



Studies on Environmental Monitoring of Aeromicroflora in a Hospital at Kalyani, West Bengal, India

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Abstract: A qualitative and quantitative study of indoor air in a hospital at Kalyani, West Bengal, India was carried out. For the enumeration of bacteria and fungi, samples were collected using the settle plate method. This study focuses to assess the microbial population of indoor air of different wards of the hospital and in different sampling time. The highest bacterial and fungal population was recorded in the evening time between 5 pm and 6 pm compared to the morning. The microbial flora isolated included four genera each of bacteria and fungi among which are *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella* sp, *Aspergillus* sp, *Fusarium* sp, *Penicillium* sp and *Candida* sp. The occurrence of microorganisms was highest in the general and female wards and lowest in the operation theatre.

Keywords: Aeromicroflora, Environmental Monitoring, Air pollution

1. Introduction

For the past few decades atmospheric pollution is one of the most serious problems and in recent times it has reached its climax which poses a great threat human health that deteriorates well being of the population [1]. Air pollution is the introduction of particulate matter, chemicals and biological materials into the atmosphere that causes discomfort, disease or death to humans, damage to other living organisms including food crops. Exposure to bio-aerosols, containing airborne microorganisms and their by-products, can result in respiratory disorders and other adverse health effects such as infections, hypersensitivity pneumonitis and toxic reactions [2, 3]. Microbes are the basic sources of indoor air contamination. Microbial damage in indoor or outdoor areas is caused most frequently by molds and bacteria. Patients are exposed to greater risk in indoor air environment because confined areas contained aerosols and allow them to develop an infectious level [4].

Indoor air of hospital contains a variety of microbial population. Nosocomial infection also known as hospital acquired infection is infection acquired in a hospital environment, which was not present in the patient at the time of admission [5]. Nosocomial infections can cause urinary tract infections, severe pneumonia and infections of other parts of

the body. The microorganisms implicated can enter the body through wounds, catheters as well as by inhalation [6]. In the tropics, researchers have identified microorganisms such as *Staphylococcus aureus*, *Escherichia coli*, *Streptococcus* sp, *Klebsiella* sp, *Bacillus* sp, *Penicillium* sp, *Aspergillus* sp and *Candida* sp are some of the most commonly isolated microorganisms from hospital environments [7]. The measurement of the quantity and aeromicroflora types serves as an index for cleanliness of the environment as well as profile revealing human health and nosocomial infections [4,8]. The source and spread of microorganisms inside the hospital are important concern, human related organisms or body flora, also found in clothing are disseminated through shedding during human activities [9]. Patients activity such as coughing, sneezing, yawning, talking and the number of patients per room may likewise be sources of hospital infection [10,11]. This present study was aimed at investigating the types of airborne micro-flora of a major government hospital in Kalyani, West Bengal, India.

2. Materials and Methods

2.1. Study Area

This work was carried out at a government hospital of Kalyani, West Bengal, India. Four wards of the hospital were

selected for sample collection. These wards were the general ward, female ward, children's ward and operation theatre.

2.2. Sampling and Microbiological Analysis

Plate exposure or settle plate which involves the opening of plate with specific culture media was used for this study [7, 12]. This method allows bacteria or fungi carrying particles to settle on the respective culture media. Prepared plates were exposed for about 10-15 minutes in the different wards in the mornings (10 am-11 am) and evenings (5 pm-6 pm). The plates containing nutrient agar (NA) and potato dextrose agar (PDA) were used for the isolation of bacterial and fungal isolates respectively. The bacterial culture plates were incubated at 37°C for 24-48 hr while the incubation of fungal culture plates were done at 25°C for 72-96 hr. The total number of colony forming units (cfu) for the bacterial and fungal air-flora were enumerated after incubation and converted to organism's colony forming unit per cubic meter.

2.3. Identification of Microorganisms

Bacterial colonies were initially characterized by cultural, morphological and further identified by biochemical examination of the isolates in accordance with Bergey's Manual of Determinative Bacteriology [13]. The fungal colonies were identified based on colony appearance and microscopic examination of the spore and hyphae [14].

3. Results and Discussion

The total viable count for bacteria obtained from hospital is shown in Figure 1. The lowest count was 13 cfu/m³ obtained for the operation theatre in morning while the highest count of 61 cfu/m³ was obtained for the general ward in evening. In hospital air, the highest fungal count of 36 cfu/m³ was obtained in the evening in the female ward while the lowest count of 8 cfu/m³ in morning was obtained in the operation theatre (Figure 2).

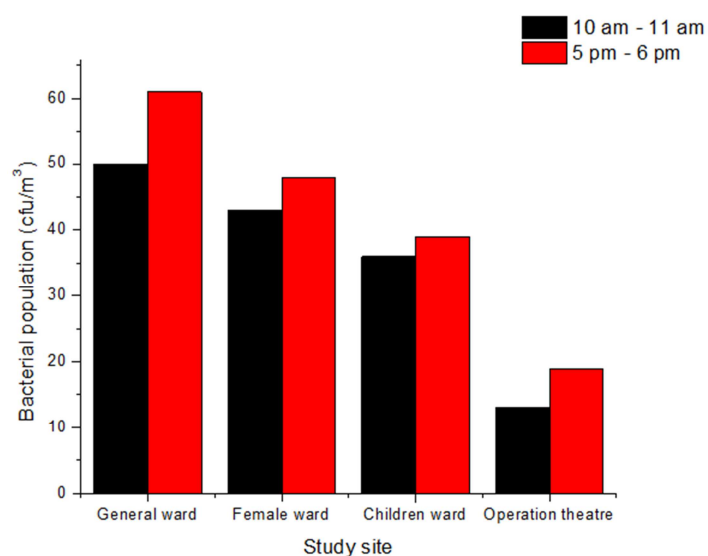


Figure 1. Bacterial population of air in four wards of hospital.

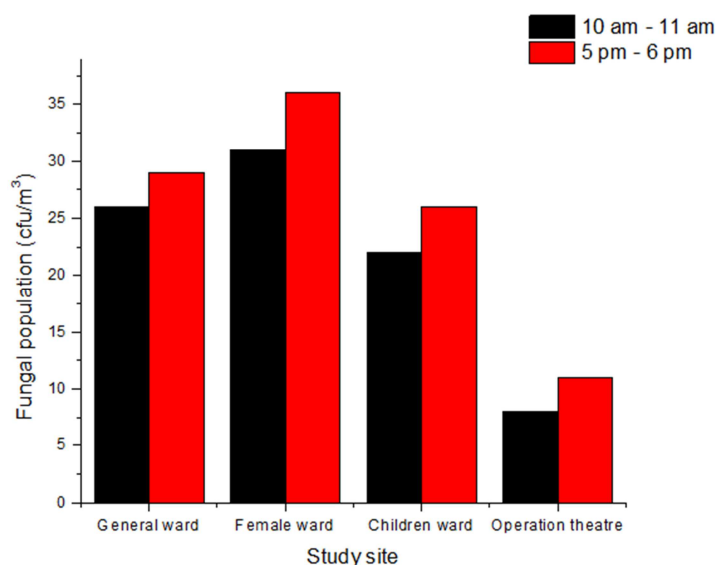


Figure 2. Fungal population of air in four wards of hospital.

Table 1 indicates the distribution frequency of aeromicroflora isolated from four different wards of the hospital. Four bacterial and four fungal species were isolated. Among the bacterial isolates *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* were observed to be the most dominant bacteria in general and female wards of hospital investigated, while *Aspergillus* was most commonly frequent fungal species in all the ward studied. The occurrence of microorganism was higher in the general and female wards than in the children ward and operation theatre.

Table 1. Occurrence of hospital aeromicroflora in four wards of hospital.

Microorganisms	General ward	Female ward	Children ward	Operation theatre
<i>Escherichia coli</i>	+++	+++	++	+
<i>Staphylococcus aureus</i>	+	++	++	-
<i>Pseudomonas aeruginosa</i>	++	+	-	-
<i>Klebsiella</i> sp	+	++	+	-
<i>Aspergillus</i> sp	+++	+++	+	+
<i>Fusarium</i> sp	++	+	-	-
<i>Penicillium</i> sp	++	++	+	+
<i>Candida</i> sp	+	++	+	-

+ present, ++ present in higher degree, +++ present in highest degree, - absent

The microflora of any habitat varies with environmental condition, host type and relation among them [15]. The indoor air environment of hospital has great risk for patient because they confine aerosols to an infectious level [1]. The study of airborne microorganisms in indoor hospital environments is important to understand the dissemination of airborne microbes particularly the pathogenic ones [8]. It is assumed that the environment where treatments of patients are done has an important impact on the future of such patients recovering or acquiring infection which may complicate their conditions [11]. Therefore, it is of utmost importance for evaluating the quality of the indoor air of the hospital environments. In this study, the most frequently isolated microorganisms were *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Aspergillus* sp. These airborne micro-flora recorded in the present study corroborated the study of Omoigberale *et al.* [16]. According to Lateef [17], *Staphylococcus aureus* was the major causal agent of infections of the deeper tissue and organs, skin. The microorganisms recorded in the present investigation are known to be primary agents of nosocomial infections in hospitals. Similar types of aero-microflora was isolated in hospital by various researchers [12,18].

In the present study airborne bacterial and fungal colonies were recorded in higher numbers during the evening, which was probably due to the cleaning activities when the doors are open [18]. Dust from anthropogenic activities, such as movement, sweeping, and bed making, increase the count of microbes [19,20]. In the morning, microbial fluctuations occurred which might be associated to variations in the number of operating personnel and their activities [21]. High microbial counts in different indoor environments indicate a

potential health risk such as respiratory problems. As the isolated bacteria and fungi in the present study are pathogenic, it is appropriate that their presence should be checked. Attempts should be made to reduce airborne transmission of opportunistic microflora and their potential effect on patients.

4. Conclusion

From this study it is revealed that a large number of pathogenic microorganisms are always presents in the hospital atmosphere that cause serious health hazards so it is important so it is important that the hospital ambient air should be continuously monitored for air-borne pathogens. Periodic cleaning operations and maintenance activities of different indoor environment should be taken as a preventive measure, though isolated bacteria and fungi are tentatively identified by morphological, physiological and biochemical tests it needs further identification through 16S and 18S rRNA sequencing for bacteria and fungi respectively.

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