

# HOSPITAL ACQUIRED INFECTION

## WHAT DO WE UNDERSTAND ABOUT IT?

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### INTRODUCTION

Hospital acquired infection (HAI) or nosocomial infection has been described as an infection not present or incubating at the time of admission to a hospital but acquired during a stay in the hospital or in a period following a hospital stay. The Center for Disease Control and Prevention has classified infections as: community-acquired – an infection occurring in the community and manifests on admission to the hospital; hospital acquired – in infection originated in the hospital and deemed to be related to the current hospital admission; or ICU acquired – an infection having originated in the ICU<sup>1</sup>. About one in ten patients in acute hospitals at any one time has an infection acquired after admission to hospital. Infections acquired in hospitals are likely to complicate illness, cause discomfort and anxiety and can lead to death. Resources are required to implement control programmes and to diagnose and treat patients suffering from hospital acquired infections.

### HISTORICAL BACKGROUND

Some of the earlier reference about hospital acquired infections (HAI) are found from the classical Greek scholars. One of the earliest explanation suggested is the miasma theory. This is based on the belief that fetid

air was laden with poisons and products of putrefaction. Some people have advocated better ventilation to get rid wards of corrupted air He observed that wards with broken windows had lower rate of infections and advocated the use of chimneys which would act as ventilation shafts. Others have advocated the destruction of hospitals, "the truth is that once a hospital has become incurably pyaemic stricken it is impossible to disinfect it by any known means as it would be to disinfect a crumbling wall of ants that has been taken possession of it<sup>2</sup>.

Some people have challenged the concept of hospital designs and advocated the improvement that included more ventilation and smaller wards. It has been observed<sup>2</sup> that fewer women died of puerperal fever when treated by midwives than when treated by medical students. It was found that a colleague wounded through a needle stick injury whilst undertaking a post-martum, died of sepsis. Students often went straight from post-martum room to deliver babies. The idea that a health care worker could transfer disease is still a source of concern today especially in the spread of blood-borne infections such as HIV and hepatitis and the emerging problem of resistant organisms. This theory of cross-infection led to the introduction of gloves

and masks to protect doctors, nurses and other patients.

### AETIOLOGY OF HAI

Infections occur when a micro-organism invades a susceptible host and cause disease. If the micro-organism is a commensal organism i.e. it already resides in the host, an infection may develop as a result of a change in the relationship between the micro-organism and the host. The interaction between the micro-organism the route of transmission and the host is called the chain of infection. A micro-organism that leads to a disease state in an individual is called a pathogen. It can be bacteria, protozoa, viruses or fungi. The vast majority of HAIs are caused by bacteria.

The pathogenicity of an organism refers to the ability of the organism to cause disease while virulence refers to the degree of pathogenicity of an organism and may be described by reference to epidemiological measures such as morbidity, mortality communicability and by clinical factors characterising the severity of infection observed. Some organisms ie. *P. aeruginosa*, *S. epidermidis* and *Acinetobacter baumannii* rarely cause disease in individuals with intact immunity and are therefore called opportunistic organisms. A number of predisposing factors to HAI have been identified. Susceptible patients (mostly elderly or neonates) include those who have recently undergone major surgery, those with chronic underlying disease such as malignancy, burns, or immunosuppression<sup>3</sup>. Prolonged hospitalization particularly in an ICU as a result of severe underlying disease, prolonged respiratory therapy with mechanical ventilation, permanent indwelling urinary catheters and previous antimicrobial therapy are all key factors in predisposing to HAI. The high incidence of colonization with nosocomial bacteria is attributed to frequent cross-contamination of epidemic strains throughout the hospital<sup>4</sup>. The use of

antibiotics probably alters the normal flora and results in the selection of resistant micro-organisms such as *Klebsiella* spp. *Pseudomonas* spp. and *Acinetobacter* spp. There are reports of endemic occurrence of a single strain causing outbreaks upto three years after its appearance causing a single infection or colonization suggesting that an outbreak strain may become an endemic strain and *vice versa*<sup>5</sup>. This reflects the degree to which nosocomial bacteria can survive in the hospital environment where they can cause repeated outbreaks, especially after incomplete dis-infection.

### ROUTES OF TRANSMISSION

There are four main routes of transmission:

1. Contact, which may be direct physical or indirect
2. Common vehicle transmission such as food or water.
3. Air-borne transmission from source to host by droplets, dust, or skin scales.
4. Vector-borne transmission via insects.

The route of transmission in nosocomial outbreaks may be patients to patients or patients to environment to patient. Allen and Green<sup>6</sup> have reported the airborne spread may be a route of transmission in outbreaks. This has been confirmed during a two years study in which the bacterium involved in nosocomial outbreaks was found both in the air and on the hands of hospital staff<sup>7</sup>. Compared with other genera, acinetobacters survive much better than other Gram-negative bacilli when tested on finger tips<sup>8</sup>. That is why the skin of medical personnel have been implicated as the route of transmission in some outbreaks<sup>9,10</sup>. Different non-biotic dry environmental sources have been implicated as a route of transmission e.g. re-usable equipment used for the management of severely ill patients<sup>11,3</sup> bed mattresses<sup>12</sup>, gloves<sup>13</sup>, and pillows<sup>14,3</sup>, a fan,

tape recorder and television set<sup>15</sup>, cot sides, bed wheels and horizontal surfaces<sup>16</sup>.

Individuals are protected from microbial invasion by non-specific and specific defence systems. The non-specific defence system includes the skin, mucus membrane, certain body secretions (sweat, tears etc.) and the inflammatory response. Immune response comprises the humoral and cellular arms, both may be naturally acquired through infection or artificially through vaccination.

Within the hospital environment, individuals are exposed to greater microbial risk than in the community. On admission to hospital normal skin flora is often replaced by strains of hospital; bacteria which are more resistant to antibiotics and can cause serious infection if they enter the body. Medical or surgical therapy often require interventions that breach the natural defence mechanisms providing a portal of entry for invading micro-organism. Micro-organisms may enter the urinary tract during the process of catheterisation or instrumentation or they may travel retrogressively through or along a urinary catheter. The protective action of mucous membrane and cilia of the lung may be inhibited by drugs or bypassed in a ventilated patient by an endotracheal tube providing a direct route of entry for micro-organisms. The development of infection is dependent on the pathogenicity of invading agent and the susceptibility of the host. The very young and immature are at great risk due to immature or less efficient immune system as well as those with diseases impairing immune system.

Environmental factors such as temperature, air movement, the presence of chemicals, gases or toxins may have an effect on the development of infection.

### PREVALENCE

The overall prevalence rate of HAI is 10%. Many healthcare systems are experi-

encing a change in the discharge policy with patients being discharged into the community earlier. Since the length of stay is a risk factor for infection, this policy could possibly result in a reduction in the infection rate. The move towards shorter lengths of stay may well be accompanied by an increase in the number of infections presenting post-discharge. Results of a one day point prevalence study of nosocomial infection in ICUs in 17 countries in Europe indicated that 44.8% of the patients were infected and 20.6% had ICU-acquired infections. Pneumonia (46.9%), lower respiratory tract infection (17.8%), urinary tract infection (17.6%), and blood stream infection (12%) were the most frequent type of ICU acquired infections reported<sup>1</sup>.

### TYPES OF INFECTION

Urinary tract infections (27%) are the most common types of infection, with surgical wound infection (23%) and lower respiratory tract infection (15%) consistently comprising the other major groups (Fig. 1). It has been suggested that 10% of the patients who acquire an infection in hospital will subsequently die in hospital<sup>2</sup>.

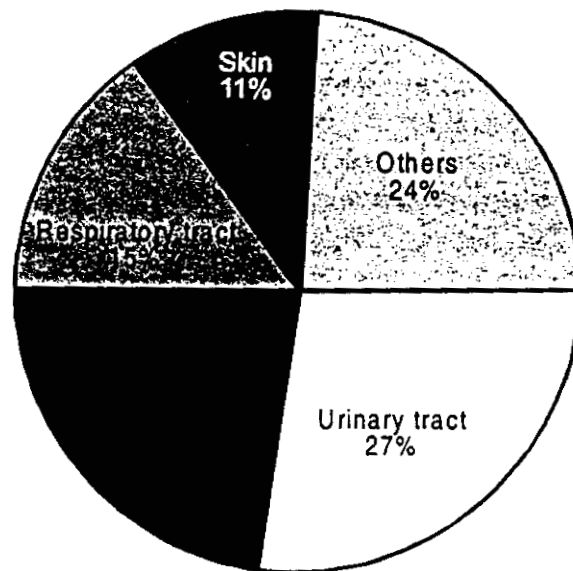


Fig. 1: The frequency of infection by site of infection<sup>2</sup>

**TEN LEADING CAUSES OF DEATH IN THE  
UNITED STATES IN 1982**

Rank cause	Cause of death	Estimated number of deaths
1	Heart disease	756000
2	Cancer	434000
3	Stroke	158
4	Hospital Acquired Infection	80000
5	Chronic lung disease	59000
6	Pneumonia and Influenza	49000
7	Motor vehicle accidents	46000
8	Diabetes mellitus	36000
9	Suicide	28000
10	Chronic liver disease	28000

TABLE - 1

HAI is directly responsible for 10% of these deaths and is a major factor in a further 30%. If deaths directly and partially attributed to HAI are considered, HAI is the 4th leading cause of death (Table 1).

### PREVENTION OF HAI

Although not all HAI can be prevented, there being an irreducible minimum. It has been estimated that approximately one third of these infections may be prevented through effective infection control strategies. Infection control aims to reduce the number of infections occurring by reducing the risk of transmission of potentially pathogenic organisms from their source to the host, limiting their impact once they have entered the host and minimising the spread of an established infection from patient to patient, patient to staff and *vice versa*. Surveillance involves the collection and analysis of data on infections occurring in staff and patients and dissemination of the results to the relevant personnel so that appropriate action can be taken. Antibiotics are used both in the treatment of HAI and as a mean of prevention through their

prophylactic administration but caution must be taken when prescribing antibiotics because of growing resistance. In 9141 virtually all strains of *S. aureus* were sensitive to penicillin. Within three years of its introduction several strains of *S. aureus* became capable of producing  $\beta$ -lactamase thereby inactivating the drug's clinical efficacy. About half of the antibiotics are prescribed inappropriately; that is antibiotics are either not indicated for the conditions or they are incorrectly prescribed. Greater care must therefore be taken when prescribing antibiotics to ensure that the most appropriate antibiotics is prescribed in term of type, dose, and duration of therapy.

Until now demands for infection control have largely been driven by health care professionals; doctors, nurses, microbiologists and specialists in public health. Increasing consumer involvement in public health care in particular the increased emphasis on providing information to patients about the quality of hospitals and empowering them to make choices may add a further pressure group lobbying for investment in measure to reduce HAI. A knowledge and appreciation of the costs involved is likely to raise the profile of HAI in the minds of managers of health services possibly resulting in their being more receptive to these demands and themselves actively seeking to improve infection control. Special selective and differential bacteriological isolation media have been developed for sampling the hospital environment, surgical and medical equipment<sup>15</sup>. In our situation like Pakistan, health care professionals are more exposed to HAI if proper measures are not adopted. Following are a few recommendations for the prevention and control of HAI in Pakistan.

### HOSPITALS DESIGNS

Hospital building designers must consider requirements of local population and their traditions so that facilities of their

standards within their resources and funds are provided. Proper ventilatory facilities must be provided in all wards of the hospitals.

An incinerator must be provided near the hospital for the proper disposal of waste material/product of the hospital.

### HOSPITAL LABORATORY

Laboratory play a key role in the control and prevention of HAI. Special facilities must be provided in the lab. for handling highly infectious pathogens such as Mycobacteria, and viruses (i.e. HBV, HCV, and HIV). According to WHO recommendations all specimens are considered infectious and must be handled carefully by the laboratory staff.

All health care professionals (including lab. staff) must be vaccinated for dangerous pathogens and special training programmes/ refresher courses must be arranged regularly for updating their know-how about emerging pathogens.

Proper protocols in the lab. must be followed by all the staff members handling and disposal of microbiological specimens/materials. White coats used in the labs must not be outside the lab. because they may also be involved in the transmission of pathogens in the hospital.

### INFECTION CONTROL TEAM OF THE HOSPITAL

Teaching hospitals must constitute an infection control team in the hospital. This should include a physician, microbiologist and an infection control nurse. This team can visit district headquarters hospitals and supervise their measures to control HAI. Infection control team will supervise disinfecting procedures carried out in the hospital, fumigation of the wards and operation theatres. All the multi-drug resistant bacteria originate in the hospital due to mis-use and over-use of antibiotics in the

hospitals. The microbiologist should be consulted for prescription of appropriate antibiotics in the control of infection after culture and sensitivity report. Proper surveillance record of the infections in the hospital must be kept by the microbiologist in the lab. to quickly identify any suspected outbreak of infection and properly manage it in time.

It is now time to think over our hospital infection rate and try to control it. A policy for the counter-sale of antibiotics should be designed by the government and must be implemented strictly so that the development of resistance to antibiotics in the community is controlled.

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