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A POSSIBLE SOLUTION TO THE PROBLEM OF THE UBIQUITOUS HOSPITAL INFECTION

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Florence Nightingale, in 1857, said: 'The very first requirement of a hospital is that it should do the sick no harm'. This sounds like stating the obvious, but reflection will show that the modern hospital frequently falls short of the standard set by Miss Nightingale.

Prof. M. van den Ende, late Professor of Bacteriology at Cape Town University, while working for the British Medical Research Council during the early years of the last war, forcibly drew attention to cross-infection in hospitals. He was then searching for a substance that would 'fix' and 'kill' hospital organisms.

Since then, antibiotics, often prescribed too freely, have added to the problem of hospital infection by the production of 'resistant' organisms. Bacterial strains resistant to every known antibiotic have taken the stage, and all efforts to dislodge them have so far failed. The villain of the piece is of course *Staphylococcus aureus* 80/81, the notorious 'hospital staph.'. In hospitals all over the world this organism is causing wound infection, furunculosis, puerperal sepsis and neonatal sepsis, sometimes with fatal results. Once introduced into a hospital, it is carried from department to department by hospital personnel. It has proved impossible to eliminate it from wards, nurseries, outpatient departments, and even operating theatres.

USE OF TBTO (PERMACHEM) IN THE USA

The problem is now of such magnitude that in hospitals in many countries infection committees have been formed. Some 3 years ago one such committee at the Francis Delafield Hospital of Columbia University, USA, conceived and developed a new approach to the problem. Having failed to control the bacterial population carried by the patients and hospital staff, they decided to attempt control of the hospital environment.

At their request a synergistic agent* with lasting bactericidal properties was developed. This agent, with tributyl tin oxide and a quaternary ammonium compound as its chief components (in this report it will be referred to as TBTO), had been shown to be highly effective against *Staphylococcus aureus* 80/81 in addition to other organisms such as *Enterococcus coli,* salmonella and various fungi. It was then incorporated into paint for the hospital walls, wax and mopping fluid for the floors, and rinses for the laundry, in an effort to make the hospital self-decontaminating. It was also introduced into the standard hospital air-filters.

*Known in the USA as 'permachem'.

The results of this system, as reported by Hudson *et al.*,[1] were truly remarkable. In areas where, before treatment, culture showed staphylococcus counts of 40 - 50 colonies, culture after treatment, even though hospital routine was unaltered, gave counts of 5 - 10 colonies. Eight weeks later, in spite of the usual hospital traffic of patients, staff and visitors, these same areas still gave counts of 5 - 10 colonies, thus satisfying an important requirement for an anti-bacterial agent — prolonged effectiveness.

This advance in the fight against staphylococci soon became known in other centres. In August 1959 the Administrator of Broadway Hospital, Shawnee, Oklahoma, introduced the environmental decontamination system into his hospital. Previous to this the hospital had been troubled by postoperative infection and had also had a 'siege of epidemic diarrhea' in the nursery. During the installation of the system there was another outbreak of 'staph.' diarrhoea in the newborn nursery. The nursery was closed, formulations were applied, and the infants were returned after 24 hours. There was no recurrence of infection. The Chief of Medical Staff of Broadway Hospital reported that until May 1960 (the time of the report), only 2 cases of infection were charted, and stated 'the staff feels that both these were grossly contaminated before admittance'.

TBTO in a New Hospital

Obviously the ideal method of applying this new bactericidal concept would be to 'build it in' to hospitals during construction. In March 1960 an opportunity to do this arose. A 40-bed general hospital was opened in Culpeper, Virginia. During building this hospital was treated throughout with TBTO. Six weeks later, after some 40 operations and 40 deliveries had been performed, the administrator reported 'no infection of any kind'. Complete culturing of every area showed no growth in any culture, whether taken from the floors, walls, air or hospital equipment. On 30 June 1960 a further 57 cultures were taken throughout the hospital. All were sterile, except that taken from a grill over a bed-pan washer where dirt had accumulated. On 28 November 1960, when the hospital had been in commission for 9 months, James P. Baker, Chairman of the Infection Committee at Culpeper, reported 'our third round of cultures shows negative results in all areas of permachem usage'. He added: 'Speaking as a surgeon with constant dressing and burn cases, I can only say how consistently fascinating I find the complete lack of odor in the hospital'.

Use Outside the USA

In December 1961 the first supplies of TBTO arrived in South Africa. A further study of the above and many similar reports only served to heighten surprise at the fact that what appeared to be such a striking advance in medicine could for so long have remained confined to the USA. Enquiries did indeed show that experiments were under way at the Postgraduate Hospital, Hammersmith, London, and that preliminary results were good. Apart from this, however, no evidence could be found that this system had been adopted or even tested outside the USA. It was in a mood of semi-scepticism, therefore, that TBTO was put to the test in Cape Town.

CAPE TOWN TESTS

The site of the experiment was a Cape Town maternity home. The preliminary cultures showed that the hospital walls, whether in the theatre, nursery, or sluice-rooms were, relatively, not heavily infected, and air was only moderately contaminated. The floors in all areas except the operating theatre were, however, heavily contaminated with *Staphylococcus aureus*. It was decided to put TBTO to the severest test by evaluating its ability to clear infection from the floors of sluice-rooms and nursery.

On 8 December 1961 preliminary cultures were taken. Then the nursery and both hospital sluice-rooms were decontaminated, using TBTO paint for the walls, wax for the floors and rinse for the nursery laundry. Thereafter the floor of each room was mopped daily with TBTO solution.

RESULTS

1. *Lower Sluice-room Floor*

8 December — Culture showed '*Staphylococcus aureus* T.N.T.C.' (too numerous to count).

14 December — Culture produced 2 colonies of staphylococcus.

20 December — Culture showed 1 colony of staphylococcus.

2. *Upper Sluice-room*

8 December — Culture showed 13 colonies of *Staphylococcus aureus*.

14 December — Culture was sterile.

20 December — Culture showed no growth of staphylococcus, but 35 colonies of *B. alkaligenes*.

3. *Nursery Floor*

8 December — Culture showed 161 colonies of *Staphylococcus aureus*.

14 December — Culture was sterile.

20 December — Culture showed 20 colonies of *Staphylococcus aureus* and 1 colony of *B. subtilis*.

4. *Nursery Fomites*

(*a*) *Baby's laundered napkin:*

8 December — Culture showed 2 colonies of *Staphylococcus aureus*.

14 December — Same napkin after laundering with TBTO, culture sterile.

(*b*) *Baby's laundered cot blanket:*

8 December — Culture showed 4 colonies of *Staphylococcus aureus*.

14 December — After laundering in TBTO solution, culture sterile.

On 14 December 1961 it was noticed that in the nursery one baby had a 'spotty' face. A culture from its blanket showed 5 colonies of *Staphylococcus aureus*.

Enquiry brought to light the fact that possibly one or two blankets had escaped the TBTO regime. Since no other babies developed spots (the nursery was full at the time) it seems probable that this explanation was the right one.

DISCUSSION

No attempt was made in the above experiment to decontaminate the hospital air directly. Blowers *et al.*[2] pointed out that a direct correlation can be drawn between air contamination and wound infection. Young and Porter[3] stated that by incorporating TBTO into existing air filters or air-conditioning systems (without other treatment) hospital air contamination can be reduced by 60%. Conversely, it was stated by Hudson *et al.*[4] that if walls, floors and fomites alone are treated, air contamination is reduced by two-thirds. It seems clear that, if the maximum anti-bacterial power is to be maintained, both inanimate objects and air must be decontaminated. Probably only in this way would it be possible to overcome, quickly, sudden heavy invasions of bacteria.

The results of this preliminary work with TBTO are impressive. Arrangements are now being made to test it on a far greater scale at our teaching hospitals.

SUMMARY

A short history is given of the development of a new system for combating 'hospital staph.'. The system makes use of a new bactericidal agent which is incorporated into preparations for treating hospital walls and floors. All hospital laundry is subjected to a last rinse in bactericidal solution. Hospital air is decontaminated by means of treated filters. A preliminary experiment in a Cape Town maternity home appears to corroborate the remarkable results claimed in America.

The various bactericidal preparations used in these experiments were kindly formulated and supplied by Messrs. Elterman Distributors (Pty.) Ltd., Cape Town.

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