were completed based to the manufacturer's instructions (Biomerieux) [18].

Biochemical tests

The study included conducting some biochemical tests to detect and diagnose the types of bacteria. These tests include: production of catalase, production of oxidase, Indole, MR, VP, H2S, production of citrate, production of urease enzymes, mannitol fermentatio.

3. Results and Discussion

Samples distribution

The current investigation contained 147 samples, including environmental samples (table 2). The results revealed that 157 (60.4%) of total samples demonstrated positive results for bacterial growth on appropriate cultured agar like blood and MacConkey agars. 103 (39.6%) of the total samples had negative outcomes for growth of bacteria.

Table 2. Distribution of study samples based on the sources.

Groups	No. (%) +ve culture	No. (%) -ve culture	Total No.(%)
Environment samples	85(57.8%)	62(42.2%)	147(100.0%)

Table (3) displays the number of various kinds of bacteria isolated from environmental sources in the hospital accredited for the current investigation. It is noticed that E. coli was 32.9% of the total 85 isolates, then followed by S. aureus 22.4%, while Leuconostoc pseudomesenteroides was the least isolated strain of bacteria, 1.2%.

Table 3. Number of strains from hospital with an environmental source.

Bacteria types	Tikrit Teaching Hospital	
	Number	%
E. coli	28	32.9%
Klebsiella spp.	15	17.6%
P. aeruginosa	10	11.8%
E. faecalis	4	4.7%
S. aureus	19	22.4%
S. haemolyticus	5	5.9%
Kocuria kristinae	3	3.5%
Leuconostoc pseudomesenteroides	1	1.2%
Total	85	100

Table (4) shows the biochemical tests for the study bacteria that including production of catalase, production of oxidase, indole, MR, VP, H2S, production of citrate, production of urease enzymes, mannitol fermentation, motility.

Table 4. Biochemical testing for the isolated bacteria.

Types of bacteria \ Tests	Motility	Simmons citrate	V-P	M-R	Indol	Oxidase	H_2S	Gram stain	Urease	Catalase
E. coli	-	-	-	+	+	-	-	-	-	+
P. aeruginosa	+	+	-	-	-	+	-	-	-	+
Klebsiella spp.	-	+	+	-	-	-	-	-	+	+
E. faecalis	+	-	+	+	-	-	+	+	-	-
S. aureus	-	+	-	+	-	-	+	+	+	+
S. haemolyticus	-	+	-	+	-	-	+	+	+	+
Kocuria kristinae	-	-	-	-	-	-	-	+	-	+
Leuconostoc pseudomesenteroides	-	+	-	+	/	-	-	+	/	-

Table (5) demonstrates that floors are the most polluted 44 (51.8%), while surgical equipment were the least polluted 1 (1.2%) of 85 positive environmental isolates. In contrast, the number of isolates from beds was 25 (29.4%), whereas the number of isolates from air was 15 (17.6%).

Table 5. Number of isolates from Tikrit Teaching hospital.

Groups	Surgical instruments	Sick beds	Floors	Air of rooms	Total No.(%)
E. coli	0(0.0%)	10(35.7%)	16(57.1%)	2(7.1%)	28(32.9%)
Klebsiella spp.	0(0.0%)	5(33.3%)	6(40.0%)	4(26.7%)	15(17.6%)
P. aeruginosa	0(0.0%)	2(20.0%)	5(50.0%)	3(30.0%)	10(11.8%)
E. faecalis	0(0.0%)	1(25.0%)	3(75.0%)	0(0.0%)	4(4.7%)
S. aureus	1(5.3%)	6(31.6%)	7(36.8%)	5(26.3%)	19(22.4%)
S. haemolyticus	0(0.0%)	1(20.0%)	4(80.0%)	0(0.0%)	5(5.9%)
Kocuria kristinae	0(0.0%)	0(0.0%)	2(66.7%)	1(33.3%)	3(3.5%)
Leuconostoc pseudomesenteroides	0(0.0%)	0(0.0%)	1(100.0%)	0(0.0%)	1(1.2%)
Total	1(1.2%)	25(29.4%)	44(51.8%)	15(17.6%)	85(100%)

The widespread occurrence of bacteria in hospital yards could be attributed to the type of individuals receiving treatment in every yard. Staphylococcus spp. are frequent because they are thought to be the worldwide first suspect in infections in hospitals, which involve microbiological strains such Staphylococcus spp. [19]. This reveals the current study's findings about the prevalence of S. aureus in various sorts of environmental specimens, such as surgical tools (1.3%), the beds (6.36%), and the floors (7.36%). The occurrence of other types of germs in RCU is primarily caused by in-patients, who carry these bacteria and pollute instruments used for surgery; this finding is in line with the findings of Akash et al. [20] and is acknowledged as a fact [21], which clarifies the results of the current study regarding the presence of Klebsiella spp. For floors, it was 1 (33.3%), while for patient beds, it was 2 (66.7%). It is believed that the most frequent source of NIs in abdominal operating rooms is E. coli [22]. Although these bacteria were isolated from the air of rooms where the prevalence of E. coli was 2 (7.1%), this is also confirmed in this experiment. With 19(22.4%) of the 85 isolates in our investigation, Staph aureus had the highest isolation rate across all operating and intensive care unit rooms. This result is nearly similar to the study of [23] in India they found isolation of staph aureus is the highest isolation in 16%. A similar study done in Mosul teaching hospital by [24], S. aureus was isolated at 9.5% out of 32.27% of gram positive in her investigation, while Klebsilla was dominant. in Iran found 13.7%of staph aureus and it was not the dominating bacteria while had 1% [25].

4. Conclusion

These findings illustrate the highly prevalent nature of bacterial contamination on a wide range of surfaces within Tikrit Teaching Hospital, with no exception being made for floors of the hospital (51.8%), least present on surgical instruments (1.2%). The presence of the isolation of E. coli (32.9%) and S. aureus (22.4%) as isolated bacteria indicated that there were risks for the occurrence of healthcare associated infection (HAI). These results underscore the need for strict infection control measures that then include processes for regular disinfection protocols, an increased ability to sterilize medical equipment, and better hygiene practices within the environment in order to prevent further spread of pathogens. Its implications range from the hospital administrators to policymakers to demand for the holistic microbial monitoring strategies to ensure patient safety. Future research should include the evaluation of the efficacy of current disinfection techniques, antibiotic resistance patterns of nosocomial bacteria, and inventing new ways of diminishing bacterial contamination of healthcare setting.

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