one another, and in particular to protect newly admitted patients from exposure to those who have been in hospital long enough to acquire hospital staphylococci.

Summary

The natural history of staphylococcal infection was studied in three male surgical wards, in two of which an attempt was made to isolate all patients known to carry or be infected with tetracycline-resistant staphylococci. One of the wards was provided with four exhaust-ventilated cubicles for isolation purposes.

The introduction of cotton blankets, washed at frequent intervals, into one of the wards had no detectable effect.

Patients who acquired staphylococci in their nose during their stay in hospital developed staphylococcal sepsis more than five times as often as those who did not. In most cases the nasal colonization preceded the sepsis. The patients who acquired staphylococci also had a higher incidence of non-staphylococcal sepsis, but this appeared to be associated with prolonged stay in hospital.

The post-operative sepsis rates were compared in patients having operations performed with comparable frequency in one of the isolation wards, and in the non-isolation ward. The rates were 2.7 and 6.1% respectively; the difference of 3.4% does not reach the level of statistical significance.

Patients in the isolation wards became nasal carriers of tetracycline-resistant staphylococci more slowly than those in the non-isolation ward.

There was some evidence that epidemic spread of staphylococci was less in the isolation wards than in the non-isolation ward.

When individual sources of infection were considered, it was found that nasal carriers were almost as important in generating cross-infection as patients with septic lesions. When all patients known to be sources of infection in the ward were isolated the incidence of cross-infection was apparently reduced. The exact magnitude of the reduction is difficult to determine because of the almost certain presence of undetected sources of infection in the ward.

The limitations of any study of this sort based on three wards is stressed, but, taken at their face value, the results suggest that the isolation policy might have reduced the sepsis rate by about one-half. The demonstrable importance of nasal carriers as sources of cross-infection implies that such an isolation policy can be applied only if continuous bacteriological surveillance is available. Since this is seldom practicable, the conclusion is reached that, to prevent the transfer of staphylococcal infection, hospitals need to be constructed so as to isolate as many patients as possible from one another.

For permission to study their patients, we are grateful to our surgical colleagues, Mr. C. Naunton Morgan, Mr. D. F. Ellison Nash, Mr. A. W. Badenoch, Mr. I. P. Todd, and Sir James Paterson Ross, Bt. Our thanks are also due to the sisters and nursing staff of the wards; to the Treasurer and Governors of St. Bartholomew's Hospital for the construction of the cubicles, and to Mr. John Weeks for help in their design; to the Medical Research Council for a grant for scientific assistance; and to Miss Olive Duke and Miss Susan Green, B.Sc., for assistance in the laboratory.

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SPREAD OF A MARKER ORGANISM IN A HOSPITAL WARD

BY

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In an earlier study (Rubbo, Pressley, Stratford, and Dixson, 1960) it was suggested that air-borne bacteria were dispersed in hospital wards either as free organisms or in association with fibre nuclei arising from personal clothing or bedclothing The present study is a continuation of this work. Here an attempt has been made to follow the spread of a marker organism in a hospital ward when its source, time of entry, and concentration in the ward are known. These conditions were met by introducing *Staphylococcus citreus* into a bacteriologically clean ward and subsequently tracing its movement in that ward over a period of two days. In this way it was possible to compare the degree of environmental contamination which may arise when different types of textiles act as reservoirs of infection. At the same time the dispersion of naturally introduced *Staph. aureus* was followed, and it was found that the movement of this organism closely paralleled that of the marker organism.

The main points which emerge from the present study are: (1) contaminated woollen blankets do not disperse organisms more freely than similarly contaminated cotton blankets; (2) contaminated blankets, either woollen or cotton, disperse their organisms most effectively when covered by cotton counterpanes (quilt or bed-covers); and (3) the degree of airborne contamination of textiles depends largely on the presence of counterpanes and the manner in which they are handled.

Materials and Methods

Marker Organism

Staph. citreus was selected as a marker organism for several reasons. First, the background count arising from sources other than those produced experimentally was extremely low and could be disregarded in all calculations. Secondly, the same selective medium could be used for *Staph. aureus* and *Staph. citreus*; thus the differentiation of the two species on pigmentation was not difficult. Thirdly, the survival time of *Staph. citreus* was quite adequate to cover the two-day period of our ward experiments. Finally, it was innocuous to patients and laboratory personnel.

A saline suspension of the organism was prepared from overnight nutrient agar cultures, the turbidity of which was adjusted to give 10^8 viable units per ml. Freshly made suspensions were used to contaminate laundry-clean textiles and were applied as a finely atomized spray ejected by compressed air from an all-glass atomizer. The textile, which was sprayed in a building physically separated from the experimental ward, was dried at 37° C. for half to one hour. The dry contaminated material (later referred to as "donor textile") was transferred carefully to the ward for use on a patient's bed.

The inoculum for each ward experiment was measured by volume; it varied, depending on whether one or two textiles were contaminated, from 30 to 60 ml. of the 10^8 suspension of *Staph. citreus*.

A standard medium was used throughout and consisted of 8% sodium chloride papain digest agar containing 1% maltose and 1% neopeptone. On this medium (salt agar for short) good differentiation between *citreus* and *aureus* species was obtained after 48 hours' incubation at 37° C. followed by 48 hours on the bench, preferably in sunlight.

Sampling Technique

All samples were collected by the contact-plate method previously described (Rubbo and Dixson, 1960). The larger textiles, counterpanes and blankets, were sampled at nine sites (in the case of the former, on both surfaces) using one salt-agar plate for three sites. Pillow-cases, which were nearly always heavily contaminated, were sampled at one site only. In all, 10 contact plates per bed were used for each sampling before, and 3 hours, 24 hours, and 48 hours after, the introduction of the marker organism. Thus in each experiment three textiles from ten beds were sampled, requiring at least 400 plates of salt-agar medium. The sampling sites are shown in Fig. 1.

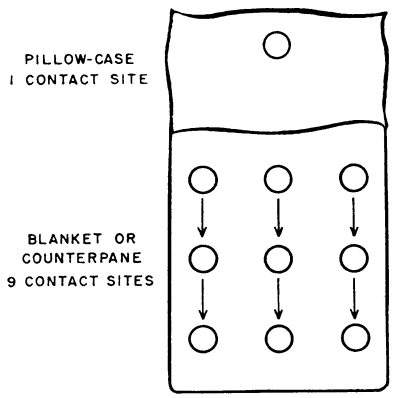

FIG. 1.—Sites of sampling textiles by contact plates.

In addition, in the early part of this work contact plates were taken from various sites on nurses' uniforms and settle plates, and slit-air sampler plates were also used for air samplings.

Textiles

The woollen blankets used consisted of 70% wool weft and 30% cotton warp except in the experiment in which no counterpanes were used, when 100% woollen blankets were substituted. The cotton blankets were made up of terry towelling, and the counterpanes were cotton quilts.

Ward Routine

A twenty-bed female surgical ward having a total air space of 11,655 cu. ft. (330 cu. m.) was put at our disposal, one-half of which (beds 1 to 10, Fig. 2) was used in the present study. The ward had a ceiling height of 15 ft. (4.6 m.), with balconies on either side, one of which was glassed in. The other balcony provided open-window ventilation. The ward, which was divided by a glass partition 7 ft. (2.1 m.) high, had recently been modernized and repainted. The beds were set approximately 4 ft. (1.2 m.) apart and were occupied by unselected female surgical cases. As this work extended over many months there was a continual turnover of patients, but no changes in nursing management were sought. Visitors were allowed every evening.

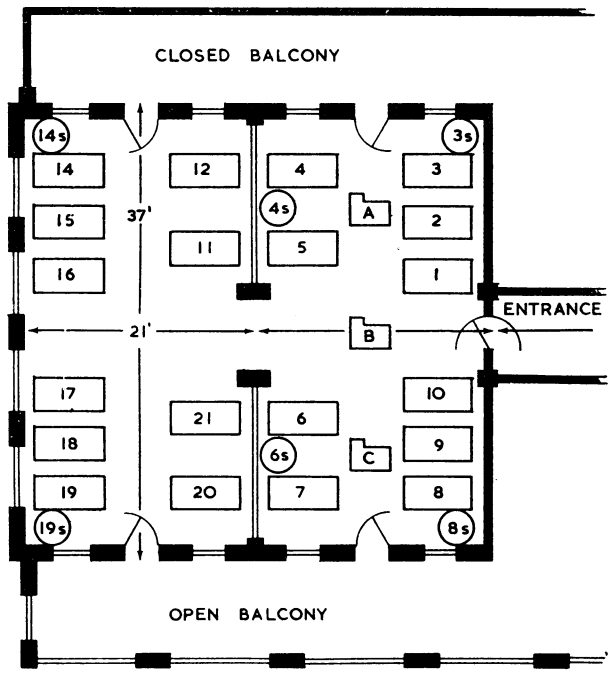

FIG. 2.—Plan of ward. Experimentally contaminated textiles placed on bed 6 or beds 6 and 8. A, B, and C are positions for air sampling by slit sampler; "s" denotes positions for settle plates.

The ward was cleaned by the conventional sweeping, wet mopping, and electric polishing methods. Every evening the counterpanes were removed from the beds and folded, leaving the top blanket exposed to the ward air.

In collaboration with the nursing staff a standard procedure was developed for the conduct of each ward experiment. At 8 o'clock on a Monday morning all bed-linen in the ward was removed and replaced with freshly laundered pillow-cases, blankets, sheets, and cotton counterpanes. Contact-plate samples were taken about 8.30 a.m., before the donor textile carrying a known inoculum of *Staph. citreus* was introduced. About 9 a.m. either one or two donor textiles were placed on one or two beds—namely, bed 6 or beds 6 and 8 (see Fig. 2). In the beginning the nurses were not told which of the textiles were artificially contaminated, but soon our method was obvious. All textiles were tagged with a coloured cloth so that they would not be reversed or inverted during the experiment. Apart from the initial upheaval of setting up an experiment, the ward work proceeded as usual.

At the termination of the experiment the ward was decontaminated by thrice-daily fogging for four days with 1/1,000 aqueous chlorhexidine ("hibitane" diacetate). On the following Monday a new experiment would be started. In all, 28 ward experiments have been carried out in the present study, a number being duplicate and sometimes triplicate experiments.

Presentation of Results

It will be obvious that a very large number of plate counts have been performed (approximately 14,000), and the problem of presenting these results in an acceptable form has been peculiarly difficult. It was decided that this could best be done by expressing the plate counts for *Staph. citreus* as a "contamination index" (C.I. value) for each textile. The C.I. value can be defined as the number of *Staph. citreus* colonies which would have been isolated if 1 sq. ft. (0.09 sq. m.) of the textile had been sampled by the contact-plate method when an inoculum of 10^9 viable units was introduced in the ward. In order to explain the calculation of the C.I. value, the following example may be given. Average *Staph. citreus* count for a blanket (9 contact plates)=12. Surface area of blanket sampled (9 contact plates)=0.57 per sq. ft. Number of *Staph. citreus* used as ward inoculum $=4\times10^9$. C.I. value for blanket $=\frac{12\times1.8}{4}=5.4$.

The reasons for offering a C.I. value as an index of textile contamination are several. In the first place, it allowed us to compare plate counts in the separate ward experiments by correcting for two factors which would affect those counts—namely, the surface area of textile sampled and the size of the ward inoculum used. Further condensation of the results was reached by expressing the C.I. value for a textile as an average of the C.I. values for that textile from all beds in the ward, except those carrying the donor textiles. In this way a very large number of counts was reduced to easily recordable figures.

There were, of course, many other factors over which we had no control and which could affect the counts. For example, the movement of patients in and out of beds, the method of bed-making by different nurses, the variations in ventilation, and so on. However, the results showed unmistakable trends, and it is from these trends that we draw our main conclusions.

Results

It was stated earlier that the natural contamination of textiles by *Staph. citreus* would not affect the interpretations of the *citreus* counts when this organism was artificially introduced into the ward. This did not mean that *Staph. citreus* could not be isolated as a contaminant, but rather that the natural background count was so low—less than 10% of the experimental counts—that its presence could be ignored. This is shown in Table I. Accordingly, the C.I. values in all experiments have been interpreted as representing counts of the marker strain.

Before proceeding to a detailed analysis of our results, two observations of general interest should be briefly mentioned. The first is concerned with the rate, and the second with the extent, of ward contamination when different textiles serve as reservoirs of the marker organism. In Table II we have extracted data from four separate experiments to illustrate how rapidly bed-linen in a ward becomes contaminated after introduction of the organism into a ward. For evidence of contamination we have taken the recovery of *Staph. citreus* from counterpanes and recorded a positive result if a *citreus* count greater than that equivalent to 25 colonies per square foot of surface area was obtained. This standard automatically eliminated the chance of recording a false positive due to naturally occurring *Staph. citreus* (Table I). The results show the rapid and widespread dissemination of the organism from the donor materials to almost all beds in the ward within three hours of its introduction.

TABLE I.—*Staph. citreus Counts in Normal and Experimental Wards*

Textile Sampled	No. Sampled	*Staph. citreus* per Square Foot After					
		Normal	3 Hours Experimental*	N/E	Normal	24 Hours Experimental*	N/E
Pillow-cases	8	6	53	11·3%	2	120	1·7%
Counterpanes	8	2	19	10·5%	2	52	3·8%
Blankets ..	8	0	3	<1%	2	17	11·8%

* Average of three experiments using two donor textiles covered with counterpanes.
N/E=Normal background count expressed as a percentage of the experimental count.

TABLE II.—*Rate of Contamination by Staph. citreus After its Introduction into the Ward*

Source of *Staph. citreus*	No. of Counterpanes from 8 Beds showing Evidence of Contamination (More than 25 Colonies per Sq. Ft.) After	
	3 Hours	24 Hours
2 counterpanes	8/8 (100%)	8/8
2 woollen blankets ..	5/8	8/8
2 cotton blankets ..	6/8	7/8

Apart from revealing the speed of ward contamination, Table II amply illustrates its extent—namely, that the organism was recoverable from all but one counterpane 24 hours after its entry into the ward.

The movement of the marker organism can be shown in another manner from the same experimental data. In Table III we have recorded an average of the combined C.I. values for counterpanes, pillow-cases, and blankets on two beds in the ward, one (bed 7) 4 ft. (1.2 m.) and the other (bed 3) 21 ft. (6.4 m.) from a donor bed. In general there is a noticeable gradient in the degree of contamination shown by the two beds, which must be attributed to aerial dilution of the marker organism. In spite of this, one or more of the textiles on the remotely placed bed was contaminated in three hours.

TABLE III.—*Degree of Contamination by Staph. citreus of Beds Adjacent to and Remote from Source*

Source of *Staph. citreus*	Combined Average C.I. Values (3 Textiles from Each Bed) After			
	3 Hours		24 Hours	
	Adiacent Bed. 4 ft. (1·2 m.)	Remote Bed. 21 ft. (6·4 m.)	Adiacent Bed. 4 ft.	Remote Bed. 21 ft.
2 counterpanes, beds 6 and 8	4·1	3·7	16·3	11·4
2 woollen blankets, beds 6 and 8	7·5	2·1	33·4	2·7
2 cotton blankets, beds 6 and 8	4·5	1·4	27·6	4·0

All donor blankets were covered with clean counterpanes.

The results also show that woollen and cotton blankets and counterpanes are all equally effective in dispersing the marker organism. In all instances it was concluded that the dispersion was predominantly air-borne, a view which was supported by the isolation of the organism from inaccessible cross-straps at the back of the nurses' uniforms and by extensive air sampling (Table IV).

Although it is evident from the foregoing experiments that ward contamination is extensive irrespective of the nature of the textile reservoir, the number of organisms delivered to a bed varied considerably, depending on whether the source (or donor) textile was or was not

TABLE IV.—*Isolation of Staph. citreus from Ward Air*

Sampling Technique	Source of *Staph. citreus*	Average No. *Staph. citreus* from Ward Air
Slit air-sampler (Casella). Av. 9 samples taken in positions A, B, and C (Fig. 2)	Two counterpanes	At 3 hours. 5·5 per 10 cu. ft. (0·28 cu. m.) air At 24 hours. 8 per 10 cu. ft. air At 48 hours. 7·5 per 10 cu. ft. air
Settle plates. Av. 20 settle plates, exposed for 24 hours at 4 positions (see Fig. 2), 35, 45, 65, and 85	One woollen blanket	0–24 hours. 2·5 per plate (=39 sq. ft.: 420 sq. m.) 24–48 hours. 6 per plate (=94 sq. ft.: 1,000 sq. m.)

covered with a clean cotton counterpane. For example, it will be seen (Table V) that the overall picture of ward contamination is not greatly different when the organisms are introduced on either woollen or cotton blankets. The C.I. values for each textile from the eight test beds showed a progressive increase with time. However, a striking and consistent difference in the degree of contamination was observed when the same donor textiles were compared with and without their covering counterpanes. As shown in Table V, every C.I. value determined at 24 and 48 hours after the introduction of the marker organism was significantly lower in the absence of the counterpanes.

TABLE V.—*Dispersion of Staph. citreus from Woollen and Cotton Blankets Acting as Donor Textile*

Source of *Staph. citreus*	C.I. Values for Each Textile (Average of 8 Beds) After								
	3 Hours			24 Hours			48 Hours		
	P	C	B	P	C	B	P	C	B
2 woollen blankets covered with clean counterpanes	10·0	4·4	0·6	20·0	6·8	6·1	40·0	21·9	7·4
2 woollen blankets not covered with counterpanes	3·0	2·3	1·7	2·0	1·1	0·5	20·0	1·9	0·8
2 cotton blankets covered with clean counterpanes	7·0	2·5	1·4	30·0	16·1	4·8	34·0	15·4	9·1
2 cotton blankets not covered with counterpanes	8·0	4·0	0·8	11·0	7·3	2·1	11·0	8·7	2·6

P = Pillow-cases. C = Counterpanes. B = Blankets.

This is also well shown in Fig. 3, which has been derived by plotting the average C.I. value for all samples taken at 3, 24, and 48 hours in each experiment.

This unexpected observation was further investigated by comparing C.I. values in the ward when all beds were covered by counterpanes, including the donor textiles, with those when no counterpanes were used on any bed. The results, listed in Table VI, show the marked reduction of ward contamination in the absence of counterpanes. This is particularly clear in the samples taken at 24 and 48 hours, and applies equally well when woollen or cotton blankets acted as donor textiles.

TABLE VI.—*Environmental Contamination by Staph. citreus in Presence and Absence of Counterpanes*

Source of *Staph. citreus*	Counterpanes in Ward	C.I. Values for Each Textile (Average 8 Beds) After					
		3 Hours		24 Hours		48 Hours	
		P	B	P	B	P	B
2 woollen blankets	Absent	5·0	3·6	0·0	1·0	1·0	0·7
	Present	10·0	0·6	20·0	6·1	40·0	7·4
2 cotton blankets	Absent	5·0	1·2	12·0	4·0	6·0	3·9
	Present	7·0	1·4	30·0	4·8	34·0	9·1

P = Pillow-cases. B = Blankets.

In order to demonstrate the "counterpane-effect" in the clearest possible manner, we have plotted the average C.I. values for blankets against time of sampling (Fig. 4). It will be seen that the critical factor determining the degree of blanket (and environmental) contamination is the presence or absence of a counterpane cover on the source textile. There can be little doubt that the counterpane-effect is responsible for a large amount of air-borne bacterial dispersion.

In fact, one contaminated woollen blanket covered with a counterpane can cause more environmental contamination than two contaminated blankets not covered by counterpanes (Table VII). It was not at all clear what explanation should be offered for this

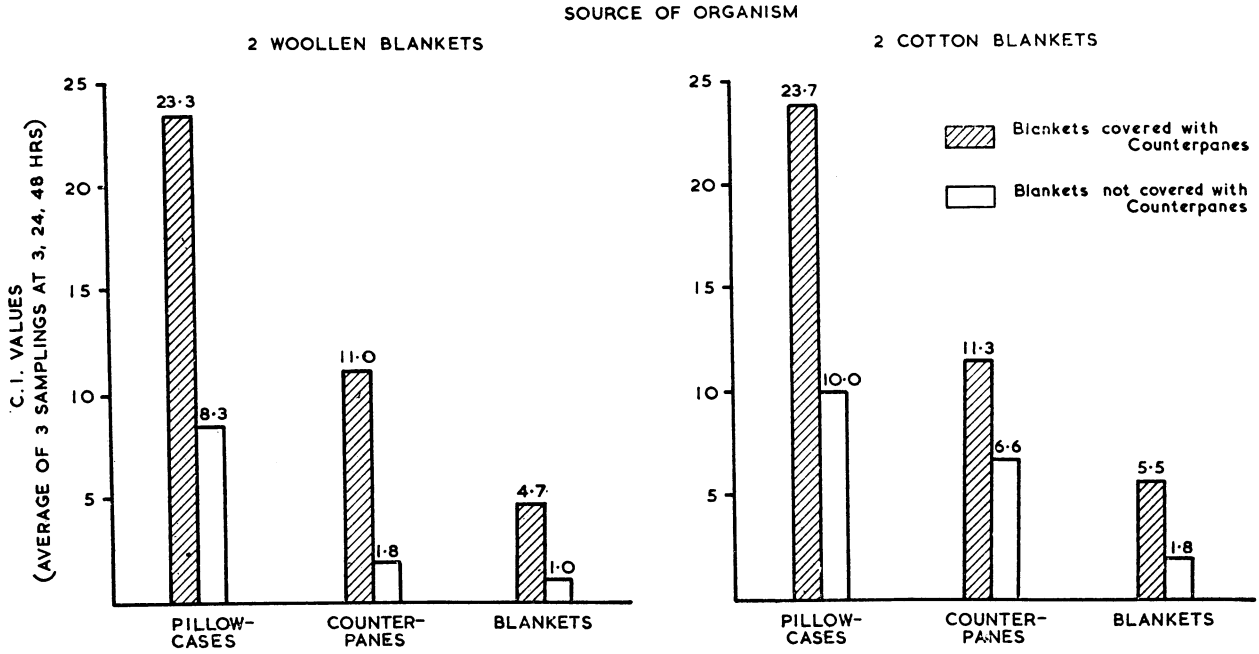

FIG. 3.—Comparison of ward contamination, expressed as average C.I. values, when counterpanes were and were not used to cover experimentally contaminated blankets.

apparently paradoxical and hitherto unsuspected phenomenon. The most plausible reason seemed to be that the continual movement between the counterpane and the blanket during use liberated bacterial-carrying particles fixed to the surface of the contaminated blanket. The dispersion of these particles into the air during bed-making would be determined not so much by the violence of this activity but by the amount of friction which had occurred prior to the act of making a bed.

An attempt was made to test this hypothesis by studying the dispersion of the marker organism under the following conditions. In one experiment the beds carrying the contaminated textiles were occupied by patients who were nursed in the usual manner; in another the beds were occupied but the counterpanes were pinned to the contaminated blankets; in a third the beds were unoccupied but were made up twice daily as other beds in the ward; in a fourth experiment the beds were unoccupied and disturbed only for taking contact-plate samples. The results are shown in Fig. 5 and Table VIII.

It is clear from Fig. 5 that the presence of a patient in the bed and the inevitable movement of bedclothes provided the optimal conditions for air-borne dispersion of organisms from that bed. However, when the friction between the contaminated blanket surface and the clean counterpane was reduced by pinning the two together, then environmental contamination was also reduced although the bed was occupied. When the beds were disturbed only for bed-making or for

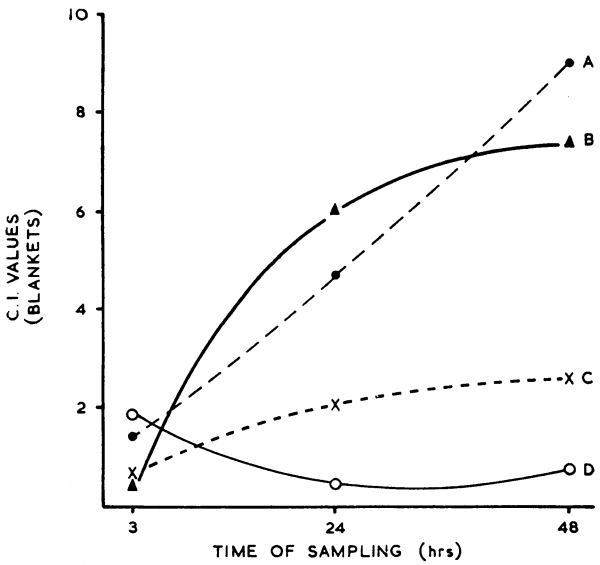

FIG. 4.—Contamination of blankets when counterpanes were and were not used to cover the experimentally contaminated blankets. (C.I. values derived from Table V.) A=2 cotton blankets with counterpane. B=2 woollen blankets with counterpane. C=2 cotton blankets without counterpane. D=2 woollen blankets without counterpane.

TABLE VII.—*Environmental Contamination by Staph. citreus from Single and Multiple Sources*

Source of *Staph. citreus*	C.I. Values for Each Textile (Average 8 Beds) After								
	3 Hours			24 Hours			48 Hours		
	C	B	Av.	C	B	Av.	C	B	Av.
1 woollen blanket covered with a clean counterpane	3·1	0·7	1·9	6·0	8·3	7·2	6·1	5·0	5·5
2 woollen blankets not covered with counterpanes ..	2·3	1·7	2·0	1·1	0·5	0·8	1·9	0·8	1·3

C = Counterpanes. B = Blankets.

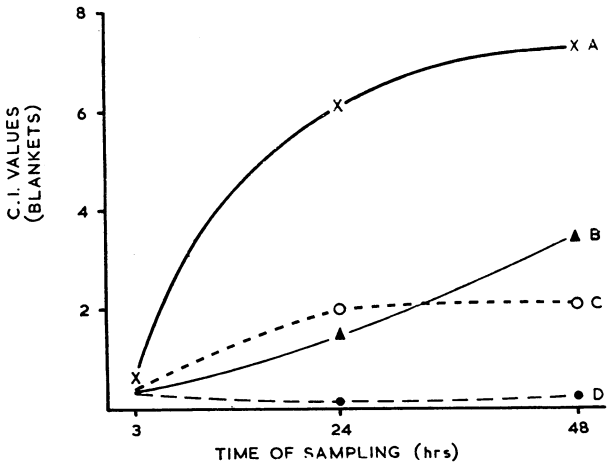

FIG. 5.—Comparison of ward contamination, expressed as average C.I. values for blankets, when counterpanes were placed on beds under different conditions of use (see text). A=Normal. B=Occupied but pinned. C=Unoccupied but made twice daily. D=Unoccupied: sampled only.

TABLE VIII.—*Dispersion of Staph. citreus from Woollen Blankets on Differently Used Beds*

Source of *Staph. citreus* 2 Woollen Blankets Covered by Counterpanes	C.I. Values for Each Textile (Average of 8 Beds) After			
	24 Hours		48 Hours	
	C	B	C	B
Unoccupied and undisturbed beds ..	1·9	0·3	2·3	0·4
,, beds but made twice daily	4·2	1·2	4·6	2·7
Occupied beds but counterpane covers pinned	6·2	2·1	7·0	2·0
Occupied beds, normal routine ..	6·8	6·1	21·9	7·4

C = Counterpanes. B = Blankets.

sampling the degree of contamination was further lowered. These findings suggest that the counterpane-effect is, in fact, a frictional effect, and this will be discussed more fully in a separate communication (Rubbo, to be published).

Before concluding it might be of interest to report briefly on an episode of staphylococcal cross-infection which occurred during the course of these experiments. A female patient suffering from a fulminating and fatal staphylococcal pneumonia and a staphylococcal wound infection was admitted to the ward at the commencement of a routine ward experiment. She was nursed in bed 11 (see Fig. 2). The infecting organism was distinguishable from other species of *Staph. aureus* in the ward by its resistance to all antibiotics except kanamycin. The pathogen was recovered by contact plates from at least one textile on each of the 21 beds in the double ward 24 and 48 hours after its introduction. Two patients in beds 12 and 20 developed wound infections due to this organism five and seven days after its introduction into the ward. It was evident that the offending organism was dispersed from the bedclothing of this moribund patient in a manner identical with the spread of the marker organism described in this study.

Discussion

Any attempt to analyse the factors concerned with the acquisition of infection in wards presents problems of peculiar difficulty. One aspect of this general problem to which the present study was directed has been an analysis of environmental contamination using a marker organism in a normal working surgical ward. The experimental procedure allowed us to follow quantitatively the spread of the organism, *Staph. citreus*,

when its entry, concentration, and source were known and to analyse some of the factors responsible for this spread.

The findings reported here show that contaminated textiles, either in the form of woollen or cotton blankets or of cotton counterpanes, disseminate organisms in detectable numbers to almost all beds in a ward approximately three hours after their introduction (Table II). The extent and intensity of the contamination increases with time irrespective of the nature of the donor textile (Table V). In general, cotton blankets appeared to be more effective in dispersing the marker organism than woollen ones (Table V).

The most interesting finding which emerged in this study was the unexpected effect on ward contamination when contaminated textiles were covered with laundry-clean counterpanes. It was consistently found that covering a contaminated blanket with a counterpane greatly increased the dispersion of the marker organism throughout the ward (Tables V and VI, Figs. 3 and 4). Indeed, one contaminated blanket covered by a clean counterpane was a more productive source of organisms than two contaminated blankets not covered by counterpanes (Table VII). While these observations were made with counterpanes in contact with a contaminated textile surface, it is not unlikely that any clean textile cover will provide the necessary conditions for the release of air-borne organisms from a contaminated textile.

An essential prerequisite for demonstrating the counterpane effect is the movement of the counterpane on the contaminated blanket. When, for example, the movement between the counterpane and the blanket is prevented by pinning the two together the air-borne contamination will be greatly reduced (Fig. 5). Thus the release of organisms from the textile surface is probably due to friction. Their dispersion from the bed will be due to air currents or agitation.

The findings suggest that the use of counterpane covers in wards might be discouraged and that their removal would lower the incidence of air-borne infection. Although we have no clinical evidence to support this view, preliminary experiments have shown that air-borne counts were 20–40% lower in wards in which no counterpanes were used. In these experiments the upper surface of the top blankets was not brought in contact with the other bedclothes. This measure, together with the intermittent use of framycetin sulphate nasal spray (to be reported later) and the frequent laundering of the top blanket, would undoubtedly lower both nasal carrier rate and air-borne dispersion of *Staph. aureus* in a hospital ward.

Summary

The spread of a marker organism, *Staphylococcus citreus*, in a normal surgical ward has been investigated. The organism was introduced in the ward in a known concentration on known textiles and its rate and intensity of dispersion were determined over 48 hours. The results showed that the dispersion of the marker organism in the ward was very similar when cotton and woollen blankets were used as source textiles. Of the two, cotton blankets yielded a higher intensity of air-borne contamination than woollen blankets. The use of counterpane covers greatly increased the dispersion of the organism. This "counterpane effect" seems to be due to the removal of bacteria-carrying particles from a contaminated textile surface by friction. It is suggested that air-borne dispersion of organisms from textiles might be reduced in the absence of counterpanes provided the upper surface of the top blanket is not brought into contact with the other textiles.

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HEAT ILLNESS IN INFANTS AND YOUNG CHILDREN

A STUDY OF 47 CASES

BY

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Stimulated by the waging of two world wars in the tropics, considerable interest has been shown in the reactions of the adult human body to heat stress and in the illnesses induced by heat. Far less has been written on this subject in infants and children, though several authors have made an experimental approach and have obtained valuable information; the work of Cooke, Pratt, and Darrow (1949–50) and of Kuno (1956) is notable.

An opportunity to contribute to knowledge of heat illness in children was provided by a heat wave in Melbourne in the period January 17–20, 1959. Though very variable, summer conditions in Melbourne are normally temperate, with a few days each year over 100° F. (37.8° C.); humidity is usually moderate. This heat wave, the most intense for 50 years, was distinguished by sustained high temperatures—95 to 109° F. (35 to 42.8° C.) by day and 75 to 90° F. (24 to 32.2° C.) at night—and by low humidity. In Fig. 1 it will be noted that two other periods of fairly intense heat occurred in the summer, but that no ill children were seen in these periods.

Case Material and Methods

We saw 47 infants and children who were ill principally as a result of the heat; six of these were dead on arrival at the hospital. Though the heat complicated all cases over this period, only those in whose illness it played the major part are included in this study. A further eight patients died after admission, but in only six of these was death directly attributable to the heat-induced illness. The remaining two (Cases