ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of DEVELOPMENT RESEARCH

International Journal of Development Research
Vol. 4, Issue, 8, pp. 1604-1610, August, 2014

Full Length Research Article

ANALYSIS OF AIR IN THE HOSPITAL ENVIRONMENT

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ARTICLE INFO

Article History:
Received 13th May, 2014
Received in revised form
06th June, 2014
Accepted 12th July, 2014
Published online 31st August, 2014

Key words:
Hospital wards,
Hospital personnel,
Occupational diseases,
Infection,
Bacteria and Fungus.

ABSTRACT

The aim of this study is to determine the presence of pathogenic bacteria and fungi in the hospital environment. The samples for the study were obtained from the hospital wards and were taken from the indoor air during, before and after disinfection by means of settle plate method. Nutrient agar, Blood agar, Macconkey agar, and Sabouraud's dextrose agar were used for isolation of bacteria and fungi respectively. 35 bacterial species and 19 fungal species were cultured from the hospital wards. The most frequently isolated bacteria was 43% *Staphylococcus aureus*, followed by 26% *Klebsiella pneumoniae,* 14% *E.coli*, 11% *Pseudomonas aeruginosa* and 6% *Proteus mirabilis*. The commonly isolated fungi was 43% *Aspergillus niger* followed by 27% *Candida albicans*, 10% *Fusarium spp*, 10% *Rhizopus spp* and 10% *Mucor spp*. Samples were collected over a period of three months, between April-June 2014. During the first month (April), no disinfectants were used and the air sample was collected by settle plate method from different areas of the hospital and it showed positive results for bacteria and fungi with exuberant growth. The second month (May) samplings were collected by the same technique after the utilization of Phenol as disinfectant in the same areas that were screened in the first month. This had bacterial and fungal growth but with less number of colonies. The third month (June) samples were screened after using 2% Sodium hypochlorite as the disinfectant in specified areas. This agent inhibited the bacterial and fungal growth and majority of the plates were sterile.
From the results observed in the study, the following issues were analyzed:
1.Airborne microbes in the hospital environment.
2.Most appropriate disinfectant that can be used.
3.Formulation of infection control measures.
4.Health education pertaining to hospital environment and
5.Infections related to the diseases and
6.Its control measures.

INTRODUCTION

Hospitals and other healthcare facilities are complex environment that requires ventilation for comfort of the patients and control of hazardous pathogens. Moreover, the biological quality of air in the hospital environment is of particular concern, as the patients may serve as a source of infection to staff and hospital visitors, in addition to fellow patients. Although hospital treatment and medical procedures are designed to cure diseases, they can sometimes inadvertently introduce pathogenic microorganisms into the body and initiate nosocomial infection (NI). The most important source of airborne pathogens inside the hospital is the infected patients. Airborne transmission occurs when pathogenic microorganisms are transferred from an infected to a susceptible individual via the air. The predominant mechanism that makes the pathogens airborne is the production of aerosol droplets by sneezing or coughing, and their subsequent loss of water which allows them to float in the air over considerable distance for a long time. Biological aerosols contain bacteria, viruses, yeasts, moulds and fungal spores. Under special clinical circumstances, skin lesions may also be a source of airborne particles. Controlling airborne pathogens in healthcare facilities is not only important for the safety of the patient, but it is also important for hospital personnel. Various infection control measures can limit the

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exposure and reduce the risk of infection. Although it is not possible to eliminate all NI, their incidence can be significantly reduced by implementation of appropriate infection control policies (Qudiesat *et al*., 2009). Airborne transmission is one of the routes of spreading diseases responsible for number of nosocomial infections (Claudete *et al*., 2006). Human exposure to airborne microorganisms may result in a variety of adverse health effects, including infectious diseases, allergic and irritant responses, respiratory problems, and hypersensitivity reactions (Mark P. Buttner and Linda D. Stetzenbach, Jan, 1993). Biological contamination of indoor air is mostly caused by bacteria, moulds and yeasts. They pose a dangerous threat as pathogens; as they secrete some harmful substances for health. These include different toxic metabolites like mycotoxins. Epidemiological studies shows that very high concentration of microorganisms in the air can be allergenic; however, even very low concentration of some microorganisms can cause serious diseases in some cases. It is supposed to be that, about 30% of health problems related to the indoor air quality is the result of a human's immune reaction to moulds (Stryjakowska-Sekulska *et al*., 2007).

The sources of hospital airborne infection or contamination could be traced to a variety of factors. These include patient's normal flora, linens, bed sheets, staff clothes, visitors and the materials such as flowers. Physical activity of the patients (sneezing, coughing, talking, yawning) and the number of patients per room may likewise be the sources of hospital infection (Jaffal *et al*., 1997; Alberti *et al*., 2001 and Ekhaise *et al*., 2010). According to current Swedish requirements, the number of 500 colony-forming units (cfu) of bacteria and 300 cfu of fungal spores in 1 m^3 can be accepted in an indoor environment (Abel *et al*., 2002). Especially, air contamination caused by fungi is taken into consideration because of their extremely dangerous influence on human health. However, it can be noticed that during the last 20 years opinions concerning innocuous fungal spore amounts in the indoor air of various kinds of rooms have varied (www.wondermakers.com, 2001). According to Berk *et al*., in 1979 exposure of 20 cfu/m^3 to over 700 cfu/m^3 has no harmful effect (Berk *et al*., 1979).

In this study, it was aimed to investigate the presence of bacteria and fungi that might be a pathogen in indoor air of the hospital wards. We also targeted to investigate the factors affecting the presence of microbes and the colony number of such microorganisms e.g. season, temperature and humidity of indoor air, air conditioning and ventilation, number of persons in the room, number of hospital wards and disinfectants used in the wards to control the microbes. The study embraced the presence of bacteria and fungi in the air of selected rooms and microbial composition of the air. The disinfectant recommendations here in provide guidance to minimize the risk and to prevent the transmission of pathogens in the indoor environment.

MATERIALS AND METHODS

Air Sampling location

The project was initiated after getting the approval from Ethical committee of the institution-serial no: 128/2013. Samples were collected from specified areas in the hospital and processed in the Microbiology lab. The sampling in the air from the hospital wards was done for 3 months duration, during summer months (April- June) 2014.

Settle plate method

The samples were collected by settle plate method by placing the petri plates in the targeted areas in the hospital wards according to 1/1/1 rule (petri dishes that will be left open for one hour, placed at a height of 1 meter from the floor and at a distance of 1 meter from the wall or any object) accepted by IMA index as the basis. According to this method, cfu (colony forming unit) index was used to determine the number of the colonies (Ergon, 2005 and Pasquarella *et al*., 2000). Air sampling was done by settle plate technique before, during and after disinfection of the room which were earmarked for the project. We utilized Nutrient agar, Blood agar, Macconkey agar and Sabouraud's dextrose agar for processing the samples. Blood agar was meant for identification and characterization of Gram positive bacteria and Macconkey agar for the further identification and characterization of Gram negative bacteria. For the purpose of isolating fungi, Sabouraud's dextrose agar (SDA) was used. Petri dishes containing Nutrient agar, Blood agar and Macconkey agar were incubated at 37°C for 48 hours and petri dishes containing SDA were incubated at 26°C for 72 hours. The definition and colony counting of the microorganisms that were grown in the petri dishes at the end of time were achieved (ErselSonmez *et al*., 2011). Bacteria were identified by three arrays:

1. Macroscopic estimation (description of colony).
2. Microscopic estimation (staining by Gram stain method).
3. Biochemical tests according to bacterial classification by Bergey (Holt *et al*., 1994).

The index of microbial air contamination (IMA)

IMA classes and maximum acceptable levels of IMA have been defined empirically. This has been possible, there were large amounts of data collected in many different types of closed environments and in the open air, over a number of years. The measurement of the IMA is meaningful in places where there is an infection or contamination risk. Therefore, the lower levels of contamination have been taken into account. The maximum IMA level included in the classification is 76. Higher values, well over 1000, can be found in dirty areas or places which are not controlled. However, if there is any risk, such counts must be lowered. Five classes of IMA have been devised: 0–5 very good; 6–25 good; 26–50 fair; 51–75 poor; >76 very poor. IMA classes have been also normalized to cfu/dm^2. Each class represents a different increasing level of contamination. In practice, this choice proved, for the aim to which it was intended. Maximum acceptable values of IMA have been established, related to different infection or contamination risks (Pitzurra *et al*., 1997). Following the studies of Fisher, the IMA was devised in 1978 with the aim of unifying and standardizing the technique of air sampling by settle plates. The 1/1/1 scheme was adopted. The IMA classes and the maximum acceptable IMA levels for each environment at risk were empirically defined by performing a large number of tests in different

environments (Pitzurra, 1984; Pitzurra and Morlunghi, 1978 and Pitzurra *et al*., 1997).

RESULTS

A total of 54 organisms were isolated which included 35 bacterial species and 19 fungal species from the hospital wards. Bacterial isolates were identified as *Staphylococcus aureus, Klebsiella pneumoniae, E.coli, Pseudomonas aeruginosa, Proteus mirabilis* and fungal isolates were *Aspergillus niger, Fusarium spp, Rhizopus spp, Mucor spp* were observed in the hospital wards. (Fig 3 & 5)

Table 1. Recommended Limit for Microbial Contamination According To EUGMP (European Union Good Manufacturing Practice) (1997)

GRADE	CFU/M3	CFU/plate†	CFU/RODAC‡	CFU/glove§
A	<1	<1	<1	<1
B	1	5	5	5
C	10	50	25	-
D	100	100	50	-

Table 2. Index of Microbial Air Contamination (IMA) Classes and Their Application

IMA VALUES	$CFU.dm^{-2}.h^{-1}$	PERFORMANCES
0-5	0-9	Very good
6-25	10-39	Good
26-50	40-84	Fair
51-75	85-124	Poor
≥ 76	≥ 125	Very poor

For bacteria, the results obtained by air investigation conducted in SSSMC & RI before disinfection, had 'C' grade and colony counts 39 $CFU.m^{-3}$(26-50 $CFU.dm^{-2}.h^{-1}$) as per EUGMP & IMA respectively. So the performance was Fair. (Table 3 & Fig 1)

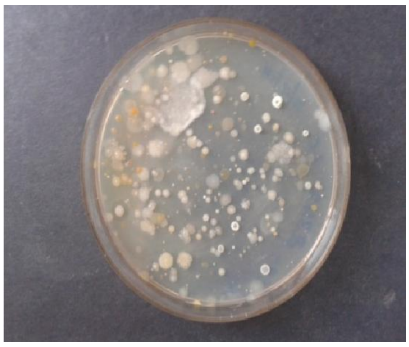

Figure 1. Showing Bacterial Growth In Nutrient Agar Before Disinfection

The same places were subjected for phenol disinfection and the performance was Good with grade 'B' and colony counts 25 $CFU.m^{-3}$(6-25 $CFU.dm^{-2}.h^{-1}$). The performance was graded as Good. (Table 4) The same hospital sites were screened also with 2% sodium hypochlorite as the third stage of the study and it was the one, with best result 'A' grade and colony count 3 CFU. m^{-3} (0-5 $CFU.dm^{-2}.h^{-1}$). And the performance was concluded as Very Good. (Table 5)

For fungi, the results obtained before disinfection also had grade 'C' and colony counts 33 $CFU.m^{-3}$(26-50 $CFU.dm^{-2}.h^{-1}$) as per EUGMP & IMA classes. So the performance was Fair. (Table 6 & Fig 2) Following the disinfection with phenol, the performance was Good with grade 'B' and colony counts 23 $CFU.m^{-3}$(6-25 $CFU.dm^{-2}.h^{-1}$). The outcome of 2% sodium hypochlorite as disinfectant, had 'A' grade and colony count 2 $CFU.m^{-3}$ (0-5 $CFU.dm^{-2}.h^{-1}$). And the performance was graded as Very Good. (Table 7&8)

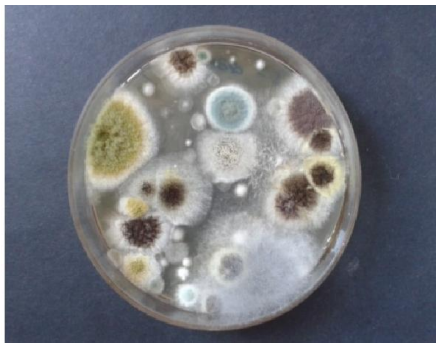

Figure 2. Showing Fungal Growth in Sabouraud's dextrose Agar Before Disinfection

BACTERIA	TOTAL NO.OF BACTERIA	PERCENTAGE (%) OF BACTERIA
Staphylococcus aureus	15	43
Klebsiella pneumoniae	9	26
E.coli	5	14
Pseudomonas aeruginosa	4	11
Proteus mirabilis	2	6

Figure 3. Prevalence of Bacterial Isolates Before Disinfection

Ultimately, the culture in all the screened areas had more of bacterial colony forming units than fungi as observed in our study.

DISCUSSION

Our study can be divided into three steps:

1. The samples collected before disinfection
2. The samples collected after disinfection with phenol
3. The samples collected after disinfection with 2% sodium hypochlorite.

The bacterial isolates in the predisinfection were identified as *Staphylococcus aureus, Klebsiella pneumoniae, E.coli, Pseudomonas aeruginosa, Proteus mirabilis* and fungal isolates were *Aspergillus niger, Candida albicans, Fusarium spp, Rhizopus spp, Mucor spp.*

A total of 35 bacterial species were isolated from 19 wards. 43% of *staphylococcus aureus* were isolated from Male surgical ward, Female surgical ward, Male medical ward, Female medical ward, Female TBCD ward, TBCD-OP, Ophthalmology-OP, ENT-OP, Orthopaedics-OP, Microbiology central lab, Biochemistry central lab, Pathology central lab, Medical ICU, Male ortho ward, Female ortho ward. 9% of Klebsiella pneumoniae were isolated from Female TBCD ward, Female ortho ward, Medical ICU, TBCD-OP, Biochemistry central lab, Pathology central lab, Orthopaedics-OP, Casualty and OG ward. 5% of *E.coli* were isolated from Male TBCD ward, Female medical ward, Male ortho ward, Blood bank, OG ward. 4% of *Pseudomonas aeruginosa* were isolated from Male TBCD ward, ENT-OP,

Table 3. Bacterial Species Isolated From The Hospital Wards Before Disinfection

S.No	Ward Name	No.Of.Patients	No.Of. Colonies	Organisms Isolated	IMA Value	Performance	Grade	Area
1	Male surgical ward	90	36	*Staphylococcus aureus*	26-50	Fair	C	112sq.m
2	Female surgical ward	60	32	*Staphylococcus aureus*	26-50	Fair	C	112sq.m
3	Male TBCD ward	15	28	*Pseudomonas aeruginosa, E.coli*	26-50	Fair	C	98sq.m
4	Female TBCD ward	15	27	*Klebsiella pneumoniae, Staphylococcus aureus*	26-50	Fair	C	98sq.m
5	Male medical ward	56	30	*Staphylococcus aureus, Proteus mirabilis*	26-50	Fair	C	140sq.m
6	Female medical ward	94	37	*Staphylococcus aureus, E.coli*	26-50	Fair	C	140sq.m
7	Male ortho ward	60	33	*E.coli, Staphylococcus aureus*	26-50	Fair	C	120sq.m
8	Female ortho ward	30	27	*Staphylococcus aureus, Klebsiella pneumoniae*	26-50	Fair	C	120sq.m
9	Medical ICU	9	26	*Staphylococcus aureus, Klebsiella pneumoniae*	26-50	Fair	C	144sq.m
10	TBCD-OP	40	29	*Staphylococcus aureus, Klebsiella pneumoniae*	26-50	Fair	C	20sq.m
11	Microbiology – central lab	10	30	*Staphylococcus aureus, Proteus mirabilis*	26-50	Fair	C	96sq.m
12	Biochemistry – central lab	15	26	*Klebsiella pneumoniae, Staphylococcus aureus*	26-50	Fair	C	96sq.m
13	Pathology-central lab	20	26	*Staphylococcus aureus, Klebsiella pneumoniae*	26-50	Fair	C	96sq.m
14	ENT - OP	40	27	*Staphylococcus aureus, Pseudomonas aeruginosa*	26-50	Fair	C	20sq.m
15	Orthopaedics – OP	30	28	*Staphylococcus aureus, Klebsiella pneumoniae*	26-50	Fair	C	20sq.m
16	Ophthalmology– OP	35	28	*Staphylococcus aureus, Pseudomonas aeruginosa*	26-50	Fair	C	20sq.m
17	Blood bank	20	26	*E.coli*	26-50	Fair	C	192sq.m
18	OG ward	90	39	*Klebsiella pneumoniae, E.coli*	26-50	Fair	C	100sq.m
19	Casualty	20	32	*Klebsiella pneumoniae, Pseudomonas aeruginosa*	26-50	Fair	C	80sq.m

Table 4. Bacterial Species Isolated From the Hospital Wards After Disinfection With Phenol

S.No	Ward Name	Growth In Culture Media		IMA Value	Performance	Grade
		No.Of.Colonies	Organisms			
1	Male surgical ward	22	*Staphylococcus aureus*	6-25	Good	B
2	Female surgical ward	20	*Staphylococcus aureus*	6-25	Good	B
3	Male TBCD ward	19	*Staphylococcus aureus*	6-25	Good	B
4	Female TBCD ward	17	*Staphylococcus aureus*	6-25	Good	B
5	Male medical ward	21	*Klebsiella pneumoniae*	6-25	Good	B
6	Female medical ward	23	*Staphylococcus aureus*	6-25	Good	B
7	Male ortho ward	20	*Staphylococcus aureus*	6-25	Good	B
8	Female ortho ward	19	*Staphylococcus aureus*	6-25	Good	B
9	Medical ICU	15	*Staphylococcus aureus*	6-25	Good	B
10	TBCD-OP	20	*Klebsiella pneumonia*	6-25	Good	B
11	Microbiology – central lab	21	*Pseudomonas aeruginosa*	6-25	Good	B
12	Biochemistry – central lab	17	*Staphylococcus aureus*	6-25	Good	B
13	Pathology-central lab	14	*Staphylococcus aureus*	6-25	Good	B
14	ENT – OP	15	*Staphylococcus aureus*	6-25	Good	B
15	Orthopaedics – OP	20	*Staphylococcus aureus*	6-25	Good	B
16	Ophthalmology– OP	18	*Staphylococcus aureus*	6-25	Good	B
17	Blood bank	12	*Staphylococcus aureus*	6-25	Good	B
18	OG ward	25	*Staphylococcus aureus*	6-25	Good	B
19	Casualty	20	*Staphylococcus aureus*	6-25	Good	B

Table 5. Bacterial species isolated from hospital wards after disinfection with 2% Sodium hypochlorite

S.No	Ward Name	Growth In Culture Media		IMA Value	Performance	Grade
		No.Of.Colonies	Organisms			
1	Male surgical ward	2	*Micrococci*	0-5	Very good	A
2	Female surgical ward	1	*Micrococci*	0-5	Very good	A
3	Male TBCD ward	No Growth	*Sterile*	0-5	Very good	A
4	Female TBCD ward	2	*Micrococci*	0-5	Very good	A
5	Male medical ward	No Growth	*Sterile*	0-5	Very good	A
6	Female medical ward	1	*Micrococci*	0-5	Very good	A
7	Male ortho ward	2	*Micrococci*	0-5	Very good	A
8	Female ortho ward	1	*Micrococci*	0-5	Very good	A
9	Medical ICU	No Growth	*Sterile*	0-5	Very good	A
10	TBCD-OP	3	*Micrococci*	0-5	Very good	A
11	Microbiology – central lab	No Growth	*Sterile*	0-5	Very good	A
12	Biochemistry – central lab	No Growth	*Sterile*	0-5	Very good	A
13	Pathology-central lab	2	*Micrococci*	0-5	Very good	A
-14	ENT – OP	No Growth	*Sterile*	0-5	Very good	A
15	Orthopaedics– OP	No Growth	*Sterile*	0-5	Very good	A
16	Ophthalmology– OP	No Growth	*Sterile*	0-5	Very good	A
17	Blood bank	No Growth	*Sterile*	0-5	Very good	A
18	OG ward	1	*Micrococci*	0-5	Very good	A
19	Casualty	No Growth	*Sterile*	0-5	Very good	A

Table 6. Fungus Isolated From The Hospital Wards Before Disinfection

S.No	Ward Name	No.Of. Patients	No.Of. Colonies	Organisms In SDA Agar	IMA Value	Performance	Grade
1	Male surgical ward	90	31	*Aspergillus niger*	26-50	Fair	C
2	Female surgical ward	60	30	*Candida albicans*	26-50	Fair	C
3	Male TBCD ward	15	26	*Aspergillus niger*	26-50	Fair	C
4	Female TBCD ward	15	26	*Mucor spp*	26-50	Fair	C
5	Male medical ward	56	28	*Rhizopus spp*	26-50	Fair	C
6	Female medical ward	94	33	*Candida albicans*	26-50	Fair	C
7	Male ortho ward	60	28	*Fusarium spp*	26-50	Fair	C
8	Female ortho ward	30	26	*Aspergillus niger*	26-50	Fair	C
9	Medical ICU	9	26	*Candida albicans*	26-50	Fair	C
10	TBCD-OP	40	29	*Mucor spp*	26-50	Fair	C
11	Microbiology – central lab	10	26	*Aspergillus niger*	26-50	Fair	C
12	Biochemistry – central lab	15	26	*Rhizopus spp*	26-50	Fair	C
13	Pathology-central lab	15	27	*Aspergillus niger*	26-50	Fair	C
14	ENT – OP	30	26	*Aspergillus niger*	26-50	Fair	C
15	Orthopaedics– OP	50	29	*Fusarium spp*	26-50	Fair	C
16	Ophthalmology – OP	35	28	*Aspergillus niger*	26-50	Fair	C
17	Blood bank	20	26	*Candida albicans*	26-50	Fair	C
18	OG ward	90	30	*Candida albicans*	26-50	Fair	C
19	Casualty	20	27	*Aspergillus niger*	26-50	Fair	C

Table 7. Fungus Isolated From Hospital Wards After Disinfection With Phenol

S.No	Ward Name	No.Of. Colonies	Organisms	IMA Value	Performance	Grade
1	Male surgical ward	22	*Aspergillus niger*	6-25	Good	B
2	Female surgical ward	20	*Candida albicans*	6-25	Good	B
3	Male TBCD ward	15	*Aspergillus niger*	6-25	Good	B
4	Female TBCD ward	19	*Mucor spp*	6-25	Good	B
5	Male medical ward	16	*Rhizopus spp*	6-25	Good	B
6	Female medical ward	23	*Candida albicans*	6-25	Good	B
7	Male ortho ward	19	*Fusarium spp*	6-25	Good	B
8	Female ortho ward	18	*Aspergillus niger*	6-25	Good	B
9	Medical ICU	13	*Candida albicans*	6-25	Good	B
10	TBCD-OP	21	*Mucor spp*	6-25	Good	B
11	Microbiology – central lab	20	*Aspergillus niger*	6-25	Good	B
12	Biochemistry – central lab	19	*Rhizopus spp*	6-25	Good	B
13	Pathology-central lab	19	*Aspergillus niger*	6-25	Good	B
14	ENT – OP	18	*Aspergillus niger*	6-25	Good	B
15	Orthopaedics – OP	20	*Fusarium spp*	6-25	Good	B
16	Ophthalmology - OP	20	*Aspergillus niger*	6-25	Good	B
17	Blood bank	14	*Candida albicans*	6-25	Good	B
18	OG ward	22	*Candida albicans*	6-25	Good	B
19	Casualty	16	*Aspergillus niger*	6-25	Good	B

Table 8. Fungus Isolated From Hospital Wards After Disinfection With 2% Sodium Hypochlorite

S.No	Ward Name	No.Of. Colonies	Organisms	IMA Value	Performance	Grade
1	Male surgical ward	No growth	*Sterile*	0-5	Very Good	A
2	Female surgical ward	No growth	*Sterile*	0-5	Very Good	A
3	Male TBCD ward	2	*Aspergillus niger*	0-5	Very Good	A
4	Female TBCD ward	1	*Mucor spp*	0-5	Very Good	A
5	Male medical ward	2	*Rhizopus spp*	0-5	Very Good	A
6	Female medical ward	1	*Candida albicans*	0-5	Very Good	A
7	Male ortho ward	No growth	*Sterile*	0-5	Very Good	A
8	Female ortho ward	2	*Aspergillus niger*	0-5	Very Good	A
9	Medical ICU	No growth	*Sterile*	0-5	Very Good	A
10	TBCD-OP	2	*Mucor spp*	0-5	Very Good	A
11	Microbiology – central lab	1	*Aspergillus niger*	0-5	Very Good	A
12	Biochemistry – central lab	2	*Rhizopus spp*	0-5	Very Good	A
13	Pathology-central lab	2	*Aspergillus niger*	0-5	Very Good	A
14	ENT – OP	1	*Aspergillus niger*	0-5	Very Good	A
15	Orthopaedics – OP	No growth	*Sterile*	0-5	Very Good	A
16	Ophthalmology– OP	2	*Aspergillus niger*	0-5	Very Good	A
17	Blood bank	No growth	*Sterile*	0-5	Very Good	A
18	OG ward	1	*Candida albicans*	0-5	Very Good	A
19	Casualty	2	*Aspergillus niger*	0-5	Very Good	A

Casualty, Ophthalmology-OP. 2% of *Proteus mirabilis* were isolated from Male medical ward, Microbiology central lab. (Fig 4)

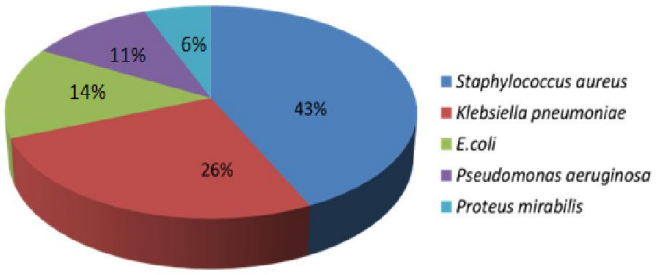

Figure 4. Bacterial Isolates before Disinfection

FUNGI	TOTAL NO OF FUNGI	PERCENTAGE (%) OF FUNGI
Aspergillus niger	8	43
Candida albicans	5	27
Fusarium spp	2	10
Rhizopus spp	2	10
Mucor spp	2	10

Figure 5. Prevalence of Fungal Isolates Before Disinfection

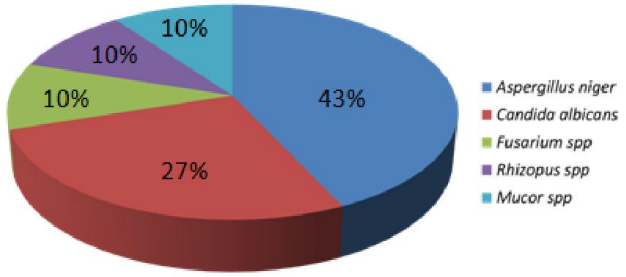

Figure 6. Fungal Isolates before Disinfection

A total of 19 species of fungi were isolated from 19 wards. 43% of *Aspergillus niger* were isolated from Male surgical ward, Male TBCD ward, Casualty, Ophthalmology-OP, Female ortho ward, ENT-OP, Microbiology central lab. 27% of *candida albicans* were isolated from Blood bank, OG ward, Female medical ward, Medical ICU, Female surgical ward.10% of *Fusarium spp* were isolated from Orthopaedics-OP, Male ortho ward.10% of *Rhizopus spp* were isolated from Biochemistry central lab, Male medical ward.10% of *Mucor spp* were isolated from Female TBCD ward, TBCD-OP. (Fig 6) Both bacterial and fungal species were isolated from the wards of which bacterial isolates were predominantly present compared to fungal isolates. After the use of sodium hypochlorite, all the wards were found to be sterile and only few *Micrococci* were isolated as shown in (Table 5).

In the present study, our selected hospital characteristics and environmental factors were analyzed, and variables that significantly influenced the levels of airborne microorganisms were identified. This can be used as a guide for controlling microorganism levels in hospital wards. To minimize the airborne microorganism level, it is crucial to characterise the environmental determinants affecting the level of microorganisms generated in hospital wards. First, special attention should be paid to the hospital wards air during summer, and the highest levels of microorganisms should be carefully noted to minimize the effects of contamination. This can be enabled by regular maintenance of ward cleanliness, periodical disinfection procedures, monitoring the visitor's schedule by regulating the visitors to be minimal. In this paper, according to the indoor work, the issues for the airborne microbes and environmental factors in Shri Sathya Sai Medical College were discussed using disinfectant method in order to analyze the infection prevention. This study can make a contribution towards the reduction in the incidence of nosocomial infection associated microbes and to establish the best disinfectant in the hospital wards.

Fungi and bacteria were the major types of microorganisms present in all hospital environments that may be transmitted through medical personnel, indoor air, outdoor air, visitors, patients, and air conditions. These were the major sources of hospital indoor contamination (Beggs, 2003; Manuel and Kibbler, 1998). The level and diversity of bio contamination in the hospital environment depend on different factors such as the number and activities of visitors, patients, design of hospital rooms, disinfection techniques, outdoor air and dust, and other factors (Sessa *et al*., 2002; Saad, 2003). The IMA rule, which has been used in the present study, gives the opportunity to compare the results of different studies, which have been conducted at different places about microbial air contamination by different researchers, provides easy and

generally acceptable parameters for guidelines, and is cheap and easily applicable. It is stated that IMA, which is tested in different environments, has always given true results in accordance with the real conditions, and that it has provided more reliable outcomes than volumetric measurements (Ergon, 2005). (Table 1 & 2) Our study confirms the presence of bacterial and fungal microbial organisms in the hospital environment, which can be removed with effective disinfection techniques and in our analysis we have concluded that 2% sodium hypochlorite was most effective than phenol. Therefore proper and effective disinfection in the hospital areas becomes mandatory for not only preventing colonization of microbes but also to control hospital borne infection among the inpatients who require prolonged hospital stay for treatment. This in turn will reduce the morbidity and mortality of the sick patients. Proper ventilation must be ensured for control of microbial colonization.

Conclusion

From our study, it has been showed that the hospital air is dispersed with bacterial and fungal microorganisms & to make it healthy, safe for the diseased patients, disinfection is a must in the given scenario, 2% sodium hypochlorite was the ideal disinfectant when compared to phenol as proved by our study. The hospital disinfection becomes mandatory to control these environmental flora, in order to alleviate the incidence of nosocomial infection among the inpatients. Health education with respect to the flora in the given area, situation, number of patients, attenders and HCW is a must and the maintenance of such details and laying the guidelines for the hospital not only helps in the control of infection in hospitalized patients but also prevent its onset. "Thereby helping the health care system achieve zero infection status".

Acknowledgements

We are grateful to the Management and Dr.Muruga prakash (CEO) of Shri Sathya Sai Medical College and Research Institute, for allowing us to use the laboratory facilities & the sampling in different areas of the hospital and supporting the needs to make this study a success.

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