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Microbiological assessment of indoor air of a teaching hospital in Nigeria

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ABSTRACT

Objective: To investigate the quality of indoor air of different wards and units of Olabisi Onabanjo University Teaching Hospital, Sagamu, to ascertain their contribution to infection rate in the hospital. **Methods:** The microbial quality of indoor air of nine wards/units of Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria was conducted. Sedimentation technique using open Petri-dishes containing different culture media was employed and samplings were done twice daily, one in the morning shortly after cleaning and before influx of people/patients into the wards/units and the other in the evening when a lot of activities would have taken place in these wards. Isolates were identified according to standard methods. **Results:** Results showed that there was a statistically significant difference ($\chi^2 = 6.0167$) in the bacteria population of the different sampling time whereas it was not so for fungi population ($\chi^2 = 0.2857$). Male medical ward (MMW) and male surgical general (MSG) recorded the highest bacterial and fungal growth while the operating theatre (OT) was almost free of microbial burden. The bacteria isolates were *Staphylococcus aureus, Klebsiella* sp., *Bacillus cereus, Bacillus subtilis, Streptococcus pyogenes* and *Serratia marscences* while the fungi isolates included *Aspergillus flavus, Penicillium* sp., *Fusarium* sp., *Candida albicans* and *Alternaria* sp. *Staphylococcus aureus* was the predominantly isolated bacterium while *Penicillium* sp. was the most isolated fungus. **Conclusions:** Though most of the microbial isolates were potential and or opportunistic pathogens, there was no correlation between the isolates in this study and the surveillance report of nosocomial infection during the period of study, hence the contribution of the indoor air cannot be established. From the reduction noticed in the morning samples, stringent measures such as proper disinfection and regular cleaning, restriction of patient relatives' movement in and out of the wards/units need to be enforced so as to improve the quality of indoor air of our hospital wards/units.

1. Introduction

Patients are primarily admitted into hospital wards for proper management of their ailments, but while on admission some patients acquire other ailments than the one they were admitted for. These are called hospital associated infections (nosocomial infections) which can result from contact with a carrier directly or indirectly through inanimate objects or air.

The quality of indoor air in terms of microbial contamination in a given space at a given time period is said to be determined by the quality of air entering the space, the umber of occupants in the space, their physical activities and resultant aerosol generation, human traffic and the degree of ventilation[1-3]. Dust, which is a good vehicle of airborne contamination, may arise from human activities, such as sweeping, movement, waving of handkerchief and bed making. Sneezing has been described as the most vigorous mechanism of generating millions of droplet into the environment. While the larger droplets fall to the ground or on nearby objects, the smaller ones are rapidly evaporated to their non-volatile residual forms and remain suspended as droplet nuclei[4].

Measures often taken in preventing nosocomial infections include effective use of antiseptics, disinfectants, adequate cleaning, sterilization and isolation of patients with highly infectious diseases[5].

However, less attention is paid to indoor air as been a probable contributing factor to hospital acquired infections. Ishida *et al*[6] reported that airborne bacteria in the hospital environment have been a major source of post-operative

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infection and a serious problem in the Intensive Care Unit[7]. Many of these isolates (bacteria) are shown to be resistant to common antiseptics used in hospitals[8].

Organisms that are often associated with hospital acquired infections are *Staphylococcus aureus*, *Micrococcus* sp., *Pseudomonas* sp., *Proteus* sp., *Escherichia coli*, *Enterobacter*, *Bacillus cereus*, *Cladosporium* sp., *Aspergillus* sp., and viruses[9,10]. *Pseudomonas aeruginosa* has been particularly incriminated in nosocomial infection because of its intrinsic resistance to most antibiotics and its ability to survive and multiply at low temperatures and in disinfectant solutions[11]. Regular microbiological surveillance of the different hospital units, patients' surveillance by the hospital's Infection Control Unit, formulation of antibiotic policy and recommendation to hospital management for implementation of findings will go a long way to reduce nosocomial infections.

This study therefore was aimed at investigating the quality of indoor air of different wards and units of Olabisi Onabanjo University Teaching Hospital (OOUTH), Sagamu, to ascertain their contribution to infection rate in the hospital. It will also provide a baseline information on the quality of indoor air which before now was not available.

2. Materials and methods

2.1. Study area

OOUTH, Sagamu, is a tertiary health institution located in the Southwestern part of Nigeria. It has two hundred and forty bed spaces and this was the study area. Nine wards/units were used for sample collection and these included male medical ward (MMW), female medical ward (FMW), children's ward (CHW), neonatal unit (NNU), male surgical specialty (MSS), male surgical general (MSG), female surgical ward (FSW), operating theatre (OT) and accident & emergency unit (A&E). The study was carried out between May and June, 2010.

2.2. Sampling procedure

Sedimentation technique using open Petri dishes containing different culture media was used[12]. Three plates of each medium were distributed at different parts of wards/units examined. The samplings were done at the morning hours (8.00-10.00 am) and evening periods (4.00-6.00 pm). The plates containing the culture media (blood agar and Sabouraud dextrose agar) were exposed and allowed to stay for 20 minutes, after which the plates were covered and transferred to the hospital's Microbiology Laboratory Unit for incubation. The blood agar plates were incubated at 37 ℃ for 48 hours while the Saboraud dextrose agar plates were incubated for 3-5 days at 28 ℃. The total numbers of colony forming units (cfu) were enumerated. The identification of the isolates was done according to standard procedures[13,14].

2.3. Statistical analysis

The data thus generated were analyzed by simple mean value, percentage and test of significance using *Chi*-square[15].

3. Results

3.1. Bacteria distribution

A total number of nine wards/units were studied. The bacterial population was higher (56.83%) among the evening samples than the morning samples (43.17%). MSG was the most contaminated among the wards during the morning sampling (26.67%) while 31.65% was recorded in MMW in the evening samples, thus making it the most contaminated ward for the evening session. NNU, OT and A&E had low bacterial contamination in their indoor air (Table 1).

Table 1
Number and percentage of airborne bacterial population in air of the sampled wards/units (cfu).

Study area	Sampling time	
	Morning (8.00-10.00 am)	Evening (4.00-6.00 pm)
MMW	15 (25.00)	25 (31.65)
FMW	5 (8.33)	8 (10.13)
CHW	5 (8.33)	11 (13.92)
NNU	2 (3.33)	2 (2.53)
MSS	4 (6.67)	3 (3.80)
MSG	16 (26.67)	16 (20.25)
FSW	11 (18.33)	12 (15.19)
OT	1 (1.67)	-
A&E	1 (1.67)	2 (2.53)
Total	60 (100.00)	79 (100.00)

3.2. Fungi distribution

Plates from the nine ward/units for evening samples yielded 16 cfu of fungi as against 14 from the morning samples. The distribution showed that MSG had the highest growth (28.57%) in the morning session whereas the medical wards recorded the highest growth in the evening session with 31.25% and 25.00% for MMW and FMW, respectively. MSS and OT had no fungal growth while NNU and A&E yielded one and two cfu of fungi, respectively as shown in Table 2.

Table 2
Number and percentage of airborne fungal population in air of the sampled units (cfu).

Study area	Sampling time	
	Morning (8.00-10.00 am)	Evening (4.00-6.00 pm)
MMW	1 (7.14)	5 (31.25)
FMW	3 (21.43)	4 (25.00)
CW	3 (21.43)	2 (12.50)
NNU	1 (7.14)	-
MSS	-	-
MSG	4 (28.57)	2 (12.50)
FSW	2 (14.29)	1 (6.25)
OT	-	-
A & E	-	2 (12.50)
Total	14 (100.00)	16 (100.00)