



Major article

A point prevalence survey on hand hygiene, with a special focus on *Candida* species



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Background: A 1-day point prevalence study evaluated hand hygiene compliance, yeast colonization, and contamination, focusing on the hands of health care workers (HCWs) and patient-oriented surfaces.

Methods: Hand hygiene compliance was evaluated by applying the direct observation technique and the World Health Organization's compliance program, "My Five Moments for Hand Hygiene." A total of 128 samples from HCWs working in intensive care ($n = 11$) and intermediate care ($n = 2$) units and 65 environmental samples from Innsbruck Medical University Hospital were investigated.

Results: Hand hygiene compliance was superior for nurses (83.5%) and moderate for medical doctors (45.2%). In general, fungal growth was unique; only 9 of 128 HCW samples and only 4 of 65 environmental samples yielded positive results. The genetic relatedness of yeasts from the same species was investigated by random amplified polymorphic DNA (RAPD) typing. RAPD profiles exhibited the potential for cross-transmission of yeasts.

Conclusion: In general, the fungal colonization and contamination rate was low, but a high level of hand hygiene compliance was lacking.

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Nosocomial infections (NIs) are a worldwide problem that complicates patient care. Exogenous sources are being increasingly reported, and the hands of health care workers (HCWs) are the most important vehicle for pathogen transmission.^{1,2} *Candida* species has become an important cause of morbidity and mortality in critically ill patients, and various studies have pointed to yeast carriage on HCWs hands as responsible for NIs.^{3,4} It is well known that adequate and appropriate hand hygiene practices constitute the basis for NI prevention⁵; however, studies have shown that HCWs do not sufficiently recognize the significance of proper hand hygiene, resulting in poor hygiene practices.^{1,6}

In our hospital, NIs due to *Candida* species are on the rise.⁷ The reasons for this may be multiple; however, to exclude any exogenous source, an infection control initiative was undertaken. The aim of this 1-day point prevalence survey was to determine the level of

HCW hand hygiene, and to evaluate the frequency and distribution of yeast carriage of hospital personnel.

METHODS

Sampling and data collection

This surveillance study focused on internal and surgical intensive care units (ICUs; $n = 11$) and intermediate care units (IMCUs; $n = 2$) of Innsbruck Medical University Hospital (IMUH). Ten HCWs from the ICUs and 10 from the IMCUs were selected at random, and sampling was performed during work hours without previous notification. Hand hygiene compliance was evaluated by applying recommendations of the World Health Organization's compliance program "My Five Moments for Hand Hygiene." In addition, a short questionnaire documented the HCW's profession (ie, doctor or nurse), time frame of the last hand hygiene procedure, and type of clinical interventions applied during hand hygiene sampling.^{8,9} HCWs were observed, and the interventions were classified as before a patient contact, before a clean/aseptic procedure, after a body fluid exposure risk, after a patient contact, and after touching a patient's surroundings.

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Conflicts of interest: None to report.

Table 1
C albicans, *C glabrata*, and *C orthopsilosis* RAPD profiles obtained with primers CA-2, OPE-18, M13, RSD-10, and RSD-12 and reference strains *C albicans* ATCC 10231 and *C albicans* ATCC90028

<i>Candida</i> spp	CA-2 type	OPE-18 type	M13 type	RSD-10 type	RSD-12 type	Combined type	Sampling
<i>C albicans</i>	a	A	1	H	a	I	Sink*, wash pan*, nurse*
<i>C glabrata</i>	b	B	2	I	b	II	Shower head [†] , physician [†]
<i>C orthopsilosis</i>	d	D	3	J	d	III	Physician 1 [‡] , physician 2 [‡]
<i>C orthopsilosis</i>	e	E	4	J	e	IV	Physician 3 [‡]
<i>C albicans</i> ATCC 10231	a	F	5	K	a	V	Reference strain
<i>C albicans</i> ATCC 90028	a	G	6	K	f	VI	Reference strain

*Ward 1.

[†]Ward 2.

[‡]Ward 3.

The compliance rate was assessed using direct observation by validated observers consisting of 6 members of IMUH's infection prevention and control team. Hand hygiene compliance was defined as the percentage of HCWs who were compliant with hand hygiene guidelines. The compliance rate was calculated by dividing the number of hand hygiene actions performed by the total number of opportunities for hand hygiene.^{8,9}

Microbial monitoring of HCWs' hands was performed before hand hygiene by imprinting the tips of all fingers and thumbs on agar plates containing malt extract agar with chloramphenicol (Merck, Darmstadt, Germany) and Columbia III sheep's blood agar 5% (BD, Sparks, MD) for yeasts and bacteria, respectively. To investigate the spread of yeasts on patient-related hospital surfaces, 5 items per ward, such as sinks in patient rooms, shower heads, patient tables, stethoscopes, equipment trolleys, work surfaces, medical care products, and wash pans, were sampled after patient contact using malt extract agar with chloramphenicol (Merck) contact plates. Overall, 256 HCW hand samples (128 agar plates each for fungi and bacteria) and 65 environmental samples were collected by 6 researchers. Ethical approval for this study was not necessary because this study was part of an infection control quality improvement program.

Microbiology procedures

Agar plates for yeasts and bacteria were incubated for 5 days at 28 ± 2°C and for 2 days at 35 ± 2°C, respectively. The total number of colony-forming units (cfu) was counted, and species identification was performed with standard microbial methods, including the Vitek yeast identification system (bioMérieux, Marcy-l'Etoile, France) and matrix-assisted laser desorption ionization time-of-flight mass spectrometry. Genetic relatedness among *Candida* isolates was determined using random amplified polymorphic DNA (RAPD) analysis with a combination of 5 primers: CA2, M13, OPE18, RSD10, and RSD12.¹⁰ *Candida albicans* ATCC 10231 and *C albicans* ATCC 90028 served as reference strains.

RESULTS

Among the 31 doctors and 97 nurses who were investigated, hand hygiene compliance was 45.2% for physicians and 83.5% for nurses. The time of the last hand hygiene performed before sampling ranged from 2 minutes to 3 hours; the most frequently documented hand hygiene opportunity was "before and after contact with a patient," followed by "after touching patient surroundings." We detected a broad spectrum of skin and mucosal bacteria, including such indicator pathogens as *Staphylococcus aureus*, *Escherichia coli*, *Enterobacter cloacae*, *Enterococcus* spp, and *Acinetobacter* spp. Twenty-four HCWs (14 nurses and 10 physicians) exhibited high-level contamination (>100 cfu/plate) of potential

pathogenic organisms on their hands during duty. Nine HCWs (5 nurses and 4 physicians) harbored yeasts on their hands, including *C albicans* (n = 1), *Candida glabrata* (n = 1), *Candida guilliermondii* (n = 1), *Candida orthopsilosis* (n = 3), and *Malassezia furfur* (n = 3).

Among the 65 patient-oriented items sampled, including sinks, shower heads, stethoscopes, and wash pans, 4 samples were positive for yeasts. *C albicans* (103 cfu/plate), *Candida dubliniensis* (2 cfu/plate), *Cryptococcus laurentii* (1 cfu/plate), and *C glabrata* (2 cfu/plate) were identified. Identical fungal species collected from HCWs and the hospital environment underwent genotyping, and the yeast strains investigated revealed 4 different RAPD types (I, II, III, and IV). The presence of a clonal relationship among the various yeast strains suggests the possibility of cross-transmission in the clinical setting (Table 1).

DISCUSSION

Our data show superior hand hygiene compliance for nurses (83.5%) and only moderate compliance for medical doctors (45.2%). This finding is in agreement with previous studies showing that overall, only one-third of physicians perform hand hygiene before patient contact and only one-half do so after patient contact.^{8,11} Altruism may be responsible for the better hand hygiene compliance among nurses compared with medical doctors.¹² In addition, pathogenic microorganisms were detected on HCW hands at a rate of 35.5% in medical doctors compared with 12.4% in nurses.

The low incidence of yeasts detected on HCWs' hands in ICUs in the present study is in contrast to the incidence reported in previous studies in which the glove juice method was used for sampling.^{13,14} The glove juice method samples the whole hand surface, not just the fingertips as in our study.¹⁵ Thus, the discrepancy between our results obtained by contact culture and previously reported data may reflect methodological differences.^{15,16} In a previous study, however, the rate of recovery of methicillin-resistant *Staphylococcus aureus* (MRSA) from HCW hands was similar when using the glove juice method or contact cultures.¹⁵

Candida parapsilosis complex is reportedly the most frequently isolated *Candida* species on HCW hands and thus is considered readily transmitted.^{13,16,17} Similarly was observed in our study with *C orthopsilosis* detected on several occasions. Of note, *C parapsilosis* has been reclassified into separate, closely related species, *C parapsilosis sensu stricto*, *Candida metapsilosis*, and *C orthopsilosis*.¹⁸ In addition, *C parapsilosis* complex is associated with nosocomial outbreaks, with the hospital environment acting as a major source of infection.^{3,16,19} Environmental samples from patient sinks, shower heads, stored baby bottles, and wash pans revealed *C albicans*, *C dubliniensis*, *C laurentii*, and *C glabrata* in variable counts. In turn, this fungal burden may facilitate exogenous spread or pathogen transmission.¹⁹

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