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HOSPITAL INFECTION : SOURCES AND ROUTES OF TRANSMISSION

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Summary

Hospital acquired infections may be caused by bacteria, viruses, fungi, parasites arid helminths. Common bacterial causes of hospital infection include ***Staphylococcus aureus, Pseudomonas aeruginosa*** and antibiotic-resistant strains of Gram-negative rods. Infection may be acquired endogenously or from one's own body flora, and exogenously or from patients, staff and the hospital environment. Contact, especially with inadequately washed hands of the staff, plays an important role in hospital cross-infections.

INTRODUCTION

Certain hazards are inherent in modern hospital practice and that of hospital acquired infection is one of them. It is estimated that 5–10% of patients admitted to hospitals get some form of infection,' the frequency and severity of which varies with the type of patient, the nature of treatment and the duration of stay in the hospital. Hospital acquired or nosocomial infections are those which are acquired by staff or patients in the hospital. These infections may be life threatening such as meningitis caused by ***Flavobacterium meningosepticurn*** in the neonates or result in economic loss in terms of health resources and man hours of work due to prolonged hospital stay.

The presence of immunosuppressed individuals and the increasing use of diagnostic and therapeutic procedures requiring equipment and instruments which get contaminated and are difficult to sterilize has added to the risk of acquiring infection in modern hospitals. Very little published data is available on the incidence of hospital acquired infection in Malaysia. It is likely that such infections occur here regularly as they do in hospitals the world over. Figures from the United States show that about 6 per cent of patients admitted to hospitals acquired some form of infection.' The rate was highest in surgical patients and surgical wound infection was the commonest form of infection encountered followed by urinary tract and lower respiratory tract infection.

Aetiology

Infection acquired in the hospital may be caused by bacteria, viruses or fungi. It may take the form of an infestation and involve parasites and helminths. Some of the causative agents of hospital acquired infection are shown in Table 1.

Bacteria responsible for hospital infection are noted for their resistance towards antibiotics. Multiply resistant strains of bacteria emerge as a result of chemotherapeutic selection and colonize patients and staff and contaminate the environment. Infections caused by such strains are difficult to treat. Certain infections are endemic in hospitals and occur from time to time. Occasionally, outbreaks or epidemics occur as a result of some breakdown in hospital hygiene. In the 40's outbreaks of infection caused by ***Streptococcus pyogenes*** were commonly encountered. In the 50's and 60's, multiply resistant strains of ***Staphylococcus aureus*** caused outbreaks of skin sepsis, wound infection and septicaemia in hospitals in many countries. Recently, outbreaks of infection caused by Gram-negative bacilli are increasingly being reported.[3]

Sources of infection

Sources of infection can be discussed under two headings

1. Endogenous or self-infection.
2. Exogenous or cross-infection and infection from the environment.

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TABLE 1

HOSPITAL INFECTION – PRINCIPAL PATHOGENS

Bacteria	–	*Staphylococcus aureus* *Pseudomonas aeruginosa* *Streptococcus pyogenes* *Micrococcus* *Enterobacteriaceae* *Bacteroides* *Flavobacteriurn* species
Virus	–	Hepatitis B virus Cytomegalovirus Respiratory syncytial virus
Fungi	–	*Candida albicans* *Aspergillus* Saprophytic fungi
Parasite	–	*Pneurnocystitis carinii*

Endogenous or self-infection

Infection may be endogenously acquired from one's own body flora (Table 2). Bacteria are present on the skin, in the nose, mouth. throat, gastrointestinal tract and in the female genital tract. Whenever there is a lowering of general or local resistance, these organisms invade the tissues. Such opportunistic infections are difficult to prevent and control in susceptible individuals.

Prolonged hospital stay and the use of antibiotics alters the normal flora, both in the type of organisms and in their susceptibility towards antibiotics. Studies have shown that hospitalised individuals have a greater incidence of faecal carriage of *Pseudornonas aeruginosa* than the general population and intestinal carriage of multiply resistant strains of Gram-negative bacteria often precedes self-infection and cross-infection.

Exogenous or cross-infection and infection from the environment

Exogenous sources of infection may be animate or inanimate. People, both patients and hospital staff disperse a large number of bacteria into the environment from their skin and in their oral and nasal secretions during sneezing, talking and other body movements. Studies done on staphylococcal carriage in hospitals have shown that certain individuals shed large numbers of organisms from their body surface especially the perineum and are referred to as 'dispersers', such individuals may also contaminate their hands and clothing and other inanimate objects.

Contamination of environment results from human activity. Food, fluids, disinfectants, instruments, equipment, wound dressing, all act as sources of infection as a result of contamination from human organic waste, pus, blood and blood products (Table 3). Rarely free living bacteria and saprophytic fungi which are derived .from the environment may cause infection in susceptible individuals.[4]

Routes of transmission

There are two main routes of transmission.

1. Airborne.
2. Contact.

Airborne

Organisms derived from skin, mucous membranes of nose and throat disperse in the atmosphere as 'droplets' or dry particles. The distance travelled varies with the size of the particle, before it reaches the floor or settles on an environmental source. Movement or dis-

TABLE 2

ENDOGENOUS OR SELF-INFECTION– PRINCIPAL PATHOGENS AND TYPES OF INFECTION

Source	Principal pathogens	Types of infection
Skin	***Staphylococcus aureus***	Wound infections Skin sepsis
Nose	***Staphylococcus aureus***	Same as above
Intestine	***Enterobacteriaceae***	Urinary tract infection Respiratory tract infection Septicaemia
	Clostridia	Gas gangrene
	Bacteroides	Post-operative wound infections Septicaemia
Female genital tract	Gram-negative bacteria	Urinary tract infection
	Group B ***Streptococcus***	Urinary tract infection
	Bacteroides	Septicaemia Wound infection

TABLE 3

EXOGENOUS SOURCES OF INFECTION: PRINCIPAL PATHOGENS, ROUTES OF TRANSMISSION AND SURVIVAL IN THE ENVIRONMENT

Source	Pathogen	Route of transmission	Survival in the environment	
			Able to withstand drying	Survives in wet situations
Persons	Staphylococcus *aureus*	airborne	Yes	Yes
Hands and clothes of staff	Staphylococcus *aureus*	contact	Yes	Yes
	Gram-negative bacilli	contact	No	Yes
Wound dressings	*Staphylococcus aureus*	airborne	Yes	Yes
Dust	Staphylococcus *aureus*	airborne	Yes	Yes
Fomites	Staphylococcus *aureus*	contact	Yes	Yes
	Gram-negative bacilli	contact	No	Yes
Fluid and disinfectants	Gram-negative bacilli	contact	No	Yes
Food	Escherichia coli	contact	No	Yes
	Salmonella species	contact	No	Yes
	Other Gram-negative bacilli	contact	No	Yes
Inadequately sterilized instruments and equipment	Clostridia	contact	Yes	Yes
	Staplylococcusaureus	contact	Yes	Yes
	Gram-negative bacilli	contact	No	Yes

turbance in the air current disperses it again. Survival in the environment varies with the physical conditions and the types of organisms. ***Staphylococcus aureus*** and ***Mycobacterium tuberculosis*** can withstand drying whereas Gram-negative organisms thrive only in wet situations (Table 3). Contaminated droplets and particles may also be dispersed from respirators and air-conditioning plants.

Contact

Contact is also important for transmission of infection caused by ***Staphylococcus aureus*** and Gram-negative bacilli. It can be direct contact from patient to patient or from patient to nurse to patient, or indirect contact via inanimate and environmental sources of infection.

Hands of the hospital staff are the single most important factor in this form of transmission. Inadequate washing due to lack of facilities or time contributes to this. Studies have shown that overall time for hand washing was often brief, the technique was poor and certain parts of the hand remained unclean. Organisms transmitted via this route are many and include ***Enterobacter – Klebsiella*** group, ***Pseudomonas aeruginosa*** and ***Staphylococcus aureus.*** Contact may also result in direct implantation of organisms in normally sterile sites via inadequately sterilized instruments. Transmission of hepatitis B virus infection via contaminated hypodermic syringes is a classical example.

High infection risk areas in the hospital

Due to factors discussed earlier, certain areas in the hospital have a higher incidence of infection than others. The special features of some of these are represented in Table 4.

CONCLUSION

Sources of infection in a hospital are numerous and a variety of infectious agents are involved which cause infections ranging from mild to life-threatening. It is necessary to identify them and understand their mode of transmission so that effective preventive and control measures can be undertaken.

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TABLE 4
HIGH INFECTION RISK AREAS IN THE HOSPITAL

Area	Predisposing factor	Type of infection
Intensive Care Unit	Patients with poor general resistance requiring intensive handling and instrumentation, mechanical ventilation, tracheostomy, catheterization and intravenous infusions.	Lower respiratory tract infection Urinary tract infection Local wound infection Infected drip sites Septicaemia
Burns Units	Lowered local resistance due to loss of skin and presence of necrotic tissue.	Superficial infection resulting in graft rejection Gram-negative septicaemia
Urological and Renal Dialysis Units	Catheterization, Peritoneal dialysis Use of kidney machines	Urinary tract infection, peritonitis, hepatitis
Premature Baby Unit	Poorly developed immune response	Skin infection, meningitis, septicaemia