

ORIGINAL ARTICLE

Surveillance of nosocomial infections: a preliminary study on yeast carriage on hands of healthcare workers

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Key words

Yeast hand contamination • Yeasts • *Candida* sp. • Hand carriage

Summary

Hospital-acquired fungal infection is increasing. The aim of this preliminary study was to evaluate the frequency and distribution of yeast carriage on the hands of healthcare workers (HCW) from different departments. The study was conducted in three departments (Surgery, Intensive Care Unit, Obstetrics and Gynaecology) of a hospital in Campania, southern Italy. Over a six-month period, 50 healthcare workers were randomly tested. Imprints of palms and fingertips were taken monthly during the morning shift. The plate with yeast was counted and *Candida* species were identified. Risk factors for hand contamination were determined. Hand carriage of yeast and *Candida* species in the three departments were found in the following percentages: Surgery (50% and 49%); Intensive Care Unit (61% and 57%); Obstetrics and Gynaecology (65% and 59%).

No significant difference in the frequency or distribution of yeast and *Candida* sp. recovered in the three departments was ascertained by comparing every two months' data, the hand carriage of yeast and *Candida* species found in the three departments; this varied – min to max – according to the following percentages: Surgery [(45%-54%) and (42%-58%)]; Intensive Care Unit [(53%-66%) and (56%-59%)]; Obstetrics and Gynaecology [(62%-69%) and (57%-63%)]. The only factor associated with yeast carriage on the hands of healthcare workers was the absence of gloving during healthcare procedure ($p = 0.0192$). We conclude that in our study yeast carriage on the HCWs' hands is common in the three departments investigated, but its causes are unclear. Careful use of gloving may reduce pathogenic yeast on hands.

Introduction

Hospital-acquired infections (HAIs) still remain a major problem, and a large part of them are caused by fungal infections. *Candida* species are now considered to be the four largest causes of systemic nosocomial infection [1-4]. Although endogenous infection, following colonization, accounts for most systemic fungal infections [5-7], exogenous acquisition also plays a role and may result in outbreaks [8-11]. During outbreaks of systemic candidal infections, cross infection via hands of healthcare workers occurs [10, 11]. Gloving is recommended as a barrier protection for healthcare workers to reduce the risk of contamination during contact with body fluids, mucous membranes or the damaged skin of patients [12, 13]. When used properly, gloving may also reduce cross-transmission of micro-organisms from healthcare workers' hands [12-17]. In a study evaluating the dynamics of micro-organisms contamination of the hands of healthcare workers in daily hospital practice, the wearing of gloves was associated with a marked reduction in the contamination of hands [16]. However, when gloves are not removed after each contact, they become a 'second skin' and expose patients to the cross-transmission of micro-organisms [18]. Therefore, the role of transmission by hands cannot be disregarded in micro-organisms infection. Our preliminary study carried out on healthcare workers

in three departments of a hospital (high bed capacity) located in a health care district of the Campania region, has evaluated the frequency and distribution of yeast on the hands of healthcare workers, and has determined the risk factors for hand carriage.

Material and methods

The study was conducted in three departments: Surgery, Intensive Care Unit (ICU), Obstetrics and Gynaecology between January and June 2007, and was part of the environmental controls ordered to our department by the hospital sanitary management. The HCWs had been told of the environmental controls and sample collection, in compliance with the law on privacy. No one of the HCWs refused to undergo the sampling.

HEALTHCARE WORKERS

A total of 50 HCWs were monitored in this study (28 females, 22 males); for details, their number in each department and their categories are listed in Table I.

MICROBIOLOGICAL SAMPLES AND PROCESSING

Imprints of the two palms and respective fingertips of the healthcare workers were taken after each healthcare procedure or during routine clinical work. If the health-

Tab. I. Number of HCWs by departments and categories.

	Departments					
	Surgery		Intensive Care Unit		Obstetrics and Gynaecology	
Category	Males	Females	Males	Females	Males	Females
Physician	2	1	4	2	3	3
Nurse Assistant	2		4	1		4
Nurse	2	2	4	3		8
Radiology technician	1			1		
Stretcher-bearer				1		2
Total participants	7	3	12	8	3	17
	10		20		20	

care worker had taken patient care with gloves, these were removed before the sampling. Both palms and fingertips were pressed onto contact plate RODAC (55 mm) containing Sabouraud Chloramphenicol agar, (one for each palm and one for each group of five fingertips) for 20", with the observer helping to achieve identical pressure. The samples were collected between 09:00 a.m. and 11:00 a.m. since these were the times when the most intensive work occurred. Plates were incubated aerobically at 37 °C and examined after 48-72 hours. The plates with colony growth, identified by their macroscopic aspect as yeast, were counted and the colonies translated onto plates containing CHROMagar™*Candida*. The plates were aerobically incubated at 37°C and examined after 48 hours. The plates with colony growth, identified by their macroscopic aspect and colour as *Candida* sp., were counted.

STATISTICAL ANALYSIS

Statistical analyses were carried out with STATS DIRECT program (STATS DIRECT Ltd version 2.4.4). Descriptive statistics regarding all the variables were given as geometric mean with 95% confidence interval (95% CI). Uni-variate analysis was performed to detect predictors among variables. Multivariate analysis was then performed, including variables with $p < 0.1$ in unvaried analysis. Chi-square or Fisher's exact tests were used as appropriate to test for proportion difference. Values of $p < 0.05$ were considered as statistically significant [19].

Results

A total of 1,200 specimens (600 palms and 600 fingertips) obtained after healthcare procedure or during routine clinical work, were analyzed. There was no significant difference in yeast carriage on hands in the departments ($p > 0.05$), and slightest variation in the concentration of these micro-organisms, evidenced by the number of isolated colonies, was observed. The samples obtained from the three departments contained all types of yeasts (one to five colonies per plate), but, owing to confluent growth, these were often difficult

to count. The geometric mean of the number of yeast samples isolated from palm and fingers of participants in the three departments are 127 and 115 respectively. Factors associated with increased hand carriage of yeast and *Candida* sp. after healthcare procedure or during routine clinical work are shown in Table II.

Yeast and *Candida* sp. carriage on the hands of the participants from the three departments resulted in the following percentage: in Surgery department 240 samples were collected 50% of these were positive for yeast, and *Candida* accounts for 50% of this percentage. In ICU department, out of the 480 samples collected, 61% were positive for yeast, and *Candida* accounted for 57% of this percentage. In Obstetrics and Gynaecology department: 65% of 480 samples were positive for yeast, and *Candida* accounted for 59% of this percentage. *Candida* sp. were isolated from 412 yeast samples obtained from HCWs' hands. Some were isolated from both the palms and fingertips of the same hands, others either from palms or fingertips only. As regards the job title and sex, hand yeast and *Candida* sp. carriage resulted in the following percentages: physician 66% of the 360 samples collected were positive for yeast, and *Candida* accounted for 63% of the percentage; nurse assistant 264 samples were collected, 55% of these were positive for yeast, and *Candida* accounted for 57% of this percentage; 65% of the 456 Nurse samples were positive for yeast as well and *Candida* accounted for 52% of the percentage. As to the 48 samples from Radiology technicians 58% of these were positive for yeast, and *Candida* accounted for 50% of this percentage; stretcher-bearer 56% of the 72 samples collected were positive for yeast, and *Candida* accounted for 50% of that figure. Likewise, out of the 528 samples collected from male participants 67% were positive for yeast, and *Candida* accounted for 54% of the percentage. Percentages for the analyses on the 672 female samples proved that 55% of them were positive for yeast, and *Candida* accounted for 60% of the percentage.

Yeast and *Candida* sp. carriage on the hands of the participants during healthcare procedure and gloving during procedure yielded the following data: contact with patient 1,020 samples were collected, 67% of these were positive for yeast, and *Candida* accounted for 59% of

Tab. II. Risk factors associated with total fungi spores carriage on hands during clinical routine work.

Variables	No. of samples with yeast/Total no. of samples		No. of samples with yeast (%)	No. of samples with <i>Candida</i> (%)
	Palm	Fingers	Total	Total
Department				
Surgery (n = 240)	70/120	50/120	120 (50)	59 (49)
ICU (n = 480)	151/240	143/240	294 (61)	168 (57)
Obstetrics and Gynaecology (n = 480)	160/240	151/240	311 (65)	185 (59)
Job title				
Physician (n = 360)	125/180	111/180	236 (66)	150 (63)
Nurse assistant (n = 264)	90/132	81/132	171 (55)	98 (57)
Nurse (n = 456)	130/228	120/228	250 (65)	130 (52)
Radiology technician (n = 48)	16/24	12/24	28 (58)	14 (50)
Stretcher-bearer (n = 72)	20/36	20/36	40 (56)	20 (50)
Sex				
Male (n = 528)	185/264	169/264	354 (67)	190 (54)
Female (n = 672)	196/336	175/336	371 (55)	222 (60)
Healthcare procedure				
Contact with patient (n = 1,020)	360/510	320/510	680 (67)	405 (59)
Contact with environment (n = 180)	21/90	24/90	45 (25)	7(15)
Gloving during procedure				
Yes (n = 580)	25/290	18/290	43 (9) *	8 (19) *
No (n = 620)	356/310	326/310	682 (92) *	404 (59) *
n = Total number of samples; * = p ≤ 0.02				

this percentage: contact with environment out of the 180 samples collected, 25% of these were positive for yeast and *Candida* accounted for 15% of the percentage.

Crucial evidence was given when gloving during procedure was considered and, then, compared with bare-handed practice. On the one hand, out of the 580 gloving during procedure “Yes” samples only 9% were positive for yeast, and *Candida* accounted for 19% of the percentage. On the other, 92% of the 620 “No” Gloving during procedure samples were positive for yeast, and *Candida* sp. accounted for 59% of the percentage.

In other words, if the column of palm and finger results were examined, there was no significant difference.

This sharply contrasted, though, with the significant difference of the results from the procedure with gloves compared with those from the procedure without gloves.

The frequency and distribution of yeast carriage and *Candida* sp. on the hands of the healthcare workers are reported in Table III; the data were analyzed for every two months of study and compared.

Hand carriage of yeast and *Candida* species in the three departments were found, from minimum to maximum, in the following percentages: Surgery [(45%-54%) and (42%-58%)]; ICU [(53%-66%) and (56%-59%)]; Obstetrics and Gynaecology [(62%-69%) and (57%-63%)]. There was no significant difference in frequency or distribution of yeast and *Candida* sp. recovered in the

three departments. With regard to job title and sex, hand yeast and *Candida* sp. carriage resulted in the following percentages: Physicians [(61%-73%) and (60%-67%)]; Nurse assistants [(63%-66%) and (50%-65%)]; Nurse [(53%-56%) and (47%-58%)]; Radiology technicians [(50%-63%) and (30%-70%)]; Stretcher-bearers [(46%-67%) and (38%-56%)]; Male [(64%-70%) and (51%-55%)]; Female [(53%-57%) and (56%-64%)]. There was no significant difference in frequency or distribution of yeast and *Candida* sp. recovered among HCWs.

Discussion

Almost all studies concerning hand hygiene have indicated that a high rate of yeast colonization on the hands of HCWs, and *Candida* sp. were the most commonly isolated species [4, 20]. HCWs may be colonized by a species of yeast with a high capacity for adhesion to plastic surfaces, providing an infection risk to susceptible individuals [8, 9]. Our preliminary study, carried out in three departments of a hospital (high bed capacity) located in a health care district of the Campania region, during routine hospital practice, has shown a high yeast colonization on workers' hands. On average, the percentage of the samples with yeast obtained from HCWs' hands during clinical routine work in the three departments was 60%. All the categories, have shown a

Tab. III. Two months' frequency and distribution of yeasts and *Candida* sp. carried on HCWs' hands.

Variables	January-February						March-April							
	No. of samples with yeast/Total no. of samples		No. of samples with yeast		No. of samples with <i>Candida</i>		No. of samples with yeast/Total no. of samples		No. of samples with yeast		No. of samples with <i>Candida</i>			
	Palm	Fingers	Total	%	Total	%	Palm	Fingers	Total	%	Total	%		
Department:														
Surgery (n = 80)	25/40	11/40	36	45	15	42	25/40	16/40	41	51	19	46		
ICU (n = 160)	45/80	40/80	85	53	48	56	55/80	51/80	106	66	59	56		
Obstetrics and Gynaecology (n = 160)	52/80	50/80	102	64	60	59	50/80	49/80	99	62	62	63		
Job title:														
Physician (n = 120)	35/60	38/60	73	61	49	67	48/60	40/60	88	73	53	60		
Nurse assistant (n = 88)	31/44	27/44	58	66	29	50	30/44	25/44	55	63	36	65		
Nurse (n = 152)	43/76	38/76	81	53	41	51	44/76	40/76	84	55	49	58		
Radiology technician (n = 16)	5/8	3/8	8	50	4	50	5/8	5/8	10	63	7	70		
Stretcher-bearer (n = 24)	6/12	5/12	11	46	6	55	8/12	8/12	16	67	9	56		
Sex:														
Male (n = 176)	60/88	53/88	113	64	58	51	64/88	60/88	124	70	68	55		
Female (n = 224)	63/112	55/112	118	53	71	60	66/112	61/112	127	57	81	64		
Variables	May-June													
	No. of samples with yeast/Total no. of samples		No. of samples with yeast		No. of samples with <i>Candida</i>		No. of samples with yeast/Total no. of samples		No. of samples with yeast		No. of samples with <i>Candida</i>			
Department:														
Surgery (n = 80)	20/40	23/40	43	54	25	58	20/40	23/40	43	54	25	58		
ICU (n = 160)	51/80	57/80	103	64	61	59	51/80	57/80	103	64	61	59		
Obstetrics and Gynaecology (n = 160)	58/80	52/80	110	69	63	57	58/80	52/80	110	69	63	57		
Job title:														
Physician (n = 120)	42/60	33/60	75	63	48	64	42/60	33/60	75	63	48	64		
Nurse assistant (n = 88)	29/44	29/44	58	66	33	57	29/44	29/44	58	66	33	57		
Nurse (n = 152)	43/76	42/76	85	56	40	47	43/76	42/76	85	56	40	47		
Radiology technician (n = 16)	6/8	4/8	10	63	3	30	6/8	4/8	10	63	3	30		
Stretcher-bearer (n = 24)	6/12	7/12	13	54	5	38	6/12	7/12	13	54	5	38		
Sex:														
Male (n = 176)	61/88	56/88	117	66	64	55	61/88	56/88	117	66	64	55		
Female (n = 224)	67/112	59/112	126	56	70	56	67/112	59/112	126	56	70	56		

high percentage in the number of the samples with yeast per palm and fingertips (from 50% to 69%). Among the yeast samples obtained, *Candida* sp., on average, were found in 55% of the samples, and in a high percentage on all HCWs' hands. The highest percentage was found during contact with patients without wearing gloves.

The main source of hospital infections by yeast is still the endogenous flora of patients. However, HCWs' hands are also considered to be important for colonization and infection, especially with *Candida* sp. [1-4].

Data about carriage of exogenous and endogenous flora on the hand of staff are available from some recent study [21, 22].

In this study the investigation was also concerned with which factors could influence hand contamination in routine practice. The results of this preliminary study indicate that nearly half of the personnel working in the three departments investigated harbour yeasts on their hands. It would be of interest to verify the compliance with standard precautions of HCWs working in these three types of departments, to determine whether this high fungal load is related to common and ineffective practices involving hand hygiene and gloving. In our preliminary study, gloving was significantly associated with a reduction in the total fungal load recovered on

hands (for palm and fingertips in the multivariate analysis), and was a protective factor against the presence of any pathogenic yeast on hands. The effectiveness of gloving in the prevention of hand contamination has been observed [16], though the impact of wearing gloves in compliance with hand hygiene has not been definitively established, as published studies have yielded contradictory results [23-27].

The higher concentration of yeast on HCWs' hands can be attributed to no strict application of hygienic hand disinfection, and this can be common practice in the three departments. However, strict handwashing before and after contact with patients cannot be overemphasized. The antiseptic activity of various handwashing agents differs and none is ideal for all conditions [28, 29].

In conclusion, our preliminary study has shown that yeast carriage on the HCWs' hands is common in the three departments investigated, but the causes are unclear. Careful use of gloving may reduce pathogenic yeast on hands. An ideal handwashing agent for all conditions against yeast hands contamination should be further researched.

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