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Staphylococcal nasal carriage in mothers, babies and staff in a maternity hospital

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INTRODUCTION

The endemic nature of staphylococcal infection is well demonstrated in small, closed communities. As stated by Elek (1958), hospitals and maternity units provide the best opportunities for studies on this subject. Rountree & Barbour (1951) have shown the effect of the hospital environment on the nasal carriage of a group of nurses, while Cunliffe (1949) has studied the rapid rate of colonization of the anterior nares of infants in a maternity unit. Such units with antenatal and postnatal clinics provide a unique opportunity for more extended investigations involving both mother and child.

The present investigation was planned to provide information additional to that already available from numerous surveys conducted within maternity hospitals. By examining mothers prior to admission, during hospitalization, together with their infants, and after discharge at the postnatal clinics, it was hoped to provide specific evidence of the transfer of certain strains of staphylococci. The simultaneous examination of the hospital staff during this period would further define the hospital role in the dissemination of various phage-types and antibiotic resistant strains.

THE HOSPITAL

The investigation was carried out between the months of February and November 1959, at a city maternity hospital. The postnatal wards totalling 65 beds were located on the first floor. These beds were distributed amongst 16 rooms, 49 beds in 10 rooms for uncomplicated patients (maximum six beds, minimum three beds, five beds in one room for postoperative patients and 11 beds in an isolation wing, three rooms with three beds each and two single rooms. Two nurseries were available, one for babies immediately after delivery or if troublesome at night and the other for infected infants remaining after their mother's discharge.

The total number of nursing staff fluctuated around 120. There were six domestic staff on the postnatal floor, six resident medical officers and 28 visiting honorary medical officers. The nasal carriage rate was fairly constant being 37·5% for the month of June. The distribution of phage-types is shown in Table 1. The carrier rates for the different groups, i.e. nurses, domestics and medical officers, was found to be identical.

Some 9 months prior to the commencement of this survey the hospital had instituted several anti-staphylococcal measures. These may be enumerated as follows:

(1) Routine nasal swabbing of staff at least monthly.
(2) Treatment of carriers with a bactericidal spray.
(3) Exclusion of carriers from vulnerable areas of the hospital.
(4) The immediate isolation of any patient with a suspicious lesion or an unexplained pyrexia.
(5) The rooming in of infants with their mothers.

The hospital staff were therefore extremely conscious of the hazards of staphylococcal infection and their complete co-operation was enjoyed throughout the investigation.

TECHNICAL METHODS

In order to reduce errors due to individual variation all swabbing and collection of clinical data was carried out by one member of the team (J. R. C.). Nasal cultures were taken by rubbing a cotton-wool swab moistened with nutrient broth around the anterior nares of each individual. Swabs were cultured on blood agar medium and after incubation suspicious colonies were tested for coagulase production by the slide technique of Cadness-Graves, Williams, Harper & Miles (1943). Positive colonies were transferred to nutrient broth for further investigation. The amount of growth was recorded as heavy, medium or light.

The antibiotic sensitivity pattern was determined by the plate-diffusion method using dried paper disks (Morley, 1945). Each stain was tested against penicillin, tetracycline, chloramphenicol, oxytetracycline and erythromycin and the results were recorded as sensitive or resistant.

Phage-typing was performed throughout by one of us (D. R. K.) using the technique of Williams & Rippon (1952). Each organism was tested for susceptibility to the following 26 phages:

Group I—29, 44, 52, 52A, 79, 80, 81
Group II—3A, 3B, 3C, 55
Group III—6, 7, 31B, 42E, 47, 47A, 47C, 47D, 53, 54, 70, 73, 75, 77
Group IV—42D

METHOD AND SCOPE OF SURVEY

Antenatal examinations

Each mother was interviewed at the 36th week of pregnancy when a nasal swab was taken and the following information relating to medical history recorded:

(*a*) Previous hospital admissions.
(*b*) Previous staphylococcal sepsis.
(*c*) Previous penicillin therapy.

No attempt was made to record a history of other antibiotic therapy since it was felt that this would not be obtained with accuracy.

The mother was next seen and swabbed at the 38th week of pregnancy and finally within 24 hr. after admission to hospital for delivery.

Postnatal examinations

The anterior nares of mother and infant were swabbed on the day of discharge from hospital. The average length of stay in the postnatal wards was 8 days, but the majority of normal patients left on the 6th day. At the time of discharge a note of the patient's ward was made so that a record of patient–patient and patient–staff contacts was available.

Mothers and babies were last seen at the 6-week postnatal clinic when the anterior nares of each were again swabbed. Each mother was asked whether she was breast feeding and whether there had been any sepsis in either herself or her infant. In cases with a history of sepsis the majority of lesions were either healed or under treatment from private doctors allowing but few cultures to be made. However, as will be seen later, the correlation between staphylococcal carriage and sepsis is so good that the greater part of sepsis reported was, in all probability, staphylococcal.

A total of 800 mothers was admitted to the survey, but for various reasons (mainly non-attendance at the postnatal clinic), only 407 completed the survey as outlined above. The remaining 393 were not included in the tabulated results but were noted as contacts of those from whom the results were compiled. In addition, 570 patients were admitted to the hospital without having attended the antenatal clinic. These were swabbed once on admission and their staff and patient contacts noted.

RESULTS

Nasal carriage rate of mothers prior to admission

Of the 407 mothers included in the survey 38·8 % were found to be nasal carriers of coagulase positive staphylococci before admission to hospital. The distribution of phage-types is shown in Table 1. Nine mothers carried more than one phage-type. Seven carried a group I and a group III strain, one carried a group I and a non-typable strain and one carried a group I and a group II strain.

Penicillin sensitivity of maternal strains prior to admission

Of the strains isolated from mothers prior to admission 40 % were resistant to penicillin. This figure may be compared with a resistance rate of 72 % for nurses' strains isolated during the same period.

The intermittent carrier

Of the 168 mothers recorded as carriers, 41 (26 %) actually gave a negative nasal swab on admission to hospital. These were considered to be carriers since swabs prior to and subsequent to admission both gave a coagulase positive staphylococcus of identical phage and antibiotic sensitivity type, and in many cases the infant also became a carrier of this strain. These cases undoubtedly belong to the class of intermittent carriers described by Gould & McKillop (1954). A population

was divided into three groups by these workers; the staphylococcal carriers, the non-carriers and the intermittent carriers. We would further subdivide the last category into two: the true intermittent carrier in whom a different organism is carried from time to time and the carrier who for unknown reasons gives a negative nasal swab from time to time but whose carried organism is always of the same type.

Table 1. *Phage distribution of strains carried by mothers and nurses*

	Group I	Group II	Group III	Group IV	NT	Total
Mothers						
Sensitive to penicillin	31	21	23	2	23	100
Resistant to penicillin	35	11	15	0	7	68
Total	66	32	38	2	30	168
Nurses						
Sensitive to penicillin	4	3	4	1	5	17
Resistant to penicillin	25	1	8	0	9	43
Total	29	4	12	1	14	60

Table 2

	Carriers	Non-carriers	Total
History of hospital admission within 12 months	32	36	68
No history of hospital admission in this time	127	199	326
Total	159	235	394

It appeared that a single nasal swab taken in a series of this nature would miss at least a quarter of the positive cases and it was decided to apply a correction factor of 25% to all carrier rates compiled from a single swabbing. While this assumes that the missed positive percentage remains constant (which it almost certainly does not) it probably presents a more accurate picture of nasal carriage than the uncorrected figure. Both the corrected and uncorrected figures are given beneath each table for purposes of comparison with the work of others. An examination of serial cultures from intermittent carriers showed that there was no relationship between density of growth on the plate obtained prior to the negative culture and the detection or non-detection of coagulase positive staphylococci in subsequent cultures. Similarly, there appeared to be no relationship between phage-type or penicillin sensitivity and the phenomenon of intermittent carriage.

Nasal carriage and previous hospital admission.

A comparison of carriers and non-carriers with and without a history of hospital admission in the previous 12 months showed that there was no significant increase in the carrier rate in those patients with a history of previous hospital admission (Table 2).

An examination of phage-types in those carriers with a history of hospital admission showed no significant deviation from the distribution for the whole group.

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Nasal carriage, previous staphylococcal sepsis and penicillin therapy

There was no relationship between carriage or non-carriage and a history of previous staphylococcal sepsis (Table 3).

Similarly, a comparison of the carriage of penicillin resistant strains with a history of penicillin therapy showed no significant relationship (Table 4).

Many of the mothers in the series were Europeans who spoke little English. The totals in Tables 2–4 are all less than the number of mothers seen because of the difficulty in obtaining a precise answer to each question.

Table 3

	Carriers	Non-carriers	Total
Previous staphylococcal sepsis	70	86	156
No previous staphylococcal sepsis	84	142	226
Total	154	228	382

Table 4

	Carriers of resistant strains	Carriers of non-resistant strains	Total
History of penicillin	36	50	86
No history of penicillin	29	40	69
Total	65	90	155

The nasal carriage of staphylococci in mothers included in this survey therefore appeared uninfluenced by previous admission to hospital, by previous staphylococcal sepsis or by previous penicillin therapy. These strains therefore seemed to be passively carried and to be truly representative of organisms carried by the non-hospital community. The important differences between the hospital and non-hospital organisims lay in the proportion of group II strains and the penicillin resistance rate. Group II organisms formed 19% of the non-hospital staphylococci, but only 7% of the hospital strains. The penicillin resistance rate was 40% for non-hospital strains, but 72% for the hospital group. The increase in resistance rate was 62% for group I, 65% for group III but 178% for the non-typable organisms. This suggests that as an organism becomes resistant to the action of antibiotics it may also become resistant to the action of phage (Gould, 1955; Harrison, Beavon & Griffin, 1959). There were only 13 organisms showing resistance to three or more antibiotics and the distribution between mothers and staff was similar.

Acquisition of strains by mothers in hospital

The distribution of strains acquired by mothers in hospital is shown in Table 5.

Strains carried by mothers on discharge from hospital

The strains carried on discharge are shown in Table 6.

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Strains carried by mothers at postnatal visit.

The distribution of these strains is shown in Table 7.

The continued rise in the carrier rate after discharge and the rise in resistance rate was considered to represent the transfer of hospital strains carried by babies to their mothers. There appeared to be a tendency for mothers to preferentially acquire sensitive strains (Table 5).

Table 5. *Strains acquired by mothers in hospital*

(Penicillin resistance rate = 30 %.)

	Group I	Group II	Group III	Group IV	NT	Total
Sensitive to penicillin	8	3	3	1	6	21
Resistant to penicillin	3	1	3	0	2	9
Total	11	4	6	1	8	30

Table 6. *Strains carried by mothers on discharge*

(Carrier rate 40 %, corrected carrier rate 53 %. Penicillin resistance rate = 38 %.)

	Group I	Group II	Group III	Group IV	NT	Total
Sensitive to penicillin	33	25	18	3	22	101
Resistant to penicillin	29	8	16	0	9	62
Total	62	33	34	3	31	163

Table 7. *Strains carried by mothers at postnatal visit*

(Carrier rate 47 %, corrected carrier rate 63 %. Penicillin resistance rate = 42 %.)

	Group I	Group II	Group III	Group IV	NT	Total
Sensitive to penicillin	25	27	27	3	29	111
Resistant to penicillin	40	10	21	1	10	82
Total	65	37	48	4	39	193

Table 8. *Strains acquired by babies in hospital*

(Carrier rate 36 %, corrected carrier rate 48 %. Penicillin resistant rate for strains acquired from mothers 40 %, for strains acquired from staff 54 %, and for total 49 %.)

	Group I	Group II	Group III	Group IV	NT	Total
Strains acquired from own mother						
Sensitive to penicillin	9	9	7	0	6	31
Resistant to penicillin	10	5	3	0	2	20
Total	19	14	10	0	8	51
Strains acquired from other than mother						
Sensitive to penicillin	14	6	12	2	9	43
Resistant to penicillin	31	1	12	0	7	51
Total	45	7	24	2	16	94
Grand total	64	21	34	2	24	145

Strains acquired by babies in hospital.

Fifty-one mothers who were carrying a pathogenic staphylococcus on admission transferred the strain whilst in hospital to their infant and both mother and child were carrying this organism on discharge. The distribution of strains acquired by babies from their mothers is shown in Table 8. This distribution with respect to both phage-type and antibiotic sensitivity is the same as that shown by maternal strains. Babies showed no selection for any phage-group or sensitivity pattern.

In cases where a strain was acquired from sources other than the mother, the mother was either a non-carrier or carried a strain of different phage-type. In these cases 55 % of the strains came from other mothers and 45 % from hospital staff.

This was calculated as follows:

Let x % have come from mothers.

Then $100-x$ % has come from staff.

$$\frac{x}{100}\times 94 = \text{number of babies infected by mothers.}$$

$$\frac{40}{100}\times\frac{x}{100}\times 94 = \text{number of babies infected by mothers carrying a strain resistant to penicillin.}$$

Similarly:

$$\frac{72}{100}\times\frac{100-x}{100}\times 94 = \text{number of babies infected by staff carrying a strain resistant to penicillin.}$$

51 babies carried a strain resistant to penicillin. Therefore

$$\frac{40}{100}\times\frac{x}{100}\times 94+\frac{72}{100}\times\frac{100-x}{100}\times 94 = 51,\ x = 55\,\%.$$

The justification for this calculation rests on two facts: (1) The stable differences in penicillin sensitivity between mothers and staff. (2) The acceptance by a baby of any strain presented to it without discrimination.

The number of strains carried by babies on discharge coming from non-hospital sources equals $51 + 55$ % of $94 = 103$ and the number from hospital sources equals 45 % of $94 = 42$. The sources of staphylococci taken home by babies:

(i) 35 % from baby's own mother;
(ii) 36 % from other mothers;
(iii) 29 % from hospital staff.

Even after application of the correction factor the adjusted carrier rate of 48 % is still substantially less than that reported by other investigators (Cunliffe, 1949), who have observed carrier rates approaching 100 % at the end of the first week.

Postnatal carriage of staphylococci by babies

The distribution of strains carried by babies at the 6-week postnatal examination is shown in Table 9.

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Some infants who were carriers on discharge from hospital appeared to have lost their strain during the postnatal period, while others who had been negative acquired strains during this 6 weeks. The continued acquisition by babies of mothers' strains explains the rise in carrier rate from 48 % to 55 %. The possibility that this greater susceptibility of neonates may in part be due to the absence of other organisms from the anterior nares is discussed later.

Table 9. *Strains carried by babies at 6 weeks*

(Carrier rate 42 %, corrected carrier rate 55 %. Penicillin resistance rate = 50 %.)

	Group I	Group II	Group III	Group IV	NT	Total
Sensitive to penicillin	22	17	26	0	20	85
Resistant to penicillin	41	11	23	0	11	86
Total	63	28	49	0	31	171

Table 10 *Strains carried by mothers and babies at 6 weeks*

(Carrier rate 45 %, corrected carrier rate 60 %. Penicillin resistance rate = 46 %.)

	Group I	Group II	Group III	Group IV	NT	Total
Sensitive to penicillin	47	44	53	3	49	196
Resistant to penicillin	81	21	44	1	21	168
Total	128	65	97	4	70	364

Postnatal carriage of staphylococci by mothers and babies

The strains carried by mothers and babies at 6 weeks are shown in Table 10.

Thus from the community came 407 mothers with a nasal carriage rate of 40 % and with pathogenic staphylococci showing a penicillin resistance rate of 40 %. Back into the community went 815 individuals (406 single and one twin pregnancy) with a carrier rate of 60 % and pathogenic staphylococci showing a penicillin resistance rate of 46 %. It must be remembered that these figures are the result of a study carried out in a hospital where anti-staphylococcal measures were being vigorously prosecuted.

Staphylococcal sepsis amongst mothers and babies

Practically no staphylococcal sepsis occurred in hospital, but a considerable amount occurred after discharge and before the 6-week postnatal visit. Unfortunately, the majority of this was treated elsewhere and strains were not recovered for further study. However, the correlation between the carrier state and the occurrence of sepsis was so close, and in those cases in which the causative organism was isolated it proved to be the same as that carried in the nose, that in most cases the sepsis reported probably was staphylococcal and the organism carried in the nose the causative organism.

There were 23 cases of infection arising in babies whose mothers had been carriers throughout the survey. Eighteen infections occurred in babies who became nasal carriers whilst in hospital.

A further 18 infections occurred in mothers who were nasal carriers right through and six of these infections were breast abscesses. Two infections occurred in mothers who became nasal carriers. One of these was a breast abscess. The incidence of maternal breast abscess related to breast feeding and nasal carriage by the infant is shown in Table 11.

Table 11

	Breast abscess		No breast abscess			
	Group I	Group III	Group I	Group II	Group III	Group IV
Breast fed						
Baby carrier	2	1	49	21	29	27
Baby not carrier but mother carrying	2		79			
Not breast fed						
Baby carrier	1	0	37	17	31	19
Baby not carrier but mother carrying	2		85			

Of the three cases of breast abscess in which the baby was a carrier, the strain was identical with that carried by the mother in two instances and different in one. This compares with 38 cases in which mother's strain was carried and no breast abscess developed and 62 cases in which a different strain was carried and no breast abscess developed. Eight breast abscesses occurred during the survey, all after discharge from hospital. In seven of the eight cases the infecting phage-type was 80/81, and in six cases the strain was resistant to penicillin. The eighth case was typed as 6/47/54 and was sensitive to penicillin. Six of the eight mothers entered hospital as nasal carriers of the strain which ultimately infected them and in only two cases did the infant acquire a hospital strain and infect its mother's breast. In four cases the baby carried the causal organism in its nose but in four the baby was a non-carrier on both occasions. In five cases the babe was breast fed and in three it was bottle fed.

The transmissibility of certain strains

There were thirty-one instances of mothers who were persistent carriers and whose babies were negative on both occasions. The distribution of these mothers' strains was similar to that for the total strains being carried suggesting that one phage-type is no more difficult to transmit than another.

Heavy nasal carriers did not appear more likely to transmit infection than slight or moderate carriers. This, together with the fact that heavy carriers are just as likely to be missed at subsequent swabbings as light or moderate carriers, makes it misleading to report on the density of growth from positive nasal cultures.

There were only ten examples in which mother and baby maintained distinct strains throughout 6 weeks. The smallness of this number makes it appear that the displacement of one strain from a baby's nose and its replacement by another does not depend upon the strains involved but probably upon some other factor.

Mode of transmission of strains

It was possible through the nurses' roster-book to trace all staff who had come into contact with infants during their stay in hospital. With many of the common phage patterns (80/81) it was not possible to pinpoint the source of infection, but with the more unusual patterns an attempt was made to do this. There were thirty-four such organisms apparently arising from single sources. One resident medical officer carried a phage type 47D, resistant to penicillin, for 7 months. During this time no patients were admitted with this phage-type but six babies were discharged carrying the organism. In one of these six cases no direct contact could be proved but in four cases the medical officer concerned delivered the baby and in one case he was the ward doctor.

A nursing sister carried a strain typed as 79 (weak), resistant to penicillin, and five babies were discharged carrying this organism. In two other instances a nurse who delivered a baby and a ward nurse carried infecting strains. In five cases a patient in the same ward infected an infant; in three cases no source could be found and in the remaining 13 cases, although the same phage-type existed amongst the nursing staff no direct contact could be demonstrated.

Several of the patient-transfers were of particular interest. One patient was admitted to hospital carrying an organism of phage-type 70 sensitive to all antibiotics. A week after her discharge another mother and infant were admitted to the same ward and they both subsequently left hospital carrying this strain. A further infant was admitted to this ward 2 weeks later again, and this child was also discharged carrying the same strain. These were the only occasions on which this strain was isolated, and although it could not be isolated from either air or bedding it evidently persisted in this ward for 3 weeks.

Apart from transfer of mothers' strains to their own babies there were only 13 of these 31 cases (in which an identical pattern could be found), in which actual physical contact could be demonstrated. The other vectors are unknown. Removing a carrier from a ward reduces the risk to the patient but as long as the carrier remains in the hospital the risk continues.

SUMMARY OF RESULTS AND DISCUSSION

The nasal carriage of 407 mothers before, during and after admission to a maternity hospital and that of their babies during and after hospital stay was investigated together with the nasal carriage by the hospital staff.

The nasal carrier rate among mothers admitted to hospital was 38%, 40% of these strains being resistant to penicillin.

The nasal carrier rate among the nursing staff was 38 and 72% of these were resistant to penicillin.

If a population is swabbed only once approximately 25 % of the carriers will be missed. Those showing slight carriage were no more likely to be missed than those showing heavy carriage. The concentration of organisms in the nose is evidently varying continuously.

Heavy carriers are no more likely to transmit than light carriers and it is therefore not right to report on the profusion or otherwise of growth if that implies a greater chance of transmission.

The biggest increase in resistance among nursing staff strains occurred in the non-typable group which could be explained by resistance to phage developing concurrent with resistance to antibiotics.

The difference in phage-distribution between patient and staff strains centred in group II which formed 19 % of patient strains but only 7 % of hospital strains.

The carrier rate was no higher for those with a history of hospital admission within 12 months or without a history of staphylococcal sepsis.

Those giving a history of penicillin therapy had the same resistance rate as those without a history of such therapy.

Mothers picked up few new hospital strains and appeared to select sensitive ones. They acquired more strains from their babies so that at 6 weeks the corrected carrier rate was 60 % and the resistance rate for penicillin 42 %.

Babies appeared to pick up strains according to their concentration in the environment and without relation to phage-type or sensitivity. The corrected carrier rate at discharge was 48 % which compares very favourably with 90–100 % at the end of the first week reported by many workers.

The sources of the babies' strains were: 35 % from baby's own mother, 36 % from other mothers and 29 % from nursing staff. The penicillin resistance rate for babies' strains was 49 %. By 6 weeks the carrier rate had risen to 55 % and the penicillin resistance rate was 50 %.

The pre-admission population consisted of 407 individuals, 40 % of them were carriers and 17 % of them were carriers of strains resistant to penicillin. The population, 6 weeks after hospital discharge, consisted of 815 individuals, 60 % of whom were carriers and 28 % carriers of strains resistant to penicillin.

It is evident that within 12 months the carrier rate has dropped to that of the general community, but in the meantime it is to be expected that the antibiotic resistance rate in the general community will have been raised, but it will be seen that those carrying resistant strains are passive carriers and are not cases of carriers whose carried strain has been rendered resistant by penicillin therapy.

Strains belonging to any particular phage-group are not more easily transmitted than another and no particular phage-group is more readily displaced than another. Nasal colonization is probably determined by the patients changing physiology, the nasal oecology, but on the part of the invading organism chance is probably the dominant factor.

Direct contact as the mode of transfer could be shown in only 40 % of cases. What vectors transmitted the other 60 % it is not possible to tell.

There was practically no staphylococcal sepsis in hospital during the survey but of 57 cases of sepsis occurring in the 6 weeks after discharge 39 cases were referable

to mothers who had been carriers right through and only 18 to strains acquired in hospital. Of eight breast abscesses six were caused by strains carried by mothers before admission and only two by strains acquired in hospital. The causative organism was typed as 80/81 in seven cases. In four cases only was the baby a nasal carrier. In a population in which the carrier rate in babies is low (50%) transfer from mother's nose to nipple is just as important as transfer from baby's nose to nipple.

CONCLUSIONS

(1) The anterior nares is the reservoir of pathogenic staphylococci and attempts must be intensified to discover a satisfactory method of clearing nasal carriers. The fact that the carrier rate among nurses under constant supervision and treatment was the same as the carrier rate in mothers suggests that approximately 35% of any given population are predisposed in some unknown way to be staphylococcal carriers and will therefore thwart attempts to reduce the carrier rate below this figure. An account of the organisms occurring in swabs containing a coagulase positive staphylococcus was kept and also the organisms occurring in a similar number of swabs not containing a coagulase positive staphylococcus. An antagonism with most organisms was obvious but it was particular apparent with coagulase negative staphylococci. Also Lepper, Jackson & Dowling (1955) found that girls who were carrying coagulase negative staphylococci when they commenced training as nurses were less likely to become carriers of coagulase positive staphylococci than those who were not carrying any sort of staphylococcus when they began training.

Work is in progress here attempting to clear nasal carriers by use of nasal spray, followed by re-introduction of coagulase negative staphylococci. Later it is hoped to put a coagulase negative staphylococcus in the noses of the newborn in the hope of preventing them from becoming carriers of pathogenic strains.

(2) In only 40% of cases could direct contact as mode of transfer be proved. It follows then that all persons in a hospital must be swabbed routinely and carriers treated as rigorously as present knowledge allows. It does not matter where in a hospital carriers work; they are a potential danger.

(3) As more attention is paid to infection originating within the hospital, so the proportion of infections originating outside the hospital becomes greater. It would be prudent to swab each mother before entering hospital, say at 38 weeks. A report would be at hand by the time of admission and treatment could be carried out during hospital stay. Another swab could be taken from mother and babe at discharge and the patients brought back 3–4 days later for the report. Further treatment could then be given. Mothers carrying phage type 80/81, or having babies carrying 80/81, are particularly at risk for breast abscess. The risk (8%) is not high enough to warrant cessation of breast feeding, but a mother could be warned to report early should soreness develop and an antibiotic sensitivity test would be on hand before treatment was begun.

(4) It may be possible to separate mothers who are carriers from those who are not and nurse them with nurses who have been carriers. Although this would not entirely eliminate risk to non-carrying mothers it should reduce it.

(5) Antibiotics must be given with discretion as even in a hospital such as this, where great care is being exercised, it is none the less exerting a powerful influence towards an increase in penicillin resistance in the community.

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