

Hospital Acquired Infections, Sources, Route of Transmission, Epidemiology, Prevention and Control

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Received: 27 Feb 2018/ Revised: 01 April 2018/ Accepted: 28 June 2018

ABSTRACT

Nosocomial infections are infections acquired in the hospital or healthcare service unit that first appear 48 hours or more after hospital admission or within 30 days after discharge following in-patient care. The main routes of transmission of nosocomial infections are contact, airborne, common vehicle and vector-borne. Common infections are urinary tract infections (UTI), surgical and soft tissue infections, gastroenteritis, meningitis and respiratory infections. The agents that are usually involved in hospital acquired infections are *Streptococcus* sp., *Acinetobacter* sp., Enterococci, *Pseudomonas aeruginosa*, Coagulase negative *Staphylococci*, *Staphylococcus aureus*, *Bacillus cereus*, *Legionella* and Enterobacteriaceae family members including *Proteus mirabilis*, *Klebsiella pneumoniae*, *Escherichia coli*, *Serratia marcescens*. Out of these Enterococci, *P. aeruginosa*, *S. aureus* and *E. coli* have a major role. Various infection control programmes and organizations help to lower the risk of infection during and after the period of hospitalization.

Key-words: Epidemiology, Hospital Acquired Infections, Prevention and Control, Route of Transmission, Urinary tract infections

INTRODUCTION

According to the World Health Organization a Hospital acquired infection is an infection acquired in hospital by a patient who was admitted for a reason other than that infection ^[1]. In other words nosocomial infections are those infections, which are acquired in hospital or healthcare service unit that first appear 48 hours or more after hospital admission or within 30 days after discharge following in-patient care ^[2]. 'Nosocomial' or 'healthcare associated infections' (HCAI) can occur during healthcare delivery for other diseases and even after the discharge of the patients.

They also comprise of occupational infections among the medical staff ^[3].

The situations in which infections are not believed as nosocomial are:

- The infections that were present at the time of admission and become complicated, nevertheless pathogens or symptoms change resulting to a new infection;
- The infections that are acquired trans-placental due to some diseases like toxoplasmosis, rubella, syphilis or cytomegalovirus and appear 48 h after birth ^[4].

Increasing nosocomial infections have led to an increased antimicrobial resistance, increase in socio-economic disturbance, and increased mortality rate ^[5]. The various aspects of nosocomial infections are the route of transmission, site of infections, common nosocomial bacterial agents, selected antibiotic-resistant pathogens along with their modes of transmission and control measures.

How to cite this article

Taiyaba, Rai A, Tahira K. Hospital Acquired Infections, Sources, Route of Transmission, Epidemiology, Prevention and Control. Int. J. Life Sci. Scienti. Res., 2018; 4(4): 1858-1862.



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Routes of Transmission- The main routes of transmission include contact, airborne, common vehicle and vector borne [6].

Contact route

Direct Contact- It requires physical contact between the infectious individual or contaminated object and the susceptible host.

Indirect contact- This requires mechanical transfer of pathogens between patients through a health care worker or a medical kit.

Air borne route- Airborne transmission occurs by dissemination of airborne droplet nuclei (small particle) [7]. Microorganisms inhaled by a susceptible host within the same room or over a long distance from the source patient depending on environmental factors. Examples include Mycobacterium tuberculosis, Legionella and the Rubella and Varicella viruses.

Droplet route- Droplet particles, produced by coughing, sneezing and even talking, can settle either on surrounding surfaces or on the body mucosa which can be transferred to others. Examples include meningitis and pneumonia.

Common vehicle transmission- It applies to microorganisms transmitted to the host by contaminated items such as food, water, medications, devices and equipments.

Vector-borne transmission- Vector-borne diseases are infections transmitted by the bite of infected arthropod species, such as mosquitoes, ticks, triatomine bugs, sandflies, and blackflies.

Types of Nosocomial Infections- National Healthcare Safety Network with Center for Disease Control (CDC) for surveillance has classified nosocomial infection sites into 13 types, with 50 infection sites, which are specified on the basis of biological and clinical criteria. The sites, which are common, included UTI, surgical and soft tissue infections, gastroenteritis, meningitis and respiratory infections [8].

Agents of Nosocomial infections- Bacteria are responsible for about ninety percent infections. Protozoans, fungi, viruses and mycobacteria are less contributing compared to bacterial infection [9]. The

agents that are usually involved in hospital acquired infections include *Streptococcus* sp., *Acinetobacter* sp., Enterococci, *P. aeruginosa*, Coagulase Negative Staphylococci, *S. aureus*, *B. cereus*, *Legionella* and Enterobacteriaceae family members including *Proteus mirabilis*, *K. pneumonia*, *E. coli*, *S. marcescens*. Out of these Enterococci, *P. aeruginosa*, *S. aureus*, and *E. coli* play a major role [10]. UTIs are usually caused by *E. coli*, while it is uncommon in other infection sites. Contrarily, *S. aureus* is frequent at other body sites and rarely causes UTI. Coagulase-Negative *S. aureus* is the main causative agent in blood borne infections. Surgical-site infections contain *Enterococcus* sp., which is less prevalent in respiratory tract. One tenth of all infections is caused by *P. aeruginosa*, which is evenly distributed to the entire body sites [11]. Nosocomial infections are being elevated by excessive and improper use of broad-spectrum antibiotics especially in healthcare settings. Penicillin-resistant pneumococci, multi-drug-resistant tuberculosis, methicillin-resistant *S. aureus* (MRSA), vancomycin-resistant *S. aureus* (VRSA) are common examples of drug-resistant bacteria. The distribution of bacteria in nosocomial infections is changing over periods of time. For example, *Proteus* sp., *Klebsiella* sp. and *Escherichia* sp. were responsible for nosocomial infections in 1960, but from 1975 to 1980s, *Acinetobacter* sp. with *P. aeruginosa* created clinical difficulties [12]. Lately, streptococci along with coagulase-negative staphylococci and coagulase-positive staphylococci reemerged and incidence level of *K. pneumonia* and *E. coli* declined from 7% to 5% and 23% to 16%, respectively [13].

S. aureus, out of many species of *Staphylococcus* genus is considered one of the most important pathogens, responsible for nosocomial infections [14].

E. coli is an emerging nosocomial pathogen causing problems in health care settings. *E. coli* is responsible for a number of diseases including UTI, septicemia, pneumonia, neonatal meningitis, peritonitis and gastroenteritis [15,16]. The second leading cause of hospital acquired infections worldwide is Enterococci [17]. Three to seven percent of hospital-acquired bacterial infections are related to *K. pneumonia*, which is the eighth significant pathogen in healthcare settings. It gets involved in diseases such as neonatal septicaemia, pneumonia, wound infections and septicemia [18]. *P. aeruginosa* contributes to 11% of all nosocomial

infections, which result in high mortality and morbidity rates. It is a cause of surgical and wound infections, UTI, pneumonia, cystic fibrosis and bacteremia [19]. *C. difficile* is an important nosocomial pathogen, which mainly causes diarrhea [20].

High-risk situations for acquiring hospital-acquired infections- Numerous risk factors are there which predispose a host to acquire HAIs which include low body resistance as in infancy and old age, serious underlying illnesses, major surgeries [21], immune deficiency states [22] and prolonged hospital stay [23]. Various areas are there in the hospital which carry a greater risk of patients acquiring HAI's [24,25]. These include intensive care unit, dialysis unit, organ transplant unit, burns unit, operation theatres, delivery rooms, post-operative wards.

Prevention of Nosocomial Infections- Various measures that should be taken for the prevention of Nosocomial infections are:

- Limiting the transmission of organisms between patients indirect patient care through adequate hand washing and glove use, and appropriate aseptic practice, isolation strategies, sterilization and disinfection practices, and laundry.
- Controlling environmental risks leading to infection.
- Protecting patients with appropriate use of prophylactic antimicrobials, nutrition, and vaccinations.
- Limiting the risk of endogenous infections by minimizing invasive procedures and promoting optimal antimicrobial use.
- Surveillance of infections, identifying and controlling outbreaks.
- Prevention of infection in staff members.
- Enhancing staff patient care practices, and continuing staff education.

Routine cleaning and precautionary measures in most hospitals, effective environmental decontamination methods are still in demand. Disinfectants are commonly used to minimize the risk of MRSA [26]. Resistance to Methicillin was documented in 8(50%) of 16 *Staphylococcus* isolates [27].

Hospital Infection Control Programme- In the 1960s infection prevention and control programmes were

initially implemented in hospitals in the US. The main aim of the infection control programme is to lower the risk of an infection during the period of hospitalization [28].

Infection Control Organizations

Infection Control Committee (ICC)- Representatives of medical, nursing, pharmacy, CSSD and Microbiology departments are the members of the ICC. The committee formulates the policies for the prevention and control of infection [29]. The role of the Infection Control Committee is very multi-faceted. It should be involved in planning, monitoring, evaluating, updating and educating.

Infection Control Team (ICT)- Infection Control Team is responsible for establishing infection control policies and procedures, providing advice and guidance regarding infection control matters, regular audits and surveillance, identification and investigation of outbreaks, awareness and education of staff.

Infection Control Officer (ICO)- Secretary of Infection Control Committee are responsible for recording minutes and arranging meetings. When notified of an exposure incident, the infection control officer should ensure that notification, verification, treatment and medical follow-up occur.

Infection Control Nurse (ICN)- To cooperate between microbiology department and clinical departments for detection and control of HAI. ICN works in close assistance with the ICO on surveillance of infection and detection of outbreaks of infection. ICN also increases awareness among patients and visitors about infection control and various measures that need to be taken.

CONCLUSIONS

Increasing nosocomial infections have led to an increased antimicrobial resistance, increase in socio-economic disturbance and increased mortality rate. Nosocomial infections are uncontrollable even in this age of advanced antibiotics. Measures must be taken at the Hospitals to come up with an in-house awareness programme where staff members, patients and their relatives can be educated and well equipped on maintaining hygiene.

ACKNOWLEDGMENTS

Authors are thankful to the G.C.R.G. Institute of Medical Sciences and Hospital, Lucknow for their assistance where this study took place.

CONTRIBUTION OF AUTHORS

All authors are equally contributed.

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