

# PREVENTION OF HOSPITAL INFECTION\*

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HOSPITAL infection is defined as an infection acquired while staying in hospital or as a result of staying in hospital. It may occur as isolated cases or as epidemics and is seen not only in infectious and isolation wards but also in so called clean wards such as newborn nurseries.

The source of infection can be endogenous, i.e. from the patient himself, or hospital infection may arise from exogenous sources such as, from another patient or in the case of a newborn, from its mother, from the patient's attendants (doctors, nurses, orderlies), from the air via dust or droplets, or from other sources that include contaminated intravenous fluids, contaminated blood as well as food and drink.

In this presentation I can only briefly touch on certain aspects of hospital infections which we have had personal experience of in the last few years at the Paediatric and Postnatal Wards and the Special Care Nursery of the University Hospital, Petaling Jaya.

Most of our own efforts at investigation have been prompted by epidemics that have occurred in our wards, with a view of tracing and later eliminating the source of infection.

The first was an unusually large number of septicaemias seen in 1970. This was followed by an epidemic of gastroenteritis in 1973 (Lam, 1973), then an increased incidence of *Staphylococcus pyogenes* sepsis in 1975 (Lam, 1975) and more recently the problem of neonatal meningitis due to *Flavobacterium meningo-septicum* in 1977 (Thong, 1977).

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## INFECTION OF BABIES BY THEIR MOTHERS

Infection of babies by their mothers was investigated following the epidemic of gastroenteritis in 1973. Rectal swabs were collected from 640 mothers in the labour ward, and oral and rectal swabs were collected from the baby at the time of delivery and daily for 2 days after birth. Of the 640 mother-baby pairs, enteropathogenic *Escherichia coli* was isolated in 23 or 3.5% of the mothers and 14 or 2.18% of the babies. In only 5 or 0.78% of the pairs was the organism isolated in both the mother and child and of these 5 the same serotype was obtained in only 2 instances. None of the newborns developed any signs or symptoms of diarrhoea and we concluded that though there is a possibility that mothers carrying enteropathogenic *Escherichia coli* can infect their babies, this risk is small. On the whole, our experience indicates that hospital infections arise from other exogenous sources.

## INFECTION FROM THE PATIENT'S ATTENDANTS

I firmly believe that the doctors are a major source of cross infection in our Unit and very likely in other similar Units as well. For example in 5 days of 1973 a particular serotype of enteropathogenic *Escherichia coli* spread from the Special Care Nursery to all the Paediatric wards and to prevent further infection we were forced to close the Unit. The doctors were the only staff working in all the areas of the Unit. As it was vacation time, we could not put the blame on the medical students!

It is very easy to transmit organisms from one patient to another via the hands or our stethoscopes and it would be interesting to find out how many of us routinely wash our hands between patients and how many of us clean and disinfect our stethoscopes periodically. Even if a doctor is conscientious enough to wash his hands

between patients we should then ask if this is done thoroughly and, after washing, are facilities for hand drying adequate? Drying facilities may amount to just a hand towel hung on a towel rack used repeatedly and changed perhaps once a day and after the first few uses the towel is more wet than dry and can actually serve as a source infection. This was a problem we found during investigations of the outbreak of gastroenteritis in 1973 (Lam, 1973). Following this we now use squares of old hospital linen that can be re-washed and re-used and this has proved satisfactory and economical.

During an outbreak of *Staphylococcus pyogenes* infection in 1975, a nasal swab survey of 123 staff members, including doctors, nurses and attendants in both the Paediatric and the Obstetric wards was carried out. Of these, 41 or 33.3% were found to be nasal carriers of *Staphylococcus pyogenes*.

This was alarming but we later learnt from the Director of the Cross Infection Reference Laboratory in London that it is the personnel with actual skin lesions on their hands that are the dangerous disseminators of *Staphylococci* and that as far as the asymptomatic *Staphylococci* carriers are concerned, it is the perineal rather than the nasal carriers that we should worry about as these are the ones who tend to spread the *Staphylococci* they carry.

## INFECTION FROM EQUIPMENT AND INSTRUMENTS

The disposable intravenous sets with attached measuring burettes are very useful but if used over long periods can become potential killers as was shown by Thong and Tay (1975). The drip chambers can become contaminated by organisms as early as the 4th day of use even when antibiotics are present in the infusion fluid. We now routinely change these sets every 2 days if prolonged intravenous therapy is indicated. When patients are on parenteral intravenous alimentation, these are changed daily. Even then, there is still about a 10% risk of septicaemia in this category of patients despite painting the external surfaces of the drip sets with Povidine every 2 hours.

Thermometers are a common source of cross infection if shared among patients especially if

they are not disinfected between use with a suitable disinfectant for an adequate period of time.

We have learnt that isolettes if not cleaned carefully after use can be a serious source of hospital infection. The most difficult part to disinfect and keep sterile is the water reservoir and even if it is sterile to begin with, it becomes, while in use, quickly and heavily contaminated by organisms such as *Staphylococci*, *Pseudomonas* and *Flavobacteria*.

Only staff who have been trained to dismantle and clean incubators should be responsible for cleaning them and it is now our policy not to use so called cleaned isolettes until we have bacteriological proof that the disinfection has been adequate.

We change incubators routinely every week and for the past 2 years we have also stopped putting distilled water in the reservoirs as our air is already over 90% saturated and there really is no need to try to further humidify it.

## DISINFECTANTS

In the past there has been no set unit or hospital policy as to what antiseptic or disinfectant to use for barrier nursing, sterilization of instruments, septic material like dressings or nappies and even floors. Recent work by Puthuchery and Thong has given us some indication of the effectiveness of simple hand washing with soap and water and some of the commonly used agents in this country against 4 common organisms, namely, *Staphylococcus pyogenes*, *Escherichia coli*, *Pseudomonas species* and *Flavobacterium meningosepticum*.

It can be seen from Table I that with the test organisms, soap and water is as effective if not better than Dettol and Resiguard. The exception is Dettol and *Escherichia coli*. It can be seen here that Dettol is superior to soap and water. Aqueous Chlorhexidine and aqueous Cetrimide are better than soap and water and are uniformly effective against all the 4 organisms. Povidine, an iodinated compound, is highly effective against all the test organisms.

It is of interest to mention here that one of the

two active ingredients in Resiguard, Benzalkonium chloride, is an agent incorporated into culture media for isolation of *Pseudomonas* species.

As part of the epidemiological study of *Flavobacterium meningosepticum*, Thong (1977) examined stock samples of aqueous preparations from various areas of the hospital and found them heavily contaminated with mixed bacteria and *Pseudomonas cepacia*.

Table III (Thong, 1977) shows results of culture of different concentrations of aqueous Chlorhexidine during use and while in stock bottles. All samples grew mixed organisms and in the case of the 0.05% solution, *Flavobacterium meningosepticum* as well. Note that the pH of all the solutions is 6. Chlorhexidine works best at pH7 or at a slightly more alkaline pH than 7.

Distilled water, which is mainly used as a diluent or to humidify oxygen for example in

**Table I: Effectiveness of Antiseptics versus Washing with Soap and Water**

Agent	Bacterial Count			
	Staph. pyogenes	E. Coli	Ps. aeruginosa	Flavobacterium meningosepticum
Control	160,238	61,962	422,488	53,350
Resiguard 1:160	441	84	207	100
Povidine	0.5	0.8	7.6	1.6
Soap and water	647	132	136	13
Chlorhexidine 1%	1.6	5.4	28	2.1
Cetrimide 1%	1.8	3.5	9	5.3
Dettol 1:40	60,435	6.5	117	38.4

**Table II: Samples of Aqueous Preparations Examined Bacteriologically**

Solution	pH	Source of Solution	Total Viable Count per ml (Mixed Bacteria)	Ps. cepacia isolated
2% Sodium bicarbonate	10.0	Special Care Nursery	$2 \times 10^4$	—
1% Cetrimide	7.0	Maternity operating theatre (stock bottle)	$3 \times 10^4$	+
1% Cetrimide	6.5	Pharmacy	$1 \times 10^6$	+
1% Cetrimide	7.0	Pharmacy	$3 \times 10^6$	+
Salvon I/100 (0.5% Cetrimide and 0.5% Chlorhexidine)	6.0	Pharmacy	$1.7 \times 10^6$	+

**Table III**

**Samples of aqueous solutions of Chlorhexidine (Hibitane) examined bacteriologically**

Conc. of aqueous Chlorhexidine	pH	Source of Chlorhexidine	Mixed Bacterial Growth	F. meningosepticum
0.5%	6.0	<sup>x</sup> SCN (Wash Basin)	+	—
0.05%	6.0	<sup>x</sup> SCN (Stock Bottle)	+	+
1.0%	6.0	<sup>x</sup> SCN (Stock Bottle)	+	—
0.05%	6.0	* LW (Stock Bottle)	+	+
0.5%		<sup>a</sup> Mat. 1 (In use)	+	—
0.05%		<sup>a</sup> Mat. 3 (Stock Bottle)	+	+
0.05%	6.0	<sup>a</sup> Mat. 4 (Stock Bottle)	+	+
1.0%	6.0	Pharmacy stock	+(1.4 x 10 <sup>6</sup> )	—
0.05%	6.0	Pharmacy stock	+(4.6 x 10 <sup>3</sup> )	+

<sup>x</sup> Special Care Nursery

\*Labour Ward

<sup>a</sup> Maternity Ward

croupettes, is only as sterile as the equipment from which it is obtained and the container it is stored in. With the deionising method of obtaining ion free water direct from tap water the effluent is of course not sterile. *Pseudomonas* and *Flavobacteria* thrive in both.

## CONCLUSION

I am sure that there have been many instances of hospital infection that we have missed and that there will be many more outbreaks of hospital infection in time to come.

We may not be able to eliminate hospital infection but with the experience gained and with constant vigilance, we can reduce it to a minimum. I hope that this paper will stimulate a critical reappraisal of current practices particularly in the neonatal area where the newborn and premature are especially susceptible to infection.

## ACKNOWLEDGEMENT

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