Hospital Acquired Infection: A Study Measuring Its Impact on Increase Average Length of Stay and Cost of Care in a Multispecialty Hospital

By

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Dissertation submitted for the partial fulfillment of the
MBA Hospital and Health Management

Academic year, 2014-2016

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At

Artemis Hospital, Gurgaon

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TO WHOMSOEVER MAY CONCERN

This is to certify that **Dr. Shiva Agrawal** student of MBA Hospital and Health Management from The IIHMR University, Jaipur has undergone internship training at Artemis Hospital, Gurgaon from February 8th 2016 to April 30th 2016.

The Candidate has successfully carried out the study designated to him during internship training and his approach to the study has been sincere, scientific and analytical.
The Internship is in fulfillment of the course requirements.
I wish him all success in all future endeavors.

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During her training, she was found to be sincere and hardworking.

We wish her success in future.

For Artemis Medicare Services Ltd,

Flt. Lt. Saras Malik

(Head – HR & Training)

Mr.Satish Kumar

(Head – Quality & Systems)

Appendix F (Certificate of original work)

THE IIHMR UNIVERSITY, JAIPUR

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled Hospital Acquired Infection: A Study Measuring Its Impact on Increase Average Length of Stay and Cost of Care in a Multispecialty Hospital and submitted by (Name) Dr. Shiva Agrawal Enrollment No. 0242 under the supervision of Brig. (Dr.) S.K. Puri,VSM (Retd.), MD Advisor, IIHMR University, Jaipur for award of Postgraduate Diploma in Hospital and Health/ Pharmaceutical / Rural Management of the University carried out during the period from 2014 to 2016 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

Signature

Acknowledgement

The successful completion of the internship and final outcome of this project required a lot of guidance and assistance from different people and I consider myself fortunate to have so many people around to guide me.

Firstly, I would like to thank **Col. (Dr.) Ashok Kaushik** (Dean Academics and Student Affairs, IIHMR, Jaipur) to provide such a great learning opportunity. I am also thankful to Mr**. Satish Kumar** (Head Quality, Artemis Hospitals, Gurgaon) for his consent and help in further nurturing our understanding about the hospital and about NABH and JCI standards and guidelines. I am grateful for his invaluable support for guiding us. The entire project would not have been possible without the important inputs from **the entire team of Quality department in Artemis Hospital.**

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Abstract

Key words: HAI, CAUTI, CLABSI, SSI, VAP

Introduction: Hospital acquires infections were leading cause of morbidity and mortality among hospitalized patients. According to various study 5 to 10% of admitted patients acquire one or more infections during their stay in hospital. This proportion is greater in immunocompromised patients, patients with underlying disease, undergoing invasive procedures, admitted to ICU and elderly patients. **Aim:** Aim of this study was to provide baseline information of incidence rate of HAI and sensitize the administration about its economic impact on hospital's finance as well as on patients so as to guide priory setting in the development of strategy and policy **Objectives:** To calculate the HAI incidence rate among patients admitted in hospital, To compute the total cost incurred by hospital due to HAI in these patients, To ascertain additional out of pocket (OOP) expenditure by patients due to HAI, To take controlled measures to reduce the burden of HAI from the current incidence rate. **Study design:** It was a retrospective analytical and prospective observational study type, Study area was ICU and Wards, Sample size of 96 cases of HAI occur in 2015, Data collected from records maintained by infection control department and prospectively by observation, interviewed with experts and care takers. (Nurses, ICN, Intensivist, Doctors), **Data Analysis:** In this study we have taken data of 2015 maintained by infection control committee, total cases of HAI was 96 included 33 cases of Cather associated urinary tract infection (CAUTI), 17 cases of central line associated blood stream infection (CLABSI), 32 cases of surgical site infection (SSI) including 2 cases of vancomycin resistance entericoccus (VRE) and 1 case of Methicilline resistance staphylococcus aureas (MRSA) and 14 cases of ventilator associated pneumonia (VAP). Total average length of stay for CAUTI was 17.4, for CLABSI 19.3, for VAP 44.17 and for multiple infection ALOS was 30.4. ALOS after infection for CAUTI was 6.8, for CLABSI it was 14.7, for VAP it was 29.7 and for multiple infection it was 17.9 days. In SSI there were average days of 15.8 after surgery when the infection becomes positive. HAI mortality rate was 8.33% in a year. Economic impact of HAI shows CAUTI contributes 50372.71 rs., CLABSI contributes 76023.22 rs, VAP contribute 147650.75 rs., Multiple infection contribute 258337.3 rs. After infection, this cost included antibiotic cost, consultation fee, room rent and nursing charges etc.**Recommendations:** there is need of Sensitize the severity of the issue and increase education and awareness among health care worker as well as adhere to the standard guidelines for prevention of hospital acquired infection and reduce the burden of economic impact because of HAI. **Conclusion:** HAI add to the imbalance the recourse allocation between primary and secondary health care by diverting scarce fund to the management of potentially preventable condition.

Key words: HAI, CAUTI, CLABSI, SSI, VAP

Dissertation

Hospital Acquired Infection: A Study Measuring Its Impact on Increase Average Length of Stay and Cost of Care in a Multispecialty Hospital

1. Introduction:

Hospital acquires infections were leading cause of morbidity and mortality among hospitalized patients. According to various study 5 to 10% of admitted patients acquire one or more infections during their stay in hospital. This proportion is greater in immunocompromised patients, patients with underlying disease, undergoing invasive procedures, admitted to ICU and elderly patients. According to the WHO definition "An infection occurring in a patient in a hospital or other health care facility in whom infection was not present or incubating at the time of admission. This includes infection acquired in the hospital but appearing after discharge, and also the occupational infections among staff of the facility".

1.1 Justification of study criteria:

The hospital perspective on the cost of HAI:

Cost related to the HAI comprises of three components: Direct medical costs, the indirect costs related to productivity and non medical cost and the intangible costs related to diminished quality of life. The majority of economic and cost analysis of HAI focus primarily on medical costs as this cost directly impact on hospital finances. It also provides evidence to make decision about economic benefit through investment in infection control programme.

2. Literature review:

Hospital acquires infections were leading cause of morbidity and mortality among hospitalized patients. According to various study 5 to 10% of admitted patients acquire one or more infections during their stay in hospital. This proportion is greater in immunocompromised patients, patients with underlying disease, undergoing invasive procedures, admitted to ICU and elderly patients. Of every 100 hospitalized patient at given period of time,7 in developed and 10 in developing countries will acquired at least one healthcare associated infection. According to a study Overall, hospital acquired infection resulted in an extra 14 days in hospital, a 10% chance of dying, an extra £3154 spent on healthcare and six extra days off work. The study concluded that the economic burden of hospital acquired infection was about £1 billion a year, and affects 1 in 10 patients. The total number of bed days consumed by hospital acquired infection was estimated at about 3.6 million a year, or equivalent to about 27 400-bed hospitals working at 90% capacity.

HAI result in substantial morbidity and mortality, prolong hospital stays and increased direct patient care costs. During 2002, about 1.7 million inpatients had an HAI- 4.5 per 100 patients HAI costs the united state $5 billion in health care costs in 2000 and $6.7 billion in 2002.

How much longer the stay is depends on the type of infection, the age of the patient and any other co-morbidity that are present.

The most common type of HAIs is:

- Cather associated urinary tract infection: 32%
- Surgical site infection: 22%
- Central line associated blood stream infection: 15%
- Ventilator associated Pneumonia: 14%

The pathogenesis consists of:

- Infectious agent: human and environmental source
- Susceptible hosts: Immune status, surgical procedures, indwelling devices etc.
- Transmission: Bacteria, Viruses, fungi, parasites, or prions, direct or indirect contact.

Practically it is difficult to estimate, the proportion of healthcare spending attributed to the management of nosocomial infections, overuse and/or misuse of antimicrobials, and infections due to multidrug-resistant bacteria. However there is some studies have been done. Most studies were from different states in the United States (US), and used retrospective cohorts from administrative databases and various analyses with various levels of sophistication.

In a study done by National nosocomial infection surveillance (NNIS) central line-associated bloodstream infections (CLABSIs) were found to be the most costly (US$45,814 [2012]; xLOS 10.4 days), followed by ventilator-associated pneumonia (US$40,144; xLOS 13.1 days) and surgical site infections (US$20,785; xLOS 11.2 days). When caused by Methicillin-resistant *Staphylococcus aureus* (MRSA), both the cost and xLOS of surgical site infections increased by 105%; CLABSI cost increased by 22% and CLABSI xLOS increased by 51%. These results highlight the importance of strategies to control bacterial antibiotic resistance.[2]

3. Aim:

Aim of this study was to provide baseline information of incidence rate of HAI and sensitize the administration about its economic impact on hospital's finance as well as on patients so as to guide priory setting in the development of strategy and policy.

4. Objectives:

- To calculate the HAI incidence rate among patients admitted in hospital
- To ascertain additional out of pocket (OOP) expenditure by patients due to HAI compare with the patients without HAI.

5. Study methodology:

In this study, analytical approach of measuring of cost of HAI is comparing the group of patients affected with specific type of micro-organism with the group of the patients unaffected with HAI.

Study type: Retrospective analytical, prospective observational

Study area: ICU, Wards

Sample size: 96 cases of HAI in 2015

Inclusion criteria: All patients above 16 years of age admitted in ICU and wards with different complains and presentations and developed clinical evidence of infection which does not originate from the patients original admitting diagnosis were included in this study.

Exclusion criteria: According to the definition of HAI, patients admitted before 48 hrs excluded from the study.

Data collection tool: Retrospective from records maintained by infection control department, prospectively by observation, interviewed with experts and care takers. (Nurses, ICN, Intensivist, Doctors)

Economic evaluation method: Cost analysis

Data analysis method: MS Excel

6. Data Analysis:

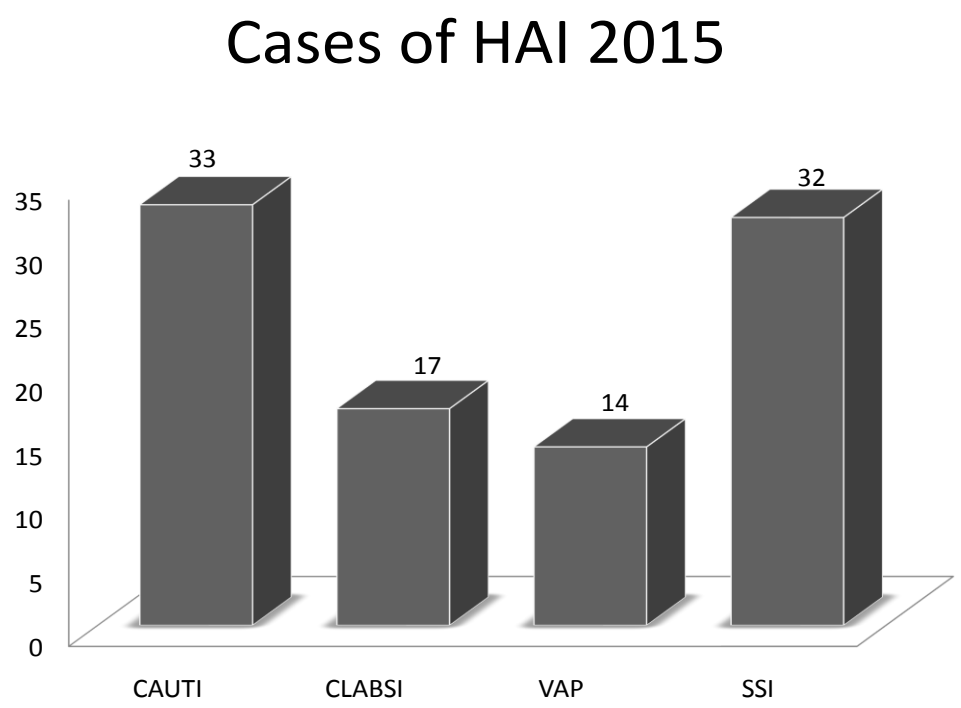


Fig: 6.1 Annual cases of HAI

In this study we have taken data of 2015 maintained by infection control committee, total cases of HAI is 96 included 33 cases of Cather associated urinary tract infection (CAUTI), 17 cases of central line associated blood stream infection (CLABSI), 32 cases of surgical site infection (SSI) including 2 cases of vancomycin resistance entericoccus (VRE) and 1 case of Methicilline resistance staphylococcus aureas (MRSA) and 14 cases of ventilator associated pneumonia (VAP).

No of multiple infection cases	17
UTI+BSI	6
UTI+VAP	4
BSI+VAP	4
BSI+UTI+VAP	1
VAP+SSI	1
BSI+SSI	1

Table: 6.1 No. of multiple HAI cases

In these 96 cases there is 17 cases which was suffered from multiple infection in which 6 cases suffer from UTI and BSI, 4 cases from UTI and VAP, 4 cases from BSI and VAP, 1 cases from BSI, UTI and VAP, 1 case suffer from VAP and SSI and 1 case suffer from BSI and SSI.

- Catheter associated urinary tract infection rate (Annually)= Number of urinary catheter associated UTIs in a year/No of urinary catheter days in that year*1000

  33/16911*1000=1.97

- Central line associated blood stream infection (Annually)= Number of central line associated BSI in a year/ Number of Central line days in that year*1000

  14/8365*1000=2.7

- Ventilator associated pneumonia rate (Annually)= Number of ventilator associated pneumonia in a year/ No of ventilator days in that year*1000

  13/5265*1000=2.5

- Surgical site infection rate(Annually): Number of surgical site infection in a year/Number of total surgery in that year*1000

  32/5117*1000=6.3

6.1: CAUTI:

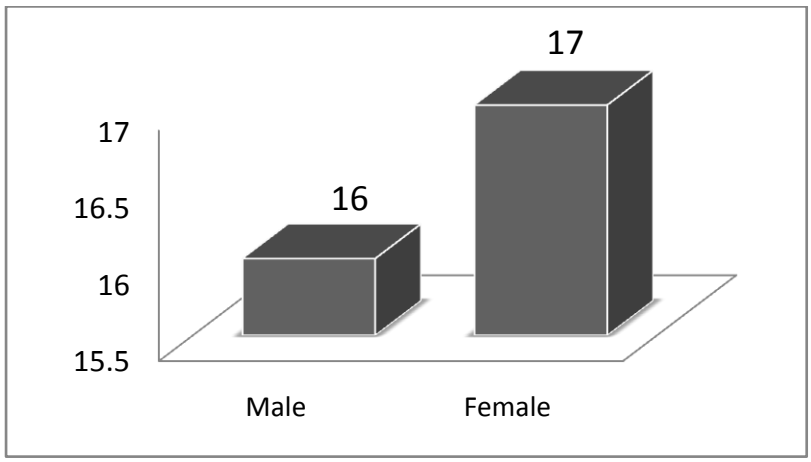


Fig: 2 Gender wise distribution of CAUTI

Gender wise distribution: Out of 28 cases 16 were males and 17 were females.

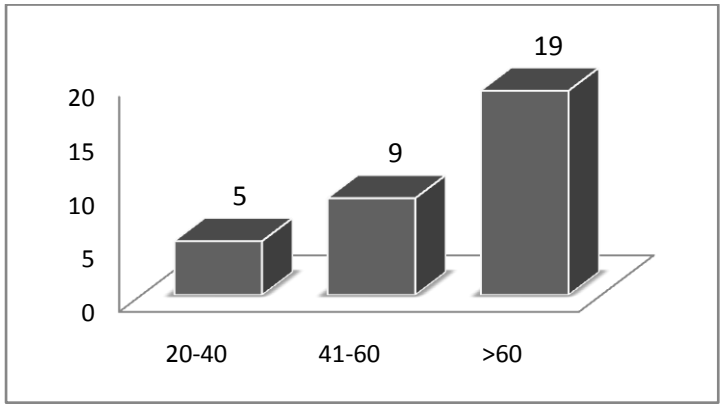


Fig: 3 Age wise Distribution of CAUTI

Age wise distribution: 5 cases below 40 years, 9 cases between 40-60 years and 19 cases of more than 60 years of age.

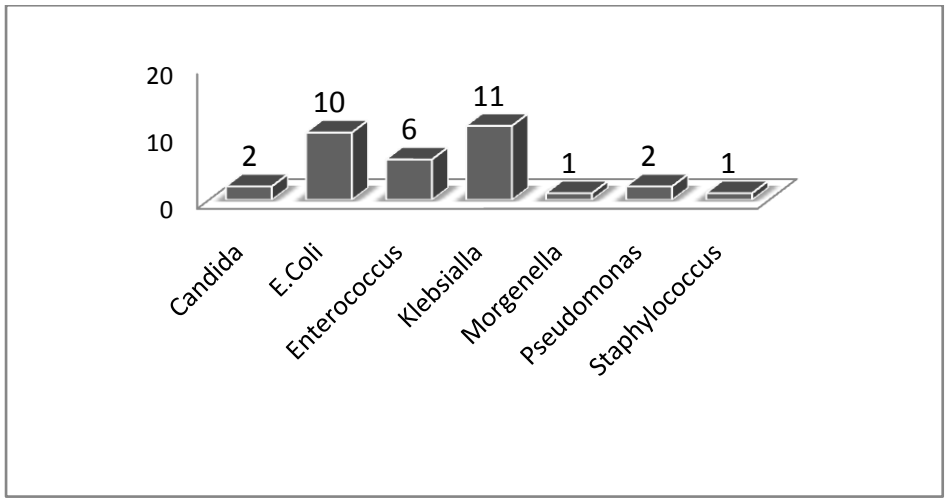


Fig: 4 Micro-organism wise distribution of CAUTI

Micro-organisms wise distribution of CAUTI: Most causative bacteria is Klabsialla and E. Coli, each contribute 10 and 11 cases, other organisms were Candida 2 cases, Enterococcus 6 cases, Pseudomonas 2 cases and staphylococcus 1 case.

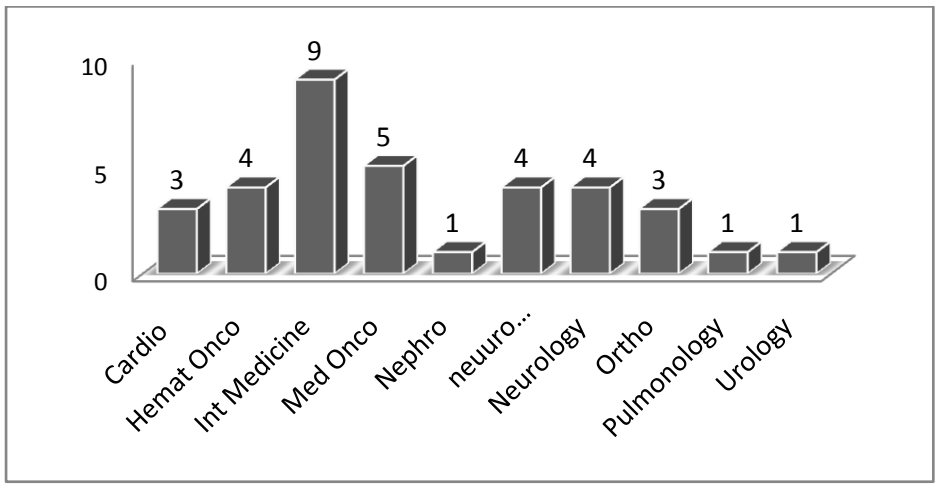


Fig: 5 Speciality wise distribution of CAUTI

Speciality wise analysis of UTI, most prevalent in Internal medicine cases, that are 9 cases and after that 5 cases from Medical oncology.

6.2: CLABSI:

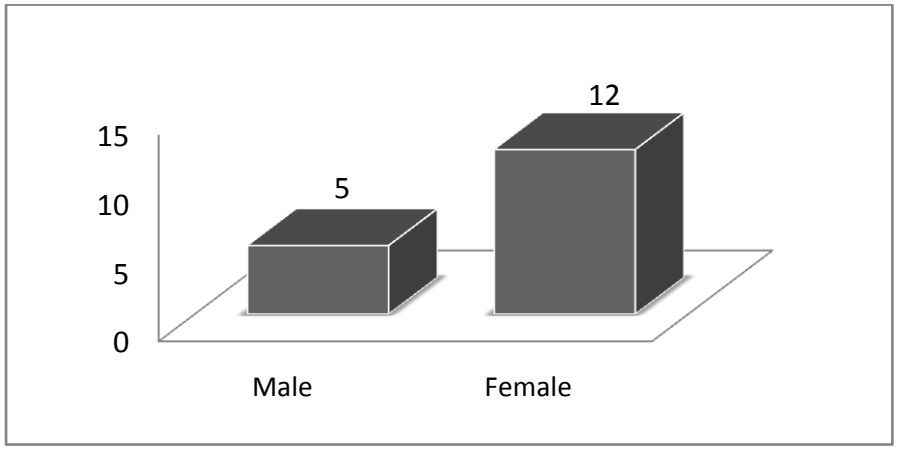


Fig: 6 Gender wise distribution of CLABSI

Gender wise distribution: Out of 17 cases 12 were females and 5 were males.

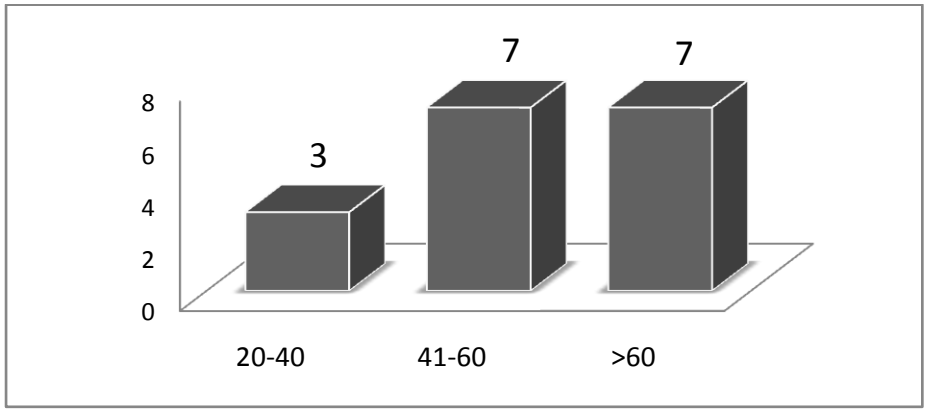
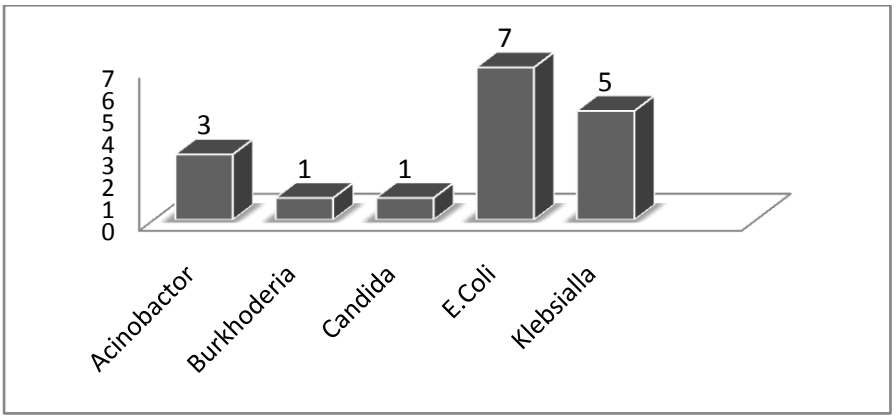


Fig: 7 Age wise distribution of CLABSI

Age wise distribution: 3 cases were from less than 40 years of age, 7 cases were from 40-60 years of age, 7 cases from more than 60 years of age.



Graph: 8 Micro- organism wise distribution of CLABSI

Micro-organism wise distribution is E-Coli contribute 7 case, Klebsialla contribute 5 cases each, Burkhoideria, Candida and Morgenella contribute 1 case each and acinatobector contribute 3 cases.

6.3: SSI:

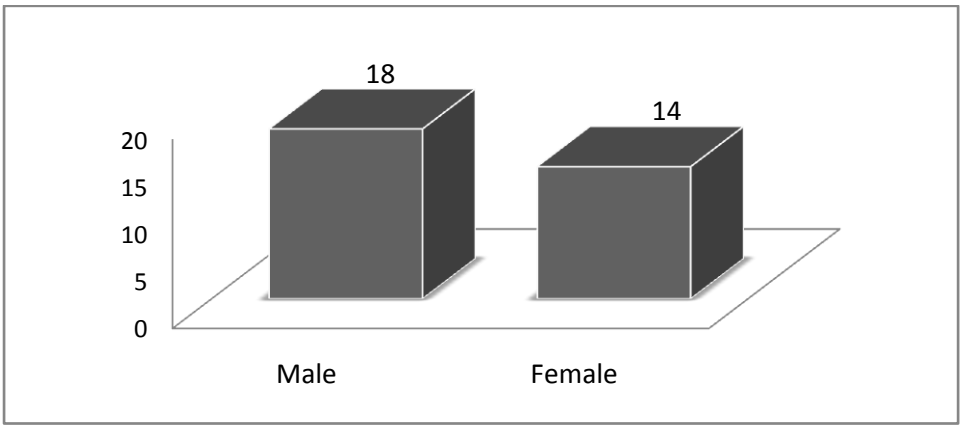


Fig: 9 Gender wise distribution of SSI

Gender wise distribution: Out of 32 cases 18 cases were males and 14 cases were females.

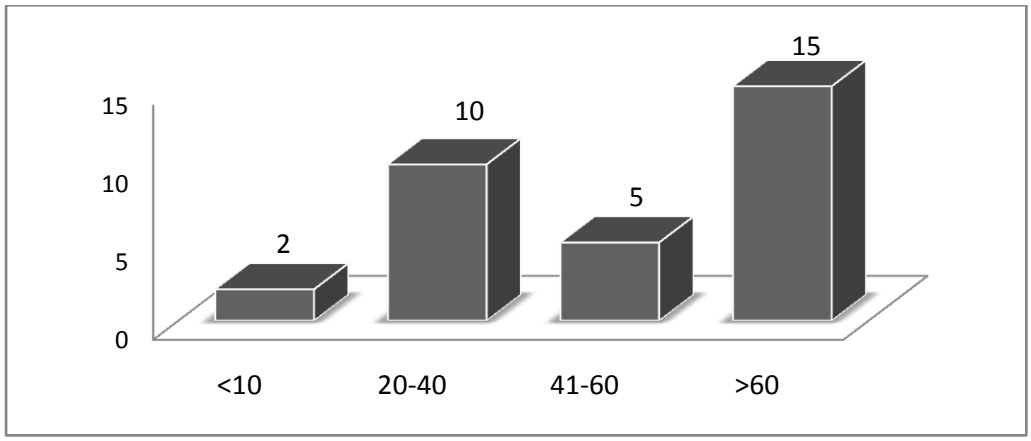


Fig: 10 Age wise distribution of SSI

Age wise distribution is 2 cases were from less than 10 years, 10 cases from 20-40 years, 10 cases from 41-70 years, 10 cases from more than 60 years of age.

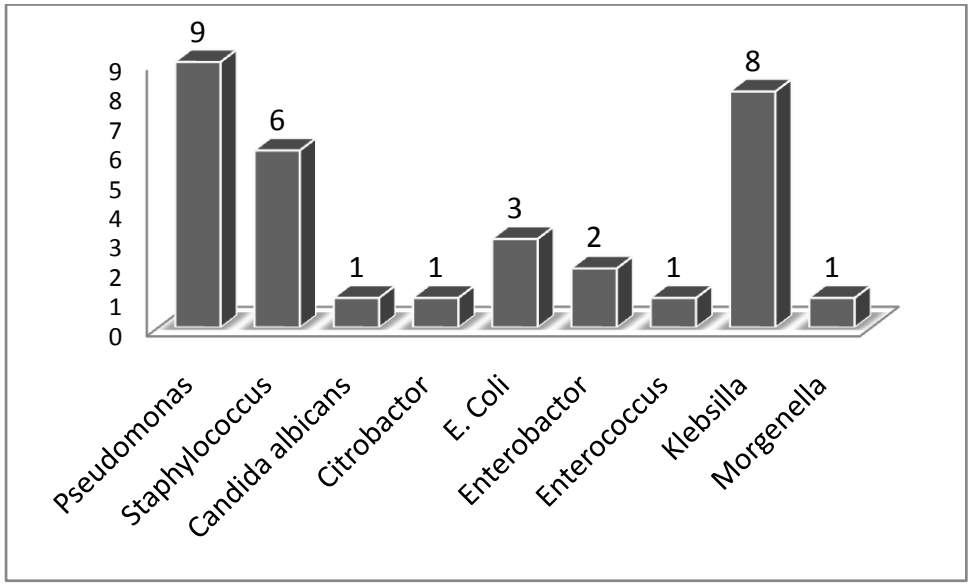


Fig: 11 Micro-Organism wise distribution of SSI

Micro-Organism wise distribution is 9 cases from Pseudomonas, 8 cases from Klebsialla, 6 cases from Staphylococcus, 3 cases from E.Coli, 2 case from Enterobactor and 1 case each for Candida, Citrobactor, Morgenella and Enterococcus.

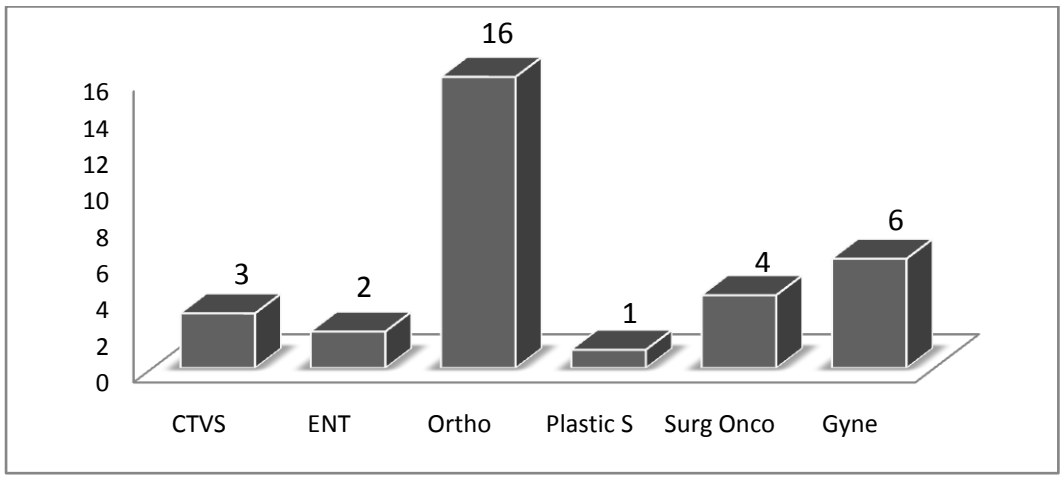


Fig: 12 Speciality wise distribution of SSI

Speciality wise SSI distribution depict maximum 16 cases of SSI belongs to Orthopaedic department, 6 cases from gynec department, 4 cases from surgical oncology, 3 cases from CTVS, 2 cases from ENT and 1 case from Plastic surgery.

6.4: VAP:

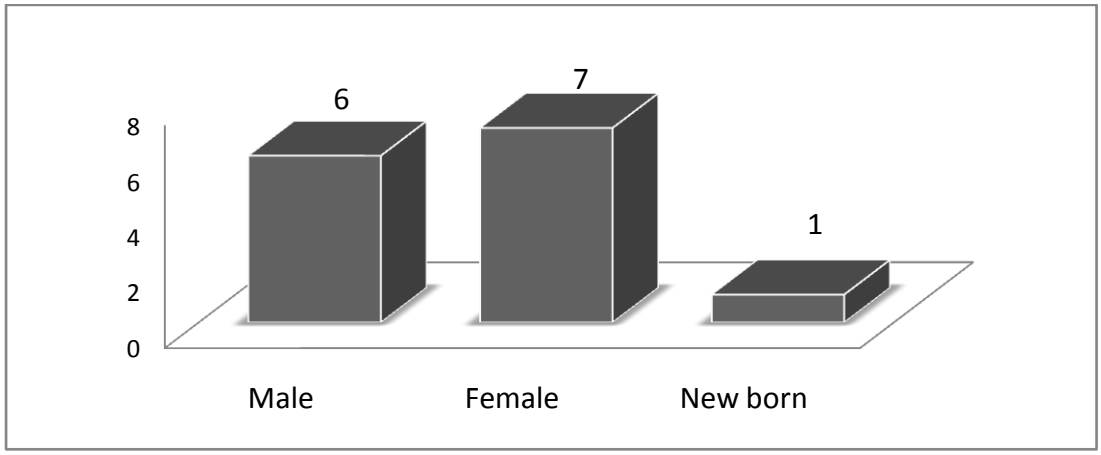


Fig: 13 Gender wise distribution of VAP

Gender wise distribution: Out of 14 cases 6 were males, 7 were females and 1 was new born baby.

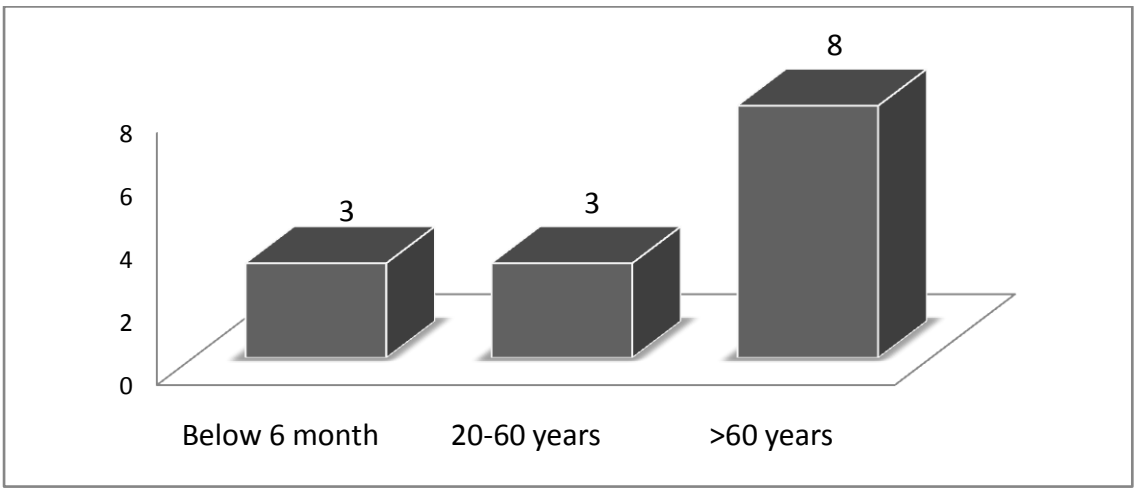


Fig: 14 Age wise distribution of VAP

Age wise distribution: 3 cases were from less than 6 month, 3 cases were from less than 60 years and 8 cases from more than 60 years of age.

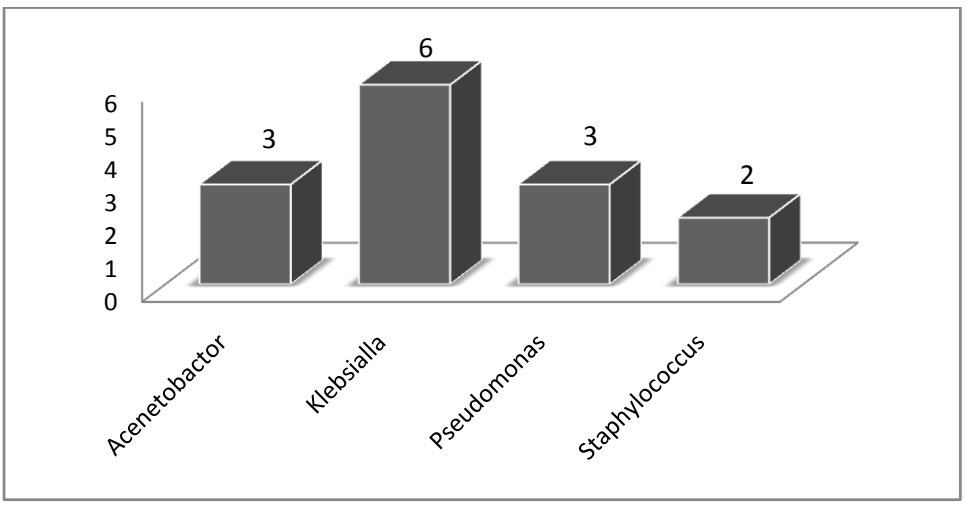


Fig: 15 Micro-organism wise distribution of VAP

Micro-organism wise distribution was 3 cases each for Acenotobactor and Pseudomonas, 6 cases from Klebsialla, 3 cases from pseudomonas and 2 case from Staphylococcus.

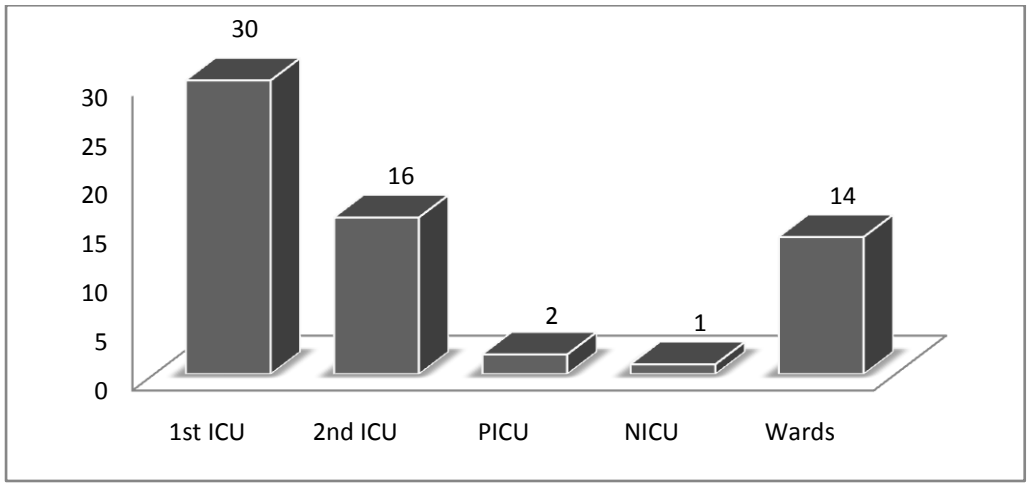


Fig: 16 Area wise distribution of HAI

Area wise HAI distribution shows maximum infection occur at 1st floor ICU, 30 cases, And then wards, 14 cases, 2nd floor ICU 16 cases, PICU 2 cases and 1 case from NICU.

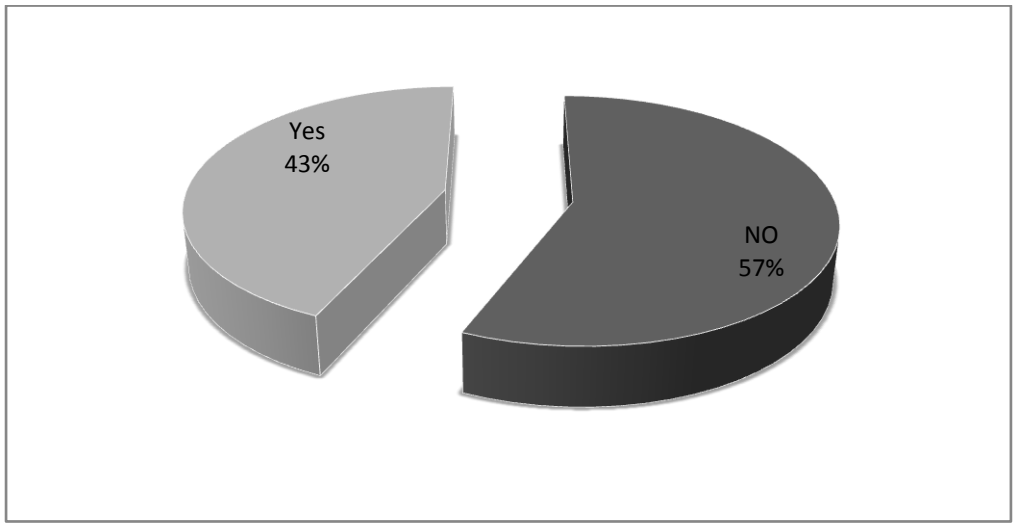


Fig: 17 immunocompromised patient ratio

43% of total HAI patients were immunocompromised and 57% patients were non immunocompromised.

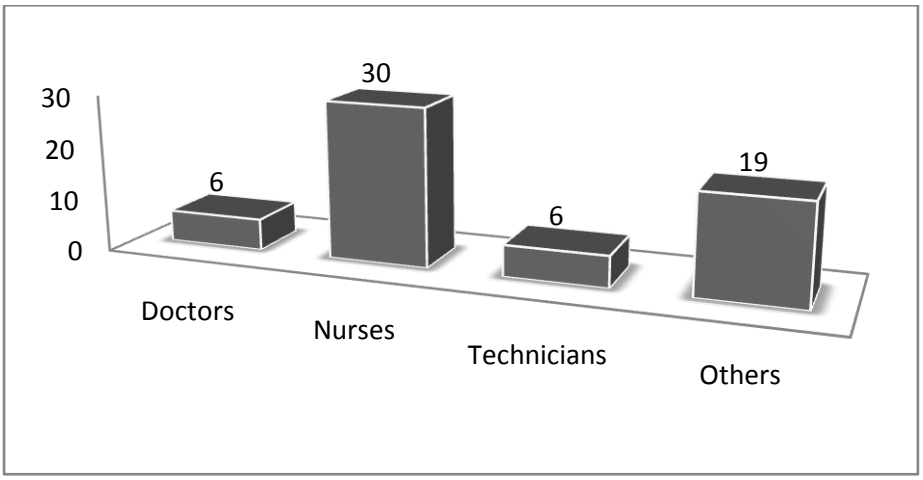


Fig: 18 Needle stick injury rate

Needle stick injury is also an important part of infection control. Annual data of NSI shows, 30 nurses, 6 doctors and 6 technicians and 19 others were suffered from NSI.

6.5: Average length of stay:

we had four dates with us, date of admission, date of discharge, date of insertion of device like Foleys catheter, IV cannula and ventilator and date of culture(on date when bacterial culture was positive). In SSI case date of surgery was considered. From these dates we analysed average length of stay, Average length of stay after infection, and after how many days of surgery surgical site infection occur.

HAI	Total ALOS	Total ALOS after infection
CAUTI	17.4	6.8
CLABSI	19.3	14.7
VAP	44.17	29.7
Multiple Infection	30.4	17.9

Table: 2 ALOS of the patients with HAI

In SSI there were average days of 15.8 after surgery when the infection becomes positive.

6.6: HAI Mortality rate:

There were 8 deaths out of 92 cases of HAI detected in 2015, where cause of death is either septic shock or sepsis was the contributing factor.

Number of death/ total number of HAI in a year*100

= 8/96*100= 8.33%

6.7: Economic impact of HAI:

Although it is very difficult to decide that which cost is contributed because of HAI because patients were admitted in critical condition. Still we categorized the cost on the basis that if patient is admitted only 1 day because of HAI what financial impact will be on patient.

We have taken time period after infection in which we took

a) cost of antibiotic administered to the patient,
b) Room rent,
c) Nursing charges,
d) Consultancy of doctor,
e) Investigation charges and
f) Some consumables.

We identified average cost incurred by patient CAUTI, CLABSI, VAP and Multiple infections.

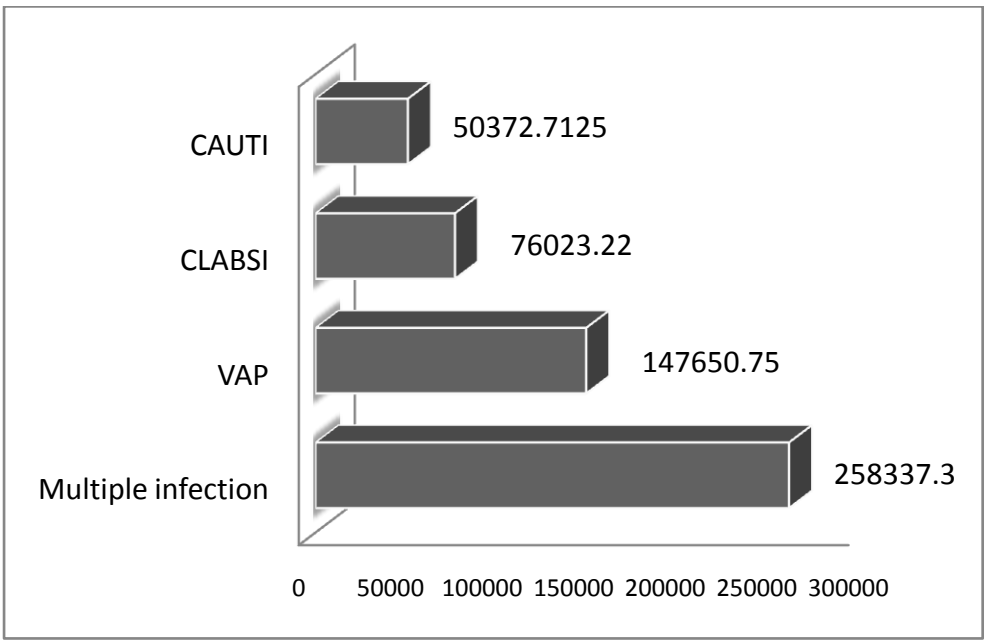


Fig: 19 Cost of HAI (in rupees)

As per the cost and ALOS after infection had been taken, the extra cost incurred by CAUTI was 50372.71 rupees, by CLABSI was 76,023.22 rupees, by VAP it was1,47,650.75 rupees and for multiple infection it was 2,58,337.3 rupees.

Economic impact of HAI on hospital mainly seen in TPA patients or package patients, where charges to the patients remain constant but cost to the hospital increases. The extra charges mean the patient with HAI consume more hospital resources. To estimate the cost impact, a hospital can convert charges into cost by multiplying by an appropriate ratio of cost to the charges (RCC).

In SSI cases there is multiple visit of OPD for daily dressing after surgery and re-admission or re-exploration costs a huge amount which is really difficult to calculate.It also bear a huge opportunity cost because of multiple visit in hospital to the patient and their attendant.

7: Recommendations:

There is only need to sensitize the issue and increase education and awareness among health care worker as well as adhere to the standard guidelines for prevention of hospital acquired infection and reduce the burden of economic impact because of HAI.

8: Conclusion:

The economic burden is increased by 2-4 times due to increase ALOS to both the hospital and patient, further compounded by the social burden of one attendant having to stay with the patient, resulting in notional loss of income. Considering the low per capita income and high out of pocket expenditures in India HAI lead to functional disability and emotional stress to the patient that reduce the quality of life. HAI add to the imbalance the recourse allocation between primary and secondary health care by diverting scarce fund to the management of potentially preventable condition.

9: References:

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4. **Incidence of healthcare associated infection in the surgical ICU ... - NCBI**
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10. Annexure:

10.1 Categories of cost:

Categories of cost	
Direct Hospital cost	Fixed cost: Building, Utilities, Equipments and technology, Labor (Admin, laundry)
	Variable cost: Medicine, consultation, food, treatmen t, procedures, investigations
Indirect cost	Diminished work productivity on the job, short term and long term morbidity, mortality, income lost by family member, time spend by family/friends for hospital visit, travel costs and home care
Intangible cost	Psychological costs (Anxiety, grief, disability, Job loss) Pain Suffering, Change in social functioning/daily activities