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RESEARCH ARTICLE

AN OBSERVATIONAL STUDY TO ASSESS THE PATTERN AND INCIDENCE OF HEALTHCARE ASSOCIATED INFECTIONS (HAI) AND EVALUATE EFFECTIVENESS OF HOSPITAL INFECTION CONTROL (HIC) POLICIES.

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Abstract

Introduction:- Knowledge about the incidence, pattern and antimicrobial susceptibility of organisms causing healthcare associated infections (HAI) along with simultaneous assessment of effectiveness of hospital infection control policies (HIC) can help us in devising new strategies for prevention of HAI.

Aim: To assess the pattern and incidence of HAI and effectiveness of HIC policies.

Materials and Methods:- An observational prospective study was conducted in 39 patients with HAI meeting the inclusion criteria from January 2014 to December 2015 at Rao Nursing Home, Pune. Exposures to various invasive devices were noted in the patients. The occurrence, site, micro-organisms responsible for HAI, antimicrobial susceptibility patterns, factors influencing HAI and antibiotic therapy were identified and recorded. The rates of HAI in 2014 and 2015 were compared to check the efficacy of HIC policies. The data was analyzed using descriptive statistics like number and percentages.

Results:- Catheter associated urinary tract infection (CAUTI) was the most common device associated HAI (43.6%) with *Pseudomonas aeruginosa* and *E. coli* being the most common organisms leading to it. Highest resistance was seenfor antibiotics like piperacillin (69.2%), ticarcillin (69.2%) and carbenicillin (69.2%). The major causes for HAI were prolonged hospital stay and co-morbid conditions of the patient. Incidence rates for device associated HAIdemonstrated a decline from 2014 to 2015, with achievement of target ratefor infection control.

Conclusion:- The incidence of HAI can be reduced by educating patients, adequate training of the staff, special care of high risk population, and implementation of proper interventions.

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Introduction:-

Healthcare associated infections (HAI) also called nosocomial infections, have become major concern to both patients and healthcare professionals worldwide.[1]HAI is defined as an infection acquired in hospital or other health care facility by a patient admitted for a reason other than that infection and in whom the infection was not present or incubating at the time of admission. It also comprises of infections appearing after discharge but contacted in hospital, along with occupational infections among staff of the healthcare facility. Infections occurring more than 48 hours after admission are usually considered nosocomial.[2] Immunocompromised patients, elderly, presence of comorbid conditions and undergoing medical or surgical treatments are most commonly affected by HAI, with overall incidence of 1.4 million patients worldwide.[2]Apart from aging, increasingly aggressive medical and therapeutic interventions, including implanted foreign bodies, organ transplantations and xenotransplantations have created a group of particularly susceptible persons, resulting in highest infection rates to be observed in intensive care unit (ICU) patients.[3,4] The 3 major factors substantially increasing the risk of nosocomial infection include: (a) intrinsic risk factors related to the need for intensive care; (b) invasive medical devices, and (c) crowding and animate reservoirs that increase the risk of cross infection in the ICU.[5]

According to the specific infection sites,nosocomial infections can be urinary tract infections, surgical site infections (SSI), nosocomial pneumonia, nosocomial bacteremia, skin and soft tissue infections, gastroenteritis, sinusitis and other enteric infections, ophthalmic infections, endometritis and other infections of the reproductive organs following childbirth. Infections that can be associated with the devices used in medical procedures, such as catheters or ventilators, arecentral line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), and ventilator-associated pneumonia (VAP).[6]

The organisms commonly contaminating urinary catheters and developing biofilms are *S. epidermidis*, *Enterococcus faecalis*, *E. coli*, *Proteus mirabilis*, *P. aeruginosa*, *K. pneumoniae,* and other gram-negative organisms, while that most commonly isolated from catheter biofilms in central venous catheters are *S. epidermidis*, *S. aureus*, *Candida albicans*, *P. aeruginosa*, *K. pneumoniae*, and *Enterococcus faecalis.*[7]

Lack of financial support, inadequate numbers of trained personnel working in infection control, understaffed hospital units, and insufficient equipment and supplies may not be considered as independent risk factors, but are common obstacles to attain optimal infection control in developing countries.[8]Health care professionalshold the responsibility of preventing nosocomial infections which can be achieved by an integrated andwell monitored programme including the following key components: reduced transmission of organisms between patients in direct patient care by means of adequate hand washing and use of gloves; appropriate aseptic practice, isolation strategies, sterilization and disinfection practices; controlling environmental risks for infection; appropriate use of prophylactic antimicrobials, nutrition, and vaccinations; limited use of invasive procedures to minimize the risk of endogenous infections and promoting optimal antimicrobial use; surveillance of infections, identifying and controlling outbreaks; prevention of infection in staff members; enhancing staff patient care practices, and continuing staff education.[2]

Hence, this study was undertaken to analyze the patterns and incidence of HAI in Rao Nursing Home, Pune, a 123 bedded tertiary care hospital, to study the factors influencing HAI, susceptibility of organisms causing HAI to antibiotics, and assess the efficacy of preventive measures taken by observing the trend inrates of HAI from 2014 to 2015.

Materials and Methods:-

After obtaining Independent Ethics Committee approval and written informed consent from all the participants, an observational study was carried out at Rao Nursing Home, Pune, a tertiary care hospital, from January 2014 to December 2015 to assess the pattern and incidence of healthcare associated infections, their susceptibility to antibiotics and effect of preventive measures on the incidence of HAI. Daily rounds were conducted to monitor infections. Data for catheter days, central line days, ventilator days was collected and captured in case record form (CRF) on daily basis. When patient was suspected for HAI as per CDC definition for suspected HAI[9-12], their necessary samples were sent along with the clinical history to the microbiology laboratory. HAI was confirmed as per CDC diagnostic criteria[9-12].All positive cases were analyzed in the form of surveillance form adapted from National Healthcare Safety Network (NHSN). All samples were processed by fully automated Vitek® 2 Identification and AST systems from Biomerieux at Rao Nursing Home Microbiology Laboratory. Total 100 patients were suspected for HAI. Out of 100 patients, 39 patients' samples were tested positive for HAI. Patients

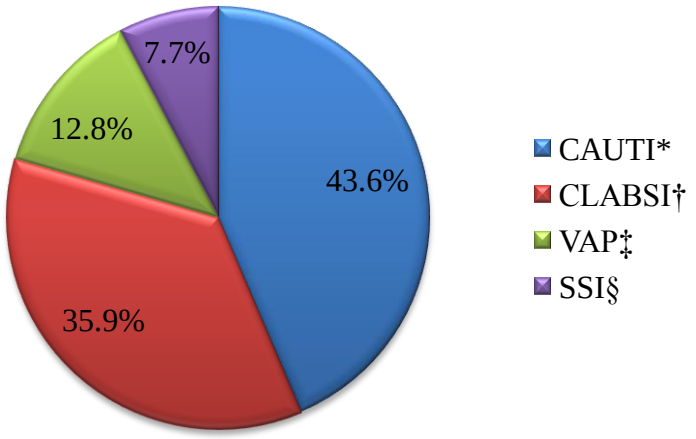
screened were of the age group between 18 to 85 years and had developed infection after 48 hours of admission to the hospital (wards /ICU), in whom the infection was not present or incubating at the time of admission. The study excluded patients with community-associated infection, healthcare-associated community-onset infection, and patients transferred to a study hospital after developing HAI in another hospital. Staff was trained for entry of the data in case record forms(CRF) which includedpatient's age, gender, admission date, ward type (surgery, medicine, and intensive care unit), duration of hospital stay etc. Antibiotic susceptibility testing of collected samples was donefully automated Vitek® 2 Identification and AST systems from Biomerieux at Rao Nursing Home Microbiology Laboratory. HAI was defined according to Centre's for Disease Control and Prevention standards[13]and was classified as catheter associated urinary tract infection, surgical wound infection, pneumonia, ventilator associated pneumonia, bloodstream infection, and others (skin and soft-tissue infections, intra-vascular and gastrointestinal system infections). The occurrence, site, micro-organisms responsible for HAI, antimicrobial susceptibility patterns, and antibiotic therapy were identified and recorded in Case record forms (CRF). The data was analyzed on daily basis using Microsoft Excel and was reviewed on monthly basis. Based on the review, the necessary control and preventive measures were planned and were implemented for successive month. The rates of HAI in 2014 and 2015 were compared. The data was analyzed using descriptive statistics like number and percentages. Infection control target rates were defined as <2.1/1000 catheter days for CAUTI, <4.0/1000 ventilator days for VAP, <4.5 central line days for CLABSI, <3.5% for SSI as national median average obtained from National Accreditation Board for Hospitals & Healthcare Providers (NABH) which is constituent board of Quality Council of India. Ethical approval was obtained from the Institutional Ethics Committee.

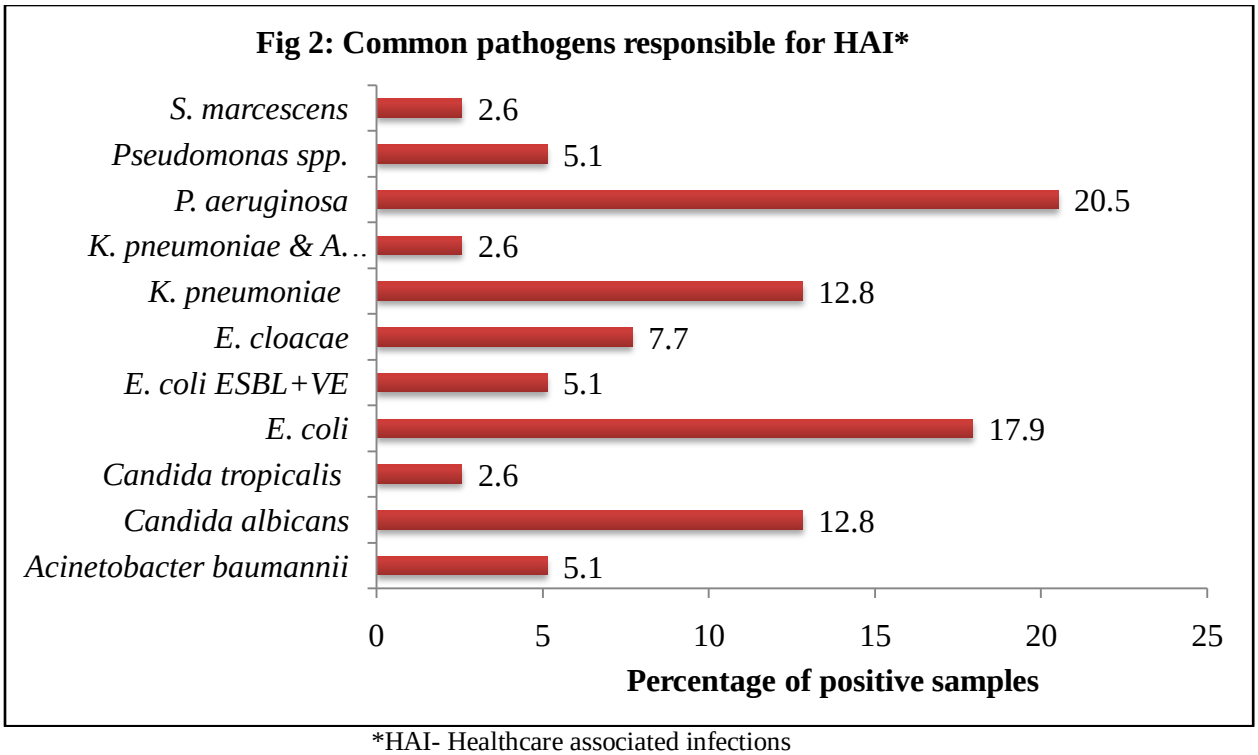
Results:-

Out of total 100 patients suspected for HAI in 2015, 39 patients were diagnosed with HAI. These comprised CAUTI, CLABSI, VAP and SSI. CAUTI was the most common HAI (43.6%), while CLABSI was second most prevalent infection (35.9%) followed by VAP (12.8%) & SSI (7.7%) (Figure 1).Infection with *Pseudomonas aeruginosa* was most prevalent (20.5%) followed by *E. coli* (17.9%) (Figure 2). Approximately 67% of *E. coli* strains identified were extended-spectrum beta-lactamases (ESBL) positive (Figure 3). Injection colistin and meropenem were used commonly along with piperacillin-tazobactum intravenous and cefoperazone injection as antibiotic therapy for treating HAI. As shown in figure 4, in patients identified to have CAUTI, infection with *Pseudomonas aeruginosa* and *E. coli* was most prevalent. Antibiotic susceptibility testing of collected samples suggested that resistance was highest for piperacillin (69.2%), ticarcillin (69.2%) and carbenicillin (69.2%) and susceptibility was highest for polymyxin B (79.5%), clindamycin (79.5%) and amikacin (46.2%). As shown in figure 5, root cause analysis of factors responsible for HAI depicted that prolonged hospital stay and co-morbid conditions were the main contributors for infection among various others (Figure 5).As compared to previous year data (2014) of HAI, urinary tract infection rate declined considerably with 1.18% in 2014 to 0.87% in 2015. Similarly, CLABSI, SSI rates declined from 1.18% to 0.78% and 0.7% to 0.2% respectively in 2015compared to 2014. VAP decreased from 3.1% to 1.7%.(Fig. 6,7,8,9)Target rate for infection control were achieved for CAUTI, CLABSI and SSI.

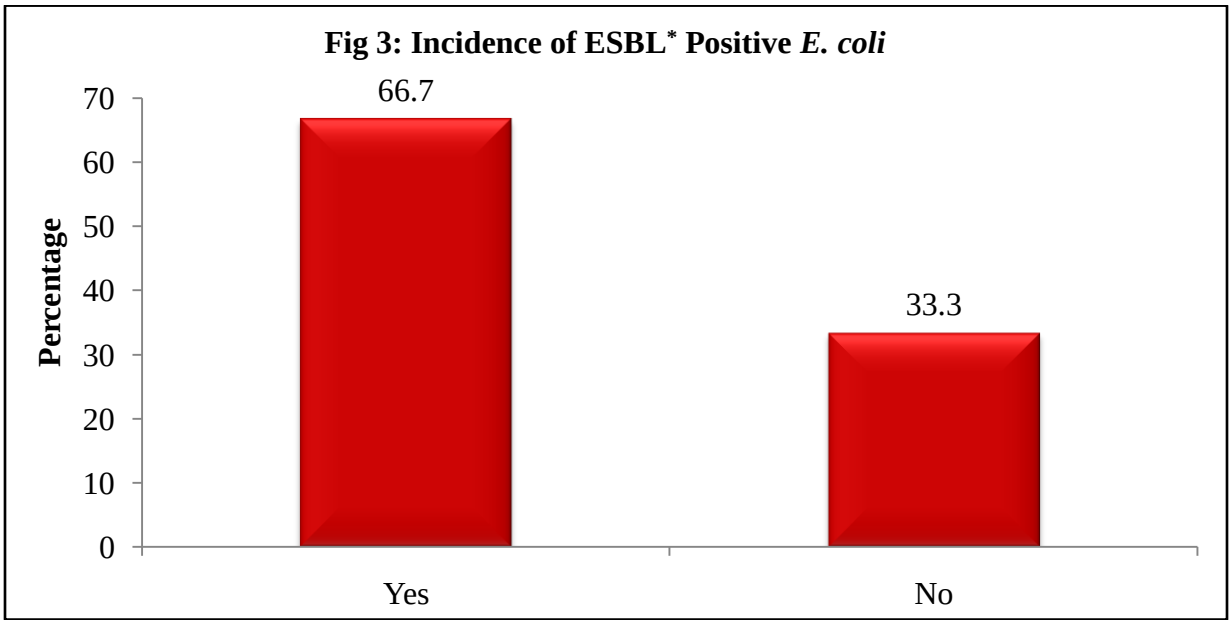
*CAUTI: catheter-associated urinary tract infections,†CLABSI: central line-associated bloodstream infections,‡VAP: ventilator-associated pneumonia, §SSI: surgical site infection.

Fig 1: Incidence of Device Related Healthcare Associated



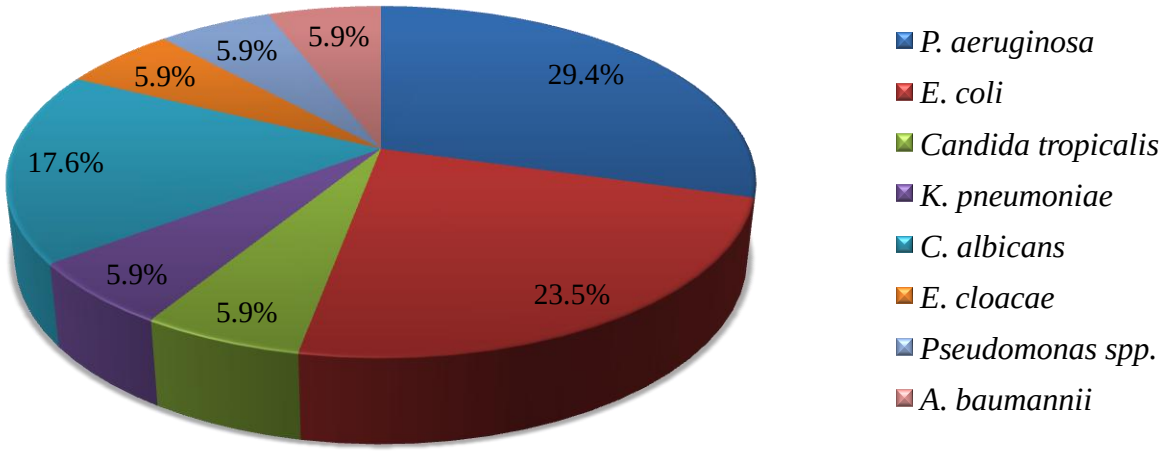


*HAI- Healthcare associated infections



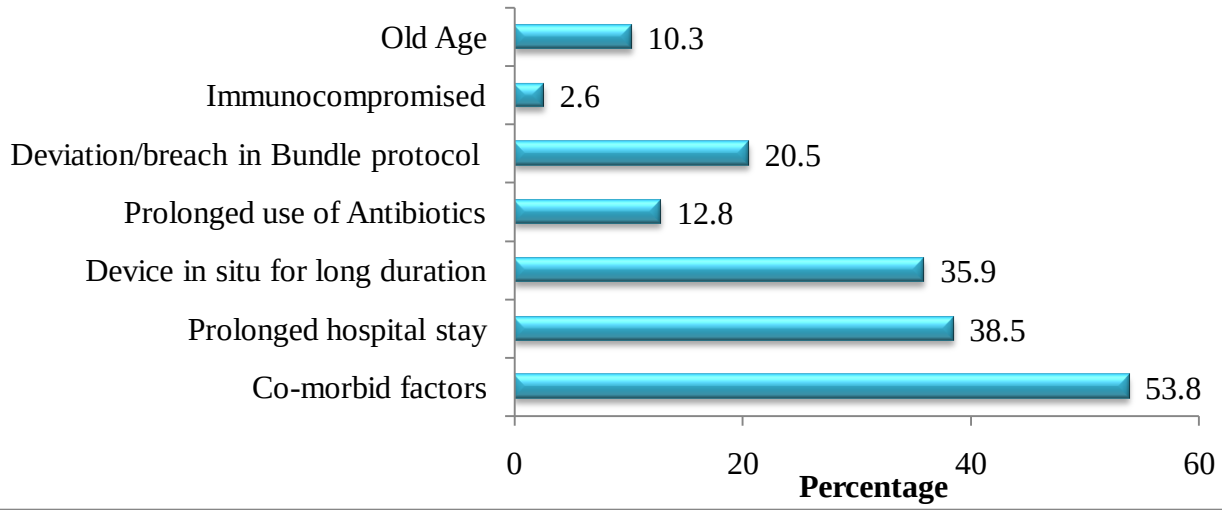
*ESBL- Extended spectrum beta lactamase

Fig 4: Common Pathogens Contributing to CAUTI*



*CAUTI- catheter-associated urinary tract infections

Fig 5: Root Cause Analysis of HAI



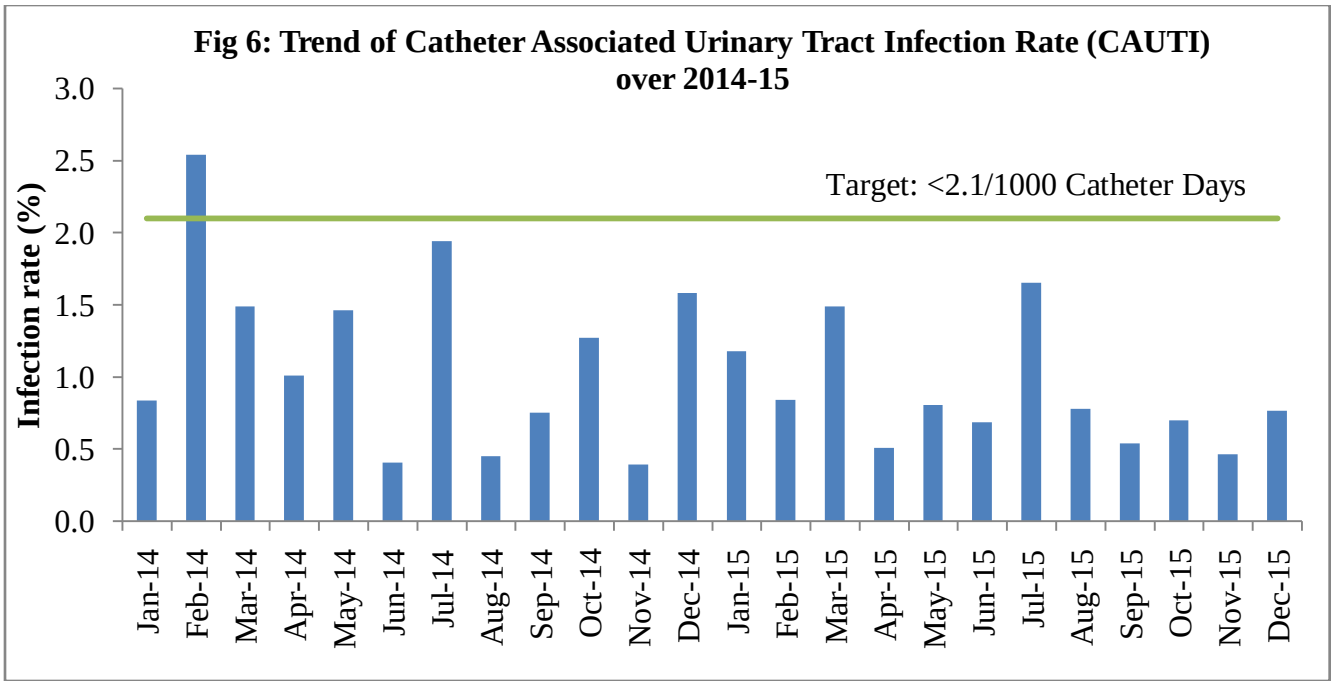


Fig 6: Trend of Catheter Associated Urinary Tract Infection Rate (CAUTI) over 2014-15
Infection rate (%)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Target: <2.1/1000 Catheter Days
Jan-14
Feb-14
Mar-14
Apr-14
May-14
Jun-14
Jul-14
Aug-14
Sep-14
Oct-14
Nov-14
Dec-14
Jan-15
Feb-15
Mar-15
Apr-15
May-15
Jun-15
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Aug-15
Sep-15
Oct-15
Nov-15
Dec-15

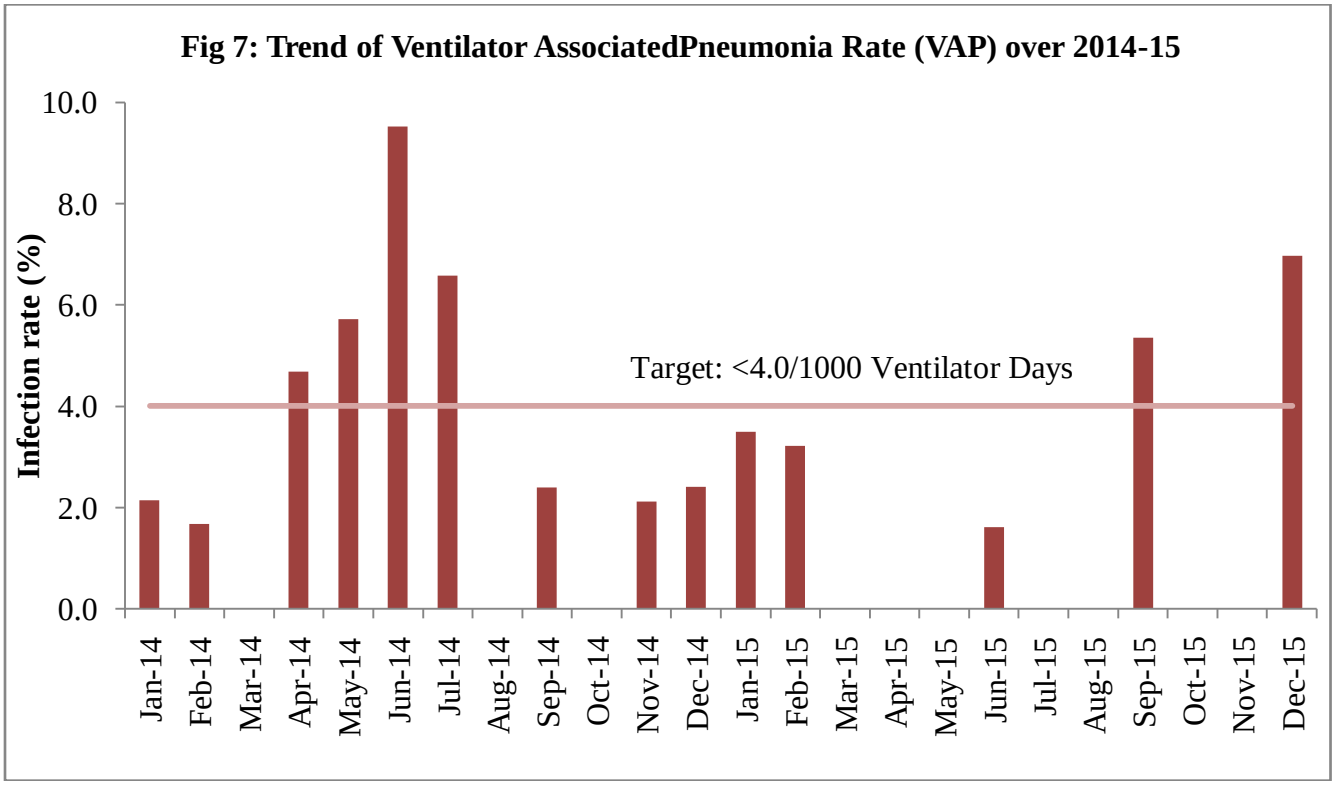


Fig 7: Trend of Ventilator AssociatedPneumonia Rate (VAP) over 2014-15
Infection rate (%)
10.0
8.0
6.0
4.0
2.0
0.0
Target: <4.0/1000 Ventilator Days
Jan-14
Feb-14
Mar-14
Apr-14
May-14
Jun-14
Jul-14
Aug-14
Sep-14
Oct-14
Nov-14
Dec-14
Jan-15
Feb-15
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Dec-15

Fig 8: Trend of Central Line Associated Blood Stream Infection Rate (CLABSI) Over 2014-15

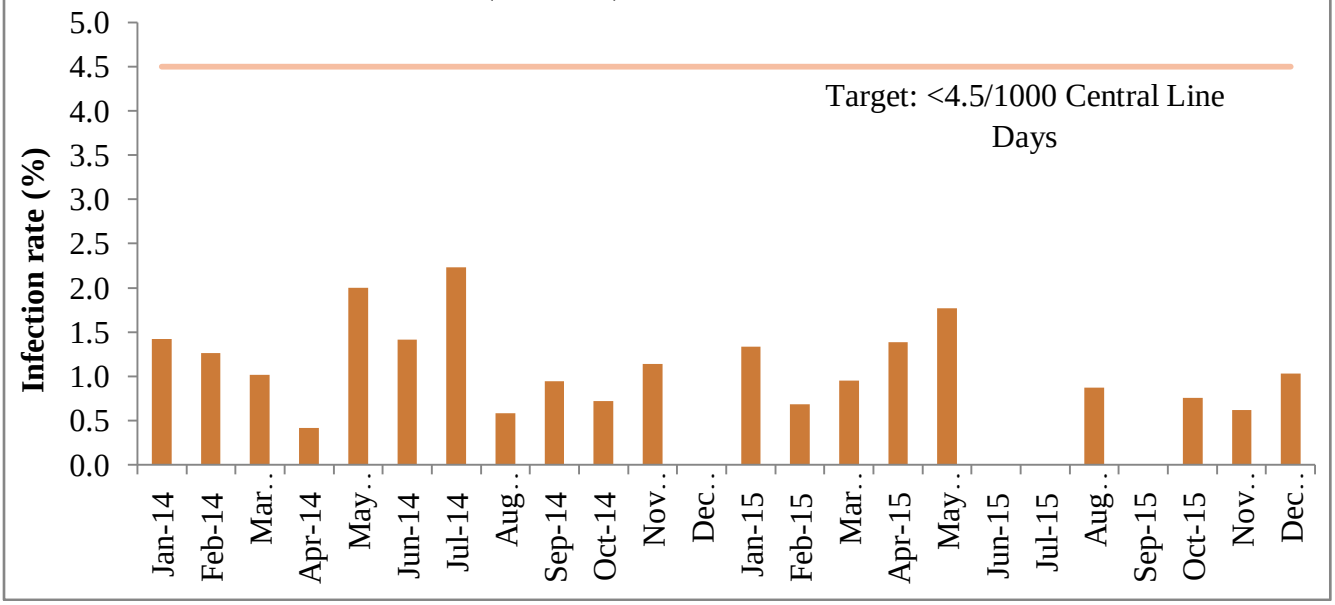
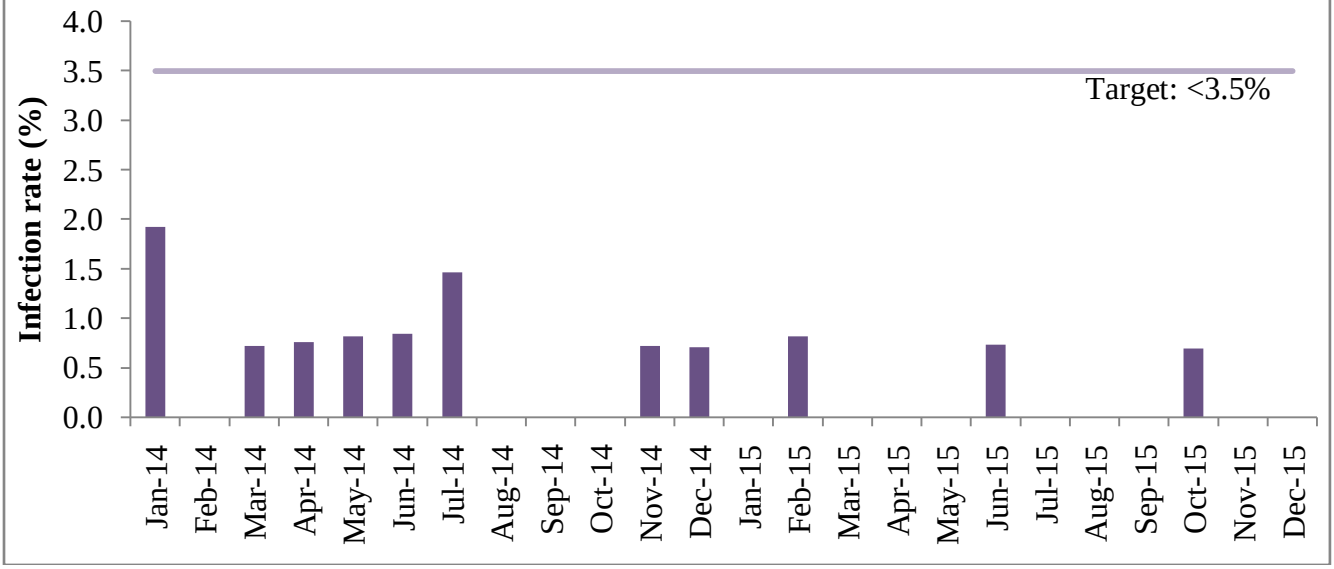


Fig 9: Trend of Surgical Site Infection Rate (SSI) over 2014-15



Discussion:-

This study indicated that device associated infections are very common among various sources of HAI, which was proved in a previous study where the incidence of ICU-HAI is 5–10-times higher when compared to HAI rates in general wards[14]. The higher rates of HAI in ICU are due to the complex interactions between the patient's underlying diseases, comorbidities, severity of illness, type of ICU, length of stay, besides use of multiple invasive devices.[14]We observed CAUTI as the most common HAI which was different from other studies,[14,15]where VAP was more common.It may be because of collection of greater number of samples of the patients admitted in wards where urinary catheters were more commonly used with less frequent use of endotracheal tube as compared to that of ICU.

Infection with *Pseudomonas aeruginosa* was most prevalent (20.5%) followed by *E. coli* (17.9%), a similar pattern was observed in previous studies.[5,16,17] especially from developing countries like India.They were also the prime causes of HAI in CAUTI, as also seen in a previous study.[18]

Majority of the *E. coli* strains(67%) were identified to be ESBL positive, similar to that seen inother study.[14]It has been observed that in the past few decades, there has been an emergence of multidrug resistant (MDR) organisms in the hospital like methicillin resistant *Staphylococcus aureus*, AmpCbeta lactamase production and carbapenemase production along with extended spectrum ß-lactamase(ESBL).[17]It has led to antimicrobial resistance which is a cause for concern as HAIs are difficult and more expensive to treat and are associated with increased patient morbidity and mortality.

On testing for susceptibility of bacteria, we observed that antimicrobial resistance was observed mainly to antibiotics like Piperacillin, Ticarcillin and Carbenicillin. The findings were similar to a previous study.[19]Effective strategies/guidelines should be established to minimize the misuse of existing antimicrobials with continuous antimicrobial surveillance to determinethe changing status of antibiotic resistance in local, provincial and national referral hospitals. Rational antimicrobial use, establishment of national surveillance program monitoring antimicrobial resistance, along with implementation of precautionary measures for enhanced patient management can facilitate in achieving the above goal.[19]

Prolonged hospital stay along with various co-morbid conditions were the main factors accounting for healthcare associated infection. Similar results were seen in previous study,[20]where prolonged hospital stay was shown to collaborate with HAI and high frequency of comorbidities was observed in HAI patients.

Based on higher prevalence of HAI and the its impact on patient morbidity and mortality as documented in previous studies, it has been generally recommended that hospital infection control (HIC) practices and procedures need to be strengthened further and also training and reinforcement of aseptic techniques in healthcare personnel for performing invasive procedures is required. A strong infection control programme by the hospital with strict adherence to infection control practices play a vital role in control of HAI. Implementation of bundle for prevention of CAUTI, SSI, VAP, and CLABSI with strict monitoring to adherence plays an important role in prevention of HAI.[21]Hence it is necessary to provide comprehensive educational programs for healthcare workers, addressing basic HIC issues, such as standard precautions, device utilization, and evidence-based practices and procedures, and to establish more effective institutional HIC policies.[17]

Based on the various reports for HAI (data on file) at our centerduring 2014, though lesser than overall reported incidence, remedial decision was taken by the hospital management to strictly implement hospital infection control measures to curtail the incidence of HAI at our center. Every corrective/preventive action policies need to be checked for its effectiveness and outcome. Therefore, when findings of 2015 with respect to occurrence of HAI at our center was weighted against last year's HAI, it was encouraging to see a decline in CAUTI, CLASBI, VAP, and SSI due to preventive measures like training of staff, patients and relatives, strict adherence to CAUTI, CLABSI bundles, catheterization only in strict indication, use of silicone catheter in suspected cases of prolonged need for catheterizationand isolation of contacts. The findings were consistent to a previous study,[15]whereintegrated hospital infection control programs, including surveillance of HAIs, have led to a significant reduction in the incidence of infections with resulting reduced health care costs.Moreover, it may not be an exaggeration to make the statement that CAUTI, VAP and CLABSI are important hospital infection control quality indicators that would give the ground reality of HAI at healthcare facility and give fair amount of idea about how robustly the hospital infection control policies are implemented.Capture and recording the progress of HAI using checklistsfor monitoring adherence to bundles withassessment of deviations and their prevention are good tools that the hospitals should implement as an essential part of their medical records.[22,23]

Limitations:-

The surveillance data have some limitations. The study included major infection sites, device utilization, and types of organisms and their susceptibility to commonly used antibacterial agents but did not attempt to investigate the underlying disease conditions of patients or the role of nosocomial infection. The study was a single-center investigation, which limits its generalization. However, such data if collected and analyzed on a cross dimensional level, will help us to analyze the trends and patterns of HAI in India.

Conclusion:-

CAUTI, VAP and CLABSI healthcare associated infection probably serve as remarkable hospital infection control quality indicators. Strict adherence to the hospital infection control policies including strict hygiene practices with adherence to bundle protocol shall be followed. Special attention needs to be paid to elderly patients, those with different co-morbidities and patients staying for prolonged duration in hospital. Inculcating knowledge amongst patients and nursing staff about HAI through education and training along withan active ongoing surveillance to monitor the burden of infections and evaluate interventions can prevent healthcare associated infections and reduce the risk of outbreaks.

Conflict of interests:-

We declare no conflict of interests for publication of this paper.

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References:-

1. Allegranzi B, Nejad SB, Combescure C, Graafmans W, Attar H, Donaldson L, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis.Lancet 2011; 377: 228–241.
2. University of Malta Msida MSD 2080. Prevention of hospital-acquired infections: A practical guide [Internet]. Ducel G, Fabry J, Nicolle L, editors. Prevention of hospital-acquired infections: A practical guide Dec, 2002. Available from: http://apps.who.int/medicinedocs/documents/s16355e/s16355e.pdf
3. Weinstein RA. Nosocomial infection update. Emerging Infectious Diseases1998; 4(3): 416-20.
4. Naidu K, Nabose I, Ram S, Viney K, Graham SM, Bissell K. A Descriptive Study of Nosocomial Infections in an Adult Intensive Care Unit in Fiji: 2011-12. Journal of Tropical Medicine 2014: 1-5.
5. Aly NY, Al-Mousa HH, Al Asar ESM. Nosocomial infections in a medical–surgical intensive care unit.Med Princ Pract 2008;17:373–7
6. Darouiche RO. Device-Associated Infections: A Macroproblem that Starts with Microadherence. Healthcare Epidemiology 2001; 33: 1567-72
7. Donlan RM. Biofilms and Device-Associated Infections. Emerg Infect Dis. 2001; 7(2): 277-81.
8. WHO Document production services, Allegranzi B. Report on the burden of endemic healthcare-associated infection worldwide - A systematic review [Internet]. Report on the burden of endemic healthcare-associated infection worldwide - A systematic review 2011. Available from: http://apps.who.int/iris/bitstream/10665/80135/1/9789241501507_eng.pdf
9. Urinary Tract Infection (Catheter-Associated Urinary Tract Infection [CAUTI] and Non-Catheter-Associated Urinary Tract Infection [UTI]) and Other Urinary System Infection [USI]) Events [Internet]. 2016 [cited 2016Sep26]. Available from: http://www.cdc.gov/nhsn/pdfs/pscmanual/7psccauticurrent.pdf
10. Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-central line-associated Bloodstream Infection) [Internet]. 2016 [cited 2016Sep26]. Available from: http://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf
11. Pneumonia (Ventilator-associated [VAP] and non-ventilator-associated Pneumonia [PNEU]) Event [Internet]. CDC; 2016 [cited 2016Sep26]. Available from: http://www.cdc.gov/nhsn/pdfs/pscmanual/6pscvapcurrent.pdf
12. Surgical Site Infection (SSI) Event [Internet]. CDC; 2016 [cited 2016Sep26]. Available from: http://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf
13. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care–associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control 2008; 36: 309-32.
14. Cornejo-Juarez P, Vilar-Compte D, Perez-Jimenez C, Namendys-Silva SA, Sandoval-Herna´ndez S, Volkow-Fernandez P. The impact of hospital-acquired infections with multidrug-resistant bacteria in an oncology intensive care unit. International Journal of Infectious Diseases 2015; 31: 31–34
15. El-Kholy A, Saied T, Gaber M, Younan MA, Haleim MMA, El-Sayed H, et.al. Device-associated nosocomial infection rates in intensive care units at Cairo University hospitals: First step toward initiating surveillance programs in a resource-limited country. American Journal of Infection Control 2012; 40: 216-20
16. Atif ML, Bezzaoucha A, Mesbah S, Djellato S, Boubechou N, Bellouni R. Evolution of nosocomial infection prevalence in an Algeria university hospital (2001 to 2005). Med Mal Infect 2006; 36(8): 423–8.

17. S Malhotra, S Sharma, C Hans. Prevalence of Hospital Acquired Infections in a tertiary care hospital in India. Int. Inv. J. Med. Med. Sci. 2014; 1(7): 91-4
18. Department of health and human services, Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA. GUIDELINE FOR PREVENTION OF CATHETER-ASSOCIATED URINARY TRACT INFECTIONS 2009 [Internet]. GUIDELINE FOR PREVENTION OF CATHETER-ASSOCIATED URINARY TRACT INFECTIONS 2009 2009. Available from: https://www.cdc.gov/hicpac/pdf/cauti/cautiguideline2009final.pdf
19. Soltani J, Poorabbas B, Miri N, Mardaneh J. Health care associated infections, antibiotic resistance and clinical outcome: A surveillance study from Sanandaj, Iran. World J Clin Cases 2016; 4(3): 63-70
20. Souza ES, Belei RA, Carrilho CMDM, Matsuo T, Yamada-Ogatta SF, Andrade G, et. al. Text Context Nursing, Florianópolis 2015; 24(1): 220-8
21. Mehta Y, Gupta A, Todi S, Myatra SN, Samaddar DP, Patil V, et.al. Guidelines for prevention of hospital acquired infections. Indian J Crit Care Med 2014; 18(3): 149-63
22. Pyrek KM. Checklists and Bundles: Patient Safety Tools Require Appropriate Implementation. INFECTIONCONTROLTODAY [Internet]. 2016Aug5 [cited 2016Aug16]; Available from: http://www.infectioncontroltoday.com/articles/2016/08/checklists-and-bundles-patient-safety-tools-require-appropriate-implementation.aspx#content
23. Checklist for Prevention of Central Line Associated Blood Stream Infections [Internet]. [cited 2016Aug16]. Available from: http://www.cdc.gov/hai/pdfs/bsi/checklist-for-clabsi.pdf.