

**DISSERTATION SUBMITTED FOR THE MASTER'S DEGREE
IN MEDICAL MICROBIOLOGY**



**HOSPITAL ACQUIRED INFECTION IN INDIA – A META
ANALYSIS
SUBMITTED**

BY

KM PARUL

2022

**DEPARTMENT OF MICROBIOLOGY
INTEGRAL INSTITUTE OF MEDICAL SCIENCES & RESEARCH
INTEGRAL UNIVERSITY
DASULI, KURSI ROAD, LUCKNOW-226026, U. P.**

**“HOSPITAL ACQUIRED INFECTION IN INDIA – A META
ANALYSIS”**

A

DISSERTATION

Submitted to

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In partial fulfillment of the requirements for the award of degree of



Masters of sciences

In

Medical Microbiology

By

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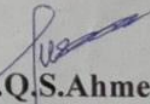


CERTIFICATE

This is to certify that research work entitled "Hospital acquired infection in India - A meta analysis" submitted by **KM Parul, Dr.Mohd Saquib, Dr.Ausaf Ahmad** for ethical approval before the Institutional Ethics Committee IIMS&R.

The above mentioned research work has been approved by Institutional Ethics Committee, IIMS&R with consensus in the meeting held on **19 May 2022**.


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DEDICATED TO
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&
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INTRODUCTION

Healthcare-associated infections (HAI), also referred to as hospital-acquired infections (HAI), are nosocomially acquired infections that are frequently absent or may be incubating at the time of admission. These infections typically develop after being admitted to the hospital and become apparent 48 hours later. Organizations like the National Healthcare Safety Network (NHSN) of the Center for Disease Control and Prevention keep a close eye on the infections (CDC). [1] To stop HAI and increase patient safety, surveillance is conducted. Surgical site infections (SSI), catheter-associated urinary tract infections (CAUTI), central line-associated bloodstream infections (CLABSI), hospital-acquired pneumonia (HAP), ventilator-associated pneumonia (VAP), and Clostridium difficile infections are examples of HAI infections (CDI). [1]

Hospitals have been concerned about hospital-acquired illnesses for a while now. To lower the occurrence of hospital-acquired illnesses, several hospitals have put in place infection tracking and surveillance systems as well as effective prevention measures. [2] Due to their association with multidrug-resistant illnesses, the effects of hospital acquired infections are felt not only at the level of the individual patient but also at the community level. In order to prevent and reduce hospital-acquired infections and multidrug-resistant illnesses, it is crucial to identify individuals who have these risk factors.

The criteria of pneumonia have been modified in accordance with recommendations from the American Thoracic Society (ATS) and the Infectious Disease Society of America (IDSA) in order to more accurately identify patients at risk for multidrug-resistant (MDR) bacteria. The goal of this is to prevent the overuse of antibiotics. Before, the term "healthcare-acquired pneumonia," or HCAP, was frequently used. HCAP has been replaced with the term "Hospital-

acquired Pneumonia," or HAP. According to the IDSA guidelines, "pneumonia that occurs 48 hours or more after admission to the hospital and did not appear to be incubating at the time of admission" is what is meant by "hospital-acquired pneumonia." [3] According to IDSA, "pneumonia that develops greater than 48 to 72 hours following endotracheal intubation is designated as ventilator-associated pneumonia, or VAP." [4]

The number of infections in the intensive care unit is significant and causes major medical issues. Nosocomial infections, originally described as infections occurring after 48 hours of hospital admission, are commonly used to describe illnesses acquired during the hospital stay. [5,6] Infections Nosocomiales Nationwide The term "nosocomial infection" refers to a localised or systemic illness brought on by an immune response to the presence of an infectious agent (s) or its toxin (s) that were absent or dormant at the time of the patient's admission to the hospital. [5] These infections are opportunistic, and hospital patients with compromised immune systems can develop illness from bacteria with low pathogenicity. Antimicrobial resistance grows as a result, leading to a rise in morbidity and death under such circumstances. Most nosocomial infections are external, with any component of the hospital ecosystem, including people, objects, food, water, and air in the hospital. [7]

Additionally, they place a significant financial burden on hospitals, lengthening hospital stays and increasing morbidity and death. [8] Diabetes mellitus, intubation, chronic sounds, surgical drains, poor health, failure to use gloves, irregular and incorrect debridement, and wound bandaging are among the risk factors for nosocomial infections. In most hospitals, less than 10% of all beds are in intensive care units (ICUs), but more than 20% of all nosocomial infections are contracted there. [9]

An illness known as a nosocomial infection is one that is contracted in a hospital or other tertiary healthcare facility. Infection that was obtained at a hospital or other tertiary healthcare facility is another name for it. A hospital, nursing home, clinic, institution for rehabilitation, or other therapeutic setting may be the source of such an illness. In the clinical context, the infection is transmitted to the vulnerable patient in a variety of ways. Along with infected medical supplies, bed linens, air droplets, etc., healthcare workers can also transmit infections to patients who are vulnerable. The infection may have come from the outside environment, another sick patient, potentially contaminated employees, or in rare circumstances, it may not be possible to identify the virus's source. occasionally the microorganism originates from the patient's own skin microbiot, becoming opportunistic after surgery or other procedures that compromise the protective skin barrier.[10]

Infection control is responsible for preventing and lowering the risk of hospital acquired infections. This may be accomplished by putting in place effective infection control strategies, including policies and administration for surveillance, isolation, outbreak management, environmental cleanliness, personnel health, and education.

The high amount of antibiotic resistance present in the organism causing HAI is a significant issue. It is extremely difficult to treat multidrug resistant organisms with currently available antibiotics, such as extended spectrum beta lactamase and metallo beta lactamase generating gramme negative bacilli that are frequently linked to HAI. Additionally, it might be challenging to treat Staphylococcus that has been acquired in a hospital. Antifungal resistance fungal infections have been more prevalent in inpatient settings recently, which has made things more difficult for patients and physicians alike. The morbidity and mortality of admitted patients have considerably increased as a result of all of this. Additionally, the prognosis is dismal and the cost of treating these infections is

high. Since we have little resources and few preventative HAI policies in place, combating the problem of HAI is even more crucial in emerging economies like India. This meta-analysis aims to raise awareness of this grave problem and examine the potential improvements that HAI prevention measures may make.

[11]

Review of literature

A localised or systemic illness known as a nosocomial infection or hospital-acquired infection (HAI) is brought on by an unfavourable response to the presence of infectious organisms. When the patient is brought to the critical care unit, there are no nosocomial infections present or incubating. They are brought on by germs that spread quickly throughout the body. Due to their weakened immune systems, many hospitalised patients in CCU are less able to fend against diseases. These illnesses may be found anywhere in the world, in both developing and developed nations. They place a heavy strain on both the health of the community and the patients . They are a significant contributor to mortality and increased morbidity in hospitalised patients, which is a significant current concern[12]

Source of hospital acquired infection: Endogenous or exogenous sources are both potential origins of healthcare-associated infections (HCAI).

Endogenous source:

Body flora serves as an endogenous source of infection. Bacteria can be found on the skin, in the female reproductive system, nose, mouth, throat, and gastrointestinal tract. These germs infiltrate the tissues whenever there is a decrease in resistance. In those who are vulnerable, it can be challenging to prevent and treat such opportunistic illnesses. The natural flora is altered by prolonged hospital stays and antibiotic treatment, both in terms of the types of organisms present and their sensitivity to drugs. *Pseudomonas aeruginosa* is more common in the faeces of hospital patients than in the general population, and

studies have shown that intestinal carriage of multidrug-resistant strains of Gram-negative bacteria frequently occurs before self-infection and cross-infection.

Exogenous source:

Infections from exogenous sources can come from either living things or inanimate objects. People, both patients and hospital personnel, release a lot of germs into the environment through their skin and oral and nasal secretions when they sneeze, talk, or move their bodies in various ways. Numerous germs are shed from the surface of certain people's bodies, particularly the perineum, according to studies on staphylococcal carriage in hospitals. Exogenous sources of infection can be both living things and inanimate objects. People, including hospital personnel and patients, release a lot of germs into the air through their skin, mouth secretions, and other bodily motions like sneezing. Studies on staphylococcal carriage in hospitals have revealed that some people, known as "dispersers," shed significant quantities of germs from their body surface, particularly the perineum. These people may also contaminate their hands, clothing, and other inanimate things. Human activity leads to environmental contamination. As a result of contamination from human organic waste, pus, blood, and blood products, food, fluids, disinfectants, tools, equipment, and wound dressing all operate as sources of infection. Rarely are live bacteria free, and they are saprophytic fungi are derived .from the environment may cause infection in susceptible individuals. [13]

The primary goal of a hospital's infection control programme is to halt and prevent the spread of infections. Depending on the microorganism, specific measures are required to avoid infection transmission.

•**Endogenous source:** Infection is endogenously acquired from

The following are examples of indications for transmission-based precautions:

Standard precautions: employed in all patient care. It covers things like hand washing, wearing protective gear, placing patients correctly, using safe injection techniques, cleaning and sanitising the patient's surroundings, equipment, linens, and laundry, and properly disposing of biological waste.

Contact precaution: Applied to patients with known or suspected contact-transmittable illnesses. Common sense safety measures are required for those patients. Use disposable patient care equipment and implement comprehensive cleaning and disinfection procedures in addition to the restriction on patient travel and mobility. Contact precautions must be used for patients who have acute infectious diarrhoea, such as *Clostridium difficile*, vesicular rash, respiratory tract infection caused by a multidrug-resistant bacterium, abscess, or draining wound that cannot be covered.

Droplet precautions: used on patients who have known or suspected airborne illnesses that can spread by talking, sneezing, or coughing. In these situations, it's crucial to contain the source by covering the patient with a mask, take the usual precautions, and restrict mobility and transport. Patients who have meningitis, petechial or ecchymotic rash with fever, or respiratory tract infection in newborns and young children are subject to droplet precautions.

Airborne precautions: Use of this drug is recommended for those with known or suspected airborne diseases. With the aforementioned precautions, these patients must be maintained in an isolation room to prevent airborne infections. The most serious illnesses that need for airborne protection include tuberculosis, measles, chicken pox, and disseminated herpes zoster. Patients who have lung infiltration and cough/fever, a maculopapular rash with cough/coryza/fever, or a suspected vesicular rash should be placed under an airborne precaution.

Equipment-

The required tools must be available in healthcare institutions so that all patients can benefit from the common precautions. Hand hygiene is the main measure that is successful in stopping the spread of infections. To do this, wash your hands with soap and warm water. You can also spread alcohol- or non-alcohol-based hand sanitizer-on your hands. Additionally, gloves can be used as a precautionary measure; however, brand-new gloves must be used for each patient and discarded after each patient encounter. Before entering the patient's room, you should put on a gown and use facial protection (procedure/surgical masks, goggles, and face shields). The instruments used for proper and frequent surface and floor cleaning are included in the category of infection control equipment. Additionally, linens must be handled and transported while wearing the proper personal protective equipment to avoid skin and mucous exposure.

Isolation-

Isolation's primary goal is to stop the spread of infectious patients' germs to other people. Since isolation is a costly and time-consuming technique, it should only be used when absolutely required. On the other hand, if isolation is not used, we run the danger of higher rates of morbidity and death, which would raise the cost of healthcare as a whole. Hospitals with a single patient per room model can apply isolation well, but large institutions still contain a sizable proportion of double-patient rooms, which makes it difficult to administer isolation. To describe the methods to improve isolation, the CDC and the Healthcare Infection Control Practice Advisory Committee have released a guideline.

The main purpose of isolation is to prevent the transmission of microorganisms from infected patients to others. Isolation is an expensive and time-consuming process, therefore, should only be utilized if necessary. On the other hand, if isolation is not implemented then we risk the increase in morbidity and mortality,

henceforth, increasing overall healthcare cost. Hospitals that operate based on single-patient per room can implement isolation efficiently, however, significant facilities still have a substantial number of double-patient rooms which is challenging for isolation. To describe the methods to improve isolation, the CDC and the Healthcare Infection Control Practice Advisory Committee have released a guideline. These recommendations are based on common sense safeguards and transmission theory. The term "standard precaution" refers to the presumption that every patient may be colonised or infected with microbes; as a result, precautions are taken at all times and in all departments with regard to every patient. Hand washing (both before and after patient contact), personal protection equipment (for contact with any bodily fluid, mucous membrane, or nonintact skin), and safe needle techniques are the key components of standard precautions (use one needle per single dose medication per single time, then dispose of it in a safe container). The programme known as "bare below the elbows" has been embraced by other nations as well, notably the United Kingdom, and calls on all medical professionals to dress in short-sleeved clothing with no jewellery, including no rings, bracelets, or wristwatches. Regarding the precautions based on transmission, a cohort of patients is chosen based on their clinical manifestations, diagnostic standards, or confirmatory tests with particular indications of infection or colonisation of microorganisms to be isolated. In these situations, the use of airborne, droplet, and contact precautions is required.

Clinical Significance-

Clinically speaking, infection control entails locating and limiting infections to reduce their spread. By recognising patient signs and symptoms that may be indicative of a transmissible infection like TB, clinicians play a critical role in infection management. Before a confirmed diagnosis is made, precaution instructions must be issued and put into effect in order to prevent the spread of the infectious disease.

Infection control clinically translates to identifying and containing infections to minimize its dissemination. Clinicians play a significant role in infection control by identifying patients' signs and symptoms suspicious for a transmissible infection such as tuberculosis. Precaution orders have to be placed and implemented even before a confirmatory diagnosis is reached to avoid the possible transmission of the infectious pathogen. Clinically, an effective infection control programme leads to decreased infection rates and a reduced likelihood of the emergence of bacteria that are resistant to several drugs. One of the most frequent consequences in healthcare is infection contracted while hospitalised. Therefore, taking common sense measures like washing your hands may be quite helpful. In reality, washing hands before and after all patient interactions is the most efficient and affordable approach for doctors to also use infection control concepts. As a result, hospitals must encourage and facilitate handwashing by placing reminders at each bedside and placing basins or hand sanitizer stations at the entrance to each room. Teaching patients to always attempt to use their forearm to block their coughs or sneezes is another straightforward step that may be taken. [14]

MAJOR COMMON INFECTION:

central line. Clinically, an effective infection control programme results in lower infection rates and a lower risk for the development of CLABSI. When placing the line, medical professionals must adhere to a stringent protocol to guarantee that the line stays sterile and that a CLABSI does not occur. In terms of medicine, effective infection control. Healthcare professionals must appropriately implant the central line and follow strict infection control procedures each time they examine the line or alter the dressing. Patients who develop a CLABSI may also experience red skin and pain near the central line in addition to a fever. If this occurs, medical professionals can do tests to find out if an infection is present. programme lowers the rate of infection .



REFERENCE:(14)

The following actions can be taken by healthcare professionals to assist prevent CLABSIs:

To prevent infection after inserting a central line, adhere to prescribed procedures, which include:

Wash your hands often;

- use the proper skin antiseptic;
- wait until the skin prep agent has dried fully before inserting the central line.
- Apply all five sterile barrier maximum precautions:
 - Gloves
 - sterile drape,
 - cap,
 - mask
 - and sterile gown



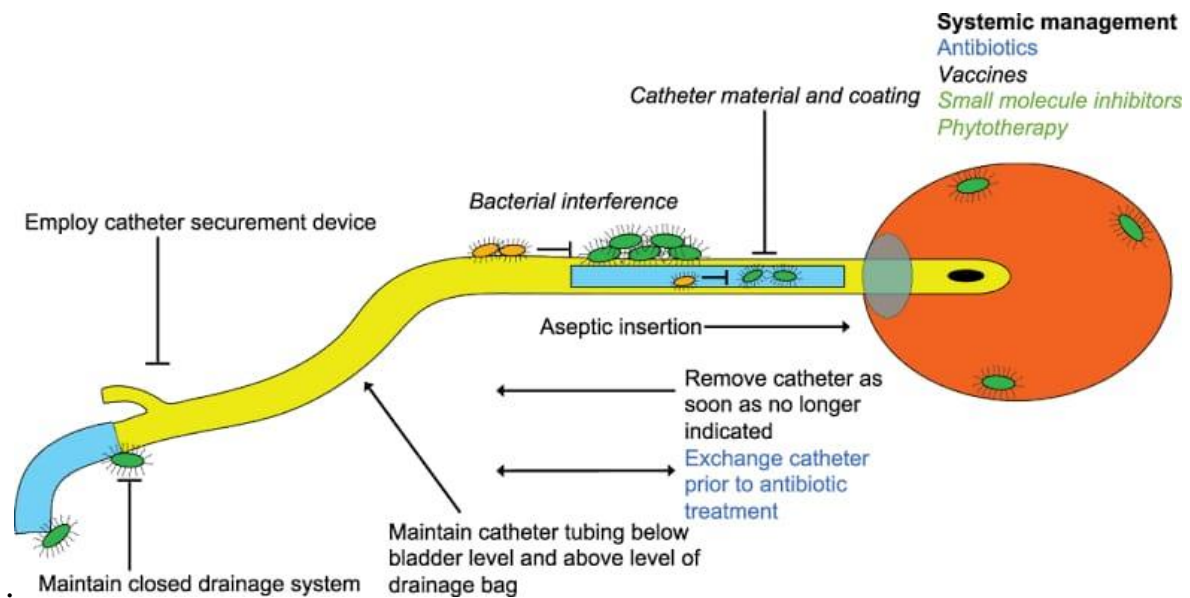
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After installing the central line, be sure to:

- Comply with suggested central line maintenance procedures .
- Wash their hands with soap and water or an alcohol-based hand rub before and after contacting the line.
- As soon as a central line is no longer required, remove it. The likelihood of infection decreases the sooner a catheter is removed. [16]

The device-associated healthcare acquired infection known as CA-UTI is significant. The use of an indwelling urethral catheter is linked to increased risk of bacteremia and symptomatic UTIs, as well as increased morbidity from non-infectious consequences. To reduce infections linked to the use of these devices, infection control programmes must create, implement, and monitor rules and procedures. The use of indwelling urethral catheters should be kept to a minimum, and they should be removed as soon as they are no longer necessary.

But ultimately, the creation of biofilm-resistant catheter materials will be necessary to prevent CA-ASB.



REFERENCE: (17)

About 40% of infections connected to medical treatment are catheter-associated urinary tract infections (CAUTIs). Despite research demonstrating the value of therapies for CAUTI prevention, implementation of these procedures has not been widespread in American healthcare settings. The majority of UTIs in healthcare settings are caused by urinary catheters, hence preventing urinary catheter installation and encouraging early removal when necessary are the most crucial therapies. Considerations should be given to intermittent catheterization and condom catheters as alternatives to indwelling. If indwelling catheterization is necessary, using a closed catheter collection system, adhering to aseptic catheter maintenance procedures, and insertion procedures are crucial for preventing CAUTI. When CAUTI rates are consistently high despite treatment,

using antimicrobial catheters may potentially be an option. when patients are assessed to be at high risk for CAUTI or its consequences, or when they follow other evidence-based procedures. As the Centers for Medicare and Medicaid Services and other third-party payers stop paying for hospital-acquired UTI, attention will likely turn more toward CAUTI prevention.

One of the most typical healthcare-acquired illnesses is catheter-associated urinary tract infection. Use of an indwelling urethral catheter is to blame for 70–80% of these infections.

In general, indwelling urinary catheters are categorised as chronic or long-term if they are in place for more than 30 days as opposed to chronic or long-term if they are in place for less than 30 days. While chronic catheters are most frequently used by residents of long-term care institutions, indwelling catheter usage is typically brief in acute care facilities. For short-term and long-term catheters, there may be different clinical and microbiologic issues. The most common sign of an infection contracted with a urinary catheter is silent bacteriuria (CA-ASB). Those with symptomatic infection are referred to as having a catheter-associated urinary tract infection (CA-UTI).

Asymptomatic bacteriuria-

The primary predictor of bacteriuria is catheterization duration. 3-7 percent of people who have an indwelling catheter in place daily risk developing bacteriuria. Women and elderly individuals acquire at a faster pace. Once a catheter is in place for several weeks, bacteriuria is present in everyone. It is considered that patients with persistent indwelling catheters are always bacteriuric.

Symptomatic urinary tract infection-

Despite the fact that only a tiny percentage of acute care facility individuals with CA-ASB experience symptomatic infection, CA-UTI is the most frequent adverse event linked to the use of indwelling urinary catheters. The number of intrusive devices, including indwelling urethral catheters, was independently related with the presence of any healthcare-acquired infections, however the percentage of patients with catheters and urinary infections was not reported.

Clinical diagnosis

The diagnosis of symptomatic CA-UTI is frequently an excluding diagnosis. The typical CA-UTI presentation is fever in the absence of localising evidence. Although they are present in a small percentage of episodes of suspected symptomatic infection, localising signs or symptoms including catheter blockage, acute hematuria, recent trauma, suprapubic pain, or costovertebral angle discomfort or soreness are helpful in identifying a urinary cause of fever. Fever in bacteriuric individuals should only be attributed to urine infection when there are no other possible causes and localising genitourinary signs are absent. In the absence of a different cause for the bacteremia, a diagnosis of CA-UTI is assumed when the same organism is identified from both the urine and a concurrent blood culture.

Pyuria

Patients with bacterial urethritis typically have pyuria, regardless of symptoms. Due to the catheter's potential to produce bladder irritation, patients with indwelling catheters may also experience pyuria without bacteriuria. In addition to these non-infectious reasons, renal illness such as interstitial nephritis can induce pyuria. The presence of pyuria in urine samples taken from patients who have indwelling urinary catheters does not, therefore, indicate symptomatic

infection in a bacteriuric individual or a need for antibiotic therapy preventing urethral infections brought on by catheters.

Guidelines-

The creation and upkeep of CA-UTI preventive programmes are advised by a number of evidence-based guidelines. Avoiding catheter use is one method of prevention, along with regulations for catheter insertion and upkeep, catheter selection, monitoring of CA-UTI and catheter use, and suggestions for quality indicators.

The establishment of policies for catheter indications, catheter selection, catheter insertion, and maintenance is part of the infrastructure required to support an efficient programme. There must be adequate staffing, training for the staff, and access to sufficient and suitable supplies. The use of urinary catheters should be documented in some way, including the indications and the dates of insertion and removal. Where an electronic patient record is utilised, the usage of catheters and automated removal reminders should be documented and included in the record. It has been detailed how "bundles" were created and put into use to avoid urinary tract infections brought on by catheter use. There was a 37 percent decrease after the introduction of a urinary catheter bundle that includes education, catheter insertion and maintenance recommendations, and CA-UTI surveillance in intensive care units in 15 developing nations.

Avoiding the use of an indwelling urinary catheter is the most crucial measure to prevent CA-UTI. There are just a few approved uses for catheters, including:

- The hourly monitoring of urine output in critically unwell individuals.
- Utilization during some surgical procedures
- Urologic procedures

-Genitourinary tract surgery involving adjacent tissues -Large volume infusions or diuretics used during surgery

-Need for intraoperative urine output monitoring

- Treatment of acute urinary blockage and retention.
- To assist certain patients with urine incontinence in healing open pressure sores or skin grafts.
- At the patient's request in extraordinary situations (such as end-of-life care), to increase comfort.

Whenever feasible, it's best to adopt alternative voiding management techniques like intermittent catheterization or, for males, external condom catheters. Institutional rules should also encourage early catheter removal following procedures and, where accessible, monitor bladder volume with ultrasound bladder scanners to prevent catheter reinsertion for probable urine retention. Once it is no longer necessary, a catheter that has been prescribed should be withdrawn right away. Patients who have indwelling catheters should be recognised, examined often (ideally daily rounds), and the catheter should be removed when no longer necessary. Catheters are regularly reported to stay in place longer than required, sometimes because medical staff are unaware that the catheter is there. A comprehensive analysis of methods for removing catheters from hospitalised patients found that the use of either catheter reminders or stop orders decreased the CA-UTI rate by 53% and that the intervention of a "stop order" to promote quick removal of unneeded catheters reduced the length of catheter usage by 1.06 days.

Selection of urinary catheter-

To lessen urethral damage, the lowest gauge catheter should be utilised. Whether the catheter is coated in hydrogel or not, the risks of infection are the same for silicone and latex catheters. Although this discovery is related to the greater bore size of the catheter rather than the catheter material, residents with chronic catheters had a lower frequency of blockage with silicone catheters. The prevalence of CA-UTI does not reduce with the use of silver alloy coated catheters. A slight reduction in CA-UTI has been linked to nitrofurazone coated catheters, albeit at the cost of more frequent catheter removal and more catheter pain.

Therefore, existing research does not support the widespread use of catheters coated with an antibacterial agent.

Catheter insertion and maintenance-

The following procedures for placing and caring for catheters are advised. These suggestions are mostly based on agreement, however there is compelling evidence that keeping a closed drainage system can reduce the incidence of bacteriuria. Antiseptics added to the drainage bag or routine daily periurethral cleansing with regular saline, soap, or an antiseptic had no positive effects.

- Catheter insertion:
 - Correct hand washing
 - selection of catheter
 - Aseptic methods and sterile tools
 - Barrier safety measures
 - cleaning of beef with antiseptic

- Catheter maintenance
 - Correct hand washing

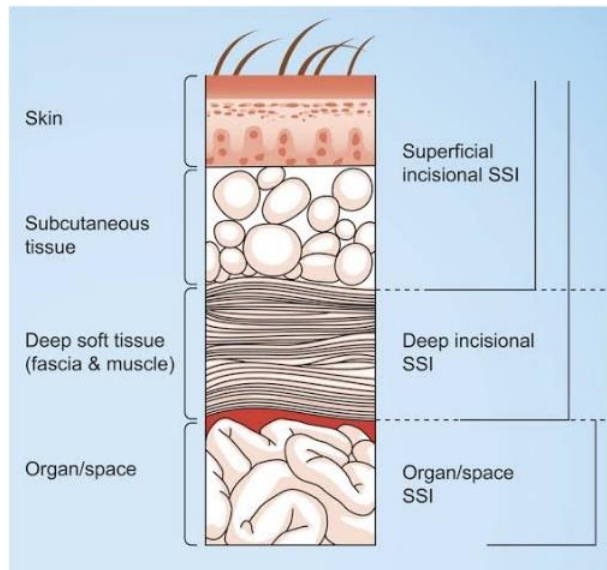
- reliable catheter
- system of closed drainage
- Sampling urine aseptically
- If system fails during asepsis, replace it.
- For the objective of preventing infection, avoid irrigation.

Prevention of CA-UTI in long term care facilities-

Residents with a persistent indwelling catheter are the main focus of CA-UTI prevention in long-term care settings. Any resident who has a chronic indwelling catheter should undergo regular, thorough reviews to evaluate if the catheter is still required.

It is impossible to prevent bacteriuria in these inhabitants. When possible, interventions should concentrate on removing the catheter, reducing catheter trauma, and spotting catheter blockage as soon as possible. Catheters left in place for a long time shouldn't be replaced frequently. When treating a symptomatic urinary infection, they should only be changed if there is blockage, another defect, or when starting antibiotic medication. A leg bag for drainage can be used by residents with chronic catheters to improve mobility. Reusability, cleaning, and/or replacement of the leg bags should be covered by facility policies. Antimicrobial therapy increases the isolation of resistant organisms when used to treat bacteriuria in long-term care individuals with persistent indwelling catheters, but it does not reduce CA-UTI. Therefore, it is advised against treating asymptomatic bacteriuria. [18]

An infection that develops at the site of a surgical procedure is known as a surgical site infection (SSI). Infections at the site of surgery might occasionally just affect the skin. Other, more dangerous surgery site infections might affect tissues under the skin, organs, or implanted materials.



REFERENCE: (19)

Symptoms include:-

- Pain and redness at the site of your procedure.
- Clear fluid draining from your surgery wound
- Fever

Doctors, nurses, and other healthcare professionals should adhere to the following CDC infection prevention recommendations to avoid SSIs:

Before and after caring for each patient, wash their hands with soap and water or an alcohol-based hand massage. Just before the surgery, clean their hands and arms up to their elbows with an antiseptic agent.

- If necessary, trim part of your hair with electric clippers just before your operation if it is in the same region as the procedure.
- When necessary, provide you antibiotics prior to your procedure. • Wear protective hair coverings, masks, gowns, and gloves throughout surgery to keep the operating room clean.

- Give you antibiotics as necessary before your procedure. Most of the time, you should start taking antibiotics at least 60 minutes before surgery, and you should stop taking them within 24 hours after recovery.

- Use a special soap that destroys germs to clean the skin where your surgery was performed.

Before surgery:-

- Health issues including diabetes, obesity, and allergies may have an impact on your operation and recovery.

- Give up smoking. Smokers are more likely to get infections. Consult your doctor about quitting prior to surgery.

- Avoid shaving in the vicinity of your procedure. Using a razor to shave might irritate your skin and make it simpler for an illness to spread.

At the time of surgery:-

If someone tries to shave you before surgery with a razor, speak out. If you have any questions, discuss them with your surgeon and find out why you need to be shaved.

After surgery:

- Ask your healthcare professionals to wash their hands if you don't see them doing so.

- When visiting you, family and friends shouldn't touch the surgical wound or bandages.

- Before and after visiting you, family and friends should wash their hands with soap and water or an alcohol-based hand massager. Ask them to wipe their hands if you don't see them doing it.

- Before you leave the hospital, make sure you know how to treat your wound.
- Prior to and after tending to your wound, always wash your hands.

Confirm who to contact if you have inquiries or issues after you reach home.

- If you have any signs of an infection, such as discomfort or redness where the procedure was done.[20]

Ventilator-associated pneumonia:

A person using a ventilator may get a lung infection known as ventilator-associated pneumonia. By supplying oxygen through a tube put in the patient's mouth, nose, or through a hole in the front of the neck, a ventilator is a device that assists a patient in breathing. If bacteria enter the patient's lungs through the tube and get established, an infection could develop. The CDC offers materials to the public to assist them understand these illnesses and take actions to protect their own health wherever possible, as well as recommendations and tools to the medical community to help stop ventilator-associated pneumonia.

Guidelines-

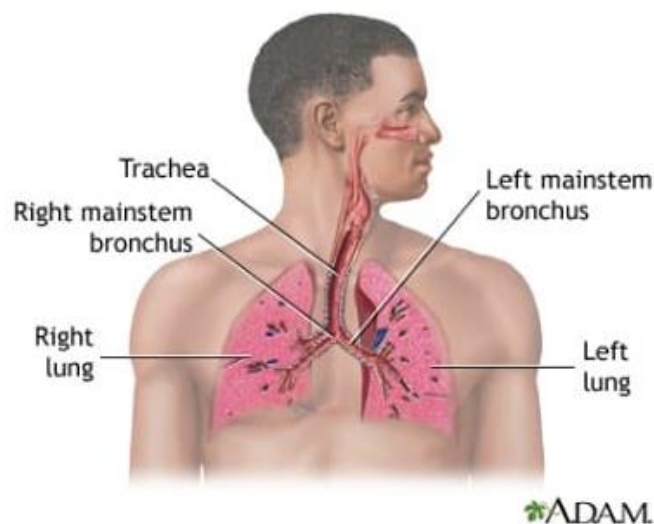
Protective environment (PE) is a specific patient-care area with positive airflow compared to the corridor, often in a hospital (i.e., air flows from the room to the outside adjacent space). High-efficiency particulate air (HEPA) filtering, several air changes per hour (>12 ACH), and little air leakage into the room all work together to provide a setting that is safe for patients who have had an allogeneic hematopoietic stem-cell transplant (HSCT).

Patients who have immunologic disorders, such as human immunodeficiency virus (HIV) infection, congenital immune deficiency syndrome, and chronic diseases (such as diabetes mellitus, cancer, emphysema, or cardiac failure), as well as immunosuppressive therapy, are considered to be immune-compromised (e.g., radiation, cytotoxic chemotherapy, anti-rejection medication, and steroids).

Patients who have severe neutropenia (i.e., an absolute neutrophil count [ANC]

of 500 cells/mL] for extended periods of time, those who receive allogeneic HSCT, and those who undergo the most intensive chemotherapy) for prolonged periods of time are considered immune-compromised patients who are at high risk and have the greatest risk for infection (e.g., patients with childhood acute myelogenous leukemia). [21]

Hospital-acquired pneumonia (HAP) is defined as pneumonia occurring at least 48 hours after hospital admission, excluding any infection incubating at the time of admission. Incidence, etiology, investigation, and outcomes differ slightly for a specific subgroup of HAP known as ventilator-associated pneumonia (VAP). Health-care associated pneumonia (HCAP), a subtype of HAP, has recently received more attention. HCAP is a risk for the following patients:



REFERENCE: (22)

- Those getting home nursing, home intravenous antibiotics, or home wound care;
- occupants of nursing homes or other facilities for long-term care;
- People who have spent more than two days in the hospital within the last 90 days;
- Those who have had intravenous treatment or dialysis at a

within the previous 30 days at a hospital-based clinic.

Recognizing this category is crucial since these individuals have

a greater chance of developing multidrug-resistant (MDR) pathogens, necessitating therapy more in line with VAP than community-acquired pneumonia.

Causes-

The disease of pneumonia is frequent. It is brought on by a wide variety of microorganisms. Hospital-acquired pneumonia often has a higher mortality rate than other lung infections because:

- The sorts of bacteria prevalent in a hospital are frequently more hazardous and more resistant to treatment than those outside in the community.
- Patients in a hospital are frequently severely ill and unable to fight off infections.

People who use a ventilator, a device that aids in breathing, are more likely to get pneumonia.

Health care professionals have the potential to disseminate germs from their hands, clothing, or equipment to other patients, leading to the spread of hospital-acquired pneumonia. This is why it's so crucial to wash your hands, wear a gown, and follow other safety procedures in the hospital. [23]

A person's risk of developing pneumonia while hospitalised can increase if they: have undergone chest surgery or another major procedure, have a weakened immune system as a result of cancer treatment, certain medications, or have significant wounds.

.Suffer from persistent (chronic) lung illness

- Breathe saliva or food into their lungs due to a lack of awareness or difficulty swallowing (for example, after a stroke).

Are older and, as a result of medications or disease, are not cognitively alert are using a breathing apparatus (ventilator).

Symptoms-

Mental changes or disorientation may be the initial indication of hospital-acquired pneumonia in older persons.

Other signs can include:

- a cough that produces sputum that is green or pus-like;
- A general sense of unease or discomfort (malaise)
- Appetite loss
- Nausea and vomiting
- Sharp chest discomfort that worsens with coughing or hard breathing
- Shortness of breath
- Low blood pressure and a rapid heartbeat

Exams and Tests-

Blood cultures and chest x-rays or CT scans are used to examine the lungs and determine whether an infection has spread to the blood.

Arterial blood gases evaluate the amount of oxygen in the blood.

- Complete blood count (CBC)
- Pulse oximetry, to assess blood oxygen levels.
- Sputum culture or sputum Gram stain, to identify the pathogens causing pneumonia.
- Bronchoscopy, in some circumstances, to get cultures directly from the lungs.

Treatment-

Treatments may include:

Prevention-

IV antibiotics injected into your veins to treat lung infection. The antibiotic you are prescribed will battle the microorganisms that were identified in your sputum culture or are thought to be the source of your infection.

- Lung treatments to assist your lungs relax and clear up heavy mucus, as well as oxygen to improve your breathing.
- A ventilator (breathing apparatus) that helps you breathe by utilising a tube or a mask.

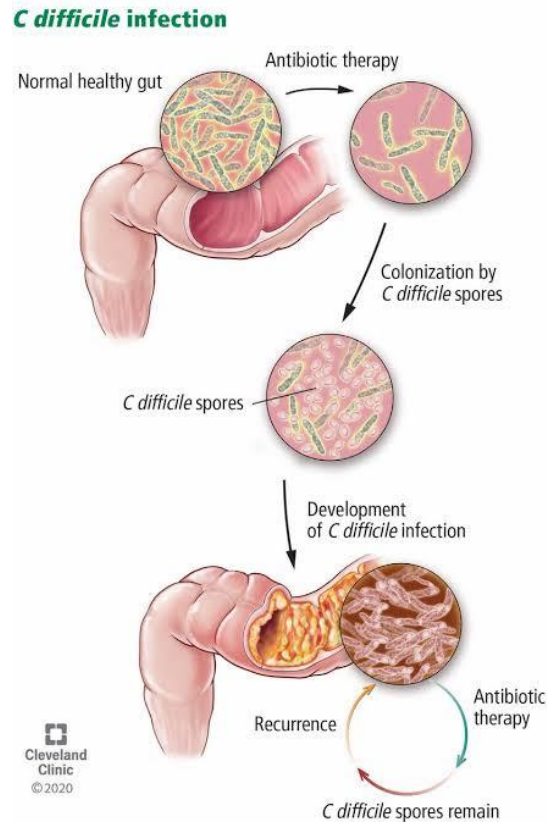
It is important for visitors to take precautions to stop the transmission of pathogens. Washing your hands frequently is the most effective technique to reduce the transmission of germs. If you're unwell, stay at home. Keep your vaccinations current.

To keep your lungs open after surgery, you will be instructed to walk around as soon as you can and take deep breaths. To aid in the prevention of pneumonia, heed your doctor's advise.

Hospital-acquired infections are often prevented through programmes at hospitals.[24]

Clostridium Difficile:

A form of bacterium called Clostridium Difficile can lead to colitis, a severe colon inflammation. C. diff infections frequently begin after you've taken antibiotics. Sometimes, it poses a risk to life.



REFERENCE: (25)

Clostridium Difficile Symptoms-

The symptoms of *C. diff* might be anything from minor to severe.

Mild symptoms can be brought on by issues like:

- For many days, watery diarrhoea that occurs three to four times each day.
- Aching, cramping, or discomfort in the stomach

Blood or pus in the stool is a sign of more severe illnesses. The colon, often known as the large intestine, can become inflamed as a result of *C. diff*. When this occurs, colonic tissue may bleed or produce pus. Additional indications of a severe infection include:

Extreme cramps

Fever

- Vomiting
- Appetite loss/weight loss
- Dehydration
- Quick heartbeat

Severe intestinal inflammation may result from a severe C. diff infection. Additionally, you can experience colon enlargement and sepsis, a severe infection-related reaction. These are all major issues that could require hospitalisation.

Get medical attention right away if you have really bad C. diff diarrhoea. Dehydration that is life-threatening can result from severe diarrhoea.

Clostridium Difficile (C. diff) Causes and Risk Factors-

There is C. diff everywhere around us. It may be found in the soil, water, excrement of both people and animals, and in the air.

Outside of the body, C. diff bacteria transform into spores, which may survive on surfaces for weeks or months. These spores are not "active," but they have the potential to become so if you ingest them and allow them to enter your intestines. Even though they have the bacteria in their intestines, some people never show any signs of it. For some people, however, the bacteria produce toxins that harm the intestines.

The toxin production of a new strain of C. diff bacterium has increased. These sorts are challenging to medicate.

Most at danger are elderly patients in healthcare settings, particularly if they are receiving antibiotics. The reason for this is because the human body harbours hundreds of different bacterial species, some of which are beneficial. The bacteria

that cause C. diff may proliferate uncontrolled and make you unwell if the medicines kill enough beneficial bacteria.

Clostridium Difficile Complications-

The following drugs are most closely associated with an increased risk of C. diff infection:

fluoroquinolones

cephalosporins

penicillins

clindamycin

Younger individuals are also getting C. diff infections more frequently, even when they are not hospitalised or using antibiotics. Infection can result from not fully washing your hands after coming in contact with the bacterium.

If a C. diff infection is not treated right away, you might experience severe diarrhoea and dehydration. This fluid loss might have an impact on your:

- Blood pressure
- Kidney health
- General well-being

Additionally, a C. diff infection might cause such uncommon issues as:

Colon dilates due to toxic megacolon, which prevents stool or gas production. This can make it swell and break. Without immediate surgery, it may pose a life-threatening hazard.

A hole in your big intestine called a bowel perforation allows harmful microorganisms to escape. Peritonitis, a potentially harmful illness, may result from it.

Clostridium Difficile Diagnosis-

Clostridium Difficile Treatment-

The doctor will likely conduct one or more stool tests if they have any reason to believe you have this infection. They include:

- Polymerase chain reaction
- Enzyme immunoassay
- Cell cytotoxicity test; GDH/EIA

The doctor may request X-rays or a CT scan of your intestines if they have major concerns about your colon. In exceptional circumstances, your doctor could do a flexible sigmoidoscopy or colonoscopy to evaluate your colon.

Your illness may have been brought on by antibiotics, however some of these medications specifically target C. diff.

Fidaxomicin,

Metronidazole,

Vancomycin are a few of them.

Discuss the negative effects of these antibiotics with your doctor.

It's crucial to replenish any fluids you lost to diarrhoea. Drink lots of liquids that are high in sugar, salt, and water, including fruit juices and broth.

You could require surgery to remove the afflicted portions of your intestines if there has been damage.

A C. diff infection may occasionally recur. In order to assist the colon become repopulated with beneficial bacteria, doctors occasionally suggest a therapy. The procedure frequently involves inserting another person's faeces into your colon

using a colonoscope. The method is known as a faecal microbiota transplant (FMT).

To ensure that they are not transmitting any illnesses or parasites, donors are thoroughly tested.

Clostridium Difficile Prevention-

There are various steps you may take to safeguard yourself against C. diff if you're a patient in a hospital or long-term care facility. For instance, request that medical personnel wash their hands thoroughly both before and after attending to you.

ASK for the sanitization of all medical equipment before it is delivered into your room.[26]

Skin and Soft Tissue Infections (SSTI):

Skin and soft tissue infections (SSTIs), also known as severe microbial invasion of skin and skin structure, are a class of diseases with a wide range of clinical manifestations and severity levels. There are two types: non-purulent infections and purulent infections (such as abscesses, furuncles, and carbuncles) (e.g., erysipelas, cellulitis, necrotizing fasciitis).

Stevens DL, Bisno A L, Chambers HF, et al classified into three subcategories (I&D) plus oral antibiotics are also classified as severe cases. light, medium, and heavy. Only local symptoms (inflammatory symptoms) are present in mild skin and soft tissue infections, and moderate to severe infections are characterised by systemic signs of infection like temperature above 38°C, heart rate above 90 beats per minute, respiratory rate above 24 breaths per minute, or WBC above 12 x 10⁶ cells/m³. Additionally, patients with inflammatory problems (skin redness, discomfort, swelling, or blisters) and immune-compromising diseases. a crimson streak, clinical indications indicating a deeper infection or an infection that does not respond to incision and drainage, swelling lymph node, weariness, irritability,

lack of appetite, nausea, and vomiting [27]. Antibiotics are needed to maintain control. Infections that are purulent and nonpurulent. The majority of soft tissue infections are mild to moderate in intensity and may be readily treated with a range of medications. Impetigo, erysipelas, cellulites, and subcutaneous bursitis are examples of frequent, superficial infections that, for the most part, are readily treatable. Alternatively, diffuse necrotizing infections can present themselves in a variety of ways, delaying both diagnosis and treatment. Important indicators of such necrotizing infections include skin vesicles, subcutaneous gas, and edoema that is out of proportion to erythema. [28] One of the most common consequences in people with diabetes mellitus is diabetic foot ulcers (DFU) and concurrent infections. Chronic foot ulcers that are life- or limb-threatening can occur in diabetics. One of the most typical reasons for hospitalisation is chronic DFU. Sonja Marie demonstrates that among hospital acquired SSTI, burn wounds are one unique circumstance that is difficult to treat and control. Between 50 and 75 percent of patients have abscesses, while between 25 and 50 percent have cellulitis. [29]

Aim of the Study

The aim of the study is to look at the types of pathogens isolated and their antimicrobial resistance pattern from hospital settings and patient prognosis following HAI infection.

Methodology

Standard protocol systematic literature review will be used in this study. The search will be undertaken. The methods and reporting will be developed and conducted with systematic methodology.

Source of literature

This will be drawn from published literature in the electronic bibliographic databases of: Academic Search Complete, Cumulative Index to Nursing and Allied Health (CINAHL), Global Health, MEDLINE Web of Knowledge and Scopus and supplemented by scanning the reference lists of papers included for review.

Search terms

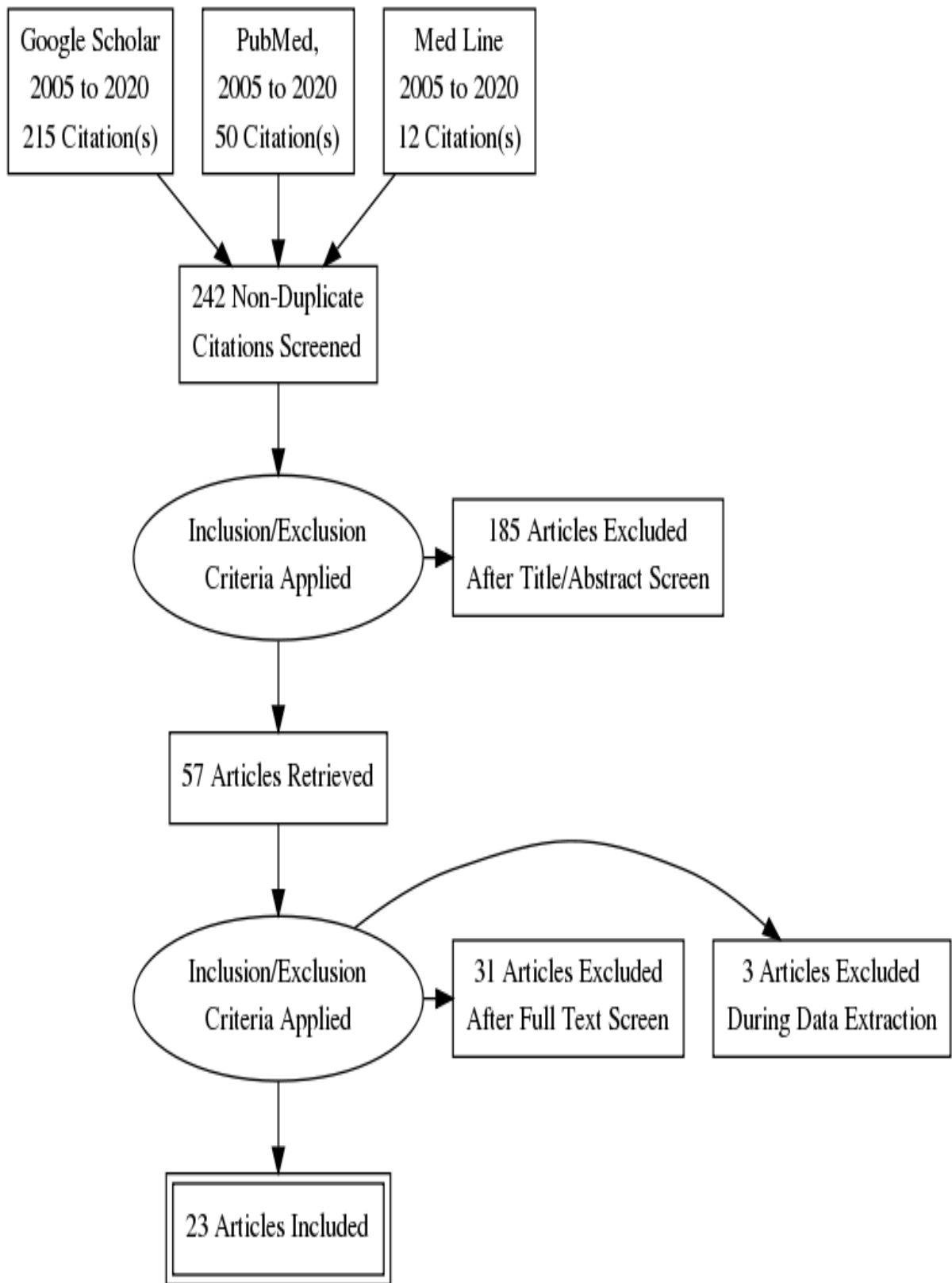
Search terms will be applied with various Boolean operators for three coreconcepts: Hospital acquired infection (HAI); HAI in India; prevalence of HAI.

Inclusion and exclusion criteria

The eligibility of studies for review will be assessed on a set of inclusion and exclusion criteria, based on the availability of studies.

Study selection, data extraction and analysis

Studies from databases will be exported to full review and duplicated citations were removed. Abstracts will be screened for relevance to the study question and country of the study. All other inclusion and exclusion criteria were applied through assessment of the full text publications. Studies selected for inclusion were transferred to a Microsoft Excel spreadsheet for extraction of data items of: type of pathogens, patient outcome and antimicrobial susceptibility pattern.



RESULT

S.No.	AUTHOR	YEAR	COUNTRY	STUDY FINDING
1.	Maumita D, Dipanshu M.	2018	West Bengal	Hospital acquired infections had an incidence rate of 19.6% and a density of 26.35 per 1000 patient days, according to the study. The most frequent kind of infection was surgical site infection (57.2%), followed by urinary tract infection (23.8%) and bloodstream infection (19.0 percent) Pseudomonas and Klebsiella were the two bacteria that were most often discovered. The study's main finding was that the hospital acquired infection rate could not be reduced to less than 10% in tertiary healthcare facilities. Therefore, the installation of strict HAI prevention standards as well as ongoing surveillance and monitoring systems can aid in the future reduction of this issue.
2.	Narendranath V et al.	2017	India	Researchers report that UTI-1318 (1.66%) is more common in females than other forms of

				<p>HAI overall and has the greatest prevalence in general ward (51.7%). BSI-360 (0.45 percent) had 54 percent male patients, 79.7 percent diagnoses that were medical in nature, and 66.9 percent of cases were from intensive care units. According to a mortality study, the greatest number of fatalities was caused by BSI, which was responsible for a case fatality rate of 27.22 percent and a proportionate mortality rate of 60.12 percent. The study's conclusion was that tertiary care facilities need a multi-pronged approach to combat these diseases. HAIs increase hospital stays, cause long-term impairment, and place a financial burden on the family. Many times, illnesses related to healthcare can be avoided by employing</p>
3.	Yatin M et al	2014	India	<p>The researchers' methods for preventing infection include identifying patients who are at risk for nosocomial infections,</p>

				<p>practising good hand hygiene, adhering to protocol to prevent transmission, and developing plans to lower the incidence of pneumonia caused by ventilators, catheters, and urinary tract infections, among other things. For the purpose of estimating the risk of infections, the post-transplant timeline is divided into three time periods. Special attention must be paid to cleaning and decontaminating the room's ventilation system, wearing protective gear, and handling food with care.</p>
4.	Christine Boev et al.	2017	New York	<p>The Centers for Disease Control and Prevention (CDC) classifies complications or infections resulting from surgical procedures or the implantation of medical devices as HAIs. The CDC specifically keeps an eye on pneumonias linked to ventilators, bloodstream infections linked to central lines, urinary tract infections</p>

				linked to catheters, and surgical site infections. The aetiology, epidemiology, and prevention of HAIs are covered in this article, as well as how nurses may collaborate with other medical professionals to reduce the frequency of these avoidable problems.
5.	Velu Nair et al.	2014	Pune	Each patient's information was gathered utilising a standardised data input form. Patients with HAI were identified and given a diagnosis using Centers for Disease Control and Prevention standards. The outcome of this research was 3.76 percent of people had HAI overall. This study's result was that HAI prevalence gradually decreased across several survey cycles. All parties involved must make a conscious effort to shorten hospital stays. Medical gadgets should only be used sparingly and carefully.
6.	Babcock H.etal	2003	Midwestern united states	Between hospitals and between various intensive care units

				<p>(ICUs) within hospitals, microbiologic data were compared. The outcome of this research was Reviewable culture data were available for 753 ventilator-associated pneumonia occurrences. In all hospitals, Staphylococcus aureus and Pseudomonas aeruginosa were the most prevalent microorganisms (25.2 percent). Escherichia coli (9.5 percent vs 2.3 percent; P .001) and Klebsiella pneumoniae (13 percent vs 3.1 percent; P .001) were more prevalent in the paediatric hospital than in the adult hospitals. Pediatric ICU rates in the paediatric hospital were greater than neonatal ICU rates (33.3 percent vs. 17 percent; P =.01). The surgical ICU in the adult hospitals showed higher Acinetobacter baumannii rates than the other ICUs (10.2 percent vs. 1.7 percent; P .001). Ventilator-associated pneumonia has</p>
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				different microbiologic causes in different institutions. Understanding these variations can help with initial antibiotic regimen selection, which may reduce mortality.
7.	Zeina A Kanafani et al.	2003	Lebanon America	In accordance with the study's findings, 70 patients participated. The prevalence of VAP was 47%. Of all isolates, gram-negative bacilli made up 83 percent. Pseudomonas aeruginosa and Acinetobacter anitratus were the two most frequent organisms found. All gram-negative bacterial isolates were categorised as antibiotic resistant in 50% of cases. The study's result was The findings from this referral centre in Lebanon show a greater frequency of VAP and a significant prevalence of resistant microorganisms when compared to previous research. Because they influence the selection of empiric antibiotic

				treatment for VAP, these results are important.
8.	Yaowen Zhang et.al	2014	China	Incidences of ICU-acquired pneumonia and VAP were 16.2% (95 percent confidence interval (CI) 12.8-20.4%) and 33.7% (95 percent CI 31.4-36.1%), respectively, according to the findings of this study. Mortality rates were 37.4% (95 percent CI 24.6-52.2%) and 34.5 percent (95 percent CI 29.2-40.1%), respectively. For ICU-acquired pneumonia and VAP, the lengths of stay in the ICU and hospital were 12.4 (95 percent confidence interval [CI] 9.6-15.3) and 17.7 (95 percent CI 15.6-19.7) days and 18.0 (95 percent CI 16.5-19.6) and 30.5 (95 percent CI 26.4-34.7) days, respectively. The most commonly isolated pathogens were <i>Pseudomonas aeruginosa</i> (19.9%), <i>Acinetobacter baumannii</i> (13.9%), <i>Klebsiella pneumoniae</i> (11.9%), and <i>Staphylococcus aureus</i>

				(10.4%); 82.9 percent of <i>S. aureus</i> isolates were found to be methicillin-resistant.
9.	Siyi He et.al	2014	China	<p>According to the findings of this study, the prevalence was 6.37 percent overall and 35.2% among patients who had been receiving mechanical ventilation for more than 48 hours. The average detection rate for the isolated pathogens was 23.19 percent for <i>Pseudomonas aeruginosa</i>, 20.15 percent for <i>Staphylococcus aureus</i>, 19.53 percent for <i>Haemophilus influenzae</i>, 10.68 percent for <i>Acinetobacter baumannii</i>, 10.18 percent for <i>Escherichia coli</i>, 10.18 percent for <i>Klebsiella pneumoniae</i>, and 9.52 percent for <i>Candida albicans</i> (7.20 percent). Also examined were risk variables. The study's findings indicate that VAP is frequent and has a poor prognosis in patients who have undergone cardiac surgery. It is mostly brought on</p>

				by gram-negative bacteria and may be influenced by a number of variables.	
10.	Harika et.al	B	2018	India	In a tertiary hospital in India, a recent study discovered 143 strains of Acinetobacter, 126 of which (88.1%) were incredibly drug resistant. In India, there are little reliable and consistent surveillance data on infections related to healthcare.

DISCUSSION

During the study period, the hospital acquired infection rate was 33.33%. In India nosocomial infections rate is alarming and is estimated at about 30-50% of all hospital infections according to world health. The observed study indicated high prevalence rate. However, in developing countries, due to lack of surveillance the rate of health- formal care-associated infections is high and compliance with hand hygiene is low.

They can increase the costs of patient care from several economic perspectives, including those of hospital administrators, third-party payers and patients. In healthcare systems relying on fixed per diem accounting systems, the presence of an HAI does not necessarily decrease reimbursement revenue for hospitals, as added bed-days can be charged to third-party payers (e.g. health insurance companies). Excess costs of HAI are related to additional diagnostic tests and treatment, additional hospital days, and post discharge complications, among others. Quantifying the exact economic burden attributable to HAI still remains a challenging issues.

CONCLUSION

From the above and the researcher's clinical experience the researcher thought to do this meta-analysis on "Hospital acquired infection in India". Thereby trying to understand the latest evidence on hospital acquired infection in India. This will further help in developing better hospital practices and policies to prevent and manage HAI.

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