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Airborne Microbial Population in Different Health Care Units of Dehradun City

Rabia Quadir*, *Pallavi P. Chauhan* and *Irfan Rashid Sofi*
**Uttaranchal College of Science and Technology, Dehradun (Uttarakhand), INDIA*
***Department of Environmental Science, Jiwaji University Gwalior (Madhya Pradesh), INDIA*

(Corresponding author: Rabia Quadir)
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ABSTRACT: Contamination of environment due to microbes has become a serious problem nowadays. In recent years hospitals have become a medium for transmitting infectious diseases because of the patients infected with pathogenic and communicable diseases. This study was focused at the isolation and identification of airborne microorganisms found in the different wards of two different hospitals, one private and one Govt. hospital at morning and evening time. The study was carried out using "exposed plate technique". The samples were collected during the winter season (Jan – March 2013) and summer season (April-June, 2013). Plates containing culture media were exposed for half an hour in the different wards, after which plates were incubated at 24°C for 24 hours or 48 hours for bacteria while fungal plates were incubated at room temperature. Results obtained from this study showed that maximum microbial population was observed in Govt. hospital than Private hospital.

Key Words: Hospitals, wards, airborne microflora, bacteria, fungi

INTRODUCTION

Hospital is an important indoor environment responsible for spread of airbornepathogens. A wide range of microbes are found in hospital indoor and outdoor air (Burge and Hower 1990). In fact hospitals serves as a reservoir of disease causing microbes because of the individuals infected with number of microorganisms and these infections are transmitted to other individuals including the patients present in the hospital, hospital staff and even attendants and visitors. Hospital-associated infection which has a worldwide distribution remains a major cause of deaths among hospitalized patients (Baha and AL-Amiedi 2007; Dutkiewicz and Augustowska 2006).

It has been estimated that over 1.4 million people worldwide suffer from infectious complications acquired in the hospital. Hospital indoor air can carry inorganic particulates and allergens that cause uneasiness and various health problems for both the patients and the other persons present in the hospital (Ducel 2002).

Hospital acquired infections are the infections acquired from health care services during treatment, which are secondary to the patients (Ekhaise 2010). People that go to hospitals are prone to infections originating in a hospital also called nosocomial infections, whose extent is dependent upon the hygienic conditions of the hospital environment, number and type of visitors (Ekhaise 2008; Falvey and Streifel 2007).

Therefore, it is important that these pathogens must be identified as early as possible to stop the hospital related infections and also presence of these pathogens in different wards of a hospital and to implement monitoring programs in order to evaluate the effectiveness of aseptic techniques that can be applied and contribute to better preventive measures against infectious diseases caused by pathogens (Fang 2007).

The objective of this study was to investigate the airborne microbial population in different health care units (hospitals) of Dehradun city.

MATERIALS AND METHODS

Study Area-Doon Valley: The present research work on the topic "Study of Air Borne Microbial Population In Different Health Care Units (Hospitals) of Dehradun City" was carried out in the Department of Environmental Science, Uttaranchal College of Science and Technology, at two different hospitals i.e. Doon Hospital and Combined Medical Institute in Dehradun city of Uttarakhand during the period of six month from January 2013 to June 2013.Doon Valley lies in between 77° 35′ and 78° 20′ East longitude and corresponding 29° 57′ and 31°02′ North latitude. It is bounded by the Lesser Himalayan foot hills to the north–east, the Shiwalik hills to the south–west, the Yamuna River to the north–west and the Ganges hills to the south–east. The saucer shaped Doon Valley covers an area of approximately 1500m^2 having 20 km width and about 76 km length with an average annual rainfall of about 2200 mm per year.

A. Study Sites

Doon Hospital: Doon Hospital in Dehradun ranked top most government hospital in north India. Doon hospital offers all ultra-modern facilities and technologies *i.e.,* ultra sound, brain mapping, MRI, CT- Scan, ECG, and all major surgery receiving 600-1000 patients per day.

CMI Hospital: CMI Hospital is a multi-specialty medical facility and a leading private hospital of highest quality in Uttaranchal. It is centrally located 150 bedded healthcare centres in the Dehradun city. The hospital apart from providing primary health services like medicine, maternal & childcare, immunization and nutrition also provides secondary health services.

B. Sampling Procedure and calculation

The samples were taken from two different hospitals i.e. Doon Hospital and Combined Medical Institute located (CMI), in Dehradun city of Uttarakhand during two seasons i.e. winter and summer seasons.

The samples of the study were collected from 4 wards in the hospitals twice a day, once in the morning time and secondly in the evening time. These include general and maternity wards of Doon hospital, general and ICU wards of CMI hospital.

Total density of pathogens as CFU/ml was estimated using the below mentioned formula:

$$\text{CFU/ml} = \frac{\text{Total number of colonies on agar plates 25/ml}}{\text{Times of exposure in minutes}}$$

C. Preparation of Media and sampling

Two different kinds of media were prepared for sampling of microorganisms. Nutrient Agar Media (NAM) for bacteria and Potato Dextrose Agar (PDA) for fungi. After media preparation, it was autoclaved for sterilization. Media was poured into petriplates in Laminar Air Flow (LAF) for solidification and also to avoid contamination. The air samples were collected from the indoor and outdoor air of General, Maternity wards of Doon Hospital and General and ICU wards of CMI hospital. The samples were collected by using the "Exposed Plate Technique". The media plates were carried to hospitals in a transport medium wrapped with parafilm to avoid contamination. The Petri plates of media were exposed to air of sampling sites by opening their lids. The media plates were exposed to air continuously for half an hour. After this the lids of the plates were closed and the plates were again wrapped with parafilm to avoid contamination. All the microbial sample plates were collected in a transport medium.

The airborne microbial samples collected from four wards of hospitals were brought to laboratory in a transport medium immediately to avoid contamination and were incubated. The samples were incubated at 24°C temperature for 24 hours or 48 hours. After 48 hours the microbial colonies were counted.

After incubation, bacterial and fungal colonies were isolated for identification. Bacteria were identified using Gram staining and various biochemical tests were done for their identification like catalase test, carbohydrate fermentation test, indole test, citrate test, MR/VP test. Fungal colonies were identified by the Tease Mount Procedure using Lacto phenol cotton blue staining.

RESULTS

In the present study time, four species of bacterial isolate, *Staphylococcus*, *Escherichia coli, Bacillus, Micrococcus* and five species of fungal isolates, which include *Aspergillus* sp*, Penicillum* sp*,*

Cladosporium, Alternaria, Aspergillus were consistently isolated from the two different hospital units investigated. These species of microorganisms were identified by following the manual of K R Aneja 2003.

The present study also showed that in summer season higher airborne microbial population were observed in Doon and CMI hospitals during evening time. The same results were observed in winter season. In Doon hospital average numbers of colonies isolated was 812 CFU/ml during winter season and 859 CFU/ml during summer season. The present study showed that in winter season most abundant species found among microbial isolates were *Staphylococcus* and *Micrococcus. Bacillus & E. coli* were noted to be dominant, while *Aspergillus and Penecillium* were observed to be frequent and *Alternaria, Rhizopus, Cladosporium* were isolated to be rare. In summer season, the most abundant species were *Bacillus and E. coli. Aspergillus, Cladosporium and Penicillium* were observed to be dominant*, Rhizopus and Alternaria* were frequent and Staphylococcus and micrococcus were noted to be rare.

In CMI hospital total numbers of colonies isolated were 738 CFU/ml in winter season and 285 CFU/ml in summer season. The present study showed that in CMI hospital during winter season (January-March 2013) most abundant microbial isolates were noted to be Staphylococcus and micrococcus. *Bacillus*, *E. coli* and *Penicillium* were noted to be dominant, while *Cladosporium* and *Rhizopus* were found to be frequent and *Aspergillus* and *Alternaria* were noticed to be rare. In summer season (April-June), the most abundant microbial species were observed to be *E. coli, Bacillus* and *Cladosporium. Aspergillus and Rhizopus* were noted to be dominant, while *Penicillium* was found to be frequent. *Alternaria, Staphylococcus* and *micrococcus* were noted to be rare.

Table 1: Variation of microbial population during summer at different hospital in Dehradun city.

	Morning (10.00-11.00 A.M.)				Evening (4.00-5.00 P.M.)			
Name of Species	**Doon (General)**	**Doon (Maternity)**	**CMI (General)**	**CMI (ICU)**	**Doon (General)**	**Doon (Maternity)**	**CMI General)**	**CMI (ICU)**
Staphylococcus	101	61	85	55	109	71	91	56
Micrococcus	52	43	55	34	59	51	61	36
Bacillus	40	31	24	18	48	40	30	19
E. coli	8	18	12	8	10	27	15	10
Aspergillus	6	10	4	2	6	11	5	3
Cladosporium	7	4	13	10	8	4	14	11
Rhizopus	4	3	6	10	5	4	6	10
Alternaria	0	0	0	0	1	0	0	0
Penicillium	14	6	10	15	15	7	11	16

Table 2: Variation of microbial population during winter in different hospital of Dehradun.

	Morning (10.00-11.00 A.M.)				Evening (4.00-5.00 P.M.)			
Name of Species	**Doon (General)**	**Doon (Maternity)**	**CMI (General)**	**CMI (ICU)**	**Doon (General)**	**Doon (Maternity)**	**CMI (General)**	**CMI (ICU)**
Staphylococcus	0	0	0	0	1	1	0	0
Micrococcus	0	0	0	0	1	1	0	0
Bacillus	57	38	15	16	62	43	18	17
E. Coli	64	53	18	22	69	58	22	25
Aspergillus	9	10	6	5	10	11	7	8
Cladosporium	9	7	17	13	10	8	17	13
Rhizopus	5	4	10	6	6	4	10	6
Alternaria	3	2	0	0	4	3	0	0
Penicillium	5	5	5	1	5	6	6	2

Table 3: Gram-negative bacteria and Gram-positive bacteria in different Hospitals of Dehradun city.

	Doon hospital	
	Gram-negative	**Gram-positive**
General ward	96.5 ± 14.84	4 ± 1.4
Maternity ward	61 ± 11.3	15.5 ± 4.9
	CMI hospital	
General ward	76 ± 8.4	12 ± 2.8
ICU ward	62 ± 16.9	9 ± 2.8

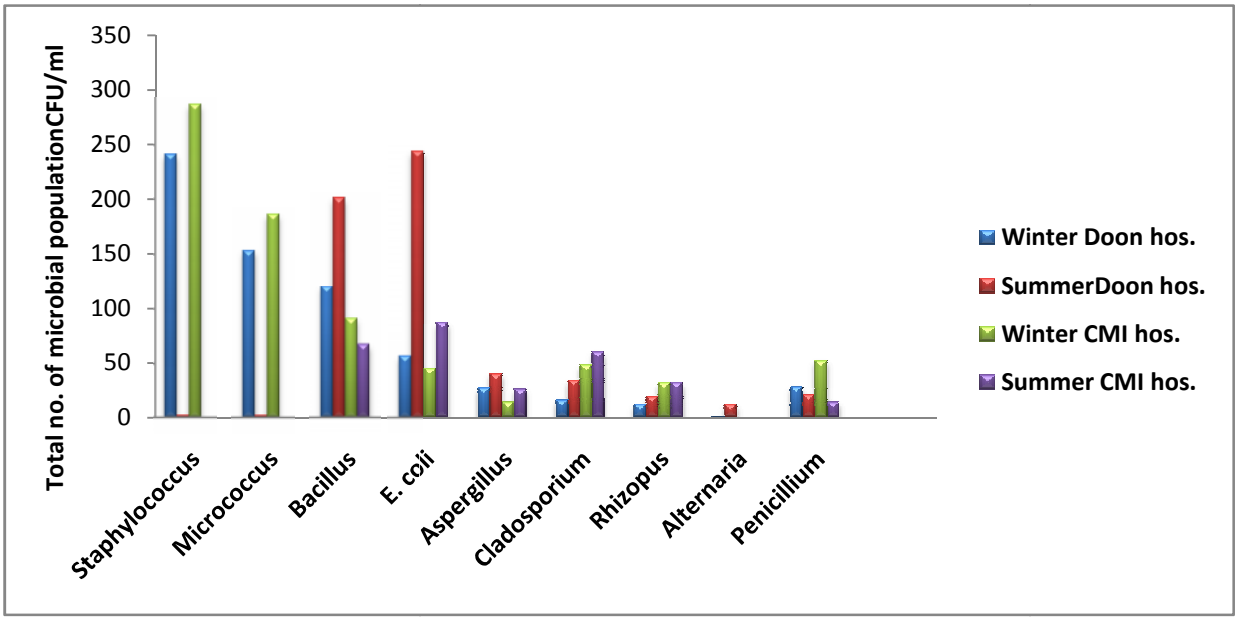

Fig. 1. Seasonal variation of airborne microbial population density in Doon and CMI hospitals (Dehradun).

DISCUSSION

Hospital environments are complex environments because they contain different types of microorganisms (Garner 1996; Gorny 2002). Airborne microorganisms are one of these microbes and their presence, numbers, and types can indicate the degree of cleanliness of these environments. There are wide varieties of factors which influence airborne counts, and therefore influence hospital infection rates (Heldman 1974; Jaffal 1997). No consistent international standard are available on levels and acceptable maximum bioaerosol loads in the wards of hospitals (Jyotshana and Helmut 2011) and various countries have different standards. A study conducted by WHO researchers on evaluation of health risks of biological agents in indoor environments argued that total microbial load beyond 1000 CFU/m^3 is considered as contaminated (Nevalainen and Morawaska 2009). Other researchers have reported that 300 CFU/m^3 and 750 CFU/m^3 is the safe limit for fungi and bacteria respectively (Francisco 2000; Cappitelli 2009). This research has showed the presence of various microorganisms in hospital environment. In the present study time, four species of bacterial isolate, Staphylococcus, *E. coli, Bacillus, Micrococcus* and five species of fungal isolates, which include *Aspergillus* sp*, Penicillum* sp*, Cladosporium, Alternaria, Aspergillus* were consistently isolated from the two different hospital units investigated.

These genera of bacteria and fungi have been shown to be amongst the most common bacterial and fungal species often isolated from the air (Burge, and Hoyer 1990). Jaffal *et al.* (1997) observed almost similar microbial genera. The highest total bacterial count was shown in General and Maternity ward followed by the ICU. The higher microbial counts were recorded for the Govt Hospital (Doon Hospital) as compared to the private hospital (CMI). Jaffal *et al* (1997) observed the same results. The reason behind this could be the Govt. hospitals are cheap and easily affordable for everyone.These variation in the number of micro flora might be because of the number of individuals in the wards. During the study, all wards were at their highest capacity, as of visitors in and out the wards, the high density of patients and the presence of high number of health science students in the wards. Thereby increasing the shading of bacteria and agitation of air as it was indicated in previous studies (Hospodsky 2012; Qian 2012; Meadow 2013). Poor ventilation in the wards might also contribute to the high microbial loads of the wards as indicated in the study done by Wamedo *et al.* 2012 The presence of these microbes may cause different types of diseases among people (Sharma 2017).

An assessment of the airborne bacteria and fungi in the hospital environment were experimentally investigated. Experiments of the types and numbers of airborne micro-organisms were carried out at four types of wards in two different hospitals i.e. Doon and CMI during winter and summer season. From this study it may be concluded that in Doon hospital microbial contamination is more than CMI hospital.The perfect hygienic conditions are not maintained in thishospital that is why it may support more microbial growth. On the other hand, in CMI hospital sanitary conditions are good and low microbial population has been observed there.

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