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Are Visitors Dangerous Carriers of Pathogens in The Hospital? an Observational Study in an University Hospital in Sicily

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ABSTRACT
The hospital environment has been suggested as having an important role in the transmission of health care-associated infections. The aim of this work is to clarify the possible role of visitors in environmental contamination at our hospital. The microbial load was determined by Rodac plate contact on flat surfaces and by swabs on uneven surfaces. A total of 137 samples were taken from four different areas of the hospital unit. The results were divided into two groups according to the types of subjects that most often frequented those environments. We found that the transmission of health care-associated infections (HAIs) occurs mainly in areas where visitors are not allowed.

KEYWORDS
HAI; environmental contamination; visitors; transmission of pathogens; surfaces

Introduction

The hospital environment has been suggested to play an important role in the transmission of health care-associated infections (HAIs). HAIs remain the major cause of morbidity and mortality in patients (Klevens et al. 2007).

Infection transmission in healthcare facilities is a growing concern. The major source of nosocomial pathogens is thought to be the patient's endogenous flora, but an estimated 20 to 40% of nosocomial infections have been attributed to cross-infection via the hands of healthcare personnel (Hota 2004).

Contaminated inanimate objects within the hospital setting can facilitate the transmission of nosocomial pathogens (Dancer 1999; Neely, Maley, and Warden 1999; Kramer, Schwebke, and Kampf 2006; Otter, Yezli, and French 2011).

Hospital staff and visitors create a potential risk of surface contamination. Several studies have documented that healthcare workers may contaminate their hands or gloves by touching contaminated environmental surfaces. Hands or gloves are then contaminated with several organisms that are likely to be transmitted to patients (Boyce 2007). Moreover, pathogens may also be transferred directly from contaminated surfaces to susceptible patients (Huang, Datta, and Platt 2006; Mitchell, Spencer, and Edmiston 2015).

Some devices have also been involved in the transmission of infectious agents between patients (Schabrun and Chipchase 2006; Suwantarat et al. 2017). Eliminating the use of these devices was the only step needed to reduce the incidence of infectious disease (Dibenedetto et al. 1996).

There is an increasing body of evidence indicating that cleaning or disinfecting the environment can reduce the transmission of healthcare-associated pathogens. Because the routine cleaning of equipment and other high-touch surfaces does not always remove pathogens from contaminated surfaces, improved methods for disinfecting the hospital environment are needed (Boyce and Pittet 2002; Kampf and Kramer 2004).

However, some hospital environmental surveys have failed to establish a correlation between surface contamination and nosocomial infections.

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Other studies have shown that the presence of fecal coliforms on surfaces that meets moist hands is a risk factor in the spread of diarrheal diseases (Dancer 2009; Weber et al. 2010).

Thus, the exact role of environmental contamination in HAI infections remains unclear. Hospitals are frequented by many individuals for different reasons.

The potential role of visitors in the transmission of infection is unknown. Although transmission-based precautions are generally used to prevent the spread of organisms in healthcare settings by healthcare staff, the application of these precautions to visitors is unclear (Banach et al. 2015).

The aim of the present study is to clarify the possible role of environmental contamination by visitors in healthcare-associated infections in hospitals.

Methods

This study was conducted between March 1 2016 and June 30 2016, at Catania University Hospital "G. Rodolico", a reference teaching and research hospital in Sicily, Italy.

The presence of *E. coli*, *Acinetobacter baumannii*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Enterococci* on environmental surfaces was determined in the visitor passage ways of 12 wards. For comparison with the available literature data regarding the surfaces that come in contact with visitors in healthcare settings, a list of surfaces that are regularly touched by visitors was first developed.

Previous studies have focused on the surfaces that visitors commonly touch through which microorganisms brought from outside by the visitors may reach hospitalized patients.

The following surfaces were considered for the study: handles (doors, toilets, faucets, cabinets, windows, etc.), electrical and other switches (lights, television, radiator, etc.), equipment (wheelchairs, walking aids, and bars of the bed), phones, furniture (desks, chairs, table, cabinets, etc.), shelves (especially those used for laundry and equipment).

Samples were taken from the following wards: Dermatology, Pneumology, Otorhinolaryngology, Gynecology, Ophthalmology, Vascular Surgery, Waiting room, Pediatrics, Urology, and Internal Medicine. Samples were also taken from two large waiting areas for patients and visitors located on the ground floor of building 1, where there are general surgical units, and building 2, where internal medicine units are located. We will call these areas Waiting room 1 (Figure 1) and Waiting room 2 (Figure 2). For each ward, the following areas were swabbed: waiting rooms, bathrooms, corridors with access to clinics, clothing, doorknobs, tables, counter supports, taps, and handrails.

The microbial load was determined by Rodac plate contact on flat surfaces using different nutrient media according to the microorganisms researched, as previously described (Marranzano et al. 2010). A Rodac weight applicator was used

Figure 1. Entrance Hall Building 1: Surgical department.

Figure 2. Waiting room Building 4: Medical department.

with the plates to standardize the sampling method. Subsequent to incubation, the developed colonies were counted (CFU/24 cm^2). To examine the microbes on uneven surfaces and difficult-to-reach corners, we collected samples with swabs to perform a qualitative study of microorganisms. The environmental samples were obtained using swabs premoistened in sterile distilled water. Each swab was immediately seeded on plates containing specific media.

The following media were used: CLED agar for *E. coli*, cetrimide agar for *P. aeruginosa*, Herellea agar for *A. baumannii*, Baird Parker agar base plus egg yolk tellurite emulsion for *S. aureus* and Slanetz and Bartley agar for *Enterococci* isolation (Lickson Clinical & Industrial Microbiology).

The presence of at least 1 CFU/$cm^2$for each swab was considered an indicator of the presence of the microorganisms.

The statistical significance was determined using the Z test.

Results

A total of 137 samples were performed near 12 recovery wards in four different areas of the hospital unit. The surfaces that were sampled were door handles, chairs, handrails, taps, shelves, chairs, bells, and keys of the elevators.

Microbial growth was observed in 93 samples (67.8%). The isolated microorganisms are presented in Table 1. Microbial growth was observed in all the waiting areas of the analyzed departments. Micrococci and coagulase-negative staphylococci growth was observed in 87 samples (63.5%).

Table 1. Patterns of isolated microorganisms and their percentages.

Isolated microorganism	Percentage (%)
Coag-neg staph	66
Coag-pos staph	9
Coag-pos-staph methicillin-resistant	1
Flavobacterium multivorum	1
Acinetobacter lwoffi	3
Enterobacter agglomerans	1
Enterococcus	3
Micrococcus	11
Streptococcus	3
Cupriavidus pauculus	1
Bacillus cereus	3
TOTAL	100

The results are shown in Table 2. The highest percentage of positive samples was found in the ophthalmology department, the otorhinolaryngology department and Waiting room 2 (92% each). The departments of Gynecology, Internal Medicine, and Urology and the billing area (83%) and vascular surgery (62%) followed in order of frequency. The departments with the lowest rates of contamination were pneumology and the withdrawal area (42%), pediatrics (50%), and dermatology (53%).

S. aureus was isolated in seven samples, one of which was methicillin-resistant, near the Operative Unit of Internal Medicine, where a particularly high microbial load was detected (>1000 UCF/cm^2). *S. aureus* was also found in Internal Medicine, Pneumology, Pediatrics, the testing room, and in Waiting rooms 1 and 2.

Other isolated microbes were compatible with normal human flora. Mold growth was only observed in one sample.

S. aureus was isolated in the most crowded hospital areas, including the lobbies, reception areas, and outpatient areas. A greater variety of isolated microbial flora, but no pathogens, was observed in the hospital areas where access is more restricted and patients remain for a long period of time, such as dermatology, gynecology, and vascular surgery.

The samples were divided into two groups according to the people who most often frequented those environments from which they were taken: Group A (62 samples) comprised rooms reserved for health professionals or surfaces that were off limits to visitors and Group B (75 samples) comprised areas reserved for visitors. In group A, microbial growth was found in 50 samples (80%) and in Group B, growth was found in 45 samples (60%). Table 3 presents the

Table 2. Percentage of positive samples from different wards.

	Samples	Percentage positive
Vascular surgery	13	61.5
Waiting room 1	6	83
Urology	6	83
Pediatric unit	12	50
Waiting room 2	12	92
Gynecology	12	83
Ophthalmology	13	92
Otolaryngology	12	92
Testing room	12	42
Dermatology	15	40
Internal medicine	12	83
Pneumology	12	33

Table 3. Distribution pattern of positive samples according to wards. Wards in the same building are shown in the same color.

	Building 1 Vascular surgery, Waiting room 1, and Urology						Building 2 Pediatric unit and Waiting room 2				Building 3 Gynecology, Ophthalmology, Otorhinolaryngology, and Specimen Collection Area								Building 4 Dermatology, Internal Medicine, and Pneumology					
Sampling site	Vascularsurgery		Waiting room 1		Urology		Pediatric clinic		Waiting room 2		Gynecology		Ophthalmology		Otorhinolaryngology		Specimen Collection Area		Dermatology		Internal medicine		Pneumology	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Reception desk		1		2						1		1						2				2		
Sink/tap	2				1		1			1	2		1		2		1			2	1			
Handles / handrails				1	1					3	4			2	2	1			2		3	1	2	
Tables	3					1				2	1				2				1		1	1	1	
Chairs/beds						1	1	1	2			1	1	3	1	2		2		1		1		
Buttons				2				3		2														
Medical trays	1				1						1				1								1	
Medical instruments	1												5											
Total A/ B	10/8						4/13				24/14								12/18					

Group A: samples taken from rooms reserved for health professionals or from medical areas where visitors are not allowed. Group B: samples taken from areas reserved for visitors in the vicinity of the medical ward

withdrawals taken inside and outside the different wards.

The percentage of samples for which no growth of microorganisms in culture was found was compared. The comparison of proportions was performed using the Z test. The result was $Z = 2.597; p > 0.01$. The samples from group A were significantly more contaminated than those of group B.

Discussion

The scientific literature has long considered the role of environmental surfaces in the transmission of infections in hospitals.

Recent studies emphasize that surfaces that are commonly touched by both visitors and hospital staff may be responsible for the transmission of opportunistic pathogens to hospitalized patients (Hyman, Rosenberg, and Larson 2012).

To clarify this point, 137 samples from 12 wards in four hospital buildings at the University Hospital “Policlinico -Vittorio Emanuele” were analyzed. The hospital has a capacity of more than 400 beds and includes various specialties. Low-media specialty operating units were selected for this study; we excluded areas dedicated to high-complexity structures where visitors are often not admitted or are admitted in limited number and for a limited part of the day.

The discovery of a microbial load of 5 CFU/cm^2 by contact, regardless of microorganism type, indicates the possibility of an increased risk of patient infection.

In only seven out of 137 cases, coagulase positive staphylococci were found; these were present particularly in areas in front of the Department of Internal Medicine but had a load of less than 5 CFU/cm^2.

The data that were obtained in this study are consistent with the latest data from the scientific literature. In the past, it was believed that surfaces with which visitors and hospital staff had been in contact were the key to the spread of opportunistic infections and HAIs in hospitalized patients.

This study verified that colonies of *E. coli, P. aeruginosa* and *A. baumannii* were not isolated on the studied surfaces, although these bacteria were sought for all specimens and sown on specific media. Objects or surfaces with which visitors often come in contact were not contaminated by pathogenic or opportunistic microorganisms. The areas reserved for visitors were less contaminated than rooms that were reserved for health professionals and off limits to visitors.

These results suggest that visitors are not carriers of microorganisms responsible for nosocomial and opportunistic infections in hospitalized patients.

The role of objects manipulated not by both visitors and health professionals remains marginal in the pathogenesis of HAIs. It seems that inanimate objects may facilitate the transmission of infections when they are used by health professionals.

In most cases, visitors meet the patients after waiting in public areas. The time they spend with patients is often short, so the possibility of transferring bacteria to the patient via hands and objects is very limited. Visitors are likely to spend more time in waiting rooms before they meet the patient than they spend with the patient. After contact with the patient and the healthcare environment, the visitor goes away immediately.

The possibility of visitors contaminating the environment is greater during the initial waiting phase; after visitors meet patients, the environments that they could contaminate are restricted to living and transitional areas. Guidelines for standardizing visitor access policies and public opening times among different departments could be helpful.

Nevertheless, because the most commonly touched surfaces can always play a role in the spread of pathogenic microorganisms and/or opportunists, particularly under certain environmental conditions, it is essential to apply a careful cleaning protocol. Adherence to proper environmental cleaning protocols in public areas can effectively contribute to the eradication of pathogens harbored by visitors and disseminated in the environment.

It has been verified that increased precautions regarding patient contact could reduce the transmission of resistant pathogens (Morgan et al. 2013), but isolation continues to be the most effective way of preventing the transmission of microorganisms from colonized patients to other patients through visitors.

Although isolation is expensive and is sometimes unpleasant to the patient, this procedure should be applied in the presence of resistant germs (Landelle, Pagani, and Harbarth 2013).

Although transmission-based precautions are generally used to prevent the spread of organisms in healthcare settings by healthcare staff, the applicability of these precautions to visitors remains unclear.

Recent studies have shown that there is a wide variety of hospital policies regarding the use of DPIs by visitors. Many hospitals have reported difficulties related to visitor compliance with isolation precautions, including hostility and refusal to comply (Kang et al. 2014). Visitors can play a role in area-transmitted infections for which the only effective measure remains the isolation of patients. The systematic use of facial masks may reduce this risk, but it remains unsuitable for visitors and patients.

Hand washing by visitors remains a correct indication (Birnbach et al. 2012; Banach et al. 2015), but evidence confirms the possibility that the main source of hospital infections is patients themselves, and the major vehicle is health care professionals hands. Studies have demonstrated that several major nosocomial pathogens are shed by patients and contaminate hospital surfaces and be transferred to the hands of healthcare workers (Otter, Yezli, and French 2011). The most common cause of healthcare-associated infectious diarrhea is Clostridium difficile (CD). Proper handwashing among health care workers appears to be a key intervention for interrupting CD cross-infection, and compliance with hand hygiene is significantly inversely associated with the number of infection cases (Ragusa et al. 2018).

In this study, cleaning of the common areas was satisfactory except for the common areas of the Internal Medicine Unit.

Disinfection of noncritical environmental surfaces and equipment is an essential component of an infection prevention program. Disinfection should render surfaces and equipment free of pathogens in enough to prevent human disease (Rutala and Weber 2016). To improve surface decontamination in hospitals, environmental decontamination with hydrogen peroxide, which has proven effective and simple to perform, is needed in both private and open-air environments (Ragusa et al. 2016). In the case of pathogen isolation, decontamination of the area is mandatory to prevent outbreaks of healthcare infections or genetic material for resistance production (Dancer 2008; Adams et al. 2017; Muzslay et al. 2017).

Suggestions and verifications of the procedures used by the cleaning staff can also be helpful. Interventions should include efforts to monitor the cleaning practices used for the surfaces investigated and the products used for disinfection and should include feedback for the housekeeping staff. A systematic cleaning process would reduce the risk of HAIs for everyone and could increase confidence in the overall quality of care (Dancer and Kramer 2018).

In conclusion, the transmission of HAIs occurs mainly in areas where visitors are not allowed; concerns about acquiring infection from visitors were not proven to be valid in this case. Simple educational interventions, including stressing the importance of hand hygiene and the use of correct protective equipment, are effective and cost effective (European Centre for Disease Prevention and Control 2017).

To reduce HAIs, it may be essential to increase the use of disposable materials as a further measure in hospital rooms. Posters and brochures could be useful for developing public awareness of compliance with the guidelines or protocols for the prevention of HAIs and to engage visitors in improving the quality of hospital care.

References

Adams, C. E., J. Smith, V. Watson, C. Robertson, and S. J. Dancer. 2017. Examining the association between surface bioburden and frequently touched sites in intensive care. *J. Hosp. Infect.* 95 (1):76–80. doi: 10.1016/j.jhin.2016.11.002.

Banach, D. B., G. M. Bearman, D. J. Morgan, and L. S. Munoz-Price. 2015. Infection control precautions for visitors to healthcare facilities. Expert Rev. Anti. Infect. Ther. 13(9):1047–50. doi: 10.1586/14787210.2015.1068119.

Birnbach, D. J., I. Nevo, S. Barnes, M. Fitzpatrick, L. F. Rosen, R. Everett-Thomas, J. S. Sanko, and K. L. Arheart. 2012. Do hospital visitors wash their hands? Assessing the use of alcohol-based hand sanitizer in a hospital lobby. *Am. J. Infect. Control* 40(4):340–3. doi: 10.1016/j.ajic.2011.05.006.

Boyce, J. M. 2007. Environmental contamination makes an important contribution to hospital infection. *J. Hosp. Infect.* 65 (Suppl 2):50–4. doi: 10.1016/S0195-6701(07)60015-2.

Boyce, J. M., D. Pittet, Healthcare Infection Control Practices Advisory Committee, and HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. 2002. Guideline for hand hygiene in health-care settings. Recommendations of the healthcare infection control practices advisory committee and the HIPAC/SHEA/APIC/IDSA hand hygiene task force. *Am. J. Infect. Control*30 (8): S1–S46.

Dancer, S. J. 1999. Mopping up hospital infection. *J. Hosp. Infect.* 43(2):85–100. doi: 10.1053/jhin.1999.0616.

Dancer, S. J. 2008. Importance of the environment in meticillin-resistant Staphylococcus aureus acquisition: The case for hospital cleaning. *Lancet Infect. Dis.* 8(2):101–13. doi: 10.1016/S1473-3099(07)70241-4.

Dancer, S. J. 2009. The role of environmental cleaning in the control of hospital-acquired infection. *J. Hosp. Infect.* 73(4):378–85. doi: 10.1016/j.jhin.2009.03.030.

Dancer, S. J., and A. Kramer. 2018. Four steps to clean hospitals: Look, plan, clean and dry. *J. Hosp. Infect.* doi: 10.1016/j.jhin.2018.12.015.

Dibenedetto, S. P., V. Miraglia, A. M. Ippolito, S. D'Amico, L. L. Nigro, R. Ragusa, and G. Schilirò. 1996. Reduction in the incidence of infection by hepatitis C virus in children with acute lymphoblastic leukemia after suspension of sampling from the finger. *Pediatr. Infect .Dis. J.* 15(3):265–6.

European Centre for Disease Prevention and Control. 2017. *Economic evaluations of interventions to prevent healthcare associated infections*. Stockholm: ECDC.

Hota, B. 2004. Contamination, disinfection, and cross-colonization: Are hospital surfaces reservoirs for nosocomial infection? *Clin. Infect. Dis.* 39 (8):1182–9. doi: 10.1086/424667.

Huang, S. S., R. Datta, and R. Platt. 2006. Risk of acquiring antibiotic-resistant bacteria from prior room occupants. *Arch. Intern. Med.* 166 (18):1945–51. doi: 10.1001/archinte.166.18.1945.

Hyman, S., L. Rosenberg, and E. Larson. 2012. Frequency of patient contact with health care personnel and visitors: Implications for infection prevention. Jt. Comm. J. Qual. Patient Saf. 38 (12):560–5. doi: 10.1016/S1553-7250(12)38073-2.

Kampf, G., and A. Kramer. 2004. Epidemiologic background of hand hygiene and evaluation of the most important agents for scrubs and rubs. *Clin. Microbiol. Rev.* 17 (4):863–93. doi: 10.1128/CMR.17.4.863-893.

Kang, J., D. J. Weber, B. A. Mark, and W. A. Rutala. 2014. Survey of North Carolina hospital policies regarding visitor use of personal protective equipment for entering the rooms of patients under isolation precautions. *Infect. Control Hosp. Epidemiol.* 35 (3):259–64. doi: 10.1086/675293.

Klevens, R. M., J. R. Edwards, C. L. Richards, Jr, T. C. Horan, R. P. Gaynes, D. A. Pollock, and D. M. Cardo. 2007. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. *Public Health Rep.* 122(2): 160–6. doi: 10.1177/003335490712200205.

Kramer, A., I. Schwebke, and G. Kampf. 2006. How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infect. Dis.* 6 :130. doi: 10.1186/1471-2334-6-130.

Landelle, C., L. Pagani, and S. Harbarth. 2013. Is patient isolation the single most important measure to prevent the spread of multidrug-resistant pathogens? *Virulence* 4(2):163–71. doi: 10.4161/viru.22641.

Marranzano, M., R. Ragusa, F. Cicciù, R. Leonardi, and S. Salvo. 2010. Evaluation of biological indicators of hygienic quality in modern dental clinics with a high perceived quality in Catania (Italy). *Igiene e sanità pubblica*. 66(6):757–66.

Mitchell, A., M. Spencer, and C. Edmiston. Jr 2015. Role of healthcare apparel and other healthcare textiles in the transmission of pathogens: A review of the literature. *J. Hosp. Infect.* 90(4):285–92. doi: 10.1016/j.jhin.2015.02.017.

Morgan, D. J., L. Pineles, M. Shardell, M. M. Graham, S. Mohammadi, G. N. Forrest, H. S. Reisinger, M. L. Schweizer, and E. N. Perencevich. 2013. The effect of contact precautions on healthcare worker activity in acute care hospitals. *Infect. Control Hosp. Epidemiol.* 34(1): 69–73. doi: 10.1086/668775.

Muzslay, M., G. Moore, N. Alhussaini, and A. P. Wilson. 2017. ESBL-producing Gram-negative organisms in the healthcare environment as a source of genetic material for resistance in human infections. *J. Hosp. Infect.* 95 (1): 59–64. doi: 10.1016/j.jhin.2016.09.009.

Neely, A. N., M. P. Maley, and G. D. Warden. 1999. Computer keyboards as reservoirs for *Acinetobacter baumannii* in a burn hospital. *Clin. Infect. Dis.* 29 (5): 1358–60. doi: 10.1086/313463.

Otter, J. A., S. Yezli, and G. L. French. 2011. The role played by contaminated surfaces in the transmission of nosocomial pathogens. *Infect. Control Hosp. Epidemiol.* 32(7):687–99. doi: 10.1016/j.jhin.2009.03.030.

Ragusa, R., A. Lombardo, A. Bruno, A. Sciacca, and L. Lupo. 2016. Environmental biodecontamination: When a procedure performed by the nursing staff has an economic impact in ICU rooms. *J. Nurs. Care.* 5 :4. doi: 10.4172/2167-1168.1000355.

Ragusa, R., G. Giorgianni, L. Lupo, A. Sciacca, S. Rametta, M. La Verde, S. Mulè, and M. Marranzano. 2018. Healthcare-associated Clostridium difficile infection: Role of correct hand hygiene in cross-infection control. *J. Prev. Med. Hyg.* 1(2):59.

Rutala, W. A., and D. J. Weber. 2016. Monitoring and improving the effectiveness of surface cleaning and disinfection. *Am. J. Infect. Control* 44 (5):e69–76. doi: 10.1016/j.ajic.2015.10.039.

Schabrun, S., and L. Chipchase. 2006. Healthcare equipment as a source of nosocomial infection: A systematic review. *J. Hosp. Infect.* 63 (3):239–45. doi: 10.1016/j.jhin.2005.10.013.

Suwantarat, N., L. A. Supple, J. L. Cadnum, T. Sankar, and C. J. Donskey. 2017. Quantitative assessment of interactions between hospitalized patients and portable medical equipment and other fomites. *Am. J. Infect. Control.* 45 (11):1276–8. doi: 10.1016/j.ajic.2017.05.003.

Weber, D. J., W. A. Rutala, M. B. Miller, K. Huslage, and E. Sickbert-Bennett. 2010. Role of hospital surfaces in the transmission of emerging health care-associated pathogens: Norovirus, Clostridium difficile and Acinetobacter species. *Am. J. Infect. Control* 38 (5): S25–S33. doi: 10.1016/j.ajic.2010.04.196.