

## Yeasts in a hospital for patients with skin diseases

BY DOROTHY A. SOMERVILLE

*St John's Hospital for Diseases of the Skin, Institute of Dermatology,  
Homerton Grove, London, E9 6BX*

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### SUMMARY

The incidence and acquisition of *Candida albicans* and other yeasts in two wards of a skin hospital is described. Carriage rates on the skin in hospital patients is higher than is generally supposed, and cutaneous sites may act as sources of infection with these organisms.

### INTRODUCTION

During a study of cross-infection in two wards for male patients in a skin hospital, the opportunity was taken to study the occurrence and spread of yeasts, with particular reference to *Candida albicans*. Patients with diseases of the skin, especially eczema and mycosis fungoides, have been shown to be major sources of micro-organisms in hospital cross-infection, dispersal taking place on particles of desquamated skin (Noble & Davies, 1965; Wilson, White & Noble, 1971). The greater ability of dermatological patients to disseminate bacteria is due to a greater degree of skin colonization and to the fact that such patients liberate more particles of skin than persons with clinically normal skin (Noble, 1971*a*). *C. albicans* is not found resident on the healthy skin in young adults (Somerville, 1966), but the carriage of this yeast is increased among hospital patients (Vince, 1959; Clayton & Noble, 1966) and it has been suggested that spread of yeasts in the hospital ward occurs in a similar way to the spread of *Staphylococcus aureus* (Clayton & Noble, 1966).

### MATERIALS AND METHODS

A total of 286 male patients was included in this study, 117 in Ward A, a ward with 12 beds in single rooms, and 169 in Ward B, an open ward for 16 patients. During the period of the study, patients in Ward A who were not confined to bed used the same dayroom as patients in Ward B.

During the 9 months of the survey, swabs were taken twice weekly from the nose, gums, chest and groins of all patients. An attempt was made to sample areas of skin without obvious lesions, though in extensive cases this proved difficult. The swabs, together with any sent to the laboratories for routine bacteriological examination, were inoculated onto Sabouraud's dextrose agar (pH 4) and then dropped into dextrose yeast extract broth (pH 4) for enrichment culture. Incubation was at 37° C. for 1 week, the broths were then subcultured onto Sabouraud's agar and these cultures incubated for 1 week at 37° C. A semi-quantitative assess-

Table 1. *Details of patients admitted to two male wards during the survey period*

	Ward A	Ward B
No. admitted	117	169
	%	%
Age		
< 15 yr.	3	3
15-39 yr.	27	39
> 39 yr.	70	58
Diagnosis		
Eczema	42	34
Psoriasis	35	31
Others	23	34
Length of stay		
1-7 days	9	17
8-14 days	28	24
15-21 days	23	22
22-29 days	11	14
29-56 days	20	16
> 56 days	9	7
Antibiotic therapy		
Topical	23	17
Systemic	25	17
Total	40	25

ment of the yeasts isolated was made: ++, heavy growth, more than 20 colonies isolated on primary culture; +, 5-20 colonies isolated on primary culture; ±, less than 5 colonies isolated on primary culture or enrichment culture necessary. All yeasts isolated were identified by the criteria of Lodder (1970). These methods of isolation restrict the yeasts obtained to those able to grow at 37° C. and the enrichment technique favours the growth chiefly of *Candida* and *Torulopsis* species. However, these are the species most commonly found associated with man and the ones usually incriminated in opportunist infection. An enrichment technique was used as yeasts generally occur on the skin in small numbers and swabbing, though the most acceptable method of sampling the skin in a hospital, is not entirely efficient. In the event, in most cases yeasts were found in sufficient numbers to be isolated on the primary Sabouraud's medium.

## RESULTS

Details of the patients admitted to the wards are shown in Table 1. Two diagnostic categories, eczema and psoriasis, contributed over 60% of the patients; the remainder were admitted with a variety of diseases, including light sensitivity, varicose ulcers and mycosis fungoides. There was no significant difference in the numbers of psoriatic and eczematous patients admitted to each ward, but the more serious cases of psoriasis were admitted to Ward A and the length of stay of psoriatic patients differed in the two wards, with an average of 31 days in Ward A compared with 23 days in Ward B. Patients admitted to Ward A were on average older than those admitted to Ward B (Table 1), but there was no difference in the

Table 2. Incidence of yeasts amongst patients on admission

	No. of patients	No. carrying on				
		Gums	Nose	Chest	Groin	Total
<i>C. albicans</i>						
Patients with						
Eczema	107	39 (36)	2 (2)	2 (2)	3 (3)	39 (36)
Psoriasis	94	24 (26)	1 (1)	2 (2)	6 (6)	27 (29)
Other disease	85	15 (18)	1 (1)	1 (1)	1 (1)	17 (20)
Total	286	78 (27)	4 (1)	5 (2)	10 (4)	83 (29)
<i>Other yeasts</i>						
Patients with						
Eczema	107	15 (14)	4 (4)	4 (4)	9 (8)	24 (22)
Psoriasis	94	5 (5)	3 (3)	6 (6)	6 (6)	14 (15)
Other disease	85	5 (6)	3 (4)	4 (5)	10 (12)	19 (22)
Total	286	25 (9)	10 (3)	14 (5)	25 (9)	55 (19)

The figures in parentheses are percentages.

length of hospital stay between the patients in the two wards. Nursing techniques were the same in both wards and some staff were shared by the two wards.

#### *Carrier status on admission*

The carriage rate of yeasts on admission is shown in Table 2: there was no difference between the patients admitted to the different wards. However, the incidence and number of *C. albicans* carried on the gums was significantly greater in patients with eczema (36%) than in those with psoriasis (26%) ( $1\% < P < 2\%$ ).

#### *Acquisition*

##### *C. albicans*

The acquisition rate of *C. albicans* among the disease categories was similar but higher in Ward A than in Ward B. As expected, the chance of acquiring *C. albicans* increased the longer the patient stayed in hospital (Table 3). In the lesions, older patients acquired yeasts more frequently than did younger ones, but this might be explained by the fact that the older patients tended to be in hospital longer (a mean of 25 days as compared with 18 days for the younger group). Although the acquisition rate on the gums did not increase with age, the older patients carried larger numbers of yeasts than did the younger ones ( $P < 2\%$ ).

Over a third of the patients acquired *C. albicans* at some site not colonized on admission and 52% of all patients carried this yeast at some time during their hospital stay, 45% on the gums, 12% on the chest and 20% in the groins (Table 4). Psoriatic patients carried *C. albicans* on the skin more frequently than did eczema patients, but the difference was not statistically significant. However, patients with eczema who were colonized by the yeast carried them longer than did other types of patients. Carriage of *C. albicans* on the gums and skin was higher in those patients treated with antibiotics (Table 5) and, although the difference was not statistically significant, the carriage rate was highest in those receiving systemic antibiotics.

Table 3. *Acquisition of C. albicans in the hospital*

	No. of patients	No. acquiring on						Total
		Gums*		Nose	Chest	Groins	Lesions	
		++	+					
Age								
< 40 yr.	106	2 (2)	14 (13)	5 (5)	12 (11)	14 (13)	1 (1)	30 (28)
≥ 40 yr.	180	17 (9)	19 (11)	15 (8)	18 (10)	32 (18)	12 (7)	67 (37)
Disease								
Eczema	107	12 (11)	10 (9)	6 (6)	10 (9)	18 (17)	6 (6)	43 (40)
Psoriasis	94	1 (1)	14 (15)	9 (10)	11 (12)	18 (19)	5 (5)	29 (31)
Others	85	6 (7)	9 (11)	5 (6)	9 (11)	10 (12)	2 (2)	25 (29)
Length of hospital stay								
< 14 days	114	2 (2)	8 (7)	3 (3)	3 (3)	6 (5)	1 (1)	20 (18)
14-29 days	101	9 (9)	12 (12)	3 (3)	12 (12)	12 (12)	1 (1)	34 (34)
> 29 days	71	8 (11)	13 (18)	14 (20)	15 (21)	28 (39)	11 (15)	43 (61)
Total	286	19 (7)	33 (12)	20 (7)	30 (10)	46 (16)	13 (5)	97 (34)

\* ++ : ≥ 20 colonies isolated on primary culture; + : < 20 colonies isolated on primary culture; The figures in parentheses are percentages.

Table 4. *Total carriage of C. albicans*

	No. of patients	No. carrying on						Total
		Gums		Nose	Chest	Groins	Lesions	
		++	+					
Age								
< 40 yr.	106	17 (16)	32 (30)	7 (7)	14 (13)	17 (16)	1 (1)	56 (53)
≥ 40 yr.	180	45 (25)	36 (20)	17 (9)	21 (12)	39 (22)	12 (7)	94 (52)
Diseases								
Eczema	107	34 (32)	27 (25)	8 (7)	12 (11)	20 (19)	6 (6)	69 (64)
Psoriasis	94	12 (13)	27 (29)	10 (11)	13 (14)	25 (27)	5 (5)	45 (48)
Others	85	16 (19)	14 (16)	6 (7)	10 (12)	11 (13)	2 (2)	36 (42)
Total	286	62 (21)	68 (24)	24 (8)	35 (12)	56 (20)	13 (5)	150 (52)

\* ++ : ≥ 20 colonies isolated on primary culture; + : < 20 colonies isolated on primary culture. The figures in parentheses are percentages.

Table 5. *Effect of treatment with antibiotics on carriage of yeasts*

	No. of patients	<i>C. albicans</i>			Other yeasts		
		No. carrying on			No. carrying on		
		Gums	Skin	Total	Gums	Skin	Total
Topical antibiotics	55	33 (60)	20 (36)	39 (71)	16 (29)	25 (45)	35 (64)
Systemic antibiotics	58	37 (64)	31 (53)	49 (84)	24 (41)	34 (59)	48 (83)
No antibiotics	195	77 (39)	35 (18)	88 (45)	28 (14)	52 (27)	78 (48)

The figures in parentheses are percentages.

Table 6. Acquisition of yeasts other than *C. albicans*

	No. of patients	No. acquiring on					Total
		Gums	Nose	Chest	Groin	Lesions	
Age							
< 40 yr.	106	10 (9)	14 (13)	10 (9)	14 (13)	3 (3)	34 (32)
≥ 40 yr.	180	37 (21)	37 (21)	43 (24)	44 (24)	14 (8)	89 (49)
Disease							
Eczema	107	19 (18)	20 (19)	20 (19)	26 (24)	6 (6)	50 (47)
Psoriasis	94	13 (14)	18 (19)	21 (22)	20 (21)	6 (6)	43 (46)
Others	85	15 (18)	13 (15)	12 (14)	12 (14)	5 (6)	30 (35)
Length of hospital stay							
< 14 days	114	6 (5)	8 (7)	5 (4)	8 (7)	2 (2)	23 (20)
14-29 days	101	14 (14)	16 (16)	17 (17)	21 (21)	5 (5)	47 (47)
> 29 days	71	27 (38)	27 (38)	31 (44)	29 (41)	10 (14)	53 (75)
Total	286	47 (16)	51 (18)	53 (19)	58 (20)	17 (6)	123 (43)

The figures in parentheses are percentages.

Table 7. Yeasts other than *C. albicans* isolated from patients (only one isolate from each patient is included)

	No. isolations				
	Gums	Chest	Groin	Lesions	Total
<i>Candida parapsilosis</i>	19	48	54	10	106
<i>C. tropicalis</i>	4	—	3	—	5
<i>C. pseudotropicalis</i>	3	—	—	1	4
<i>C. krusei</i>	4	—	1	—	5
<i>C. melinii</i>	6	1	1	1	11
<i>C. zeylanoides</i>	1	—	1	—	3
Other <i>Candida</i> spp.	2	1	2	3	6
<i>Torulopsis glabrata</i>	30	7	11	2	43
<i>T. famata</i>	7	9	7	3	28
<i>T. inconspicua</i>	13	7	2	—	18
<i>Pityrosporum pachydermatis</i>	13	23	27	5	47

#### Yeasts other than *C. albicans*

The acquisition rate of these yeasts was again higher in the older patients ( $P < 1\%$ ) (Table 6), but was not affected by disease category or ward. As with *C. albicans*, the rate increased with length of stay in hospital. Table 7 shows the species of yeasts isolated from the patients and their relative incidences (only one isolate of each species is recorded for each patient). *Pityrosporum pachydermatis*, a non-lipid-requiring *Pityrosporum* species previously reported only from animals was isolated from 47 patients (16%) (Table 8). (I am grateful to the Centraal bureau voor Schimmelcultures, Delft, for confirming the identification of this yeast.) Nine patients were considered to be heavily colonized as large numbers of *P. pachydermatis* could be isolated from the skin over long periods of time. These nine patients had severe, long-standing skin disease, eight had psoriasis and one mycosis fungoides; all were being treated with steroids, six with antibiotics and the condition of six of them warranted treatment with the cytostatic drug, metho-

Table 8. *Isolation of Pityrosporum pachydermatis*

	No. patients	No. patients carrying yeast	No. patients colonized	Diagnosis of those colonized
Ward A	117	23 (20%)	8	Psoriasis (7), Mycosis fungoides (1)
B	169	24 (14%)	1	Psoriasis

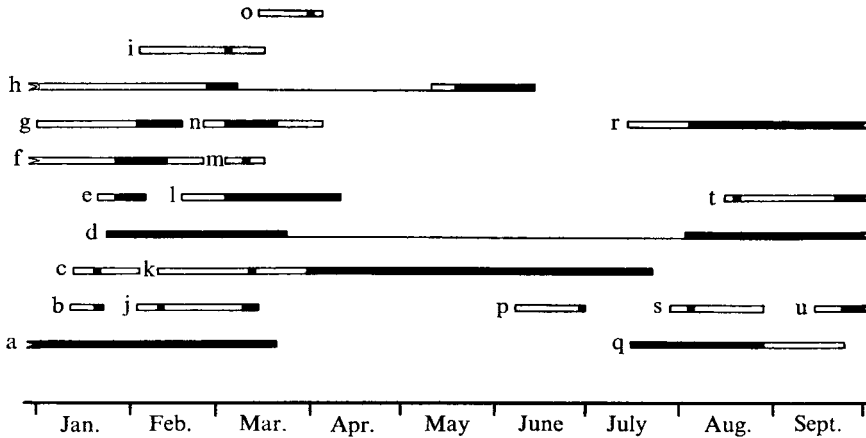


Fig. 1. Spread of *Pityrosporum pachydermatis* in Ward A. The length of a patient's stay is indicated by the horizontal bar, each individual patient is given a letter and blacked in areas indicate periods of carriage of the yeast. Only patients from whom the yeast was recovered are shown in the figure.

trexate. A higher incidence of colonization occurred in Ward A ( $\chi^2 = 8.90$ ,  $P < 1\%$ ) than in Ward B, and there was evidence of spread of the yeast in this ward (Fig. 1) though not in Ward B, even though patients mixed freely. Two patients in Ward A with pustular psoriasis were admitted already colonized by this yeast and appeared responsible for its spread through the ward. These two patients had had multiple previous admissions to the hospital and presumably acquired the yeast from some common source.

In contrast to the findings with *C. albicans*, older patients carried other yeasts for longer periods of time than did the younger patients. There was no difference between the three disease groups, but long-stay patients were more likely to carry these yeasts throughout their stay in hospital than those who stayed for less than 29 days ( $\chi^2 = 4.56$ ,  $P < 5\%$ ). This is presumably related to the severity of the disease. Antibiotic therapy also increased the numbers of patients with long-term carriage. Significantly more patients receiving systemic rather than topical antibiotics carried yeasts other than *C. albicans*, and the incidence in those patients not treated with antibiotics was much lower than in either of the antibiotic treated groups (Table 5).

#### *Yeasts in pathological material*

It is difficult to assess the significance of infection in a skin hospital as there is a high isolation rate of potentially pathogenic organisms from apparently healthy

Table 9. Incidence of yeasts in infected lesions and other specimens sent to the laboratories

Specimens	No. of specimens	No. carrying		
		<i>C. albicans</i>	Other <i>Candida</i>	Other yeasts
Swabs from				
Ulcers	78	4 (5)	12 (15)	1 (1)
Eyes/ears	78	8 (10)	5 (6)	4 (5)
Axillae/groins	59	11 (19)	5 (3)	1 (2)
Toewebs	29	0	8 (28)	3 (10)
Other areas	809	49 (6)	49 (6)	40 (5)
Sputum	131	62 (47)	7 (5)	20 (15)
Throat swab	306	110 (36)	16 (5)	28 (9)
Nose swab	155	9 (6)	5 (3)	4 (3)

The figures in parentheses are percentages.

skin sites. However, swabs sent to the laboratories under the headings 'infected eczema', 'boil', 'infected ulcer', etc., were considered to come from an infected lesion. Isolation of yeasts from such specimens sent from the two male wards was similar to that from specimens sent from the two female skin wards of the hospital, so the results are considered together in Table 9. There were 1053 lesion swabs submitted from the four wards during the survey period of which 7% carried *C. albicans*, 8% other *Candida* species and 5% other yeasts (Table 9). The differences in isolation rates from the various skin sites for *Candida* species are significant: *C. albicans* was isolated more frequently from lesions in the axillae, groins, ears and eyes; other *Candida* species were more frequent in the toewebs and in ulcers.

#### DISCUSSION

As in other investigations, the results show that the carriage of yeasts, including yeasts other than *C. albicans*, is more common among hospital patients than in the general population. Skin carriage of *C. albicans*, usually very low in young adults and almost non-existent on the general skin surface (Somerville, 1966) is increased to 15–20%. Other yeasts are more common on the skin. Carriage on the gums is more common and the results obtained in this survey are similar to those found by workers using similar sampling techniques (Clayton & Noble, 1966; Somerville, 1966; Marples & Somerville, 1968; Barlow & Chattaway, 1969). A much higher incidence of carriage (50%) is obtained if mouth washings are cultured (Marples & Di Menna, 1952; Somerville, 1964), but this method is not easily carried out in extensive studies. As in the healthy population, carriage of *C. albicans* is more common in the elderly. Skin carriage of the yeasts, especially *C. albicans*, did not merely reflect contamination from the mouth and was highest in the group of patients with psoriasis. The incidence of all yeasts, not only *C. albicans*, is increased in the group of patients treated with antibiotics (Smits, Prior & Arblaster, 1966). As expected, systemic antibiotics produced a larger increase than did topical antibiotics, but increased incidence even in the gums did occur in those patients

treated with topical antibiotics. This is similar to the findings made in a study of acquisition of *Staph. aureus* (Wilson *et al.* 1971), though it may merely reflect the more serious clinical condition. The effect of steroid treatment on yeast carriage could not be assessed as 75% of the patients received steroid therapy, usually topical, during their stay in hospital; those who did not were usually in special patient categories such as light sensitivity.

It is not possible to decide with any certainty the mode of spread of these yeasts in the hospital wards. At present, there is no means of subgrouping yeast species for epidemiological work and the source may be endogenous or exogenous. However, several patients concerned in the spread of *P. pachydermatis* in Ward A were also involved in the spread of other organisms such as *Streptococcus pyogenes*, *Pseudomonas aeruginosa* and antibiotic-resistant *Staph. aureus* (Noble, 1971*b*), and it may be a feature of certain severely affected skin patients that they become easily colonized by any organism in the environment, provide a suitable habitat for its multiplication and act as a good source of 'infection' for other patients in the wards. However, several other long-term severely affected patients admitted to the wards at the same time as these 'dispersers' did not become colonized and Ward B never showed any evidence for significant spread of the yeast from patient to patient, even though there was complete freedom of movement between wards. Spread, not only of *P. pachydermatis*, but also of *C. albicans*, was more widespread in Ward A despite the fact that patients in this ward each had single rooms.

The incidence of yeasts on the skin in patients in hospital is higher than is often supposed. With the increase in the problem of opportunist *Candida* infection in those on treatment with cytotoxic drugs, sites other than the gums and intestine should also be investigated as possible sources of yeasts for infection, given that almost a quarter of the patients in this study carried *C. albicans* on the skin.

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