Hospital surface contamination in ground floor occupied by patients in a AL-Hussain Teaching hospital

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Abstract

The aim of this study was elaborated to evaluate hospital surface contamination in ground floor occupied by patients in a Teaching AL-Hussain hospital in Thi-Qar province. Fifty samples were collected from six randomly selected units {Laboratory, X-ray, Consultation, Nuclear Magnetic Resonance (NMR) , Natural therapy, Emergency} by swabs , cultured on selective fungal and bacterial media in order to determine the genus or species of the agents in the samples. The microorganisms identified included 62 isolates were recognized as fungi and bacteria . Molds comprised 37.09% and yeasts comprised 30.64% while, bacteria comprised 32.25% . Environment contamination for Teaching AL-Hussain Hospital with fungi and bacteria were examined *Candida* spp. were the highest fungal isolate. Whereas, *Staphylococcus epidermidis* was the most common bacterial isolate.

Introduction :

There is evidence that 80% of nosocomial infections are transmitted through the medical staff's hands(Baran ,1998 ; Wierzbicka *et al.,*2000 ; Richardson,2005) and approximately 10% of all patient infections are suspected to be hospital-acquired (Meers *et al.,* 1990) that are not present in the patient at the time of admission to hospital but develop during the course of the stay in hospital. These infections can have serious consequences in terms of increased patient mortality, morbidity, and length of hospital stay and overall costs(Saadoun *et al.,*2008). Indoor environment of hospital contains different types of microorganisms (Saad, 2003), thus patients may serve as a source of pathogenic microbes to other patients, staff, and hospital visitors(Saadoun *et al.,*2008).

The main mechanism of transmission of infections within hospital is by direct contact, in particular with the hands of health professionals (Boyce, 2004) which may both contaminate or be contaminated by hospital surfaces (Rutala & Weber, 2002). Surfaces can be divided into two categories: those where little hand contact occurs (e.g. floors), and those where the hand contact is frequent (door handle, bed rail) (Sehulster *et al*., 2004).Surfaces used in medical applications have unique microbial problems and their control is a complex task. These surfaces can also act as a microbial "harbor", as most offer ideal environments for the proliferation of microorganisms that are harmful of buildings, textiles and humans, It is also leading to extensive interest in the use of antimicrobial surfaces in a care facility's environment (Krueger,2003) .

Therefore,the present study was elaborated to evaluate hospital surface contamination in ground floor occupied by patients in a Teaching AL-Hussain hospital Thi-Qar province.

Materials and Methods:

Sample collection:

The study was carried out at Teaching AL-Hussain Hospital, during September and October 2010. Environmental sites (table , door handle, tools, wall and air) from six randomly selected units {Laboratory, X-ray, Consultation, Nuclear Magnetic Resonance (NMR) , Natural therapy, Emergency} were examined. Fifty samples were collected .

Microbial swabs:

The bacterial swab was removed from its packaging and the tip was moistened with a drop of sterile, nonbacteriostatic saline. swabbed surface area were taken. The swab was then inserted into its transport tube, labeled and transferred to microbiology laboratory for isolation and identification of likelihood bacterial and fungal microorganisms

Culture of samples:

A commercially available potato dextrose agar culture medium was used to incubate the fungi samples. While, used Blood agar for culturing of gram positive bacteria (Merk, Germany) as well as Mackonkey agar for culturing of gram negative (Oxoid, UK). The cultured plates were incubated 48 h at 37°C.

Identification of Fungi :

During incubation period, different fungal colonies were subjected to macroscopic and microscopic examination to observe their growth, nature of their mycelium, and hyphae structure. Filamentous fungal growth - as mold and yeast- were present on SDA media plates; and were sub-cultured on two separate SDA culture plates. One plate was incubated at 37° C, and the second was incubated at 25° C (Koneman *et al*., 1997). Pure culture growth of each mold and yeast colony appeared on those plates; and was examined under magnification for their microscopic structures and cross identified, by using mycological keys manuals and textbooks.

Identification of bacteria:

The colonies were identified by standardbacteriological procedures ; macrosopic morphology, biochemical and gram staining in accordance with Cowan and Steel (1975) .

Statistical analysis:

Descriptive statistics were used in analysis. For each unit , the prevalence of microbial contamination was determined by using percentage. In addition, the correlation between the prevalence and setting was also assessed for each unit.

Results :

The following results were obtained and summarized in table 1 are shown the total number of swabs and number of isolated organisms from six units for ground floor in Teaching AL-Hussain hospital .

The microorganisms identified included 62 isolates were recognized as fungi and bacteria colonies appeared during September and October 2010, (Figure 1 &2). Molds comprised 37.09% and yeasts comprised 30.64% while bacteria comprised 32.25% . Table 2 are showed isolated fungi grown on BDA taken from Laboratory samples directly placed into the culture media revealed *A.niger* , *A.flavus* ,*Rhizopus* sp. ,*Fusarium* sp. ,*Alternaria* sp. ,*Candida* sp. and *Rhodotorula* sp. Percentage *A.niger* were 26.66% while, *A.flavus* ,*Rhizopus* sp. ,*Fusarium* sp. ,*Alternaria* sp. ,*Candida* sp. and *Rhodotorula* sp. were had the same percentage 6.66% .

Contrast, Bacteria grown on MA were *Pseudomonas* sp. and *Klebsiella* sp. at percentage 50% for each one .

In the present study, *Candida* spp. the most fungi were isolated from X-ray samples at percentage 75% contrast, other yeast 25% . While, *Staph.epidermidis* the most bacteria were isolated from X-ray at percentage 100% (Table 3) .

Identification of Fungi isolated from Natural therapy were *Pacilomyces* sp. ,*Fusarium* sp. , *Candida* spp. and other species of yeast . *Candida* spp. were had the most percentage 40% while, other fungi species were had percentage 20% . Whereas, bacterial isolates revealed *Staphylococcus epidermidis* was the most common isolate (66%), followed by *Enterococcus faecalis* (33%) (Table 4).

Table 5: Showed *A.terrus* ,*A.flavus,Candida* spp. , *Rhodotorula* sp. and other yeast were isolated from Consultation. *Candida* spp. were had the most percentage 50% and other yeast were had percentage 25%. while,other species fungi were 8.3%. Contrast, *Staph.epidermidis* and *Pseudomonas* sp.were isolated from Consultation at percentage 87.5% and 12.5% respectively. Three species of *Aspergillus* were *A .niger* ,*A.flavus* and *A.terrus* isolated from NMR with the same percentage 33.3% but no isolate bacteria(Table 6). The organisms isolated from Emergency were two species of *Aspergillus* : *A.flavus* and *A.terrus* with percentage 33.3% and 66.6% respectively. Contrast,one species of bacteria were *Staph.epidermidis* with percentage100%(Table7).

Table 1: The microbial contamination agents isolated from six units for ground floor in Teaching AL-Hussain hospital

Department	Number of swabs	Number of isolate organisms
Laboratory	14	4 *Aspergillus niger* 2 *A.terrus* 1 *A.flavus* 3 *Penecillium* spp. 1 *Rhizupus* sp. 1 *Fusarium* sp. 1 *Alternaria phragmospora* 1 *Candida* sp. 1 *Rhodotorula* sp. 1 *Pseudomonas* sp. 1 *Klebsiella* sp.
X-ray	6	3 *Candida* spp. 1 yeast 4 *Staphylococcus epidermidis*
Consultation	12	1 *A.terrus* 1 *A.flavus* 6 *Candida* spp. 1 *Rhodotorula* sp. 3 yeast 7 *Staph. epidermidis* 1 *Pseudomonas* sp.
Natural therapy	6	1 *Paecilomyces* sp. 1 *Fusarium* sp. 2 *Candida* spp. 1 yeast 1 *Enterococcus faecalis* 2 *Staph.epidermidis*
Nuclear Magnetic Resonance	6	1 *A.niger* 1 *A.flavus* 1 *A.terrus*
Emergency	6	1 *A.flavus* 2 *A.terrus* 3 *Staph. epidermid*

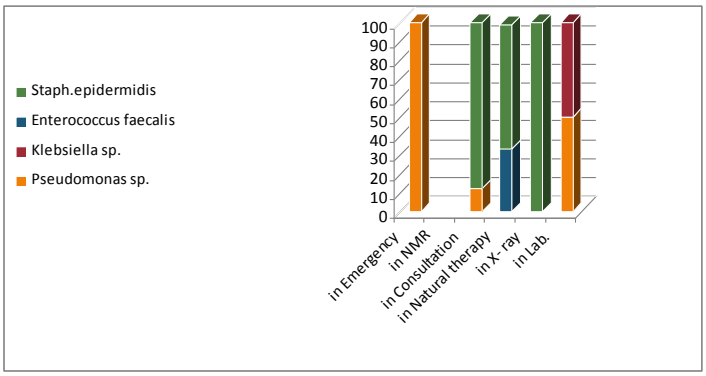

Figure 1:Genus and percentage of bacterial isolates from six units

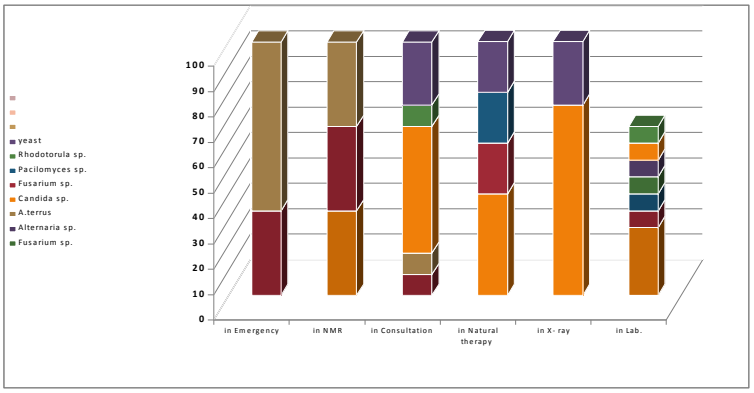

Figure 2:Genus and percentage of fungal isolates from six units

Table 2: The Percentage for organisms isolated from Laboratory

Organisms in Lab.			
Fungi	%	Bacteria	%
A.niger	26.66	*Pseudomonas* sp.	50
A.flavus	6.66	*Klebsiella* sp.	50
Rhizopus sp.	6.66		
Fusarium sp.	6.66		
Alternaria sp.	6.66		
Candida sp.	6.66		
Rhodotorula sp.	6.66		

Table 3: The Percentage for organisms isolated from X-ray

Organisms in X- ray			
Fungi	%	Bacteria	%
Candida spp.	75	*Staph.epidermidis*	100
Yeast	25		

Table 4: The Percentage for organisms isolated from Natural therapy

Organisms in Natural therapy			
Fungi	%	Bacteria	%
Pacilomyces sp.	20	*Staph.epidermidis*	66
Fusarium sp.	20	*Enterococcus faecalis*	33
Candida spp.	40		
yeast	20		

Table 5: The Percentage for organisms isolated from Consultation

Organisms in Consultation			
Fungi	%	Bacteria	%
A.terrus	8.3	*Staph.epidermidis*	87.5
A.flavus	8.3	*Pseudomonas* sp.	12.5
Candida spp.	50		
Rhodotorula sp.	8.3		
Yeast	25		

Table 6: The Percentage for organisms isolated from NMR

Organisms in NMR			
Fungi	%	Bacteria	%
A.niger	33.3	No isolate bacteria	
A.flavus	33.3		
A.terrus	33.3		

Table 7: The Percentage for organisms isolated from Emergency

Organisms in Emergency			
Fungi	%	Bacteria	%
A.flavus	33.3	*Staph.epidermidis*	100
A.terrus	66.6		

Discussion :

Hospital environments are complex environments because they contain different types of microorganisms .During the stay in hospital the patient comes into contact with new infective agents, becomes contaminated, and subsequently develops an infection. Normal skin and environmental flora are abundant in the environment. These microbes and their presence, numbers, and types can indicate the degree of cleanliness of these environments (Saadoun *et al.,*2008).

Fungi and bacteria are the major types of microorganisms present in all hospital environments that may be transmitted through air, outdoor air, visitors, patients, and air conditions. These are the major sources of hospitals indoor contamination (Manuel & Kibbler, 1998; Beggs, 2003).

In this study ,the type of contamination demonstrated, coupled with the survival potential of some pathogens causing hospital acquired infections (Griffith *et al.,*2000) could also assist in the spread of organisms within the hospital environment, that pose potential harm to patients with compromised immunity.Thus, evaluation of count, types, and diversity of microbes in hospitals is very important to control and prevent hospital acquired infections (HAI).

Fungal species were identified in 67.73% of the colonized units(Molds comprised 37.09% and yeasts comprised 30.64%).

This study has shown *Candida* fungi were isolated from indoor environment in four selected units ,from six tested location at the ground floor . As a rule, candidiasis is an endogenous infection, however, exogenous infections are also possible. Numerous studies give evidence that *Candida* fungi are detected in the indoor air at, e.g., surgical, haematological and obstetric wards; they are a potential source of infections, especially in risk group patients(Kao *et al.,*1999 ; VandenBergh *et al.,*1999; Pegues *et al.,* 2002 ;

Kołodziej *et al.,* 2003 ; Marciniak *et al.,*2003 ;Lutz *et al*.,2003; Gangneux,2004 ; Maravi-Poma *et al.,*2004) .

In the present study, large amounts of *Aspergillus* were found in the indoor environment tested because that fungal genus is ubiquitous. Even though it is harmless for healthy people, it may be dangerous for the patients of risk groups, including those treated in surgical wards and intensive care units. Therefore, it appears, that indoor air monitoring focused on the presence of fungi is an important procedure in wards where risk group patients are treated(Gniadek & Macura,2007).

Aspergillus spp. and *C. albicans* as reported in different studies (Harvey and Hyers, 1987; Overberger *et al*. 1995; Weinberger *et al.,* 1997;Ahmad *et al.,* 2003) and were considered as the major source of hospital fungal infections. Manuel and Kibbler (1998) and Overberger *et al.* (1995) found that 70-80% of the fungi in hospitals air were *Aspergillus* spp. This study showed similar distribution of the mold and yeast species.

So, in this study, *Staphylococcus epidermidis* recorded high percentage as bacterial contaminate, *S. epidermidis* , primarily considered as non-pathogenic, normally colonises human epithelium and mucous membranes and rarely causes infection in immunocompetent patients (Ziebuhr *et al.,* 2006) However, in recent years, the bacterium has emerged as a major causative organism in nosocomial infections (Vuong & Otto, 2002). Staphylococci are hardy, being resistant to heat and drying, and thus can persist for long periods on fomites (inanimate objects) and secondary locations such as dust and air inside homes, which can then serve as sources of infection . The highest number of contaminant bacteria was for *S. epidermidis* in these cases the contaminate source is usually endogenously from normal skin flora of patients or exogenously from surgical staff .

The success of *S. epidermidis* as a pathogen within the hospital environment can also be explained by its highly adaptive nature, inherent genetic variability (Yao *et al.,* 2005). *S. epidermidis* produces an extracellular polysaccharide material that facilitates adherence to bioprosthetic material surfaces, such as intravenous catheters, and acts as a barrier to antimicrobial agents (Harvey *et al.,*2007).

The source of most hospital epidemics is infected patients, i.e. patients contaminated with pathogenic microorganisms. These microorganisms are often released into the environment in very high numbers, exceeding the minimal infective dose, and contaminate other patients who subsequently develop hospital-acquired infections.

Combined with the relatively high counts of *Pseudomonas* spp. isolated, the high prevalence of resistance to antimicrobial agents commonly used in their control is definitely a source of concern (Gajadhar *et al.,*2003) . *Pseudomonas* sp. as normal flora of the human skin (Larson & Ramphal, 2002) .

This study highlights the need inclusion in routine cleaning (Michaels *et al.,* 2001) hospital surfaces with which hands are likely to make contact, such as door handles and bed rails, the current recommendation is regular cleaning and disinfecting, according to the Association for Professionals in Infection Control and Epidemiology (APIC) (Sehulster *et al.,* 2004).

Conclusions: According to the results shown we could say that the main cases for microbial contamination :

- Cross-contamination between patients and surface was subsequently shown to have occurred. Hands is a potential source of fungal and bacterial contamination in selected units ,therefore, improved techniques are required for disinfecting and controlling possible microbial infections.
- The efficiency of the emptying process prior to decontamination, as well as the decontamination process itself.
- The old design of hospitals is the major reasons of the high level contamination. However the high level of contamination in hospital may be due to outdoor contamination.

- During general care and/or medical treatment, the hands of health-care workers often come into close contact with patients. The hands of the clinical personnel are thus the most frequent vehicles for nosocomial infections. Transmission by this route is much more common than vectorborne or airborne transmission or other forms of direct or indirect contact.

Recommendations :

- The effectiveness of environmental cleaning is an important factor in strategies to prevent the nosocomial transmission .

-hand washing to prevent exposure to potentially infectious mediums.

- Check air conditioning systems for standing moisture and clean or replace as necessary.

- All objects that come in contact with patients should be considered as potentially contaminated. If an object is disposable, it should be discarded as waste. If it is reusable, transmission of infective agents must be prevented by cleaning, disinfection, or sterilization

References :

▪Ahmad, S. ; Khan, Z. ; Mustafa, AS. and Khan, Z U.(2003). Epidemiology of Candida colonization in an intensive care unit of a teaching hospital in Kuwait. Medical Mycology 41: 487-93.

▪ Baran, E. (1998). Outline of medical mycology. Volumed pp.648 Wroclaw.

▪ Beggs, C B. (2003). The airborne transmission of infection in hospital buildings: fact or fiction? Indoor Built Environment 12: 9-18.

▪ Boyce, JM.(2004). New insights for improving hand hygiene practices. Infect Control Hosp Epidemiol 25(3):187-8.

▪ Cowan, S. T and Steel, J. L. (1975). Manual for the identification of Medical Bacteria, 2nd Ed., In Cambridge University Press, England 1975, p. 45-114.

▪ Gajadhar,T. ; Lara,A. ; Sealy,P. and Adesiyun,A. (2003). Microbial contamination of disinfectants and antiseptics in four major hospitals in Trinidad. Rev Panam Salud Publica/Pan Am J Public Health 14(3).

▪ Gangneux, JP(2004). Prevention of nosocomial invasive aspergillosis: protective measures and environmental surveillance. Mikol Lek, 11: 153-5.

▪ Gniadek, A. and Macura, AB(2007). Intensive care unit environment contamination with fungi. · Advances in Medical Sciences · Vol. 52 ·

▪ Griffith, CJ ; Cooper, RA; Gilmore, J; Davies, C and Lewis, M. (2000).An evaluation of hospital cleaning regimes and standards. J Hosp Infect, 45: 19-28.

▪ Harvey, RL and Hyers, JP.(1987). Nosocomial fungemia in a large community teaching hospital. Archive International Medicine 147: 2117-2120.

▪ Harvey, R. A.; Champe, P. C.and Fisher, B. D (2007). Lippincott's Illustrated Reviews: Microbiology, 2nd ed .Lippincott Williams & Wilkins.

▪ Kao, AS ; Brandt, ME ; Pruitt, Wr ; Conn, LA ; Perkins, BA. Stephens, DS; Baughman, WS; reingold AL; rothrock, gA; Pfaller, MA; Pinner, rW and Hajjeh, rA. (1999).The epidemiology of candidemia in two United States cities: results of apopulation-based active surveillance. Cli Infect Dis; 29: 1164.

▪ Kołodziej, T. ; Baran, W. and Nockowski, P.(2003). Systemic fungal infections in intensive care. Nicholas Medicine, 10: 149-53.

▪ Koneman, E.W ; Allin, S.D ; Janad, W.M ; Schreckenberger, P.C and Winn, W.C (1997). Color Atlas and Textbook of Diagnostic Microbiology, 5 th ed. USA: J. B. Lippincott Company..

▪ Krueger,J.(2003). Reducing Microbial Contamination in Hospital Blankets aegis microbe shield, 1-13.

▪Larson,L.L. and Ramphal , R. (2002). Extended-spectrum beta-lactamases.Semin Respir Infect., 17(3):189-194.

▪. Lutz, BD. Jin, J. rinaldi, Mg. Wickes and BL. Huycke, MN. (2003).Outbreak of invasive Aspergillus infection in surgical patients, associated with a contaminated air-handling system. Clin Infect Dis, 37(6): 786-93.

▪ Manuel, R. J. and Kibbler, C. C. (1998). The epidemiology and prevention of invasive aspergillosis. Journal of Hospital Infection 39: 95-109.

▪ Maraví-Poma, E; Rodríguez-Tudela JL; de Jalón, JG; Manrique-Larralde, A; Torroba L, Urtasun, J ; Salvador, B; Montes, M ; Mellado, E; Rodríguez-Albarrán, F and Pueyo-Royo (2004).Outbreak of gastric mucormycosis associated with the use of wooden tongue depressors in critically ill patients. Intensive Care Med, 30(4): 724-8.

▪ Marciniak, R. and Drews, M. (2003). Systemic fungal infections -present danger in patients with surgical wards and intensive care. Infection, 2: 34-6.

▪ Meers, P D; Ayliffe, G A; Emmerson, J A. and Leigh, D A. (1990). Report of the national survey of infection in hospitals. Journal of Hospital Infection 2: 1-11.

▪ Michaels, B; Smith, B and Pierson, M. (2001).Pathogenic and indicator bacteria associated with handwashing and drying contact surfaces. J Food Protect, 64(Suppl A):95.

▪ Overberger, P A ; Wadowsky, R M and Schaper, M M. (1995) . Evaluation of airborne particulates and fungi during hospital renovation. American Indoor Hygiene Assessment Journal 56: 706-712.

▪ Pegues, D. ; Lasker, B; McNeil, M.; Hamm, P. ; Lundal, J. and Kubak, B. (2002).Cluster of cases on invasive aspergillosis in a transplant intensive care unit: evidence of person – to – person airborne tranmission. Clin Infect Dis, 34(3): 412-6.

▪ Richardson, MD. (2005) . Changing patterns and trends in systemic fungal infections. J Antimicrob Chemother, 56 (Suppl 1): 5-11.

▪ Rutala, WA. and Weber, DJ.(2002).Should we routinely disinfect floors? J Hosp Infect; 51(4):309-11.

▪ Saad S G. (2003). Integrated environmental management for hospitals. Indoor Built Environment 12: 93-98.

▪ Saadoun, I. ; Al Tayyar, I. and Elnasser, Z.(2008). Concentrations of Airborne Fungal Contamination in the Medical Surgery Operation Theaters (OT) of Different Hospitals in Northern Jordan. Jordan Journal of Biological Sciences. All rights reserved -1(4).

▪ Sehulster, LM. ; Chinn, RYW ; Arduino, MJ; Carpenter, J. ; Donlan, R. and Ashford, D. (2004) Guidelines for environmental infection control in health-care facilities. Recommendations from CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Chicago: American Society for Healthcare Engineering/American Hospital Association; 249p.

▪ VandenBergh, MF. ; Verwiij, PE and Voss, A. (1999) . Epidemiology of nosocomial fungal infections: invasive aspergillosis and the environment. Diag Microbiol Infect Dis, 34: 221-7.

▪ Vuong, C. and Otto, M. (2002) Staphylococcus epidermidis infections. Microbes Infect. 4: 481–489.

▪ Weinberger, M; Sacs, T and Sulkes, J. (1997). Increasing fungal isolation from clinical specimens: Experience in a university hospital over a decade. Journal of Hospital Infection 35: 185-195.

▪Wierzbicka, M. (2000). Systemic mycoses - contemporary threats. New Medicine, 4: 23-5. ▪ Yao, Y; Sturdevant, D. E ; Viallaruz, A ; Xu, L; Gao, Q and Otto, M. (2005). Factors characterising Staphylococcus epidermidis invasiveness determined by comparative genomics. Infect. Immun. 73: 1856–1860.

▪ Ziebuhr, W ; Hennig, S ; Eckart, M ; Kranzler, H; Batzilla, C and Kozitskaya, S. (2006) . Nosocomial infections by Staphylococcus epidermidis: how a commensal bacterium turns into a pathogen. Int. J. Antimicrob. Agents 28: 14–20.