

Survey of Microbial Infections in Hospital: An Overview

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Abstract- Hospital acquired infection is otherwise called as Nosocomial infection and it's comes from Greek word "nosus" means disease and "komeion" means to take care of. Infections are considered as Nosocomial if they first appear 48 hours or more after Hospital admission or within 30 days after discharge. With increase of Nosocomial infection, it shows as results of crowded Hospital conditions; new microorganisms are colonized, increasing number of people with compromised immune system, increasing bacterial resistance. Infection control is an individual and collective responsibility of the emergency (critical) care team and unit. Hand hygiene is most effective method for reduce spread of infection. Universal precautions must be observed from the risk of splashing of body fluids. Contact Isolation is an important part to Infection control. Infections acquired in health care setting is the major causes of death and increased morbidity. The major Causes of Nosocomial infection are Bacteria, fungi, virus include Hepatitis A virus (HAV), Hepatitis B virus (HBV), Human immunodeficiency virus (HIV) and parasites.

Keywords- E. coli, Staphylococcus aureus, Klebsiella Sp., Infection control committee, Hospital acquired infections, Organization of Hospital Infection Control

INTRODUCTION

Infection Acquired in Hospital is known as Nosocomial infection or Health care associated infections (HAIs) can be defined as the infections acquired in the hospital by a patient; Who was admitted for a reason other than that infections, in whom the infection was not present or incubating at the time of admission, Symptoms should appear in at least after 48 hours after admission, these infections acquired in the hospital but appearing after discharge, and also occupational infections. CDC (Centers for Disease Control and Prevention, Atlanta) has established the National Healthcare Safety Network (NAHS) to monitor the incidence of Nosocomial infections. It is estimated that 5-10% of patients admitted for the treatment and developed healthcare from hospital infection. The infection control committee (ICC) is a multidisciplinary committee responsible for establishing & maintaining infection prevention & control, its monitoring, surveillance, reporting, research and education. In these ICCs main function is to prevent & control Nosocomial infection. To minimize the risk of infection to patients, healthcare workers and visitors. To follow and obey the local guidelines & standard operations procedures (Spos) for prevention and control of infection. To educate & train of health workers and recommended antimicrobial policy for the hospital & formulate antimicrobial stewardship programmed.

ORGANIZATION OF HOSPITAL INFECTION CONTROL

The first formal step for the establishment of Hospital Infection Control Programmed was taken in 1941, by the British Medical Council. A part time post titled Control of infection officer, renamed in 1988 as infection Control Doctor was established. In 1959, the first full time infection Control Nurses was appointed. A series of guidelines from the centers for disease control and prevention and the World Health Organization (WHO) were published on isolation techniques and Universal Precautions. It was the arrival of the AIDS pandemic that revolutionized the concept of 'precautions' to be taken while handling blood and body substances. Hospital Infection Control has now graduated into a highly specialized field specialized field, with activity in practically all aspects of Patient care.

HYPOTHESIS

Like physical examination, clinical manifestation, diagnostic care used to confirm diagnosis of Hospital acquired infection (HAI). Routine blood test, which includes CBC, metabolic panels, inflammatory markers and blood gases, will be useful to evaluate for HAI. Different community acquired infection from HAI, is essential to guide the clinician (physician) to treat and manage the patient appropriately. Different diagnosis based on Presenting symptoms and Types of Infection.

EPIDEMIOLOGY

The epidemiological triangle of HAIs comprises the host, microbial agents and the hospital environments. Sources are usually infected or colonized patients or staffs, or less frequently, the inanimate environment (infected wounds, the nose or faces of a carrier, contaminated food and water, etc.) identification of the source is essential to arrest the spread of infections from this source. Reservoirs do not necessarily transmit infections, unless they are a potential source. By the removal or destruction of a reservoir does not prevent transmission of infection, it is also a potential source. It is generally accepted that the source is the part of reservoir.

The spread of infection from a colonized or infected host to another source depends on number of organisms shed from the source, route of spread from the source etc.

MICROORGANISMS IMPLICATED IN HAIS

Hospital acquired infection can be caused by almost any microorganisms but those survive in the hospital environment for long period and develop resistance to antimicrobial and disinfectants are particularly important ESCAPE pathogens as shown in (Fig.1) Enterococcus faecium, staphylococcus aureus, klebsiella pneumonia, Acinetobacterbaumannii, Pseudomonas aeruginosa, Enterobacter's., other infections that can spread in hospitals include: Escherichia coli, Nosocomial-acquired Mycobacterium tuberculosis, Candida albicans, Clostridium difficile.

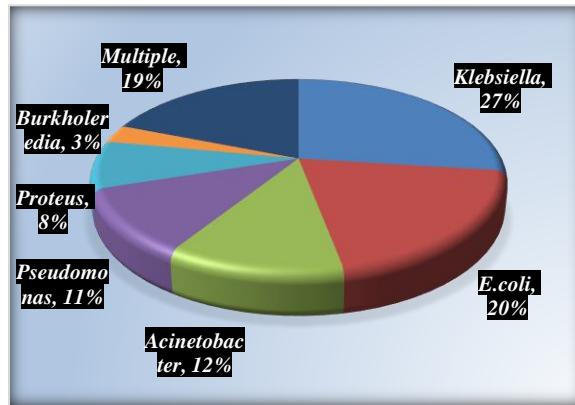


Figure 1. Microbes involved in Hospital

PROGENITORS & TRANSMISSIONAL PATHWAY

Sources of infection are Endogenous and Exogenous sources.

A. Endogenous progenitors

The most of Nosocomial infections are endogenous in origin. I.e. they involve patients own microbial flora which may invade the patient's body during some surgical or instrumental manipulations.

B. Exogenous progenitors

Exogenous sources are from hospital environment, staff and patient. Environmental sources like inanimate objects, air, water and food in the hospital. Inanimate object in the hospital or medical equipment (endoscopes, catheters, invasive procedures, etc.) bedpans, surface contaminated by patient's excretions, blood and body fluids. Healthcare workers will also be potential carriers, harboring many organisms. Other patients of the hospital may also a source of infection.

MODE OF TRANSMISSION

1. Direct contact-skin contact (usually healthcare workers, rarely other patients)
2. Indirect contact-parenteral transmission
3. Droplet transmission-coughing, sneezing
4. Airborne transmission-Legionella, mycobacterium tuberculosis, measles
5. Vector – borne transmission-mosquitoes, flies
6. Common vehicle transmission-devices, equipment.

TYPES OF NOSOCOMIAL INFECTION

A. Catheter Associated Urinary Tract Infection

This is the most common Nosocomial infection. Eighty percent of Urinary tract infections (UTIs) are associated with the use of an indwelling bladder catheter. In this infection females are highly infected comparing to males. Urinary tract infections are associated with less morbidity than over Nosocomial infections but can occasionally lead to bacteremia and death. Infection are usually diagnosed by presence of two isolated microbial species or a positive quantitative urine culture where >10⁵ microorganisms/ml of urine sample are seen. UTI accounts for the majority of HAIs. It can be: catheter associated urinary tract infection (CAUTI) and non-catheter associated urinary tract infection as shown in the figure.2. Risk factors are duration of Catheterization, Female Gender, Severe underlying illness, Geriatric patients, Diabetes mellitus, Microbial colonization of drainage bags. Organisms involved in UTI were shown in Figure 2

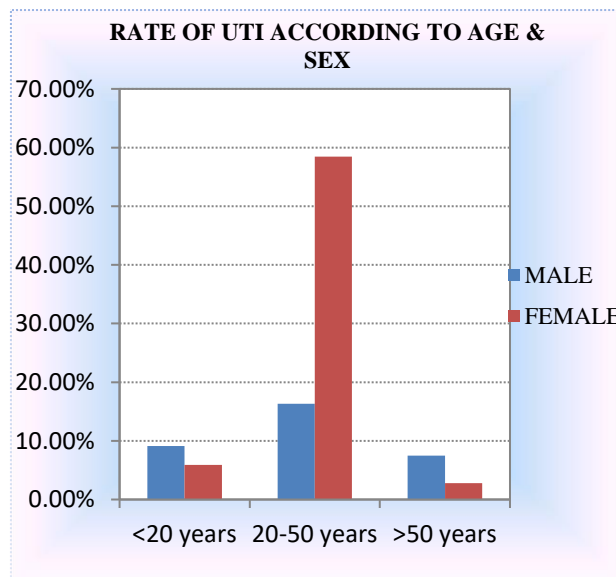


Figure 2. Organisms involved in UTI

B. Ventilator Associated Pneumonia

Ventilator-associated pneumonia (VAP) is defined as pneumonia that occurs in 48 to 72 hours or thereafter following endotracheal intubation, characterized by the presence of a new or progressive infiltrate, signs of the systemic infection (fever, altered WBC count), changes in sputum characteristics, and detection of a causative agent. VAP is estimated to occur in 9 to 27% of all ventilated patients, about highest risk being early in the course of hospitalization. It is the second most common of Nosocomial infection in intensive care unit and the most common in mechanically ventilated patients. Risk for VAP is greatest during the first days of mechanical ventilation (3%) with the mean duration between intubation and development of VAP being 3.3 days. This risk declines to 2%/day between days 5 to 10 of ventilation, and 1%/day shown in figure.3 Pathogenetically Infectious Bacteria Obtain Direct Access toThe Lower Respiratory Tract Via: (1) Micro Aspiration, Which Can Occur During Intubation Itself, (2) Development of A Biofilm Laden With Bacteria Within the Endotracheal Tube (3) Pooling and Trickling of Secretions Around the Endotracheal Tube Cuff, (4) Impairment of Mucociliary Clearance ofSecretions with Gravity Dependence of Mucus Flow Within the Airways.

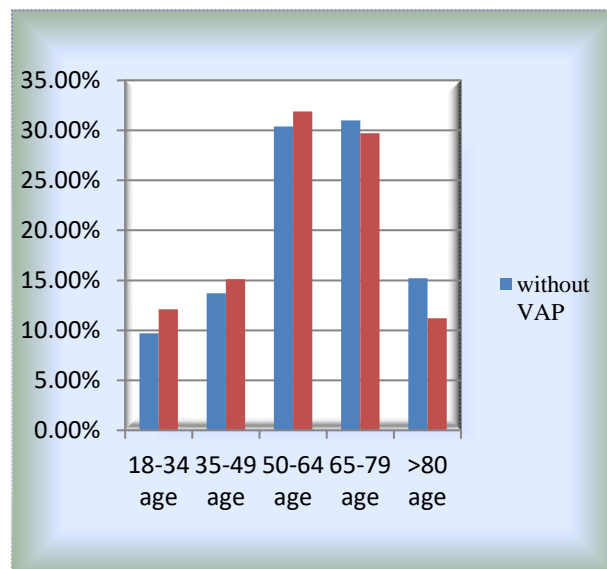
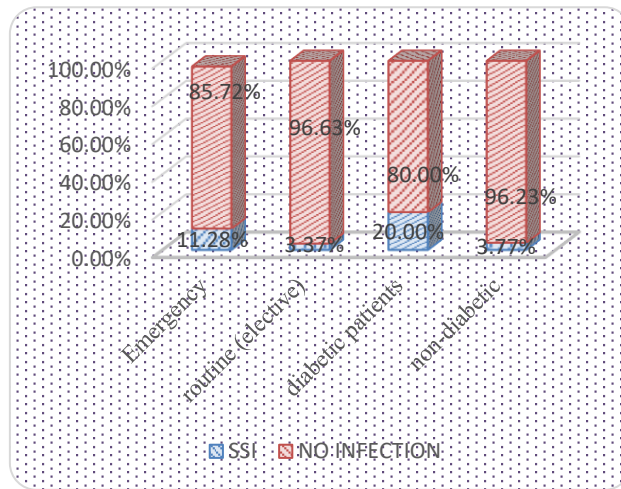


Figure 3. Organisms involved in VAP

C. Surgical site infection

Surgical site infection is also frequent and the incidence varies from 0.5% to 15% depending on the type of operation and underlying patient status. It also an infection that develops at the surgical site within 30 days of surgery (within 90 days for breast, cardiac and joints surgeries) shown in figure 4. Although SSI is a major thread in the hospitals, it is often under reported because 50% of SSIs develop after the discharge. Surgical site wounds are classified as clean, clean contaminated, contaminated or dirty and for the clean wound the

skin flora of the surgery team or the environmental organisms are the major pathogens; most common



pathogen begins from *S. aureus* then for other types the patient’s endogenous flora (anaerobes and gram-negative rods) are the common agents.

Figure.4 Organisms involved in SSI

D. Central line-associated blood stream infection

Central line-associated blood stream infection is the fourth common cause of HAIs. Coagulase negative staphylococci and *S. aureus* are rapidly increasing reported to cause bloodstream infection recently, followed by gram negative rods and candida. Risk factors that predispose to acquire a CLABSI patient related are AGE (<1year and >60 years), malnutrition, low immunity, severe underlying disease, loss of skin integrity (burn or bed sore) and also a prolonged stay in ICU. Device related are presence of central line. HCW related to poor infection control practice such as hand hygiene.

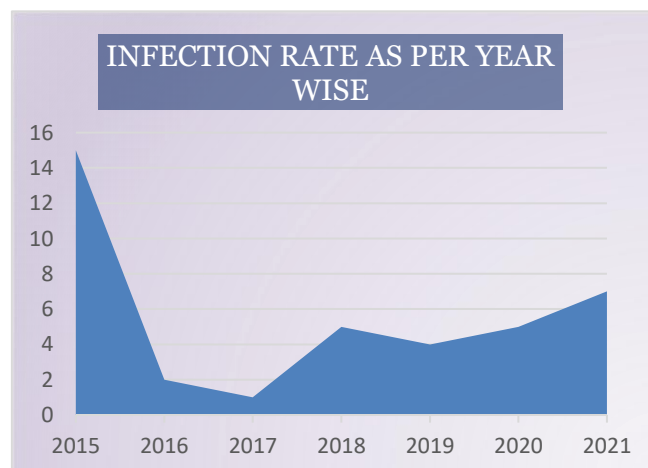
PROPHYLAXIS OF HAI

The preventive measures for HAIs can be broadly classified into Standard precautions, Transmission based or specific precautions

Standard precaution
Standard precaution is a set of infection control practices and thus used to prevent transmission of disease that can be acquired by contact with blood, body fluids, non-intact skin(including rashes) and mucous membrane. This measure should be followed when providing care to all individuals, whether they appear infectious/ symptomatic or not. All these specimens (blood or body fluids) whether they appear infectious or not. All needles and sharp items whether they appear infectious or not. They are indicated while handling all patient specimens and sharps, components of standard precautions include hand hygiene, personal protective equipment, and biomedical waste including sharp handling, spillage cleaning, disinfection, respiratory hygiene and cough etiquette.

Transmission based precautions

Transmission based precautions are contact based precautions, droplet precaution, airborne precaution Contact based precautions are isolation, patient movement, PPE, patient dedicated equipment, hand washing, environmental cleaning. Droplet precautions are



isolation, patient movement, PPE. Airborne precautions are isolation, patient movement, and personal protective equipment.

Figure. 5 Graph of Prophylaxis

RISK FACTORS OF HAI

Complications of healthcare associated infection (HAI) are broad and depend on the type of infection, the severity illness, and implicated pathogen. The list of complications of each type HAI can be extensive, below a few of the more common complications of each HAI are listed. Complications of VAP/ HAP are respiratory failure, emphysema, parapneumonic effusions and sepsis. Complication of CAUTI is upper respiratory tract involvement, sepsis. Complication of CLABSI is suppurative thrombophlebitis, endocarditis, septic arthritis, osteomyelitis, and sepsis. Complication of SSI is delayed wound healing, rejection of implanted devices and prosthetics, abscess formation, sepsis, body cavity infections.

REASONS OF HIGH INFECTION RATE

- A. Infection control has a low priority and overcrowding.
- B. Poor hygiene and sanitation
- C. Lack of central sterilization services; less quality control for sterilization, poor regulation for disinfectants
- D. Inadequate trained personal for infection control and low compliance to hand hygiene
- E. The population largely affected by malnutrition and other types of infection.
- F. By the Lack of surveillance system also leads to failure to detect outbreaks and increasing morbidity and mortality.

HOSPITAL INFECTION CONTROL COMMITTEE

The hospital infection control program is organized by the medical superintendent (MS), for which he/she constitutes the hospital infection control committee (HICC). Thus, the HICC provides a forum for multidisciplinary input and cooperation, and informing sharing, required for hospital infection control and prevention. The HICC is advisory to the MS and makes its recommended to the MS.

HICC CONSTITUTION

The Hospital Infection Control Committee (HICC) should include wide representation from relevant departments/ health sectors as follows:

1. Chairperson, usually the medical superintendent
2. Secretary, mostly by the head of department of microbiology
3. the Hospital infection control officer (HICO), generally from the department of microbiology
4. Hospital infection control nurses (HICN)
5. Head of the all clinical departments
6. Head of the staff clinic
7. Operation room officer
8. Incharge of central sterile supplies department (CSSD) and biomedical waste management
9. Incharge of pharmacy and hospital linen and laundry
10. Epidemiologist
11. Incharge of engineering department of hospital.

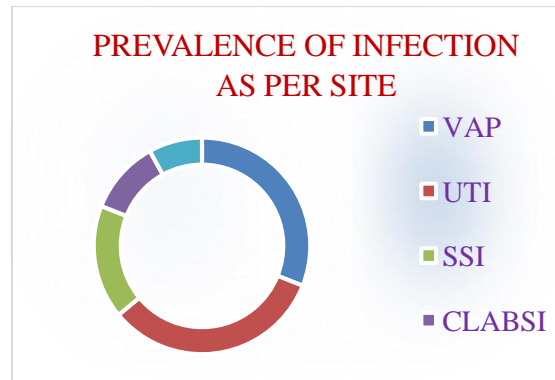
FUNCTIONS OF HICC

The HICC supervises is the implementation of the various hospital infection control program. The functions of the committee include

HAI surveillance

The main four key parameters used for HAI surveillance are as follows

1. VAP (ventilator associated pneumonia)
2. CAUTI (catheter associated urinary tract infection)
3. SSI (surgical site infection)
4. CLABSI (central line associated bloodstream infection).



Develops a system: For identifying, reporting, analyzing, Investigating and controlling healthcare-associated infections.

Antimicrobial stewardship program (AMSP): Develops antibiotic polices, monitoring the antibiotic usage, advises the MS on matters related to the proper use of antibiotics.

Education: conducts teaching sessions for healthcare workers regarding matters related to Hospital acquired infections.

Polices: Reviews and updates on the hospital infection control policies and guidelines from time to time

Staff health: monitors employee health activates regarding matters related to HAIs such as needle stick injury prevention, hepatitis B vaccination, etc.

Outbreak management: plans to identify infectious outbreaks, their source and implements preventive and corrective measures

Other departments: Department of the hospital with common interests such as:

1. Pharmacy
2. Central sterile supplies department
3. Linen and laundry departments
4. Antimicrobial usage committee
5. Biomedical safety committee
6. Blood transfusion committee

Reviews: risks associated with new technologies, and monitor infections risks of new devices and products, prior to their approval for use.

HICC meetings: HICC shall meet regularly not less than once a month and as often as required. However, in an emergency, this committee must be able to meet promptly as and when required.

CONCLUSION

There is no official national approach and no real managerial support from the authorities for Nosocomial infection. Only thing to maintain is proper asepsis, proper hand washing and sterilization. HAIs are global problem and are important contributors to morbidity and mortality and it's often caused by antibiotic-resistant organisms. Nosocomial infection has a significant impact on the length of hospital stay and Medicare. Infection control preventing Nosocomial infection may play an important role in reducing medical costs, hospital stay, and mortality in hospitalized patients. Approximately 75% of hospital construction involves remodeling, upgrading or expanding existing structures.

Recommending:

Managers should give more attention to promote infection prevention practices for better control of HAI in teaching hospitals.

REFERENCES:

- [1]. Miller SE, Maragakis LL. Central line-associated bloodstream infection prevention. *Curr Opin Infect Dis.* 2012 Aug;25(4):412-22
- [2]. Hughes JM. Study on the efficacy of nosocomial infection control (SENIC Project): results and implications for the future. *Chemotherapy.*
- [3]. Young PY, Khadaroo RG. Surgical site infections. *Surg Clin North Am.* 2014 Dec;
- [4]. Nickel JC, Costerton JW. Bacterial biofilms and catheters: A key to understanding bacterial strategies in catheter-associated urinary tract infection. *Can J Infect Dis.* 1992 Sep
- [5]. Boev C, Kiss E. Hospital-Acquired Infections: Current Trends and Prevention. *Crit Care Nurs Clin North Am.* 2017 Mar
- [6]. Boltz MM, Hollenbeck CS, Julian KG, et al. Hospital costs associated with surgical site infections in general and vascular surgery patients. *Surgery* 2011
- [7]. Martone WJ, Jarvis WR, Culver DH, et al. Incidence and nature of endemic and epidemic nosocomial infections. In: Bennett JV, Brachman PS, eds. *Hospital infections.* Boston, MA: Little, Brown, and Company, 1992.
- [8]. Klevens RM, Edwards JR, Richards CL, et al. Estimating healthcare-associated infections in U.S. hospitals, 2002. *Public Health Rep* 2007.