may be more common than is generally suspected. Insemination will increase the likelihood of conception in these cases.

When semen quality is poor, there is no evidence that insemination improves the chance of conception. These couples are best advised to continue their normal sexual relationship; for there is good evidence that, even with severe oligospermia, intercourse can result in conception and successful pregnancy (Harvey and Jackson 1948, White and Barton 1951, Russell 1954).

I am grateful to Mr. Keith Yeates of the Newcastle General Hospital for his help in dealing with one of the men with bilateral epididymal cysts and azoospermia.

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TREATMENT OF THE NASAL CARRIER OF STAPHYLOCOCCUS AUREUS WITH FRAMYCETIN AND OTHER ANTIBACTERIALS

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THERE is general agreement that the healthy nasal carrier of *Staphylococcus aureus* constitutes one important reservoir of infection. Since many different phage-types are responsible for endemic staphylococcal disease in hospitals, it is impossible to distinguish between benign and dangerous carriers (Williams 1959). Accordingly, one is forced to regard all carriers as potentially dangerous (Elek 1959). When an outbreak of staphylococcal infection is traceable to a particular phage-type—e.g., 80/81—the detection of the dangerous disperser is greatly simplified; but this ideal epidemiological situation is seldom found in endemic hospital cross-infections affecting adults.

A reduction in the number of nasal carriers of staphylococci cannot be brought about by the use of antibacterial nasal toilet alone, as the nasal mucosæ are continually exposed to reinfection by airborne organisms. The more widespread the environmental contamination, the higher the nasal carrier-rates among staff and patients. If, however, the endemic balance between primary and secondary sources of infection could be reduced, then the chances of acquiring clinical infection should be lower—assuming, of course, that there was no change in virulence of the organism and no lowering of resistance of the patient.

We are here concerned with the treatment of the nasal carrier. We have compared a number of recommended preparations—firstly as regards the rate of suppression of nasal carriage, and secondly, the success-rate after seven days of treatment. Recolonisation of the cleared carriers was sought, but this is as much an index of environmental exposure as a measure of the efficacy of nasal toilet.

Of the two methods of applying these preparations, we have found the aqueous spray generally more effective than the corresponding ointment (or cream). Doubtless the ointment remains longer in contact with the mucosal surface, but it seldom reaches sites of possible colonisation that are beyond the vestibule of the nose.

We have always used a " deep nasal swab " for detection of nasal carriers in preference to the commonly used " shallow swab " of the anterior nares. In a survey of 103 patients, deep swabbing yielded a higher proportion of positive carriers. As the success of any preparation depends on contact with the infecting organism, deeply and liberally applied sprays must carry a greater chance of success than a cream applied to the anterior nares.

Materials and Methods

Nasal swabbing.—To have a sound basis for selecting nasal carriers, two types of swabs were taken in a group of 103 patients at the one visit. The first swab was made from the vestibule of each nostril, that is, an anterior nasal swab; and the other from the vestibule to a point just below the middle turbinate, that is, a deep swab (fig. 1). In each case the swab was rotated through three full turns during the operation of swabbing. The deep-swab technique should be done by a person familiar with the internal anatomy of the nasal cavity. All swabs were plated on blood-agar media, incubated for twenty-four to forty-eight hours at 37°C. *Staph. aureus* was identified on colony form, and on pigment and coagulase production.

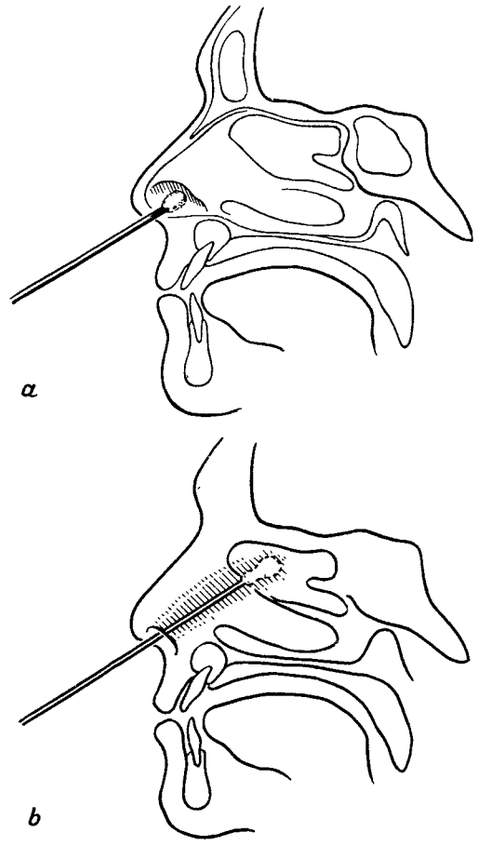

Fig. 1—*a*, area sampled in anterior nasal swab; *b*, area sampled in deep nasal swab.

Nasal preparations.—The products used were:

a. ' Neotracin ' ointment containing neomycin 5 mg., polymyxin 5000 units, and bacitracin 500 units per g.

b. ' Neomyxin ' spray containing neomycin 2 mg. and polymyxin 5000 units per ml.

c. ' Naseptin ' ointment containing chlorhexidine hydrochloride (' Hibitane ') 0·1% and neomycin 0·5%.

d. Chlorhexidine-neomycin spray in saline containing the same concentration of active ingredients as naseptin.

e. ' Soframycin ' ointment containing framycetin 1·5% and gramicidin 0·005%.

f. Soframycin spray containing framycetin 1·25% and gramicidin 0·005% in isotonic solution containing phenylephrine hydrochloride 0·25% as a vasoconstrictor.

g. Soframycin spray as (f) but without the vasoconstrictor.

The ointments were applied with a swab to the anterior nares. The sprays were instilled into the nasal cavity, under pressure, from plastic containers in such quantity that some of the liquid passed to the back of the patient's throat. All patients were treated individually by one or other of us. Each preparation

TABLE I—COMPARISON OF ANTERIOR AND DEEP NASAL SWABBING OF 103 PATIENTS IN HOSPITAL

Type of swabbing	Nasal carriers detected	
	Number	Carrier-rate
Anterior	35	34%
Deep (see text)	53	51%

was tested in 20 patients, each of whom was shown to have more than twenty colonies of *Staph. aureus* on plating of a deep swab. On every occasion, the patient was swabbed immediately before treatment, two hours after the first application, and afterwards daily for seven days. Medication then ceased, but daily swabbing was continued for at least twenty-one days, or for a shorter period if the patient was discharged from the hospital.

Results

A significant difference in the number of detectable nasal carriers can be shown after shallow (anterior nasal) and deep (anterior and middle nasal) swabbing. Table I shows the results obtained on 103 patients, and emphasises the importance of taking a deep nasal swab.

Table II summarises the results of treatment of groups of nasal carriers with the different preparations.

In this table we have listed the results obtained twenty-four hours, and seven days respectively after the beginning of treatment. The soframycin spray was outstandingly more successful after twenty-four hours than any of the other preparations. The inclusion of a vasoconstrictor in this spray appeared to improve its antibacterial action over a period of seven days. The fluted nebuliser in which the soframycin spray is dispensed may contribute to its success. About 2 ml. of fluid is ejected, first as a coarse spray and then as a fine jet. On the figures recorded here, one application of soframycin spray suppressed nasal staphylococci in 85% of nasal carriers. In fact, approximately 80% of carriers are cleared within two hours of the first application of the spray. No other product in this series was so effective. Daily treatment for seven days with soframycin spray cleared all carriers in our series. Of the other preparations, chlorhexidine-neomycin spray appeared to be the next most efficacious, but was considerably less so than soframycin.

TABLE II—RATE OF CLEARANCE OF *Staph. aureus* BY VARIOUS PREPARATIONS

Preparation	Frequency of application	Number treated	Number cleared (negative swab) after:	
			24 hours	7 days
Soframycin spray with vasoconstrictor..	once daily	20	17 (*85%*)	20 (*100%*)
Soframycin spray without vasoconstrictor	once daily	20	17 (*85%*)	17 (*85%*)
Soframycin ointment	twice daily	20	5 (*25%*)	18 (*90%*)
Chlorhexidine-neomycin spray ..	once daily	20	5 (*25%*)	15 (*75%*)
Naseptin ointment (chlorhexidine-neomycin) ..	twice daily	20	1 (*5%*)	9 (*45%*)
Neomyxin spray ..	once daily	20	7 (*35%*)	10 (*50%*)
Neotracin ointment	thrice daily	20	4 (*20%*)	13 (*65%*)

The remarkably rapid rate of clearance induced by soframycin in this series was investigated further using 85 nasal carriers, who were treated twice with the spray at twenty-four hour intervals. The results of this short treatment are shown in fig. 2.

It will be seen that 76% of the carriers were cleared within two hours after one application of the spray, and all were free of staphylococci after the second application. The antibiogram patterns of a number of staphylococci were done, and most of the strains were resistant to penicillin, streptomycin, and the tetracyclines; in other words, they were typical of the " hospital staphylococcus ".

Reinfection of the nasal mucosæ after clearance occurred with all preparations. Table III shows that approximately 50% of the cleared carriers reverted to the carrier state after cessation of treatment, but the time taken to revert after soframycin was clearly different from that found with the other preparations. With the latter, the staphylococcus free state lasted, on an average, two days, whereas after soframycin treatment an average of seven to fourteen days elapsed before reversion. Since all patients were exposed to the same degree of airborne infection, it would appear that the soframycin-treated group were reinfected from exogenous sources, whereas the reversion in other carriers was mainly endogenous. Elimination in the soframycin-treated group was bacteriologically complete, but incomplete with the other preparations. Unfortunately, phage-typing of isolates was not available to confirm this interpretation, which, if correct, provides a further reason for recommending soframycin spray for treatment of the nasal carrier.

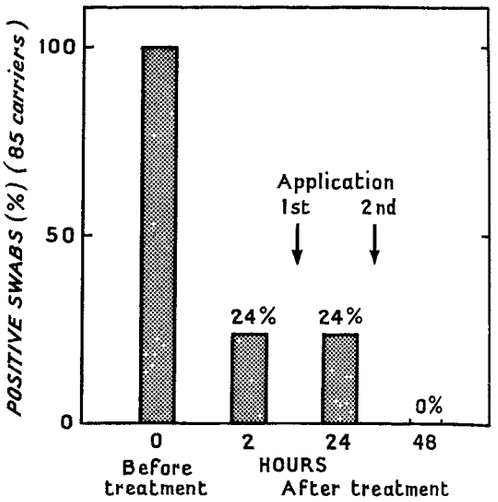

Fig. 2—Suppression of nasal carriage of *Staph. aureus* by treatment with soframycin nasal spray.

Discussion

A vast literature dealing with the nasal carriage of *Staph. aureus* has appeared during the past decade.

Some authors, e.g., Gould and Cruikshank (1957), Williams (1959) have suggested that acquired staphylococcal infections —as many as 80% of them according to Gould (1957)—might result from autoinfection. Williams et al. (1959) proved that " patients who were or became nasal carriers of staphylococci had three times as much staphylococcal sepsis as those who were never carriers ". Further, it appeared " that self-infection is important in the ætiology of the septic lesions ". In a study of postoperative surgical infections in tuberculous patients subjected to elective chest surgery, Weinstein (1959) reported that, of patients with positive nose-cultures for *Staph. aureus*, 37% exhibited postoperative infected complications, whereas

TABLE III—RECOLONISATION OF NASAL MUCOSÆ WITH *Staph. aureus* AFTER SUCCESSFUL TREATMENT

Preparation	Number of patients	Number recolonised	Average time of recolonisation after cessation of treatment (days)
Soframycin spray with vasoconstrictor ..	20	10 (*50%*)	14
Soframycin ointment ..	18	10 (*55%*)	7
Chlorhexidine-neomycin spray	15	8 (*55%*)	2
Naseptin ointment (chlorhexidine-neomycin)	9	4 (*44%*)	2
Neomyxin spray ..	10	5 (*50%*)	2

among the group with negative nose cultures, 11% had infected complications.

These findings suggest that the suppression of nasal carriage would be a useful measure before elective surgery, particularly in patients who are admitted to hospital some time before operation. Recent work by Gillespie et al. (1959) indicates, however, that the suppression of nasal carriage will not necessarily reduce the overall incidence of cross-infection in general hospitals. Environmental contamination can arise from primary reservoirs other than the nose—for example, the perineum (Hare and Ridley 1958), skin and clean infected wounds (Gillespie et al. 1959), all of which maintain the staphylococcal infection cycle. Silent nasal colonisation and the hazard of autoinfection inevitably follow. Nevertheless, any plan for effective reduction of staphylococcal disease in hospitals must be broadly based, and the suppression of nasal carriers by topical chemotherapy is only one of a number of measures which must be considered in the epidemiological control of this disease.

The present study was designed to provide information on an administratively simple and clinically effective treatment of nasal carriers in hospital. Thus, in comparing various preparations, it is only fair to state that we intentionally did not follow the manufacturer's directions if these were considered too complex for practical use. We were mainly concerned with discovering some preparation which could suppress nasal carriage in the shortest possible time. The test for suppression in this study was more rigorous than in most, since all observations were based on the deep swabbing technique (fig. 1). This method detected 17% more nasal carriers than swabbing the anterior nares (table I).

Soframycin spray was outstandingly the most successful preparation (table II). When a larger number of nasal carriers was treated, it was found that all carriers yielded negative cultures in forty-eight hours—that is, after two applications of the spray (fig. 2). Furthermore, it appeared that clearance of nasal staphylococci by soframycin was more complete than by other methods of treatment, since recolonisation of the mucosæ was significantly slower (table III). The success of soframycin spray is attributable largely to its bactericidal action. Experiments, not reported here, showed that soframycin killed *Staph. aureus*, resistant to many antibiotics, in less than a minute in the presence of 50% serum.

This work is now being extended to determine whether intermittent use of soframycin spray will decrease the nasal-carriage rate, and thus indirectly lower the environmental contamination. We hope that this proposed extension of the present study will provide a basis for control of the nasal carrier which does not impose too many demands on the nurses.

Summary

The treatment of the nasal carrier of *Staphylococcus aureus* by chemotherapeutic agents was investigated. The emphasis in this study was on the rate of clearance as well as the success after seven days' treatment.

The results indicate that, in general, atomised spray preparations are more effective than the corresponding ointments.

Of the preparations compared, 'Soframycin' spray, containing framycetin and gramicidin as antibacterial agents, was the most effective. With this spray, approximately 80% of nasal carriers were cleared in twenty-four hours (that is, by one application only), and 100% after two days' treatment.

The importance of deep nasal swabbing for detecting nasal carriers has been demonstrated.

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SCARLET-FEVER-LIKE ILLNESS DUE TO STAPHYLOCOCCAL INFECTION

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AN illness resembling scarlet fever, but caused by *Staphylococcus pyogenes*, has been described on several occasions (Stevens 1927, Mackenzie 1934, Zinsser et al. 1939, Aranow and Wood 1942, Negro et al. 1956). We report three more cases.

Case-reports

Case 1.—A woman, aged 20, was admitted on Nov. 26, 1942, with the provisional diagnosis of scarlet fever. Six days before admission, she had a left axillary abscess; and, on the day of admission, a scarlatiniform rash appeared on the neck, trunk, and limbs. There was a history of measles, rubella, and pertussis in childhood, but of no other specific infections. The temperature was 102°F, pulse-rate 118. There was a large abscess in the left axilla. The fauces were mildly injected, but there was no exudate.

Investigations.—Culture of pus from the abscess gave a pure growth of *Staph. aureus*. The hæmolytic streptococcus was not isolated from repeated nose and throat swabs. The total white-cell count was 16,000, with a neutrophil leucocytosis.

Treatment.—The abscess was incised, and 20 ml. scarlatinal antitoxin was administered intramuscularly. A course of sulphanilamide, totalling 21 g., was given.

Progress.—The pyrexia subsided on the sixth day. The tongue peeled and the rash faded on the third day; thereafter, desquamation began, particularly on the palms and soles. When discharged on Dec. 17, the soles were still peeling.

Case 2.—A woman, aged 21, was admitted on Feb. 12, 1958, with a provisional diagnosis of septic abortion. Three days before admission, there had been vaginal blood-loss with diarrhœa and vomiting. Two days later, the patient aborted. A rash appeared on the trunk on the day of admission. There had been two normal pregnancies, but no previous miscarriages. The last menstrual period had been three months previously; the patient had suffered from nausea and vomiting, and had not felt really well during the pregnancy. There was a past history of measles only and there had been no contact with recent infectious disease.

The patient looked ill and toxic. There was a bright erythema on the trunk and limbs. The fauces and buccal mucosa were red, but there was no exudate. Several small cervical lymph-nodes were palpable. The blood-pressure was 100/70 mm. Hg. The size of the uterus corresponded to three months' pregnancy. Offensive placental fragments protruded through the os.