A BACTERIOLOGICAL STUDY OF THE ENVIRONMENT OF PEDIATRIC WARD AND NEONATAL NURSERY

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ABSTRACT

The hospital environment is full of pathogens which may cause nosocomial infections. A bacteriological survey of hospital air, floor, water, milk and fomites was done. The air survey showed large number of bacteria carrying particles in air. A direct relation between floor area per person and bacterial contamination of air was established. The floor survey showed that there is abundance of bacteria on the hospital floors, much more than the accepted fair standards of house keeping. The hospital water had a high coliform and total bacterial count and stored tank water was more dirty. Neonatal nursery milk also had high total bacterial and coliform counts. Regular surveillance of hospital environment may help to reduce the incidence of cross infection.

Key words: *Cross infections, Environment, Surveillance, Hygiene.*

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Nosocomial infections are a major problem in pediatric patients leading to high morbidity and mortality due to their high susceptibility(1). The prevalence rate of such infections in India varies from 11.2%(2) to 24.4%(3) of hospitalized patients. The prevalence rate of nosocomial infections as reported from other countries varies from 4.5% in U.S.A(4), 6.1% in Czechoslovakia(5), 14.2% in Belgium(6) to 42.3% in Brazil(7). The hospital environment plays a major role in spread of these infections as the hospital air, floor, water, surfaces, fomites, *etc.* act as temporary reservoirs of pathogens and lead to their spread from one patient to another(1-7).

The present study was undertaken to find out the sources and quantity of these pathogens in the hospital environment and to know how far we are as with regards to acceptable bacteriological standards laid down for hospital environment(8).

Material and Methods

The study was conducted in the Pediatric Ward and Neonatal Nursery of Umaid Hospital for Women and Children, Jodhpur and in Department of Microbiology, Dr. S.N. Medical College, Jodhpur. The different sites studied for bacteriological sampling of air and floor in Pediatric ward were: (*i*) Intensive care unit, (*ii*) Minor theatre, (*iii*) Preparation and injection room, (*iv*) Observation block, (*v*) Pediatric Ward blocks, and (*vi*) Isolation room. The different sites studied in Neonatal Nursery for bacteriological sampling of air and floor were: (*i*) Intensive care table, (*ii*) Sorrento's cots, (*iii*) near air conditioner, and (*iv*) Phototherapy unit.

The bacteriological examination of water was done on four samples collected from Pediatric Ward and Neonatal Nursery

and included tap water and stored water. Four samples of milk were randomly collected from Neonatal nursery for total and coliform counts aseptically.

The bacteriological study was conducted by the following standard methods:

1. *Air:* By multiple Agar sampler plates (ASP) technique(9).
2. *Floor:* By Pour plate technique and Rhodac plate method at four different sites one hour after wet scrubbing with 4% phenol(10).
3. *Water:* Viable bacterial counts by Agar dilution method and Presumptive coliform counts(11-13).
4. *Milk:* Viable bacterial counts by Agar dilution method and Nipple rinse test(14).
5. *Fomites:* By Swab rinse method(9).

Results

The results of bacteriological air sampling of Pediatric ward and Neonatal nursery are shown in *Table I*. The results show a direct relationship between bacterial air counts and floor area per person. The air sampling of Neonatal Nursery show maximum bacterial air counts near the air conditioner and phototherapy unit.

The results of bacteriological floor sampling shown in *Table II* indicate very poor standards of house keeping in Pediatric ward and even in Neonatal Nursery. The results obtained with Rhodac plate method and Swab rinse method are similar.

The bacteriological examination of water (*Table III*) indicate high total bacterial counts and more so in stored water. The stored water of Pediatric ward had high coliform counts and grew fecal organisms.

The bacterial counts of milk samples and nipples (*Table IV*) also indicate high total bacterial counts and coliform counts. The nipple rinse test showed that the nipples used for feeding the babies had high bacterial counts and one sample had coliform organisms.

The results of the study of fomites showed that all the dressing solutions *viz.*, magnesium sulphate, Savlon, suction catheters, oxygen cannula and Cheetal forceps were contaminated and grew *Pseudomonas* on culture by Swab rinse method.

TABLE I–*Bacteriological Air Sampling of Children Ward and Neonatal Nursery*

Area of the ward	Bacterial counts per cubic metre	Area (sq. m.)	No. of patients	No. of attendants	Total	Floor area (sq. m.) per person
Minor theatre	1450	04.25	1	5	6	0.70
ICU	1088	22.20	7	15	22	1.09
Preparation room	1260	17.05	Nil	6	6	2.84
Observation block	0685	89.05	18	26	44	2.02
Isolation room	0190	12.00	1	1	2	6.00
Block No. 1	0743	66.00	12	18	30	2.20
Block No. 2	0559	122.85	16	19	35	3.51
Block No. 3	0413	97.85	14	16	30	3.25
Neonatal Nursery (Average)	0333	70.00	16	4	20	3.50

TABLE II—*Bacteriological Floor Sampling (Semi-quantitative Methods): Children Ward and Neonatal Nursery*

Area	Rhodac plate method (Bacteria/sq. cm.)	Swab rinse method (Bacteria/sq. cm.)
Intensive care unit	514	506
Minor theatre	546	548
Preparation room	615	555
Observation block	499	538
Isolation room	236	252
Neonatal Nursery (average)	302	271

Accepted standards of house keeping (10):
1. 0-25 bacteria/sq. cm.—Good.
2. 25-50 bacteria/sq.cm.—Fair.
3. 50 or more bacteria/sq. cm.—Poor.

TABLE III—*Bacteriological Examination of Water of Children Ward and Neonatal Nursery*

Site of collection	Total bacterial counts per ml (37°C at 48 h)	Coliform count	Fecal organisms
Tap water of children ward	246	00	Nil
Stored water of children ward	508	10	*E. coli*
Tap water of Neonatal Nursery	206	00	Nil
Stored water of Neonatal Nursery	386	00	Nil
Standards of clean potable water(11-13)	010	00	Nil

TABLE IV—*Bacterial Counts of Milk Samples and Nipples*

S.No.	Milk samples		Nipple rinse test	
	Total bacterial count/ml	Coliform count/ml	Total bacterial count/ml	Coliform count/ml
1.	36,600	45	145	Nil
2.	42,200	56	132	2
3.	28,160	28	074	Nil
4.	33,270	18	094	Nil
Accepted standards(14)	20,000	10	050	Nil

Discussion

The results of bacteriological air sampling has clearly shown that lesser the floor area per person more is the bacterial air count (*Table I*). The bacteriological air counts depend upon the amount of physical activity, moisture and ventilation of the

area. Thus bacterial air counts and floor area per person give an idea about adequacy of ventilation and dampness of Pediatric ward and also reflect on the physical activity(8).

There is no clear relationship between total air counts and risk of infection but when air counts exceed 700-1800 per cubic metre there is a significant risk of airborne infection(9). Counts of the order of 2 per cubic metre can be achieved by laminar air flow ventilation(15). The Agar sampler plate (ASP) method of finding bacteria carrying particles in the air gives approximate results as the number of such particles settling on 1 metre square of medium per minute is equal to number of such particles per 0.3 cubic metre of air(9). Now better methods of sampling the air are available(16-18). The presence of coagulase positive Staphylococci in air generally indicate nasal dispersors(18).

The air counts in Neonatal Nursery were less than those in Pediatric ward due to restricted entry of attendants and a higher floor area per person.

The bacteriological floor sampling has shown that the bacterial counts are 10 to 12 times the accepted fair standard of house keeping and that the two different methods of sampling give similar results(10). In case of floors also no clear relationship has been established between cleanliness of floors and incidence of nosocomial infections(19,20), but hospital floors are reservoirs of pathogens and these get carried away into the air by physical activity(19).

The bacteriological examination of water has shown a high total viable bacterial count and a high coliform count(11-13). There were fecal organisms in one sample of stored tank water. In a study at University Hospital of Wales (UK) 47% of samples had a high total viable count and 1.2% samples had coliform organisms(12). The efficacy of hand washing is also reduced if dirty water is used for hand washing. The hospitals should have continuous tap water supply and water tanks cleaned regularly.

The total bacterial counts and coliform counts of milk fed to the babies in the Neonatal Nursery were higher than accepted standards(14). This contamination of milk could be from extraneous sources, spoon, water, utensils, *etc.*

The tin of milk formula if kept open also lead to contamination. Nipples used for feeding the neonates also had more bacteria than the accepted standards. The neonates being highly susceptible to infection can get gastroenteritis if fed such milk(21).

The above study has focussed attention on environmental pathogens and a regular or a sporadic surveillance of environment will help educate the staff and reduce the prevalence of nosocomial infection(22,23). a multidisciplinary infection control committee should be set up for environmental survey and report on cross infection cases.

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