

## Nosocomial Infection - A Retrospective Analysis

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**ABSTRACT :** Nosocomial infections are global public health challenge owing to their frequency, severity, economic and social costs. Microbial pathogens such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella* species, *Acinetobacter* species and few less prevalent bacteria like *Stenotrophomonas maltophilia*, *Chryseobacterium indologenes*, *Ralstonia* species, *Gordonia bronchialis*, *Myroides* species, *Kocuria kristinae*, and *Morganella morganii* are considered as prime and emerging nosocomial pathogens that cause decline in the efficacy of antibiotics and eventually jeopardize the clinical outcome necessitating the use of broad spectrum antibiotics. Nosocomial infection increases the treatment costs, duration of stay and constant pursuit for alternative drugs. This review article focusses on strategies that can be leveraged to address the challenges posed by nosocomial infections especially due to antibiotic resistant microbes.

**KEYWORDS:** Antibiotic resistant microbes, Nosocomial pathogens, Broad spectrum antibiotics.

### I. INTRODUCTION

Nosocomial Infections [NI] (or) Hospital Acquired Infections [HAI] (or) Health Care Associated Infections [HCAI; term widely used over NI or HAI] are those infections that are acquired by the patients during their hospital stay. Thus, it is defined as an infection that is acquired or identified at least 48-72 hours following admission to a health care institution. A variety of organisms cause nosocomial infections including bacteria - *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Acinetobacter* species, *Escherichia coli*, *Klebsiella* etc., fungi - *Candida albicans*, *Aspergillus* species, etc., viruses and other parasites. Many microorganisms can survive on the surfaces of inanimate objects and medical devices for days/months/years. Bio films are generally associated with inanimate objects that has enough moisture or water to support microbial growth and survival. This includes urinary catheters, tracheal tubes, breast implants and few other devices. Wet bio film constitutes for about 65% of the NI. But bio films are also being discovered on dry surfaces and are referred to as dry bio films. (Ledwoch *et al.*, 2018). Antimicrobial agents are commonly used for controlling infections. However, most nosocomial bacteria have developed resistance to the commonly used antibiotics or they are naturally resistant towards them. Carbapenem, a beta lactam antibiotic having a broad-spectrum activity, usually used as the last line of defence for severe infections caused by the Gram-negative bacteria has now become the first line treatment of choice. The expanded usage of the drug had given rise to many carbapenem-resistant genes by the enzyme carbapenemase or by the overproduction of beta-lactamases. The carbapenem resistant strains are also transmitted via the resistant genes on conjugative plasmids and are found in food, water, sewage (de Man T J. B. *et al.*, 2019). Extended spectrum  $\beta$ -lactamases (ESBLs) are mostly plasmid-encoded  $\beta$ -lactamases. Organisms with the enzyme ESBL exhibit resistance to penicillin, narrow and broad-spectrum cephalosporin, aztreonam, quinolones, trimethoprim-sulfamethoxazole and amino glycosides. This review focuses on the organisms that are prevalent and/or emerging as nosocomial agents. This includes the antimicrobial susceptibility patterns of those pathogens, the epidemiological characteristics of nosocomial infections and suggestive control measures.

### II. TYPES OF NOSOCOMIAL INFECTIONS

**A. URINARY TRACT INFECTION :** Nosocomial urinary tract infection (UTI) is one of the most common healthcare associated infections worldwide. They are caused by catheter placement and hence termed as CA-UTI (Hariati *et al.*, 2019). The most common CA-UTI pathogens include multidrug resistant members of the Enterobacteriaceae family *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella*, *Proteus*, *Candida*, *Citrobacter* species and *Enterococcus* species.

**VENTILATOR ASSOCIATED PNEUMONIA :** Nosocomial Pneumonia commonly associated with ventilators referred as Ventilator Associated Pneumonia [VAP] is when a patient acquires pneumonia in 48 hours of mechanical ventilation after tracheal intubation or tracheotomy. VAP has an incidence rate of about 15% to 60% and it accounts for 25% to 76% mortality rate in hospitals (Chang *et al.*, 2017). VAP is most common and a predominant risk factor that leads to prolonged stay in hospital with increase in associated costs. Commonly isolated VAP pathogens includes both gram positive and gram-negative organisms such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Escherichia coli*, *Acinetobacter* species.

**BLOOD STREAM INFECTION :** Hospital acquired blood stream infections associated with central venous catheters named as Central Line Associated Blood Stream Infection [CLABSI] or Catheter Associated/Related Blood Stream Infection [CABSI/CRBSI]. Blood Stream Infections can also originate from burn wounds. Among the nosocomial bacteraemia, 15-30% are related to intravascular devices (Ruiz-Giardin *et al.*, 2019). Among the peripheral catheter and intravascular catheter, peripheral catheters have the complication rate in the range of 2.5% and 42% in which, up to 30% of cases have subcutaneous indurations or phlebitis. Catheter-associated blood stream infection is a major cause of morbidity and mortality in the intensive care units particularly in paediatric intensive cares. The nosocomial blood stream infection is caused by a wide range of organisms that includes *Staphylococcus aureus*, *Staphylococcus epidermidis*, *coagulase-negative Staphylococci*, *Acinetobacter baumannii*, *Klebsiella pneumoniae* and *Candida albicans*.

**SURGICAL SITE INFECTION :** Surgical Site Infections [SSI] emerge as the most frequent hospital acquired infection after an invasive surgical procedure. SSI is defined as an infection that is acquired by the patients within 30 days of the surgery if no implant had been placed or within 1 year of surgery if an implant is placed (Chorost *et al.*, 2018).

**HOSPITAL ENVIRONMENT BORNE INFECTIONS :** Hospital protocols are constantly reviewed and revised by infection control committee to reduce the incidence of nosocomial infection. Despite these efforts, several environment niches in the hospital often serve as a reservoir for the survival and transmission of aforementioned pathogens. This includes hospital beds, medical devices and other equipment, wash sinks, toilets and toiletries, furniture etc. Patients can acquire infection from these surfaces through direct contact or indirectly from other personnel by the process of cross contamination.

**WASH SINKS :** Hand washing sinks are important transmitters of high levels of pathogens like *Pseudomonas aeruginosa*, *Enterobacteriaceae*, *Escherichia coli*, *Klebsiella oxytoca*. The zone in which surfaces or objects that come in contact or can become contaminated by droplet transmission around the sink is referred as splash zone. Hand washing sink's drain traps also act as potential reservoirs of nosocomial pathogens. Sink drains can be contaminated by patient or health care professional and the pathogens that form bio films can sustain and serve as a source of nosocomial infection. The humid, wet closed protected environment favours the growth of pathogens. The luminal surface of pipes provides a favourable condition for bio film production. The flow of liquid in the pipes provides a shear force, and the force acts as a mechanism for detachment and distribution of organisms throughout the plumbing system. These bio films also have increased rates of genetic exchange, thus posing a threat for enhanced transmission of mobile genetic elements with antibiotic resistant genes. (Franco *et al.*, 2020)

**HANDS :** Hand hygiene for healthcare professionals is important to prevent infection transmission to patients. High-touch surfaces in patient rooms, such as bed controls, call buttons, and bedside tray tables are the common sources and they serve as Multi Drug Resistant Organism (MDRO) reservoirs. MDROs like VRE (Vancomycin Resistant Enterococci), MRSA (Methicillin Resistant *Staphylococcus aureus*) and antibiotic resistant gram-negative bacilli are few of the organisms that are frequently shed by patients and staff, and they contaminate the surfaces for days, eventually increasing the risk of acquisition by other people who come in contact with these surfaces. When compared to other sites, patients' hands are the commonest anatomical site to contact with the high-touch surfaces/HCP/visitors/patients which increases the risk of transmission of pathogen (Mody *et al.*, 2019).

**MOBILE PHONES AND STETHOSCOPES :** Mobile phones serve as a reservoir for the bacterial pathogen and are also a source of nosocomial infection as the pathogens can be easily transferred from mobile phones by the health care professional hand to different patients and environment (Banawas *et al.*, 2018). Stethoscopes, the most essential medical device can serve as potential vectors in transmitting nosocomial infections if proper surface disinfection is not practiced.

**CONTAMINATED WATER :** Contaminated water can also cause nosocomial infection in dialysis patients and dental care infections.

### III. CONCLUSION

Nosocomial infection caused by a variety of pathogens leads to serious illness in humans that has higher mortality rate. They can increase the cost of treatment and also prolong the hospital stay. Almost all the nosocomial pathogens including predominant and emerging organisms exhibit multi drug resistance mainly towards the  $\beta$ -lactam drugs. Hence, there must be proper understanding of the infections and the organisms that cause the infection. Every possible organism isolated must be carefully analysed and treatment of infection with respective organism should be done properly using appropriate drugs. Each hospital must make norms based on the rules implemented by their countries. Conduction of public awareness programmes on the prevalence of

nosocomial infection can help people to be more cautious. Following standard hygienic practices, sterilization, cleaning techniques with proper disinfectants can reduce the incidence of nosocomial infections and also help in reducing the microbial load. But these procedures do not ensure in eradicating the pathogens rather they help in controlling and preventing the rate of infection. Earlier studies are available on plants used as antimicrobial drugs. Marine sponges have also been found to express properties like antibacterial, antifungal, antiviral, antitumor, antimalarial and antihelminthic activity. Future study can be done on alternative treatment methods like antimicrobial drugs derived from marine sponges against nosocomial pathogens. Until the discovery of appropriate medicines, following proper treatment regime along with personal and public cleanliness can thus help in overcoming these infectious agents.

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