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## Nosocomial Infection and Its Control System in India: A Review



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### ABSTRACT

Nosocomial infection (NI) also known as Hospital Acquired Infections (HAIs) are amongst the most common complications of hospital care and one of the leading causes of death. Though WHO estimates about 7-12% HAI burden in hospitalized patients globally, the figures from India are alarming, with an incidence rate varying from 11% to 83% for different kinds of HAIs. So this article reviews the literature and data for Nosocomial infections from India particularly focusing on the lacuna in prevention and surveillance of Infection control for nosocomial infections. It was observed that though the International Nosocomial Infection Control Consortium (INICC), CDC, and National Hospital Infection Control Guidelines are in place, its implementation and awareness among hospital settings especially private tertiary care hospitals seem to be lacking. So there assumes an urgent need for proper awareness, understanding, and training among healthcare professionals and patients about the effective way of implementing appropriate infection control systems for proper surveillance & management of nosocomial infection in the hospitals that will help in preventing and decreasing its impact.

## INTRODUCTION:

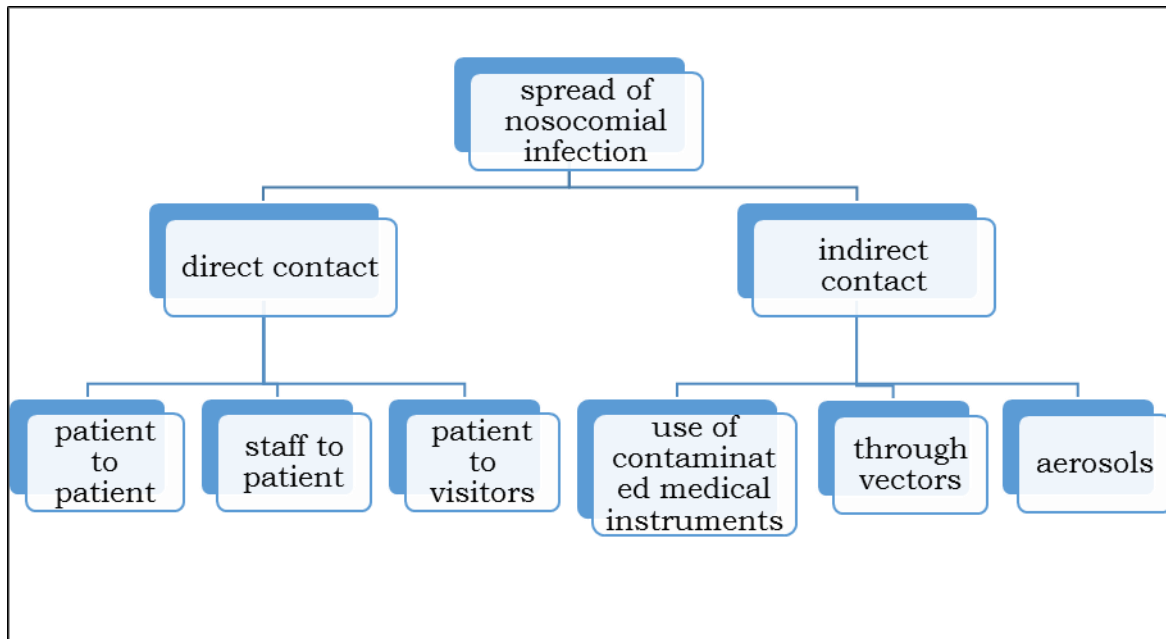
A Nosocomial infection also called as 'Hospital-acquired infection' or 'Healthcare-Associated Infection' can be defined as 'an infection which occurs inpatient while receiving health care facility in whom the infection was not present or incubating at the time of admission but appearing after discharge'.<sup>[1]</sup> These infections are acquired by the patients within 3 days of admission in the hospital or medical care unit. Most of the time it becomes too difficult to make out whether an infection was acquired inside the hospital or outside a specific healthcare setup.<sup>[2]</sup>

Nosocomial infection occurs in all types of care settings, including acute care hospitals, ambulatory surgical centres, dialysis facilities, outpatient care (e.g., physician's offices and health care clinics) and Long-term care facilities (e.g., nursing homes and rehabilitation facilities).

The current review highlights the published literature on epidemiology and infection control systems for Nosocomial infection. A thorough literature search was performed using various databases like Research Gate, Elsevier and general search engines. The citations published in last two decades mainly highlighting epidemiology, prevalence rate, incidence rate, and economic burden with special reference to India were considered for the review. Most of these were prospective observational studies.

### Sources of Nosocomial Infection

The microbes cause nosocomial infections originated in hospitals, clinics, and medical care centre. Fig. 1 shows the spreading of infection by both direct and indirect contact. Touching to an infected person, animals or reservoir of infection comes under direct contact. Communicable infectious agents and pathogens present in inanimate object lead to the indirect spreading of nosocomial infection. Aerosols which are originated by coughing and sneezing of patients may carry pathogens that can transmit the diseases. The common pathogen causing nosocomial infections are *S. aureus*, *Klebsiella*, *E. coli* and *Staphylococcus epidermis*.<sup>[3]</sup>



**Figure No. 1: Spread of nosocomial infection**

Inpatient stays in hospitals could also affect the incidence of Nosocomial infection due to cross contamination, patients' susceptibility to infection, and other clinical and non-clinical reasons. It gives the relationship between the length of stay (LOS) and NI. Both LOS and NI are interdependent. It means that the longer a patient stays in a hospital, the higher the probability of acquiring an infection; and an increase in probability of an infection increases LOS.<sup>[4]</sup>

### **Factors affecting the spread of infections**

Many factors might be responsible for the spread of such infections like Lack of proper cleaning facilities, Low body immunity in patients; More use of antibiotics can develop resistant bacteria, making the antibiotic less effective, Improper handwashing by the patient and hospital staff may increase the risk; Immunosuppressive patients; Improper ventilation in operation theatre and wards; Overcrowding of hospital; Lack of knowledge about spread of infections; Intensive care unit of the hospital represents a high-risk area which is more likely to have infection; Hospital stay for a long time can increase the risk.<sup>[5]</sup>

### **Types of Nosocomial Infections**

The common types of nosocomial infections include 1) ventilator-associated pneumonia (VAP), 2) central line-associated bloodstream infections (CLA-BSIs), 3) catheter-associated urinary tract infections (CA-UTIs), and 4) surgical-site infections (SSIs). These infections are

now frequently being caused by multidrug-resistant organisms, which causes a therapeutic dilemma. Device-associated infections continue to be one of the main threats to the patient safety, particularly in Intensive Care Units (ICUs) of low-and middle-income countries (LMICs).<sup>[6]</sup> A study conducted by Dr. Victor Rosenthal which is published in the International Nosocomial Infection Control Consortium (INICC) estimates the rates of device-associated infections across 40 Indian hospitals compared to a number of other countries. These studies were carried out on patients in intensive care units (ICUs). From these studies, it was found that ventilator-associated pneumonia rate of 10.4 per 1,000 mechanical ventilator-days, 7.92 central line-associated bloodstream infections occurred per 1,000 central line-days, 10.6 catheter-associated urinary tract infections per 1,000 urinary catheter-days.<sup>[7]</sup>

#### **Ventilator-Associated Pneumonia (VAP):**

VAP is a potentially fatal and costly NI in the ICU. Between 10% and 20% of patients ventilated for a duration of over 48 hr develop VAP. In addition, VAP is associated with a longer duration of mechanical ventilation, hospital length of stay (LOS). According to the International Nosocomial Infection Control Consortium (INICC), the overall rate of VAP in ICUs of low-and middle-income countries (LMICs) is 13.6/1000 ventilator days. In contrast to the rates of 1–4/1000 ventilator days in the developed world, the incidence in LMICs varies according to the patient group and hospital setting, ranging from 13 to 51/1000 ventilation days. The mortality associated with VAP ranges from 24% to 76%, and is higher among critically ill patients.<sup>[6]</sup>

#### **Central Line-Associated Bloodstream Infections (CLABSI):**

CLABSIs are deadly nosocomial infections with a death incidence rate of 12%–25%<sup>[5]</sup>. CLABSIs pose a threatening risk to patient safety, particularly because of their direct relationship with high mortality rates in ICUs and their impact on the limited-resource countries.<sup>[8]</sup> CLABSI pathogenesis is via two major routes i.e. intraluminally and extraluminally. Catheters are inserted in central line to provide fluid and medicines but prolonged use leads to serious bloodstream infections resulting in compromised health and increase in care cost.<sup>[9]</sup>

### **Catheter-Associated Urinary Tract Infections (CAUTI):**

The urinary tract infection (UTI) is the most common infection which is acquired in both hospitals and nursing homes and is usually associated with catheterization. The predominance of CAUTI in the catheterized patients in acute care settings (catheter used for 7 days, it is up to 25% and it approaches 100% after 30 days. CAUTIs are caused by endogenous native microflora of the patients. Study carried out by Mudita Jain et. al., estimate that the rate of bacteria was more when the duration of catheterization increased, bacteria rate was maximum when duration was more than 3-4 days. Similarly, study done by S Nivedita found that catheter-associated bacteria increases when duration of catheterization increases.<sup>[10]</sup>

### **Surgical Site Infections (SSI):**

These are the second most common type of nosocomial infections mainly caused by *S. aureus* resulting in prolonged hospitalization and risk of death. The responsible pathogens for SSI originate from the patient's endogenous microflora. The incidence of SSIs may be as high as 20%, depending on the surgical procedure and the surveillance criteria used.<sup>[11,12]</sup>

### **Epidemiology of Nosocomial Infections**

Almost any pathogen can cause nosocomial infection but those that can survive in the hospital environment for longer periods and able to develop resistance to antibiotics and disinfectants are particularly important in this respect. *S.aureus* and its strains continue to be the commonest causative agents of NI. The Gram-negative bacilli of the family Enterobacteriaceae- *E coli*, *Klebsiella*, *Enterobacter*, *Proteus*, *Serratia* have also become an important group of hospital pathogens. *P.aeruginosa* and other *Pseudomonas* species are other important causes of hospital infections.

Nosocomial infections are a recurrent problem and it affects huge number of patients globally which increases the mortality rate and financial losses significantly. 100s of patients are affected by it worldwide annually.<sup>[13]</sup> These infections are responsible for 4%–56% of all death causes in newborns. The incidence rate in high-income countries is in between 3.5% and 12% whereas it varies between 5.7% and 19.1% in middle and low income countries. The frequency of overall infections in low-income countries is three times higher than in high income countries.

To standardize the Nosocomial infection surveillance understanding and methodology across the world, the International Nosocomial Infection Control Consortium (INICC) an international, non-profit, multicentric healthcare-associated infection (HAI) cohort surveillance network was established around 1999 by creating a global network in order to join efforts to reduce healthcare-associated infections throughout the world. It comprises of more than 2,000 healthcare centers in 423 cities of 69 countries in Africa, Latin America, South-East Asia, Europe, Eastern Mediterranean and Western Pacific, which had joined this project voluntarily with the worldwide fight against nosocomial infections. INICC maintains confidentiality regarding the identity of the participating healthcare centers. Currently, around 36 Indian cities healthcare centers are part of INICC. <sup>[14]</sup>

### **Nosocomial Infections and Infection Control System in India**

Over the years, there seems to be an increase in Nosocomial infections among patients in tertiary care hospital in India. One of the study conducted by INICC, found that the rates of Nosocomial infections in India were higher than the statistics provided by the CDC (Center for Disease Control and Prevention).<sup>[15]</sup> 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 contribute to nosocomial infections-associated deaths in India. Another study found 143 strains of Acinetobacter in a tertiary hospital in India, of which, 126 (88.1%) were extremely drug-resistant. The quality and consistency of surveillance data on nosocomial infections is limited in India.<sup>[16]</sup>

In 2007, the INICC conducted prospective surveillance in 7 Indian cities to determine the rate of Nosocomial Infections, microbiological profile, and related aspects in India. Data for a total of 10,835 patients hospitalized for a total of 52,518 days from 12 ICUs at 7 different hospitals were evaluated. This study benchmarks Nosocomial Infection rates in Indian ICUs against international standards. An overall infection incidence rate of 4.4% corresponding to 9.06 infections per 1000 ICU-days was reported. <sup>[17]</sup> Similarly, there are increasing reports from different parts of the country revealing varying Nosocomial Infection incidence rates across various healthcare setups. In India, major health services are largely organised by government hospitals. Unfortunately, very limited Nosocomial infections data is available from these government hospitals to assess the actual burden of NI in India.

The crude mortality rate in the INICC survey across developing countries including India ranged from 35.2% to 44.9%. <sup>[18]</sup> In India, the extravagant use of antibiotics and antibiotic

resistance adds to the expenditure as well as mortality following Nosocomial infections. [19] Additionally, in India, infections due to multi drug-resistant organisms increase mortality and also warrant the use of high end antibiotics like Carbapenems and new generation Tetracyclines which increase the health care expenditure.

The Hospital Infection Society India is an association of medical professionals with a special interest in the prevention and control of hospital infection. It is registered with Registrar of Societies at Delhi. Founded in 1991, the society presently has more than 700 members. Hospital Infection Society India [HISI] provides the essential tools, education materials & communication that unite HISI members and foster the development of Hospital Infection Control programs based on evidence through its publications. But the activities of HISI seem to have not reached the desirable hospital settings and hence its intention could not be reached unless percolated throughout the country systematically.

It is therefore observed that there are some gaps that has to be taken care of such as: the absence of policies or guidelines at national or state level, Quality of treatment is poor in hygiene, Lack of Infection control committee organised in all the hospitals, misuse of antibiotics, inappropriate therapeutic or diagnostic procedures leading to Nosocomial Infections, Lack of knowledge among health professionals, Lack of trained health professionals, Lack of national wise data source to know the actual status about Nosocomial Infections, Inadequate hospital infrastructure with lack of maintenance in hospital environment, lack of national hospital surveillance system, lack of National hospital infection control programme, that can include: One infection control practitioner for every major health facility, A trained hospital epidemiologist, A system of reporting feedbacks on NI to concerned practitioner, Continuing education of medical staff, Control of infectious disease outbreak, Protection of employees from infection, Advice and training on new procedures, Instructions on all necessary control measures and many such measures to analyse and implement the control programme.

One of the review indicated that the bundle approach is highly effective in reducing the incidence of DAIs and in reducing the mortality and ICU stay as a preventive steps. But the interventions selected in a preventive care bundle should be supported with scientific evidence for effectiveness. Similarly, all the elements of the bundles must be executed at the same time. The responsibilities of this multidisciplinary group include setting prevention benchmarks, establishing goals and timelines and providing appropriate education, training,

audits and feedback to the staff and, at the same time, continually updating themselves on the relevant clinical and prevention strategies.<sup>[20]</sup>

Health care facilities (HCFs) are also responsible for the management of the waste generated within the facilities. Inefficiencies in following the guidelines lead to an increase likelihood of infections and may further lead to sepsis, urinary tract infection, and other complications.<sup>[21]</sup> The effective implementation of waste management, infection control, and sanitary practices requires the collective efforts of all the cadres of the facility to make it achievable. The staff should be motivated for their “good practices” rather than taking radical steps due to their “noncompliance” which only result in degrading the level of motivation within the health worker. Multimodal and multidisciplinary approaches are needed to change the established knowledge, attitude, and behavior of health-care workers toward good hygiene and sanitary practices.<sup>[22]</sup>

The qualitative observations of one of the studies identified certain gaps that included Human resource, Housekeeping, Lack of equipment/materials for waste handlers, Maintenance of records, Knowledge and practices of facility staff regarding infection prevention and control. It was observed that almost all facilities reported a lack of workforce for maintaining optimal WASH and also the available staff was overburdened doing multitasking. Similarly, knowledge and practice on unidirectional and outward mopping techniques of cleaning critical areas were poor. Most of the facilities failed to display housekeeping checklists. No records were found for regular monitoring of infection control practices such as hand hygiene and personal protection. The awareness regarding Infection Prevention Control was poor.<sup>[23]</sup>

The Health Ministry of India should therefore come up with a national surveillance program that will regulate the hospitals throughout the country. Under such a surveillance plan, a provision of recording the patient information electronically to establish a national database should be initiated. Proper functioning of the hospital infection control committees in hospitals nationwide is essential. Educating and vaccinating hospital staffs are some other measures that can be implemented in hospitals that can aid infection control. Patients that come to hospitals for treatment should be informed about the importance of timely reporting of hospital-acquired infections. Health care professionals can partner up with hospital administrators to implement interventions that can minimize medication misadventure, control infection spread and enhance patient care.<sup>[24]</sup>



An integrated infection control program can reduce the incidence of infection by as much as 30% and reduce the health care costs. <sup>[25]</sup>In India, the challenges such as poor medical infrastructure, un-controlled use of antibiotics increased the risk of development of Nosocomial infections. SSIs and CRBSIs are considered to be the commonly reported NIs in India. Measures to control the infections comprise of identifying patients at risk of getting infected, evaluating hand hygiene practices, monitoring and surveillance of medical instruments such as vascular catheters, respiratory tubes, and other hospital gear. Additionally, behavioral change is an important component for controlling the spread of NIs along with proper training to healthcare workers when dealing with patients. Patients in the ICU can get infected with diseases like pneumonia, bloodstream infection and urinary tract infection (UTI) due to contamination.

With the increased burden of nosocomial infections and antimicrobial resistance, it has become difficult for healthcare administrations and infection control committees to reach the goal for the elimination of intervals. An efficient surveillance method guided by WHO can help healthcare institutes to devise infection control programs. Proper training of hospital staff for biosafety, proper waste management and healthcare reforms and making the general public aware of these endemic infections can also help in reduction of nosocomial infections.<sup>[26]</sup>

## **CONCLUSION:**

So it could be concluded that only set up the committees would not be sufficient, but it would be essential to record & maintain timely data, maintenance of manual for infection control, educating and training the hospital staff, patient awareness, identification of risk & implementing preventive measures, incidence monitoring, and appropriate active surveillance are essential for proper and effective infection control system. Hospitals should effectively follow the Hospital Infection Control Guidelines given by ICMR thereby leading to greater and steady adherence to infection control programs and guidelines. There should also be a mandatory system of reporting the appropriate data on nosocomial infection periodically to the concerned authorities for better management of nosocomial infections. We can hope such initiatives will surely help in reducing the impact of Nosocomial infections and help in better treatment and care.

## REFERENCES

1. Bhadade R. Prospective evaluation and mortality outcome of nosocomial infections in medical intensive care unit at tertiary care teaching centre in Mumbai, *Emergency Med*, 3, 2013, 2.
2. Ramasubramanian V, Iyer V, Sewlikar S, Desai A, Epidemiology of healthcare acquired infection – An Indian perspective on surgical site infection and catheter related blood stream infection, *Indian Journal of Basic and Applied Medical Research*, 3, 2014, 46-63.
3. Joshi M, Sukhminderjit Kaur, HemantPreet Kaur and Mishra T, Nosocomial infection: source and prevention, *International Journal of Pharmaceutical Science and Research*, 10, 2019, 1613-1624. {4 into 3}
4. Hassan M, Tuckman HP, Patrick RH, Kountz DS, Kohn JL, Hospital length of stay and probability of acquiring infection, *International Journal of pharmaceutical and healthcare marketing*, 4, 2010, 324-38.
5. Nautiyal A, Madhav NS, Sharma RK, Ojha A, Bhargava S, Review on nosocomial infections. *Carib J Sci Tech*, 3, 2015, 781-8.
6. Mathur P, Prevention of healthcare-associated infections in low-and middle-income Countries: The 'bundle approach', *Indian journal of medical microbiology*, 36, 2018, 155.
7. Hospital acquired infections on the rise 2017. Available from: <<https://www.healthissuesindia.com/2017/03/21/hospital-acquired-infections-rise/>>. [Accessed on 14 september 2019]
8. Rosenthal VD, Central line-associated bloodstream infections in limited-resource countries: a review of the literature, *Clinical infectious diseases*, 49, 2009, 1899-907.
9. Kusek L. Preventing central line-associated bloodstream infections, *Journal of nursing care quality*, 27, 2012, 283-7.
10. Jain M, Kaushal R, Bharadwaj M, Infection surveillance analysis of catheter associated urinary tract infections in obstetrics and gynecology department of a tertiary care hospital of Central India, *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 7, 216.
11. Owens CD, Stoessel K, Surgical site infections: epidemiology, microbiology and prevention, *Journal of Hospital Infection*, 70, 2008, 3-10.
12. Anderson DJ, Surgical site infections, *Infectious disease clinics of North America*, 25, 2011, 135-53.
13. Khan HA, Baig FK, Mehboob R. Nosocomial infections: Epidemiology, prevention, control and surveillance, *Asian Pacific Journal of Tropical Biomedicine*, 7, 2017, 478-82.
14. <http://www.inicc.org/history/>
15. Rosenthal VD. International Nosocomial Infection Control Consortium (INICC) resources: INICC multidimensional approach and INICC surveillance online. *Am J Infect Control*. 2016;44(6):e81-90.
16. Akula S, Manderwad GP, Anukolu RS, Rajkumar HR. Emergence of Extensively drug-resistant *Acinetobacterspp* in a tertiary care centre of Hyderabad, Telangana state. *Indian J Microbiol Res*. 2017;4(4):448-52.
17. Mehta A, Rosenthal VD, Mehta Y, Chakravarthy M, Todi SK, Sen N, Sahu S, Gopinath R, Rodrigues C, Kapoor P, Jawali V, Chakraborty P, Raj JP, Bindhani D, Ravindra N, Hegde A, Pawar M, Venkatachalam N, Chatterjee S, Trehan N, Singhal T, Damani N. Device-associated nosocomial infection rates in intensive care units of seven Indian cities. Findings of the International Nosocomial Infection Control Consortium (INICC). *J Hosp Infect*. 2007 Oct;67(2):168-74. Epub 2007 Oct 1.
18. Rosenthal VD, Maki DG, Salomao R, Moreno CA, Mehta Y, Higuera F, Cuellar LE, Arikian OA, Abouqal R, Leblebicioglu H; International Nosocomial Infection Control Consortium. Device-associated nosocomial infections in 55 intensive care units of 8 developing countries. *Ann Intern Med*. 2006 Oct 17;145(8):582-91.
19. Ganguly NK, Arora NK, Chandy SJ, Fairoze MN, Gill JP, Gupta U, Hossain S, Joglekar S, Joshi PC, Kakkar M, Kotwani A, Rattan A, Sudarshan H, Thomas K, Wattal C, Easton A, Laxminarayan R; Global Antibiotic Resistance Partnership (GARP) - India Working Group. Rationalizing antibiotic use to limit antibiotic resistance in India. *Indian J Med Res*. 2011 Sep;134:281-94.
20. Mathur P. Prevention of healthcare-associated infections in low- and middle-income Countries: The 'bundle approach'. *Indian J Med Microbiol [serial online]* 2018 [cited 2020 Apr 3 ];36:155-162.

21. Bhawan P, Nagar A. Guidelines for Bar Code System for Effective Management of Bio- medical Waste Central Pollution Control Board (Ministry of Environment, Forest and Climate Change) DELHI- 110 032 website: April, 2018 Guidelines for Bar Code System for Effective. Available from: <http://Www.Cpcb.Nic.In>.
22. Van der Vegt DS, Voss A. Are hospitals too clean to trigger good hand hygiene? *J Hosp Infect* 2009;72:218- 20.
23. Patwardhan V, Kotwani P, Saxena D. Assessment of infection control practices: A cross-sectional study from public health facilities of Madhya Pradesh. *Indian J Community Med* 2019; 44:399-400.
24. HarikaBheemavarapu, Mohammad Arief, Akram Ahmad, Isha Patel. Nosocomial Infections in India: The Unaddressed Lacunae! *J of Pharmacy Practice and Community Medicine*.2018, 4(2):43
25. Shalini S, Kranthi K, GopalkrishnaBhat K. The microbiological profile of Nosocomial infections in the intensive care unit. *J ClinDiag Res*. 2010; 4:3109-12.
26. Khan HA, Baig FK, Mehboob R. Nosocomial infections: Epidemiology, prevention, control and surveillance, *Asian Pacific Journal of Tropical Biomedicine*, 7, 2017, 478-82.

