Nasal abnormality and the carrier rate of *Staphylococcus aureus*

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SYNOPSIS In a group of 178 hospital nurses minor nasal abnormalities were found to be associated with an increased rate of nasal carriage of *Staphylococcus aureus*.

The *Staphylococcus aureus* is found in the anterior nares of 30 to 50% and on the skin in 12 to 25% of healthy adults (Miles, Williams, and Clayton-Cooper, 1944; Williams, Blowers, Garrod, and Shooter, 1960). It is not known why some people carry the organism and others do not, although nasal carriage predisposes to skin carriage as the result of passive transfer. Despite this relationship, in about half the cases of skin carriage the organism is not found in the nose (Miles *et al.*, 1944), neither is there any correlation between the degree of nasal colonization and the intensity and extent of contamination of the skin (Hare and Ridley, 1958).

The incidence of staphylococcal carriage is apparently random and it has been stated that neither congenital anomalies of the upper respiratory tract (Cunliffe, 1949) nor non-staphylococcal disease of the nose (Williams *et al.*, 1960) predisposes to a higher nasal carrier rate. Although this may be true for the staphylococcus, McCartney and Harvey (1928) found that in the case of *Corynebacterium diphtheriae* nasal abnormality favoured the development of the carrier state. Subtle constitutional differences of the skin have been suggested as the reason for staphylococcal carriage on the integument (Tulloch, 1954) but this has not been demonstrated experimentally.

The paper records an attempt to determine some of the factors that may predispose to staphylococcal colonization of the nose and the skin in individuals without any obvious staphylococcal infection.

METHODS

One hundred and seventy-eight nurses, some of whom were in the preliminary training school and had not been in contact with a hospital environment, formed the group for study.

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CLINICAL ASSESSMENT An E.N.T. and dermatological history of each subject and her immediate family was taken. An aural surgeon examined the nose and throat in each individual and noted any clinically significant abnormality, and a dermatologist placed the subject into one of four skin types, namely, normal, dry, moist, or greasy. The presence of minor skin sepsis was also noted. A special note was made of recent treatment with chemotherapeutic agents.

BACTERIOLOGICAL SAMPLING Three swabs moistened with nutrient broth were taken from the following sites: the palmar surface of the left wrist, the nasal vestibule, and the mucosa immediately above the anterior end of the inferior turbinate. Under direct vision and with instrumentation an aural surgeon swabbed the inferior turbinate. A fourth swab was taken from the tonsillar area in the last 66 nurses.

The swabs were plated on to nutrient agar without delay. After 48 hours' incubation the plates were examined for coagulase-positive staphylococci. The phage and sensitivity patterns of these were determined. To determine sensitivity, Sentest (Evans) tablets were used on nutrient agar plates previously seeded with 1 ml. of a 1 in 100 dilution of an 18-hour broth culture.

RESULTS

The incidence of skin carriage was so low (7.25%) that any correlation with clinical skin types was unjustified.

The overall incidence of nasal carriage was 38% (68 out of 178). With one exception all were vestibular carriers, and in almost half (17%) carriage extended far enough to involve the mucosa above the inferior turbinate.

The staphylococci isolated were distributed amongst all phage groups (Table I). Table I also records their susceptibility to antibiotics. It can be seen that the populations studied, with respect to the character of the staphylococci present, were

TABLE I
CHARACTERISTICS OF STAPHYLOCOCCI ISOLATED FROM THE NOSES OF 178 NURSES

Sensitivity Patterns of Strains for				No. of Ward Nurses Yielding Strains of Staphylococci	No. of Preliminary Training School Nurses Yielding Strains of Staphylococci								
Penicillin	Streptomycin	Tetracycline	Erythromycin		This Sensitivity Pattern	Phage Group							
						I	II	III	Others				
S ¹	S	S	S	3	1	2	0	0	14	6	4	2	2
R ²	S	S	S	35	19	1	3	12	6	3	2	1	0
R	R	S	S	1	0	0	0	1	0	0	0	0	0
R	R	R	S	4	0	0	3	1	0	0	0	0	0
R	R	R	R	5	0	0	5	0	0	0	0	0	0
Total No. of Nurses													
Yielding staphylococcus strains				48	20	3	11	14	20	9	6	3	2
Examined				107					71				
Percentage of nurses positive				45	19	2.7	10.3	13	28	12.6	8.5	4.2	2.7

¹S = sensitive; ²R = resistant

No strain was found to be resistant to either chloramphenicol or novobiocin.

TABLE II

PHAGE GROUP DISTRIBUTION OF STAPHYLOCOCCI ISOLATED FROM NURSES WITH NORMAL AND ABNORMAL NOSES

Nurses with	Where Stationed	No. Carrying Staphylococci of Phage Group				No. of Non-carriers	Total
		I	II	III	Others		
Abnormal noses	Ward	4	0	3	4	4	20
	Preliminary training school	0	0	2	0	3	
Normal noses	Ward	16	3	8	10	55	158
	Preliminary training school	9	6	1	2	48	
Total		29	9	14	16	110	178

comparable to those of previous workers, e.g., Barber and Burston (1955).

A clinically significant minor nasal abnormality, i.e., a deviated septum or damaged turbinate, was found in 20 individuals and of these 13 (65%) carried a coagulase-positive staphylococcus in the nose. In the remainder, those having normal noses, 55 (29%) were nasal carriers. The incidence of staphylococcal carriage in the group with nasal anomalies was significantly higher than that in the group with normal noses ($\chi^2 = 6.88$, $n = 0.01 > p > 0.001$).

This relationship was further strengthened by the finding that staphylococcal carriage in the throat was almost exclusively confined to those individuals who showed some abnormality of the tonsil (Campbell, 1948). Thus, of 66 subjects examined, six had tonsillar disease and all of these carried *Staphylococcus aureus* in the throat. On the other hand, of the 60 subjects with normal throats only one carried a *Staphylococcus aureus* in this area. These findings are analogous to those of Hartley and Martin (1920), who found that the persistence of carriage of *Corynebacterium diphtheriae* was apparently related to the

presence of diseased tonsils. In the present investigation no relationship was observed between mucosal carriage and tonsillar carriage (Dingle and Plummer, and others, 1949).

Nasal abnormality does not favour colonization of the nose by staphylococci of any particular phage group (Table II), nor does it predispose to involvement of the upper reaches of the nose (Table III).

TABLE III

EXTENT OF COLONIZATION OF NORMAL AND ABNORMAL NOSES BY STAPHYLOCOCCI

Nurses with	No. Carrying Staphylococci on/in			Total
	Mucosa Alone	Mucosa and Vestibule	Vestibule Alone	
Abnormal noses	0	6	7	13
Normal noses	1	25	29	55
Total	1	31	36	68

DISCUSSION

It has been stated that nothing is gained in the estimation of staphylococcal carrier rates by

swabbing the upper reaches of the nose, and indeed that misleadingly low carrier rates may be obtained by so doing (Williams *et al.*, 1960). Stratford *et al.* (1960), however, isolated *Staphylococcus aureus* from mucosal swabs in 51% of a group of 103 patients but from vestibular swabs taken from the same group in only 34%, a result that throws some doubt on the obvious criticism of mucosal sampling that the organisms isolated might be contaminants derived from the vestibule. The technique used by Stratford, Rubbo, Christie, and Dixon (1960) is not detailed; in our tests the vestibule was opened out with a Thudichum speculum and samples taken from the clearly visualized inferior turbinate region. In our experience the mucosa is rarely involved alone.

In view of the findings of Cunliffe (1949), who found no increase in the staphylococcal carriage rate of children with gross abnormality of the nasopharynx, our finding that there is a higher rate of nasal carriage in nurses with minor nasal abnormalities might appear surprising. However, this result for the staphylococcus is in accord with that of McCartney and Harvey (1928) for *Corynebacterium diphtheriae*, who found that 72% of diphtheria carriers showed nasal abnormalities, in contrast to patients who had recovered clinically from diphtheria and were also bacteriologically free

in whom the abnormality rate was only 7%. Moreover in the discussion on the epidemiology of scarlet fever, Wilson and Miles (1955) suggest that abnormalities of the upper respiratory tract prolong carriage of *Streptococcus pyogenes*.

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