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## MICROBIAL ASSESSMENT OF SURFACES AND AIR QUALITY IN EMERGENCY AND GYNECOLOGY OPERATION THEATER OF BAHAWAL VICTORIA HOSPITAL

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### ABSTRACT

**Background:** Microorganisms present in air and on surfaces of operation theaters are the common cause of nosocomial infection in patients. Microbiological assessment of organisms is important to check the quality of environment provided to patients who are already in compromised state. So, this study was conducted to determine the level of bacterial contamination of air, environmental and medical equipment surfaces in operation theatres of Bahawal Victoria Hospital, Bahawalpur. **Objective:** To determine Microbes of surfaces and air quality in Emergency and Gynecology operation theater of Bahawal Victoria Hospital. **Methodology:** A descriptive cross-sectional analytical study performed involving 100 samples from air and surfaces of Gynecology and Emergency operation theater of BVH from July to December. Demographic and other clinical data was collected using standardized data collection tools. Culture of air and different sites (floor, walls, basin and equipment) for the microbiological assessment was done by the gold standard method. Culture positive organisms were confirmed by gram staining, microscopy and biochemical tests. **Results:** Of the 100 samples collected from different sites like air, basin, walls, floor and instruments of emergency operation theater and Gynecology Operation Theater most organisms collected from theatres were *Staphylococcus aureus* followed by *E. coli* and *K. pneumonia* respectively. Most organisms were isolated from air, basin, and floor while medical equipment were fully sterilized and their samples show no growth.

**Keywords:** Operation theaters, *Staphylococcus aureus*, Medical equipment

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### INTRODUCTION

Environmental monitoring is becoming the mandatory part of cleanliness now a days. This monitoring means the testing of air for microorganisms, as well as surfaces and equipment. These micro-organisms cause hospital associated infections. Nosocomial infections in turn are becoming a key cause of patient's morbidity and death. The primarily role of hospitals is to provide better treatment and intensive care to the patients. Control of microorganisms from causing infections & basic hygiene practices should considered the base of hospital management [1]. Maintenance of air quality in hospitals is compulsory to prevent infections particularly in patients with compromised immune levels along with operational workers and visitors. Among all the units of hospitals the operation theatres are most important to be checked

and take care of their cleanliness. In operation theatres patients are in immune-compromised state and their normal flora is suppressed. So, they are more likely to catch the infection [2].

Operation Theater and other units of hospital contaminated with microorganisms have greatly increased the prevalence of hospital acquired infections. As these can add to transfer of contamination from one health care personnel to several patients when the health care personnel handles the patients with same contaminated hands touched with contaminated surfaces [3]. Operation Theater should be equipped with totally aseptic and sterile devices and instruments because there are increased chances of contamination of freshly treated, incised and traumatized tissues. Therefore, any unwanted contaminates or unsterile object or

instrument can easily transfer the microbes from the surfaces to the sites of wound. All operative procedures are performed under sterile conditions. Most common problems of surgery are high levels of infections among surgical procedures [4].

Variety of compounds polluted the indoor air quality such as particulate matter, carbon monoxide, volatile organic compounds (VOCs) and microorganisms e.g. bacteria, fungi, viruses etc. all these pathogens and several others are a potential risk factor for causing nosocomial infections that range from mild to severe diseases like gastroenteritis, respiratory infections and urinary tract infection and many more [5]. Microbial sampling of equipments, air, surfaces and other instruments should be properly done to evaluate the quality of cleanliness in hospitals especially in surgical wards and operation theaters. Wound infection caused by several microorganisms like *S. aureus* acquired in the operating theater can be easily prevented if regular quality checkup of the air and surfaces is done in these localities. Bacterial count in the air can provide a good assessment of the quality. Total numbers of bacteria in an empty operating theater should be  $< 35 \text{ cfu/m}^3$  with less than one colony of *Clostridium perfringens* or *S. aureus*. During an operation total air counts should be  $< 180 \text{ cfu/m}^3$  [6].

Surgical procedures are usually accompanied by and are at high risk of getting infected. It is the very most common leading complications of surgery. Evaluation of the quality of air in operating theatres can be performed routinely by microbiological sampling and particle counting [7]. Conversely, sterilization of all materials that are used and equipments utilized during an operation is performed with the assumption that each and every person regardless of being patient, doctor, attendant or visitor is a potential source of infection for others. It is necessary that all hospital staff of the operating team should know about the common sources infections, and they should know the ways by which they get access to the sterile field and surgical sites. Maintaining the sterile technique should be considered as the responsibility of everyone entering in the operation theatre [8]. Based on these critical points the current study is designed to evaluate the contamination in operation theaters and to potentiate the development of better hygiene assessment in all operating theatres as well as in the remaining hospital environment. Patients come to hospital to seek treatment of their diseases or infection not to get more contaminated and filled with nosocomial infections. by poor hygienic practices [9].

Doctors if injured or having some kind of cuts, burns, or skin abrasions should not scratch, itch, scrub or handle sterile equipments as this can also increase the risk of transmission of bacterial pathogens from the infected site to the sterile objects. Only sterile items are used within a sterile field. If there is a doubt about the sterility of any object, that object should be considered as not sterile [10]. A study by Awosika et al in 2012 concluded that regular cleaning and proper disinfection, reducing the visitors and relatives of patients movement in the hospitals, can enhance the better indoor air quality in hospitals [11]. A research work of District Hospital Budgam of Kashmir Division in 2013 showed contamination of Staphylococcus, Bacillus and Coagulase negative Staphylococci. Out of these three bacteria the maximum contamination was found of Bacillus spp which was about 80%. Omoigberale et al in 2014, conducted an experiment to study the microbiological assessment of hospital indoor air quality and concluded that the level of hygiene and cleanliness was high in operation theatres that appeared to be good while the level of contamination was high in the waiting room [12]. There are various studies that are carried out in hospitals for the purpose of evaluation of microbial contamination. Studies conducted in Nigeria by Agbagwa and Obakpororo et al in 2014 show results of increased bacterial population in MMW (Male Medical Ward), while the decrease counts were observed in GW (Gynecology Ward). Bacterial counts for the morning and evening were also meaningfully different from the other wards and general hospital [13].

## **MATERIALS AND METHODS**

### **Study Design**

The design of the study is Descriptive cross-sectional carried out at the Department of Microbiology Quaid-e-Azam Medical College, Bahawalpur with the collaboration of Medical unit Bahawal Victoria Hospital Bahawalpur. Ethical approval was taken by the hospital ethical committee.

### **Data Collection**

Due to limitation of availability of resources 100 samples of air and surfaces were taken 50 from Gynecology and 50 from Emergency Operation Theaters (EOT) of BVH. Data was collected by using pretested questionnaire. The questionnaire consists of two parts. A part was about Socio-demographic variables [name, time, date and site]. Other part consisted of study variables Air and surfaces samples which met the above mentioned criteria during the study period was included in the study.

**Inclusion and Exclusion Criteria**

Sample from air and surfaces like walls, floor, wash basin, instruments of gynecology and emergency operation theaters. Contaminated samples and broken petri dishes during transportation of samples in sealed plastic bags.

**Sample Collection and Bacterial Identification**

Petri dishes containing blood and MacConkey agar were transported to operation theatres in sealed plastic bags. Plates were placed 1 Meter above the ground in operation theatres, exposed for 15 minutes and incubated at 37°C for 24 hours. The sample was inoculated on different agar to examine the growth of bacteria. Nutrient Agar (35-37 °C up to 24 hours), Blood Agar (35-37 °C up to 24 hours), MacConkey Agar (35-37 °C up to 24 hours). Growth of bacteria on agar plates were examined after 24 hours of

incubation. They were identified morphologically by Gram staining and biochemical tests system coagulase test, catalase test and cytochrome oxidase test.

**RESULTS**

Distribution of samples taken from different operation theaters (Table 1) and percentage of organisms found in both theaters (Table 2 & 4) show that emergency operation theatres were more contaminated. Hospital sites and air surfaces that were assessed for microbial contamination (Table 2 & 4) have maximum percentage of *S. aureus* followed by *E. coli* i.e, Gram positive were more prevalent than gram negative. Moreover, among all the sites floors were more contaminated while medical equipments were sterilized.

**TABLE 1:** Distribution of sample taken from different operation theaters (n=100).

Name of OT	No. of samples	Percentage
EOT	50	100%
GOT	50	100%

**TABLE 2:** Distribution of culture positive air samples in GOT and EOT in BVH (n=100).

Name of OT	S. aureus		E. Coli	
	No.	%	No.	%
EOT	5	50%	3	30%
GOT	3	30%	1	10%

**TABLE 3:** Distribution of microbes in surface (walls, floor, basin and instrument) samples in GOT and EOT in BVH (n=10 for each site).

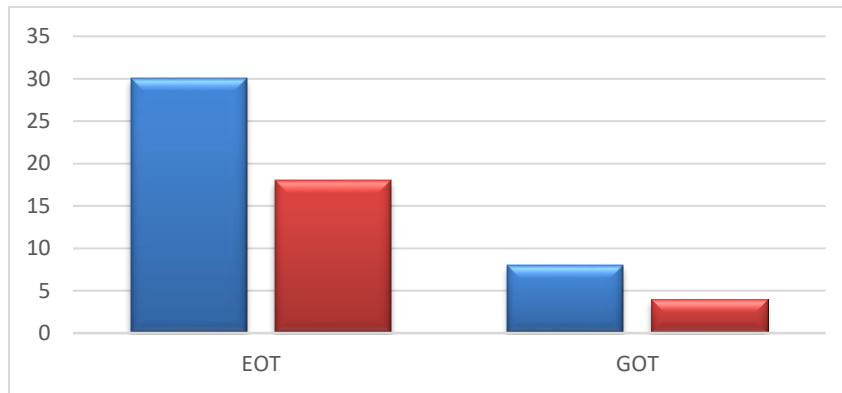
Name of OT	Floor				Walls				Basin				Instruments			
	S. aureus		E. coli		S. aureus		E. coli		S. aureus		E. coli		S. aureus		E. coli	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
EOT	5	50	0	-	2	20	0	-	3	30	1	10	0	-	0	-
GOT	3	30	0	-	1	10	1	-	2	20	0	-	0	-	0	-

**TABLE 04:** Isolated bacteria from air and surfaces of EOT & GOT of BVH.

Nome of O.T Bahawal Victoria Hospital Bahawalpur	No. of samples		Organism isolated				Total	
	No.	%	S. aureus		E. coli		No.	%
			No.	%	No.	%		
EOT	50	100	15	30	4	8	19	38
GOT	50	100	09	18	2	4	11	22

**TABLE 5:** Distribution of bacterial pathogens according to gram staining.

No	Gram staining	No of positive cases			
		EOT		GOT	
		No	%	No	%
1	Gram Positive	15	30	09	18
2	Gram Negative	04	08	02	04
Total positive case		19	38	11	22



**Figure 1:** Distribution of Isolated Bacteria from air and surfaces of emergency and gynecology operation theaters of BVH according to percentage. (EOT: Blue 30% *S. aureus*, Red: 8% *E. coli*; GOT: Blue 18% *S. aureus*, Red: 4% *E. coli*).

## DISCUSSION

The contaminating pathogens that were isolated consist gram positive cocci and gram-negative rods. These were found in the air and surface samples of theatres. These bacteria exhibited highest percentage of occurrence in air. The condition of indoor air is dependent on many factors that include external as well as internal sources like ventilation, different procedures, the hospital personnel and their performances.

The aim of this study was to check the microbial contamination in different operation theater and to rule out the causative microorganism which were involved in post-operative infections. The results of our study declared that there were higher levels of bacterial contamination in samples taken from air samples instead of samples taken from surfaces or article sample. Maximum bacterial contamination was found in the air sample and surface samples of emergency operation theater which represent the higher the risk of skin infections, boils, wound infections or abscesses. Whereas in terms of bacteria the highest contamination was observed by gram positive cocci *S. aureus* and gram negative rods in air as well as on basin and floor.

The instruments and articles which were sterilized by autoclave showed no growth [14].

In our results, instruments were fully sterilized and walls showed results with least microbial contamination while basin and floor samples showed bacterial contamination in Emergency Operation Theater.

Results of the current study showed less pathogens in Gynecology operation theater surfaces and air. A number of studies are conducted in operation theatres and other wards of hospitals of different cities to determine relationship between total bacterial air count in Operation Theater and risk of infection. A study was conducted by Javed and colleagues in 2008 used settle plate method for the determination of level of bacterial contamination of air, surfaces and equipment in operation theatres of a tertiary care hospital in Lahore. High bacteriological contamination of air and sucker machine was detected and total bacteriological counts in air samples were high. Surfaces showed less bacterial contamination [15]. Present studies have shown that the quality of indoor depends on several factors such as the number of people present in the hospital, the level of hygiene maintained in the hospital, the mechanical movement of people within a place in the hospital, the population of the ward and the number of patients put together in a small

place. All these and many other factors can lead to the increase of indoor airborne that can be released by human bodies.

## CONCLUSION

It is concluded from microbial assessment of different sites of emergency operation theater, that it

was more contaminated as compared to gynecology operation theater. Most common organisms isolated were *S. aureus* followed by *E. coli*. Moreover, among all environmental surfaces most contaminated sites were floors while medical equipments were sterilized.

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