

Hospital Acquired Infections during Patient Incubation at Tertiary Care Hospital of Northern India

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ABSTRACT

Health care associated infection (HAI) can be defined as an infection acquired in hospital by a patient who was admitted for a reason other than that of infection or an infection occurring in a patient in the hospital or other health care facility in whom the infection was not present or incubating at the time of admission. Infections occurring more than 48 hours after admission is considered as HAI. Bacteria, fungi, viruses, or other, less common pathogens can cause HAIs. Patients being susceptible to common infections due to diminished immune responses and infections at surgery sites (SSIs), many HAIs are due to implants and prostheses. These include central line-associated bloodstream infections (CLABSIs), catheter-associated UTIs (CAUTIs), and ventilator-associated pneumonia (VAP). This study was conducted from October 2021 to October 2022 in a tertiary care hospital. All wards of SSB Heart and Multispecialty Hospital were included. The incidence, prevalence and risk factors of healthcare associated infection were determined and analyzed. The specimens were processed by standard microbiological methods to isolate and identify etiology. Clinical and laboratory data were collected using structured case report formats. HAIs (CAUTI, CLABSI, VAP, SSI) data from the month of October 2021 to October 2022 has been described in Table 1 to Table 5. In a period of one year a total of 5 cases of Ventilator associated pneumonia from 1124 ventilator days and 7 cases of CAUTI out of which 4731 catheter days. Highest incidence of HAI were 10 cases of CLABSI out of which 1421 central line days in a year and lowest HAI was 1 case of SSI in 3853 days of patients susceptible to SSI in a year. This study revealed that infections rate were very less in ICU because of patient care and well manage infection rate and well defined infection guidelines at SSB Heart and Multispecialty hospital, Faridabad.

KEYWORDS: Health care associated infection, HAI, surgery sites, SSIs, ventilator-associated pneumonia, VAP, central line-associated bloodstream infections, CLABSIs, CAUTI.

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INTRODUCTION

Healthcare-associated infections (HAIs) are infections people get from healthcare centers while they are receiving care for another condition. HAIs can happen in any health care facility, including hospitals, ambulatory surgical centers, end-stage renal disease facilities, and long-term care facilities. Bacteria, fungi, viruses, or other, less common pathogens can cause HAIs.¹ Health care-associated infections are those infections occurring in a health care facility that first appear 48 hours or more after hospital admission, or within 30 days after having received health care.² Multiple studies indicate that the common types of

adverse events affecting hospitalized patients are adverse drug events, HAIs, and surgical complications.³ HAIs are a significant cause of illness and death and they can have serious emotional, financial, and medical consequences. At any given time, about 1 in 31 inpatients have an infection related to hospital care.⁴ Several studies suggest that simple infection-control procedures such as cleaning hands with an alcohol-based hand rub can help prevent HAIs and save lives, reduce morbidity, and minimize health care costs.⁵ Routine educational interventions for health care professionals can help change their hand-washing practices to prevent the spread of infection.⁶ In support of this, the

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WHO has produced guidelines to promote hand-washing practices among member countries. Out of every 100 hospitalized patients, seven patients in advanced countries and ten patients in emerging countries acquire an HAI. The WHO reports however that HAIs usually receive public attention only when there are epidemics. HAIs also have impact on critically ill patients with around 0.5 million episodes of HAIs being diagnosed every year in ICUs alone. ICU patients are often in a very critically ill, immunocompromised status, which increases their susceptibility to HAIs.⁷

What Increases the Risk of Healthcare-Associated Infections (HAIs)?

HAIs happen in hospitals, nursing homes, long-term care facilities, ambulatory surgical centers, dialysis centers, and other healthcare facilities. These factors increase the risk of an HAI:

- Use of catheter (drainage tube) or ventilator (breathing tube).
- Injections.
- Surgery.
- Facility or equipment not properly cleaned and disinfected.
- Disease that spreads between healthcare worker to patient or patient to patient.⁸

2. PATHOPHYSIOLOGY

Around 12–17 microorganisms cause 80%–87% of HAIs: *S. aureus*, *Enterococcus species* (eg, *faecalis*, *faecium*), *E. coli*, *coagulase-negative Staphylococci*, *Candida species* (eg, *albicans*, *glabrata*), *K. pneumoniae* and *Klebsiella oxytoca*, *P. aeruginosa*, *A. baumannii*, *Enterobacter species*, *Proteus species*, Yeast NOS, *Bacteroides species*, and other pathogens. Among these pathogens, 16%–20% include multidrug-resistant (MDR) phenotypes: MRSA, vancomycin-resistant *E. faecium*, carbapenem-resistant *P. aeruginosa*, extended-spectrum cephalosporin-resistant *K. pneumoniae*, *K. oxytoca*, *E. coli*, and *Enterobacter species*, and carbapenem-resistant *P. aeruginosa*, *K. pneumoniae*/*K. oxytoca*, *E. coli*, *Enterobacter species*, and *A. baumannii*.³ Some of these Gram-negative microorganisms have a much higher rate (20%–40%) of resistance than others with the organisms isolated from device-associated HAIs having the highest antimicrobial resistance phenotypes. Although similar to the percentage resistance for most phenotypes was that in an earlier research study, an upsurge in the scale of the resistance fractions against *E. coli* pathogens was observed, especially with fluoroquinolones. *Acinetobacter*, *Burkholderia spp.* and *Pseudomonas spp.* isolates were 100%, which were 92% resistant to *cephalosporins* respectively. *Burkholderia spp.* was again totally resistant to *fluoroquinolones* and *Acinetobacter spp.* and *Pseudomonas spp.* were 94.2% and 95.8% resistant, respectively. The same study reported that 86.4% *Acinetobacter spp.* and

62.5% *Pseudomonas spp.* showed a high resistance to carbapenems, the preferred drug regime in ICUs. Carbapenems were found more effective against *Burkholderia spp.* with 20% resistance. In another study, *Enterobacteriaceae* community was found to be completely resistant to third-generation cephalosporins. Over 80% of the *Klebsiella spp.* community was resistant to ciprofloxacin, gentamicin, piperacillin, tazobactam, and imipenem showing 48.6% resistance. *E. coli* was equally resistant although carbapenems were effective in almost 80% cases. Although *Citrobacter spp.*-related HAIs are a relatively minor proportion, they also show resistance toward cephalosporins, fluoroquinolones, and aminoglycosides. Another study reported that although the *Acinetobacter spp.* were 76.99%–92.01%, resistant to most antimicrobials, only 30% of *Acinetobacter spp.* isolated were susceptible. It can be seen therefore that the causative pathogenic microorganisms differ from country to country as does patterns of resistance.⁶

Types of HAIs

• CAUTI: Catheter associated urinary tract infection

A catheter is a tube that goes to the bladder through the urethra to allow urine to drain from your body into a collection bag. Urinary tract infections (UTIs) are the most common type of HAI. They affect the urinary tract (kidneys, bladders, urethra and ureters). However 75% of these UTIs are linked to the use of catheters, especially if the catheter is used for a long time.

• CLABSI: Central line associated blood stream infection

A central line, also called a central venous catheter, is placed into a major vein near your heart to give medicines and take blood.

• VAP: Ventilator associated pneumonia

A ventilator is a machine that uses tubes to help oxygen get to your lungs either by way of your mouth or through a hole in your neck. Pneumonia is a lung infection that can happen if the germs enter your lungs because of the tube.

• SSI: Surgical site infection

Any infection occurring within 30 days of an operative procedure involving a break in the designated epithelial surface with any of the one or more signs or symptoms such as pain, tenderness, localized swelling, redness, or heat.

HAI National Action Plan

Healthcare-associated infections (HAI) are a threat to patient safety and a top priority for the Department of Health and Human Services. To provide a roadmap for HAI prevention, HHS released the *National Action Plan to Prevent Health Care-Associated Infections: Roadmap to Elimination* (HAI National Action Plan) in 2009 with updates made in 2013 and 2018. HHS is currently working to update this plan with new indicator targets and data, new research and

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intervention efforts, and a review of the impact of the COVID-19 public health emergency on HAIs.⁶

How are healthcare-associated infections (HAIs) treated?

HAIs can cause illnesses ranging from mild to extremely serious and life threatening. Treatment of HAIs depends on the infection involved. Some respond to carefully chosen antibiotic treatments. However, some HAIs can be extremely difficult to treat because of their resistance to antibiotics. Because of this, the best treatment for HAIs is prevention.⁴

3. METHODOLOGY

This study was conducted from October 2021 to October 2022. All wards and ICU's of SSB Heart and Multispecialty Hospital, Faridabad, a unit of SSB Central hospital and Research Centre were included. The incidence, prevalence and risk factors of healthcare associated infection were determined. A total of 11,130 admitted patients days who were susceptible to any HAI were followed throughout their hospital stay. Biological specimens were collected from all patients suspected to have hospital-acquired infection. The specimens were processed by standard microbiological methods to isolate and identify bacteria etiology and sensitivity. Clinical and laboratory data were collected using structured case report formats and analyzed. The number of susceptible days of the patient and number of HAI were compared per month and for the year

4. RESULTS

HAIs (CAUTI, CLABSI, VAP, SSI) data from the month of October 2021 to October 2022 described in Fig 1 to Fig 5. In a period of one year a total of 5 cases of Ventilator associated pneumonia (VAP) from 1124 ventilator days and 4 cases of CAUTI out of 4731 catheter days occurred. Incidence of CLABSI was 1 case out of 1421 central line days in a year and no case of SSI in 3853 days of patients susceptible to SSI in a year.

Among patients who underwent surgical procedure, the risk of HAI was found to be high in those with regards to patient having history of previous hospitalization. Furthermore, hospital acquired infection at the hospital were associated with prolonged hospital stay and increased in hospital mortality. In month of October to November 2021, there were 1 case of HAI reported among total no of 5161 IPD patients days in which ventilator days were 151, urinary catheter days 555, central line day 107 & total no. of surgeries were 563.

In month of December 2021 there were no cases of HAI reported among total no. 3576 IPD patients days in which ventilator days were 59, urinary catheter days 217, central line days 47& total no. of surgeries were 263. In month of January to march 2022, there were 4 cases of HAI reported among total no. Of 3160 IPD patients days in which ventilator days were 221, urinary catheter days 1109, central line days 301 & total no of surgeries were 999. In month of April 2022, there were no cases of HAI reported among total no. Of 3799 IPD patients days in which ventilator days were 104, urinary catheter days 395, central line days 163 & total no of surgeries were 305. In month of May 2022, there were no cases of HAI reported among total no. Of 3935 IPD patients days in which ventilator days were 104, urinary catheter days 392, central line days 114 & total no of surgeries were 358. In month of June 2022, there were no cases of HAI reported among total no of 3997 IPD patients days in which ventilator days were 88, urinary catheter days 368, central line days 84 & total no of surgeries were 295. In month of July 2022, there were 1 case of HAI reported among total no. of 4022 IPD patients days in which ventilator days were 64, urinary catheter days 260, central line days 105 & total no. of surgeries were 274. In month of August to October 2022, there were maximum cases of HAI i.e. 4 cases were reported, all of them VAP, among total no. of 4022 IPD patients days in which ventilator days were 250.

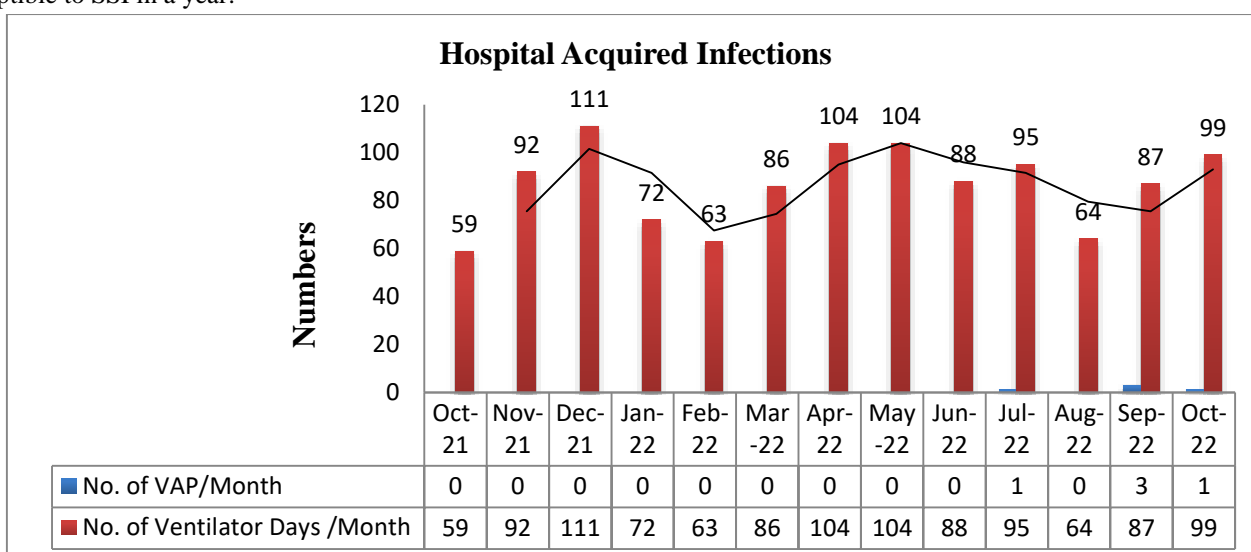


Fig no1. Shows hospital acquired infections of Ventilator Associated Pneumonia from Oct-21to Oct-2022

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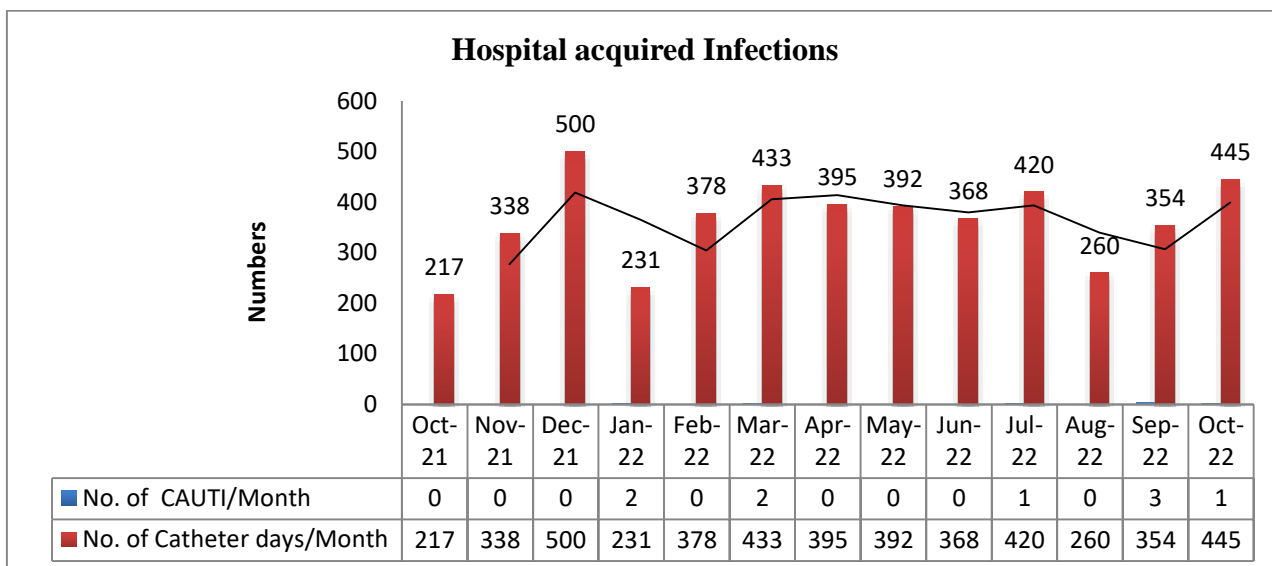


Fig no 2. Shows hospital acquired infections of Catheter-associated Urinary tract infections from Oct-21to Oct-2022

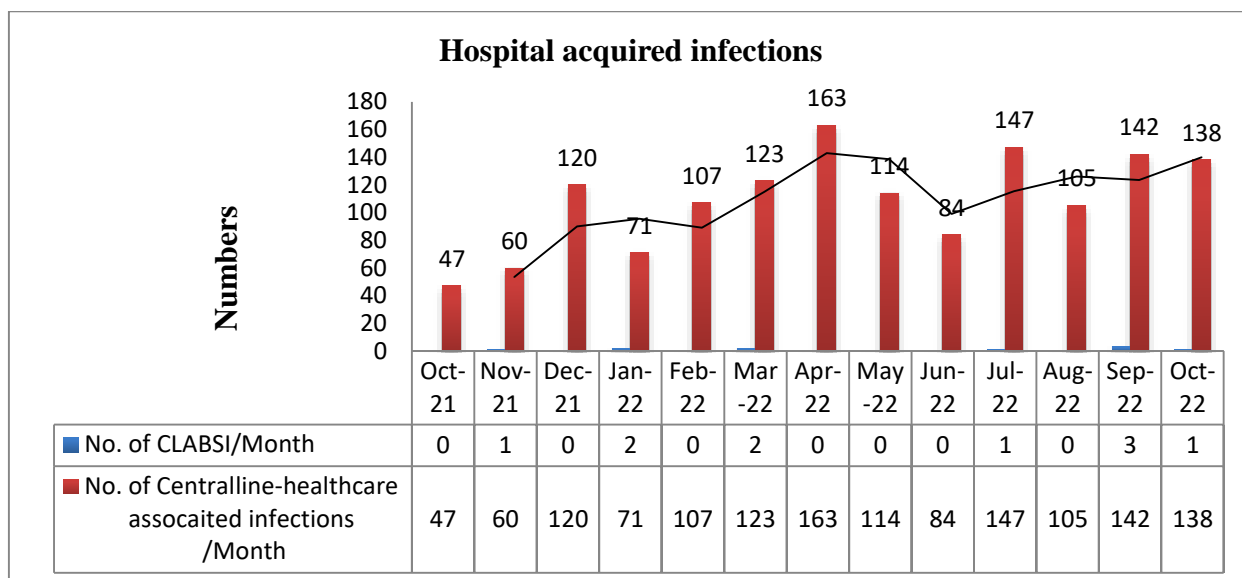


Fig no 3. Shows hospital acquired infections of Centralline-healthcare associated infections from Oct-21to Oct-2022

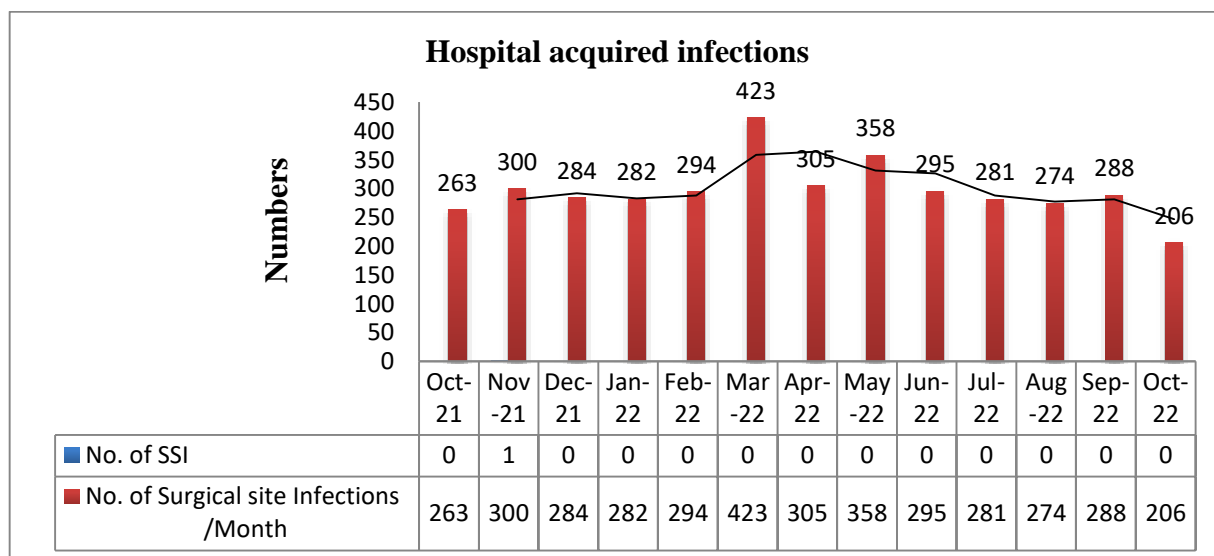


Fig no 4. Shows hospital acquired infections of Surgical site Infections from Oct-21to Oct-2022

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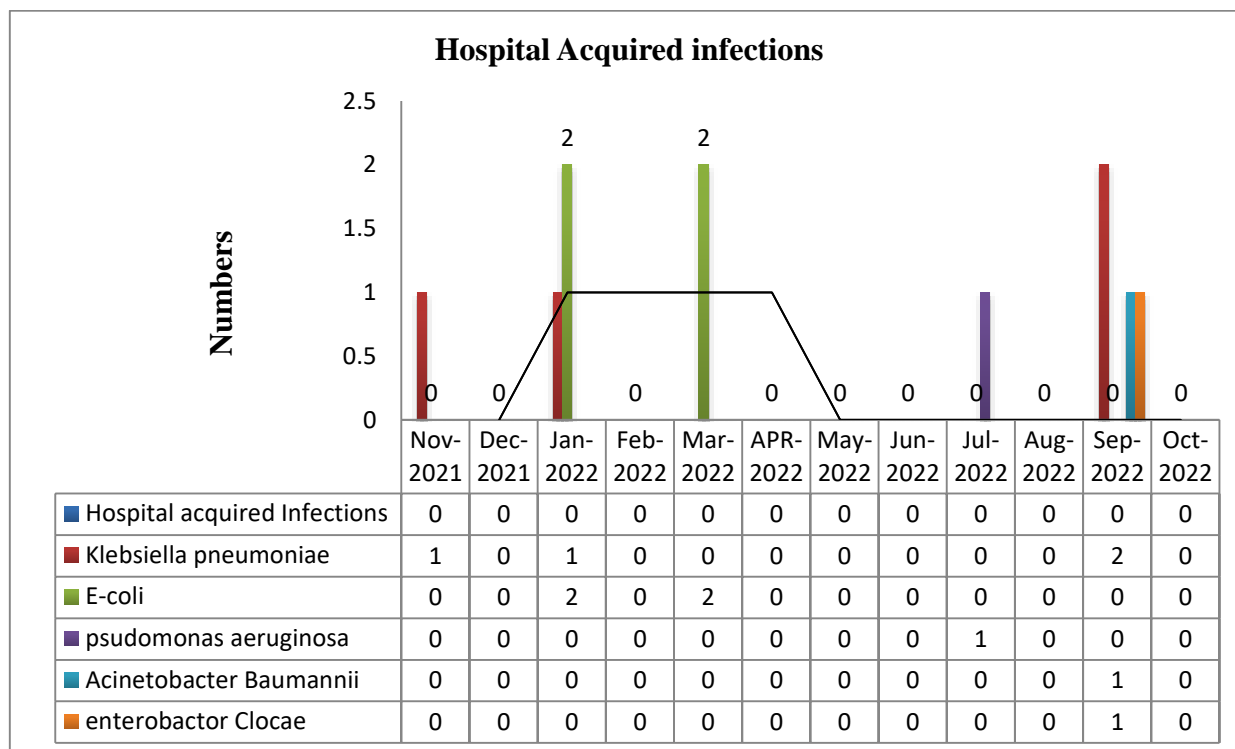


Fig no 5. Shows the most common hospital acquired infections organisms from Oct-21 to Oct-2022

5. DISCUSSION

The current study was designed to understand the healthcare-associated infections (CAUTI, CLABSI, VAP, SSI). According to Monegro AF et al, Hospital-acquired infections, also known as healthcare-associated infections (HAI), are nosocomial-acquired infections that are typically not present or might be incubating at the time of admission. These infections were usually acquired after hospitalization and manifest 48 hours after admission to the hospital. The infections are monitored closely by agencies such as the National Healthcare Safety Network (NHSN) of the Center for Disease Control and Prevention (CDC). This surveillance is done to prevent HAI and improve patient safety. HAI infections include central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), surgical site infections (SSI), Hospital-acquired Pneumonia (HAP), Ventilator-associated Pneumonia (VAP), and *Clostridium difficile* infections (CDI). Based on the guidelines from both the Infectious Disease Society of America (IDSA) and the American Thoracic Society (ATS), the definitions of Pneumonia have been changed to better identify patients at risk for multidrug-resistant (MDR) pathogens. This, in turn, is aimed at avoiding the overuse of antibiotics. Healthcare-acquired Pneumonia or HCAP, which was widely used previously, has been made obsolete. The term Hospital-acquired Pneumonia or HAP has replaced HCAP. As per the IDSA guidelines, Hospital-acquired Pneumonia is defined as "pneumonia that occurs 48 hours or more after admission to the hospital and did not appear to be incubating at the time of admission". According to IDSA, Ventilator-associated pneumonia or VAP is defined as "pneumonia that develops

more than 48 to 72 hours after endotracheal intubation". Both HAP and VAP are associated with poorer outcomes and significant morbidity and mortality worldwide.⁹ According to voidazan S et al, an analysis of the routine prevalence data collected by HAI, showed a clear correspondence between the sections and the type of infections, their associated impact on mortality, which recommends the rapid, vigilant and targeted application of systematic strategies in order to reduce the incidence of HAI. Infections associated with healthcare are a reality, occurring all over the world and their prevention must be a priority for each medical unit and a responsibility for every person involved in healthcare. In the hospital, the infectious risk is ubiquitous, and the development of a management plan for it implies that it is well explained, understood and applied by all staff in a conscious and unconditional way.¹⁰ According to Stewart S et al, a one-year prospective incidence study of HAI observed in one teaching hospital and one general hospital in NHS Scotland as part of the Evaluation of Cost of Nosocomial Infection (ECONI) study. All adult inpatients with an overnight stay were included. HAI was diagnosed using European Centres for Disease Prevention and Control definitions. A multi-state model was used to account for the time-varying nature of HAI and the competing risks of death and discharge. A reduction of 10% in HAI incidence could make 5800 bed-days available. These could be used to treat 1706 elective patients in Scotland annually and help reduce the number of patients awaiting planned treatment. This study has important implications for investment decisions in infection prevention and control interventions locally, nationally, and internationally.¹¹ Healthcare-associated infections (HCAIs)

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are a major source of morbidity and mortality and are the second most prevalent cause of death. Furthermore, it has been reported that for every one-hundred patients admitted to hospital, seven patients in high-income economies and ten in emerging and low-income economies acquire at least one type of HCAI. Currently, almost all pathogenic microorganisms have developed antimicrobial resistance, and few new antimicrobials are being developed and brought to market. We found that although hand hygiene is a centuries-old concept, it is still the primary strategy used around the world to prevent HCAs. It forms one of a bundle of approaches used to clean and maintain a safe hospital environment and to stop the transmission of contagious and infectious microorganisms, including multidrug-resistant microbes. Finally, antibiotic stewardship also has a crucial role in reducing the impact of HCAs through conserving currently available antimicrobials.¹² Comparative-effectiveness studies directly comparing disinfection modalities and monitoring strategies are limited. Future research should examine and compare newly emerging strategies, such as peracetic acid, hydrogen peroxide wipes, enhanced coatings, and microfiber cloths as cleaning strategies, and adenosine triphosphate and ultraviolet light technologies as monitoring strategies. Patient colonization and infection rates should be included as outcomes when possible. Other challenges to be addressed include identification of surfaces posing the greatest risk of pathogen transmission, developing standard thresholds for defining cleanliness, and using methods to adjust for confounders such as hand-hygiene practices when examining the impact of disinfection modalities.¹³ The highest incidence of HAI (CAUTI, CLABSI, VAP, SSI) was seen in intensive care unit in CAUTI and the lowest incidence was seen in VAP. The risk of HAI was found to be high in those with history of previous hospitalization. This study proved hospital acquired infection at the hospital was associated with prolonged hospital stay and increased in hospital mortality.

6. CONCLUSION

This study revealed that very less admitted patients had hospital-acquired infections. There is a difference in risk factors between patients with and without surgery. Perhaps, It can be concluded that Hospital acquired infections were very few with admitted patients undergoing treatments in Wards and ICU's

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