

Nosocomial Infections: A Review Article

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Abstract: *Nosocomial infections are a major threat to the patients' safety in any health-care facility. However, the prevalence is higher in the Intensive Care Units (ICUs) than other areas of the hospital. A study by the international nosocomial infection control consortium found that the rates of hospital-acquired infections in India were higher than the statistics provided by the CDC (Center for Disease Control and Prevention). Overcrowded hospitals with poor infrastructure, lack of basic hygiene, low healthcare professionals to patient ratio, inappropriate usage of invasive devices and antibiotics, and lack of regulation enforcement contributes to nosocomial infections-associated deaths in India. In spite of awareness campaigns, the prevalence of nosocomial infections remains high in India. A recent study found 143 strains of Acinetobacter in a tertiary hospital in India, of which, 126 (88.1%) were extremely drug resistant. Risk factors for hospital-acquired infections include older age, immunosuppression, longer hospital stays etc., About one third of nosocomial infections can be regarded as avoidable. Routine surveillance of nosocomial infections and multiresistant pathogens, feedback of data to all personnel involved in patient care, and routine educational activities in this field are the crucial elements for achieving high compliance with the most important infection control measures.*

Keywords: Nosocomial infection; ICU

1. Introduction

Nosocomial infection is a major problem in hospitals worldwide and the prevalence is two-to threefold higher in developing countries compared to Europe or USA. ¹The incidence is particularly high in intensive care units (ICUs) compared to non-ICU wards in the hospital as ICU patients have a range of severe comorbidities and the use of invasive devices during their management is very common. ²Reports from a range of ICU settings including those in developing countries consistently show a high burden of device-associated nosocomial infections. Nosocomial infections are caused by a wide range of pathogens, and ventilator-associated pneumonia and central line infections are common sites of infections and are associated with high mortality—as high as 50%. Nosocomial infections are associated with an increase in crude mortality, length of stay in ICU, and hospital costs. ⁴

A study by the international nosocomial infection control consortium found that the rates of hospital-acquired infections in India were higher than the statistics provided by the CDC (Center for Disease Control and Prevention). Overcrowded hospitals with poor infrastructure, lack of basic hygiene, low healthcare professionals to patient ratio, inappropriate usage of invasive devices and antibiotics, and lack of regulation enforcement contributes to nosocomial infections-associated deaths in India. Recently, few children lost their lives in a tertiary referral hospital in Gorakhpur located in the northern state of Uttar Pradesh. ⁴The Ministry of Health and Family Welfare of India launched an anti-microbial resistance awareness campaign known as 'Red Line', which encouraged people to put a stop to usage of medicines marked with a redline (antibiotics) and lacking a valid prescription from a physician. ⁵In spite of awareness campaigns, the prevalence of nosocomial infections remains high in India. A recent study found 143 strains of Acinetobacter in a tertiary hospital in India, of which, 126 (88.1%) were extremely drug resistant. ⁶

Prevalence of nosocomial infection

Nosocomial infections are a major threat to the patients' safety in any health-care facility. However, the prevalence is higher in the Intensive Care Units (ICUs) than other areas of the hospital. ⁷This increased prevalence of nosocomial infection not only influences the mortality and morbidity pattern of ICU but also poses a significant financial burden to the patient and the society. Magill National nosocomial infections surveillance system has defined nosocomial infection as a localized or systemic condition that results from an adverse reaction to the presence of an infectious agent(s) or its toxin(s) that was not present or incubating at the time of admission to the hospital. The important nosocomial infections in the ICU based on frequency and potential severity include urinary tract infection (UTI), pneumonia, bloodstream infections, skin and soft tissue infections, gastroenteritis, hepatitis, and meningitis. ⁸

Nosocomial pathogens

Nosocomial infections or healthcare associated infections occur in patients under medical care. These infections occur worldwide both in developed and developing countries. Nosocomial infections accounts for 7% in developed and 10% in developing countries. As these infections occur during hospital stay, they cause prolonged stay, disability, and economic burden. Frequently prevalent infections include central line-associated bloodstream infections, catheter-associated urinary tract infections, surgical site infections and ventilator-associated pneumonia. **Nosocomial pathogens include bacteria, viruses and fungal parasites.** According to WHO estimates, approximately 15% of all hospitalized patients suffer from these infections. During hospitalization, patient is exposed to pathogens through different sources environment, healthcare staff, and other infected patients. Transmission of these infections should be restricted for prevention. Hospital waste serves as potential source of pathogens and about 20%–25% of hospital waste is termed as hazardous. Nosocomial infections can be controlled by practicing infection control programs, keep check on antimicrobial use and its resistance, adopting

antibiotic control policy. Efficient surveillance system can play its part at national and international level. Efforts are required by all stakeholders to prevent and control nosocomial infections.⁹

Types of nosocomial infections

The most frequent types of infections include central line-associated bloodstream infections, catheter-associated urinary tract infections, surgical site infections and ventilator-associated pneumonia.

Central line-associated bloodstream infections (CLABSI)

CLABSIs are deadly nosocomial infections with the death incidence rate of 12%–25%. Catheters are placed in central line to provide fluid and medicines but prolonged use can cause serious bloodstream infections resulting in compromised health and increase in care cost. Although there is a decrease of 46% in CLABSI from 2008 to 2013 in US hospitals yet an estimated 30,100 CLABSI still occur in ICU and acute facilities wards in US each year.¹⁰

Catheter associated urinary tract infections (CAUTI)

CAUTI is the most usual type of nosocomial infection globally. According to acute care hospital stats in 2011, UTIs account for more than 12% of reported infections. CAUTIs are caused by endogenous native microflora of the patients. Catheters placed inside serves as a conduit for entry of bacteria whereas the imperfect drainage from catheter retains some volume of urine in the bladder providing stability to bacterial residence. CAUTI can develop to complications such as, orchitis, epididymitis and prostatitis in males, and pyelonephritis, cystitis and meningitis in all patients.¹¹

Surgical site infections (SSI)

SSIs are nosocomial infections be fall in 2%–5% of patients subjected to surgery. These are the second most common type of nosocomial infections mainly caused by *Staphylococcus aureus* resulting in prolonged hospitalization and risk of death. The pathogens causing SSI arise from endogenous microflora of the patient. The incidence may be as high as 20% depending upon procedure and surveillance criteria used.¹²

Ventilator associated pneumonia (VAP)

VAP is nosocomial pneumonia found in 9–27% of patients on mechanically assisted ventilator. It usually occurs within 48 h after tracheal incubation. 86% of nosocomial pneumonia is associated with ventilation. Fever, leucopenia, and bronchial sounds are common symptoms of VAP.¹³

Antibiotic resistance has emerged as a major problem in nosocomial infections and has very serious negative implications for the treatment of such infections, especially in the developing world. Highly antibiotic-resistant strains frequently encountered in healthcare infections include methicillin-resistant *S. aureus* (MRSA), vancomycin-resistant Enterococci (VRE), carbapenem-resistant Enterobacteriaceae (CRE), and extended-spectrum beta-lactamase producing *E. coli*.¹⁴

These bacterial strains account for the majority of outbreaks and mortality cases of healthcare infections. The most

studied of these antibiotic-resistant strains appears to be MRSA, which is endemic in many hospitals worldwide, particularly in Europe, the United States, and Asia. In the United States, the annual incidence of invasive MRSA infections in hospitals is estimated to be 94,360, resulting in 18,650 deaths.¹⁵ Data from 31 European countries showed that between 2007 and 2008, there were 27,711 episodes of MRSA blood stream infections with 5503 deaths. Though MRSA is considered a nosocomial pathogen traditionally, it has emerged in the community in the last two decades and is responsible for several types of community-acquired infections.¹⁶

Characteristically, healthcare-associated MRSA (HA-MRSA) and community-associated MRSA (CA-MRSA) are considered to be different from each other in terms of their epidemiology, genetic traits, and types of infections. Only a few of the known HA-MRSA clones are responsible for the majority of infection, and different clones dominate in different geographical regions. For example, the ST239-SCCmecIII clone predominates in South American, Asia, and Africa.¹⁷

Risk factors

The risk of hospital-acquired infection is dependent on the patient's immune status, infection control practices, and the prevalence of the various pathogens in the local community. Risk factors for hospital-acquired infections include older age, immunosuppression, longer hospital stays, multiple underlying chronic illnesses, frequent encounters with healthcare facilities, recent invasive procedures, mechanical ventilatory support, indwelling devices and stay in a critical care unit with an increased risk of hospital-acquired infections. One of the major factors for developing antimicrobial resistance to multiple drugs is prior receipt of antibiotics within the last 90 days. While hospitalizations play a role in the management of acute illness, they also place susceptible patients in contact with multiple nosocomial and often antimicrobial-resistant pathogens and those from other patients, hospital staff, or the hospital facility. Not surprisingly, about 20% of all nosocomial infections occur in the intensive care unit (ICU).¹⁸

Transmission

Nosocomial infection is an infection that is acquired in a hospital or other health care facility. Such an infection can be acquired in hospital, nursing home, rehabilitation facility, outpatient clinic, or other clinical settings.¹⁹ Infection is spread to the susceptible patient in the clinical setting by various means. Health care staff can spread infection, in addition to contaminated equipment, bed linens, or air droplets. The infection can originate from the outside environment, another infected patient, staff that may be infected, or in some cases, the source of the infection cannot be determined.²⁰

In some cases, the microorganism originates from the patient's own skin microbiota, becoming opportunistic after surgery or other procedures that compromise the protective skin barrier.²¹ The patient may have contracted the infection from their own skin, the infection is still considered nosocomial since it develops in the health care setting. The

nosocomial infections are caused by bacterial, viral and fungal pathogens. Barkat

The most common pathogens are staphylococci, pseudomonas, E-coli, Klebsiella, mycobacterium tuberculosis, candida, aspergillus, fusarium, trichosporon and malassezia. All of these pathogens leads to increased risk of morbidity and mortality. It can be due to contaminated food items, water or other equipments or may be vector borne due to flies, mosquito or rats.²²

Preventive measures

Nosocomial infections are still an important issue in surgical wards. About one patient in 15 is affected, most of them from surgical site or urinary tract infections, but pneumonia cases can also be observed frequently. Some of these infections are due to multiresistant pathogens. About one third of nosocomial infections can be regarded as avoidable. Routine surveillance of nosocomial infections and multiresistant pathogens, feedback of data to all personnel involved in patient care, and routine educational activities in this field are the crucial elements for achieving high compliance with the most important infection control measures.²³

Infection Prevention in Burns Patients

In burn patients, the primary mode is direct or indirect contact—either through the hands of the personnel caring for the patient or from contact with inappropriately decontaminated equipment. Burn patients are unique in their susceptibility to colonization from organisms in the environment as well as in their propensity to disperse organisms into the surrounding environment. In general, the larger the burn injury, the greater the volume of organisms that will be dispersed into the environment from the patient.²⁴

Isolation guidelines

Standard precautions should be followed when caring for all patients with burn injury. The effectiveness of simple protective barrier precautions reduces nosocomial colonization and infection. It is recommended that patients with larger burn injuries be isolated in private rooms or other enclosed bed spaces to ensure physical separation from other patients on the unit. Such isolation has been associated with a decrease in cross transmission of organisms.²⁵

Nosocomial infection can be prevented by minimizing the spread of causative agents, isolation for the patient suffering from infectious disease and maintaining well sanitary conditions in hospitals and medical care unit. A medical device or surgical instrument which comes in contact with the patient during treatment or operation procedure has an associated risk of disease transmission which is due to failure of sterilization or disinfection. Microbial air contamination is monitored by colony forming unit per cubic meter (CFU/m³) count. This can be done either by passive or active sampling methods. Nosocomial infection can be prevented by minimizing the spread of causative agents, isolation for the patient suffering from infectious disease and maintaining well sanitary conditions in hospitals and medical care unit.²⁶

2. Conclusion

Nosocomial infections are a major public health problem throughout the world. The most likely complication of hospital care, nosocomial infections, mainly surgical site infections and catheter related blood stream infection (CRBSIs) significantly impacts the morbidity and mortality, and financial cost implications due to prolonged hospital stay and related expenditure, thus adding to the overall healthcare cost for patients. The burden of hospital acquired infections (HAIs) is even higher in developing countries like India, as compared to developed countries. SSI and CRBSIs are the most preventable types of HAIs with proper prevention and control measures which not only help reducing the incidence of infection, but also decrease the related financial burden on the patient.

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