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Assessing Nosocomial Risks: A Study on Bacterial and Fungal Contamination of Hospital Surfaces and Medical Instruments

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ABSTRACT

The existence of microorganisms, such, as vancomycin enterococci (VRE) methicillin resistant Staphylococcus aureus (MRSA) Klebsiella pneumoniae and Pseudomonas aeruginosa on medical equipment and surfaces poses a significant contamination risk. While stethoscopes and mobile phones have been extensively studied the potential transmission of bacteria through hospital records has received attention. This study aims to quantify the level of contamination on touched items by patients, visitors, and healthcare professionals in hospitals. The research was conducted at Al Ramadi Teaching Hospital for gynecology and pediatrics. A total of 70 swab samples were collected from locations within the hospital. Detailed information regarding patient hospitalization duration and bed assignments, in both wards and specialized units was obtained from the medical affairs department. The collected samples underwent a series of tests including catalase, oxidase, coagulase, mannitol fermentation, indole and sugar fermentation assays to identify the presence of bacteria. The analysis revealed that microorganisms were detected in all samples taken from hospital entrances and corridors. The prevalence decreased in emergency rooms (90%) kitchens (80%) patient bedrooms (50%) and operation rooms (50%). In this study the results showed that E. Coli was present, in half of the samples taken at the entrances while Staphylococcus species were detected in around 30% of them. Klebsiella was identified in 20% of the samples and St. Pyogenes was found in 10%. Interestingly Aspergillus contamination was also discovered, with the highest occurrence being in the kitchen (90%) followed by laboratories (80%) and patient bedrooms (60%). Overall these findings highlight how bacterial contamination is widespread, throughout areas of hospitals. This emphasizes the importance of implementing hygiene protocols and regular disinfection practices to minimize the risk of healthcare associated infections. The study suggests that it is crucial to pay attention to areas and objects that are not commonly examined as part of infection control measures.

Keywords:First keyword Second keyword, Third keyword,Fourth keyword,Fifth keyword

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1. INTRODUCTION

Pathogenic or environmental microbes including VRE, MRSA, Klebsiella pneumoniae, and Pseudomonas aeruginosa may infect stethoscopes, writing pens, white coats, keyboards, case notes, faucets, mobile phones, medical charts, and wrist watches [1]. These opportunistic or causal infections may be present on the surfaces of the facilities and personal items in the wards [2]. There are, however, few research on the bacterial contamination of hospital medical records, and the two that exist are a letter and a short paper [3].

Poor infection management, such as infrequent surface cleaning, may increase hospital surface respiratory infections. Family caregivers, visitors, and hospital staff might potentially get respiratory infections via infected patients' droplets, aerosols, or surfaces [4]. For patients, medical personnel, caregivers, and visitors, contaminated hospital surfaces may significantly increase the risk of infection [5].

Clinicians and administrators at hospitals and other healthcare facilities across the globe continue to prioritize reducing healthcare-associated infection (HAI) [6]. Hand washing has been demonstrated to prevent HAIs best. According to WHO guidelines, hand hygiene reduces infection transmission [7]. Examining how healthcare staff follow suggestions in practice is difficult. Unfortunately, evidence shows that healthcare workers follow hand hygiene guidelines poorly [8].

Pathogenic or environmental microbes including VRE, MRSA, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa* may infect stethoscopes, writing pens, white coats, keyboards, case notes, faucets, mobile phones, medical charts, and wrist watches [1]. These opportunistic or causal infections may be present on the surfaces of the facilities and personal items in the wards. There are, however, few research on the bacterial contamination of hospital medical records, and the two that exist are a letter and a short paper [9].

Most infections connected to healthcare are caused by members of the family Enterobacterales. These bacteria may spread in hospitals by getting on the hands of medical personnel (HCWs) [10]. Even yet, little is known about the mechanisms that cause the most prevalent Enterobacterales, namely *Escherichia coli* and *Klebsiella* species, to contaminate HCW hands and spread from patient to patient [11].

MDR epidemiology, especially during epidemics, inspires modern infection control techniques. To curb the spread of these infections in hospitals, we must understand whether Enterobacterales' transmission dynamics alter in non-epidemic contexts [12]. Studies using MDR isolates have revealed that *Klebsiella* species that produce extended-spectrum -lactamases may be more contagious than *E. coli*, perhaps because of their improved survivability on HCW hands and in the environment [13].

Most nosocomial illnesses are brought on by bacteria. Fungi genera, which are common microorganisms, may also be found in many interior situations [14]. MDR epidemiology, particularly epidemics, influences current infection control. We must determine whether Enterobacterales' transmission dynamics change in non-epidemic environments to stop these infections in hospitals [15]. They remain neglected by hospital care quality regulations, notably in NICUs and PICUs. The lack of evidence linking anemophilous fungi to human illnesses, varied culture methods, variable fungal pathogenicity mechanisms, and, most importantly, the lack of understanding of the fungal burden (particularly in the air) may be to blame [16]. Furthermore, these fungi are discreetly managed, unlike the conspicuous epidemics, and their origin is seldom investigated [17].

Healthcare professionals and patients regularly contact objects in hospitals, which may contain infections or serve as a source of infectious agents. This research sought to ascertain the level of bacterial contamination on typical hospital items that patients, visitors, and healthcare professionals commonly contact.

1. METHOD

This study included 140 samples of swabs that have been collected from Al-Ramadi teaching hospital for maternity and children. The places within the hospitals that from which the samples were collected included ER halls, Operations rooms, Beds rooms, Labs, Kitchen, Entrance, and Passages. Following the morning shift, the sampling period was from 9 to 11 in the morning. Basic data, such as patient hospital stays and the categorization of beds into general wards and special units, were obtained for the study from the department of medical affairs. catalase test has been used to distinguish between germs from *staphylococci* and *streptococci*. A few drops of 3% hydrogen peroxide were added to the slide after transferring one colony by age (18–24 hours). bubbles starting to develop right after a positive test.

Test for oxidase using sterilized wooden sticks looped into wet filter paper and 1% oxidase reagent, a few colonies removed from the growing medium. After thirty seconds, the zone's color changed to purple, signifying a successful outcome.

Rapid diagnosis was performed using the coagulase test (slide technique) by adding two drops of sterile saline to each section of the split slide. The bacterial colonies are then moved to create a suspension. and received undiluted plasma treatment. Positive results were seen by clumping within 10- 20 seconds of the bacterial solution.

Test for Mannitol Fermentation for the investigation of *staphylococci* pathogenic kinds, primarily *Staphylococcus aureus*, mannitol salt agar (MSA) was utilized. Additionally, a clear colony of developing bacteria was introduced, and the mixture was cultured at 37C for 24 hours. The ph phenol read indicator's (MSA) through color changed to yellow, signifying a successful test.

Single colony of isolated bacteria was added to the peptone water to test indole viability, which was then incubated for between 24 and 48 hours at 37 °C with 0.5 ml of Kovacs reagent. and noted the outcome.

Fermentation of sugar test was done by adding those sugars glucose, fructose, sucrose, maltose, lactose, xylose, mannose, and sorbitol in tubes containing 5 ml of Purple Broth Base medium. The findings appeared after 24-48 hours of incubation at 37°C.

2. RESULT AND DISCUSSION

Surgery-related wounds, infections of the urinary tract (UTIs), and lower respiratory system infections are the most common causes of nosocomial infections, which can be cross-infections or endogenous. Modern diagnostic procedures such as biopsies, endoscopic examinations, catheterization, intubation/ventilation, and surgical procedures increase the risk of infection by microorganisms such as *Escherichia coli*, which are typically benign but can become pathogenic when the body's immune defenses are weakened.

The results of samples positivity have summarized in table (1). The results showed the higher number of contaminated samples are from the samples isolated from both entrances and passages which showed 100% of the samples are positive for microorganisms' presence. Followed by the samples isolated from the emergency rooms (90%). Followed by the hospital's kitchen (80%). Then the laboratories showed (60%) of the samples were positive. Then half the number of samples isolated from patients' bedrooms were positive (50%). None of the samples that isolated from operation rooms were positive. These results agreed with a previous study that showed Staphylococcus aureus was the most common bacterial isolate and majority of *S. aureus* isolates were recovered from elevator buttons, biometric attendance devices and door handles [3].

Table 1: numbers of contaminated samples isolated from the different sources

Source	Number of tested samples	Number of positive samples	%	Number of negative samples	%
ER halls	20	18	90	2	10
Operations rooms	20	0		20	100
Beds rooms	20	10	50	10	50
Labs	20	12	60	8	40
Kitchen	20	16	80	4	20
Entrance	20	20	100	0	0
Passages	20	20	100	0	0
Totals	140	96	65	44	35

After identification of bacterial isolates for each sample according to gram staining the results are shown in the table (2). The results showed 50% of the samples isolated from entrances were contaminated by *E.coli* and 30% by *Staphylococcus* Sp., 10% for both *Klebsiella* and *St. pyogenes*. The samples isolated from showed 40% were positive for *E.coli* and 30% *Staphylococcus* Sp., 20% for *Klebsiella* and only 10% by *St. pyogenes*. five samples of the positive samples isolated from ER were *E. Coli*, and 2 of them were *streptococcus*, 2 were *Staphylococcus* Sp. The 18 positive samples isolated from kitchen showed 8 of them contaminated with *E. coli*, 4 with *Staphylococcus* and 2 for each *St. pyogenes* and *Klebsiella*. 4 of the 12 positive samples isolated from labs were positive for *Klebsiella* and 4 with *Staphylococcus*, 2 for each *E. coli* and *St. pyogenes*. 6 of the samples isolated from the bedrooms are positive with *E. coli* and 2 for *Klebsiella* and 2 for *Staphylococcus*. Our results suggested higher frequency of contamination were detected by *E.coli*, *staphylococcus* and less by *streptococcus pyogenes* According to our research, patients who are colonized or infected with *E. coli* rather than *K. pneumoniae*, and *streptococcus pyogenes* are more likely to contaminate their hospital room with live *E. coli*. In a previous study, it has found that patients with co-infection between *K. pneumoniae* and *E. coli* have the higher contamination capability [18].

Table 2: types and number of isolated bacterial species according to gram staining

Source	Number	Number	Gram negative bacteria	Gram negative bacteria

	of tested samples	of positive samples	*E. Coli*		*Klebsiella*		*Streptococcus pyogenes*		*Staphylococcus Sp.*	
			Positive	%	Positive	%	Positive	%	Positive	%
ER halls	20	18	10	50	2	10	4	20	4	20
Operations rooms	20	0	0	0	0	0	0	0	0	0
Beds rooms	20	10	6	30	2	10	0	0	2	10
Labs	20	12	2	10	4	20	2	10	4	20
Kitchen	20	16	8	40	2	10	2	10	4	20
Entrance	20	20	10	50	2	10	2	10	6	30
Passages	20	20	8	40	4	20	2	10	6	30
Totals	140	96								

The results of biochemical tests that have been done for the negative samples are shown in the table (3). *E. coli* showed a positive result for each of the glucose, lactose, sucrose, and mannose fermentation, also showed an ability for gas production, positive Methyl red, indole and negative results in Voges-Proskaue, urease production, and citrate. *Klebsiella* on the other hand showed ability to ferment glucose, sucrose and mannose but not lactose, with positive results for gas, Voges-Proskaue, urease and citrate tests. *Pseudomonas* showed ability to ferment only mannose and the production of gas, citrate and urease.

Table 3: Biochemical tests for gram-negative bacteria

bacterial isolates	fermentation of				Gas	MR	VP	Indole	Citrate	Urease
	G	L	S	M						
E. coli	+	+	+	+	+	+	-	+	-	-
Klebseilla	+	-	+	+	+	-	+	-	+	+
Pseudomonas	-	-	-	+	+	-	-	-	+	+

The results of some biochemical tests for the gram-positive bacteria are shown in table (4). *S. pyogenes* showed negative results for catalase, coagulase, citrate, urease, Voges-Proskaue, indole and mannitol and showed positive results for methyl red and showed alpha hemolysis. *S. aureus* showed positive catalase, coagulase, urease, MR, mannitol and showed beta hemolysis on the blood agar. *S saprophylic* showed none-hemolysis results and positive results in catalase, urease, MR tests. *S. epidermidis* showed none hemolysis results and positive results within each of catalase MR and mannitol.

Table 4: Biochemical tests for gram-positive bacteria

Bacterial isolate	catalase	coagulase	hemolysis	citrate	urease	MR	VP	Indole	mannitol
S. pyogenes	-	-	A	-	-	+	-	-	-
S. aureus	+	+	B	-	+	+	-	-	+
S. saprophylic	+	-	None	-	+	+	-	-	_
S. epidermidis	+	-	None	-	-	+	-	-	+

The results of fungal contamination tests are summarized in the table (5). The results showed all the samples isolated from both entrances and passage were all positive for Aspergillus contamination. Followed by emergency rooms. With 90% of the samples were positive for Aspergillus. Then 80% in the kitchen. Followed by labs 60%, beds rooms 50% contaminated with penicillium. Furthermore, in their findings results imply that this disparity across species cannot be fully explained by equivalent variations in patient characteristics. The relationship between *K. pneumoniae* and environmental pollution persisted even after they used multivariate analysis to account for a broad variety of possible confounding variables. The ability of *E. coli* and *K. pneumoniae* to survive in the environment is affected by their fundamental biological differences, which is one explanation for this discovery and one for which there is at least some evidence [19]. Another option is that hospital's unique cleaning procedures had less of an effect on *K. pneumoniae* than on *E. coli*. Even after correcting for host variables using multivariate analysis, *K. pneumoniae* was still a substantial risk factor for environmental contamination in that research. Researchers from another French hospital have also observed similar results [20].

The condition known as pulmonary aspergillosis is acquired by environmental aerosol spore inhalation. *Aspergillosis* contracted in hospitals is often attributed to airborne fungal contamination of the hospital environment, particularly during construction activities. A prior study demonstrated the transmission of *Aspergillus fumigatus* (secondary pulmonary aspergillosis) from an intensive care unit (ICU) patient with a sporulating liver-transplant surgery site infection to two additional patients [21]. The results of this study showed that *Aspergillus* is the higher fungal contamination within the hospital parts. *Aspergillus* species are ubiquitous environmental organisms, however, may act as opportunistic pathogens. The results of this study agreed with the previous study that the samples obtained from air sampling show a significant presence of airborne Aspergillus [22].

Table 5: Numbers of contaminated samples with fungal species

Source	Number of tested samples	Number of positive samples	Isolated fungal species	percentage	Number of negative samples	percentage
ER halls	20	18	Aspergillus	90	2	10
Operations rooms	20	0		0		
Beds rooms	20	10	Penicillium	50	10	50
Labs	20	12	Aspergillus	60	8	40
Kitchen	20	16	Aspergillus	80	4	20
Entrance	20	20	Aspergillus	100	0	0
Passages	20	20	Aspergillus	100	0	0

3. CONCLUSION

This study brings attention to the problem of bacteria and Fungi contamination in hospitals. It reveals that everyday items and surfaces can harbor pathogens, including drug resistant bacteria and often overlooked fungal spores. These findings highlight the need for consistent infection control measures. Despite the known effectiveness of hand hygiene there remains a concerning lack of adherence among healthcare professionals indicating a gap between policy and practice that must be addressed. Furthermore the neglect towards contaminants in healthcare environments in vulnerable areas like NICUs and PICUs calls for a comprehensive approach, to infection control protocols that address both bacterial and fungal threats. The research underscores the significance of surface disinfection following hand hygiene protocols and providing continuous education to healthcare providers. By shedding light on these risks and offering evidence based recommendations this study aims to contribute towards reducing healthcare associated infections and improving patient safety outcomes in facilities.

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