

HOSPITAL ACQUIRED INFECTIONS (HAI): CONTROL AND MANAGEMENT

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Abstract: The prevalence of hospital acquired infections (HAI), commonly called as nosocomial infection in medical terms still exists in major well developed hospitals in many countries. The aim is to check for the level of hospital acquired infection and their level, steps taken to control and effective management of the same. Using standard protocol 100 staffs and 50 patients were taken for the study. Only intensive care units (ICU) patients were taken for study since the rate of infection is very high among these patients. Questionnaires were distributed to collect data and thorough observation was done throughout the hospital on what steps and procedures they are following for the prevention of hospital acquired infection. Study revealed that even though they strictly stick to the Standard Operating Procedures (SOPs), the level of hospital acquired infection sometimes exceeds the benchmark.

Index Terms: HAI, Nosocomial infection, SSI, BSI, UTI, VAP, Infection control.

I. INTRODUCTION

“Hospital is the place for cure” – this comes to our mind when we think about the hospital. Treating the patients under same roof was considered as a revolutionary idea, and was expected that it will ease the job of healing. But it turned wrong in Pre- Listerian era because of lack of knowledge on sterilization and antisepsis. Gangrene and death were almost mandatory for the patients suffering from wounds. This led into development of new discipline called as sepsis which was dealing with the nosocomial infections (Hospital-acquired infections). In 1861, Semmelweis observed the association of Puerperal sepsis with the attendants on patients by medical officers and students and he was successful to bring a dramatic reduction in infection rate by the introduction of hand washing with chlorinated lime.

Hospital acquired infections also called nosocomial infections are defined as infections developing in the patients after admission to hospital, which were neither present nor in incubation at the time of hospitalization. Such infections may manifest during their stay in hospital or, sometimes, after the patient is discharged. Patient in hospital are likely to get sick due to a new variety of microorganisms responsible for wide spectrum of hospital infection. So, hospital has increasingly become unsafe place for patient during their stay. Infection is a health hazard of great expense and significance affecting the final outcome of treatment.

Infection control (IC) is a quality standard and is essential for the wellbeing and safety of patients, staff and visitors. It affects most departments of the hospital and involves issues of quality, risk management, clinical governance and health and safety.

II.

OBJECTIVES

- To examine whether nosocomial infection is under control.
- To check whether BSI, SSI, UTI and VAP are below bench mark.
- To provide suggestions to keep HAI under control.

Common hospital acquired infection:

1. Blood Streamline Infections (BSI)
2. Surgical Site Infections (SSI)
3. Urinary Tract Infections (UTI)
4. Ventilated Associated Pneumonia (VAP)

III.

REVIEW OF LITERATURE

According to **Linchuan Wang in 2018**, 102 out of 1347 patients experienced NI. Among them, 87 were device-associated infection. The overall prevalence of NI was 7.57% with varied rates from 7.19 to 7.73% over the 3 years. The lower respiratory tract (43.1%), urinary tract (26.5%) and bloodstream (20.6%) infections accounted for the majority of infections. The device-associated infection rates of urinary catheter, central catheter and ventilator were 9.8, 7.4 and 7.4 per 1000 days, respectively. The most frequently isolated pathogens were *Staphylococcus aureus* (20.9%), *Klebsiella pneumoniae* (16.4%) and *Pseudomonas aeruginosa* (10.7%). Multivariate analysis showed that the categories D or E of Average Severity of Illness Score (ASIS), length of stay (10–30, 30–60, ≥60 days), immunosuppressive therapy and ventilator use are the independent risk factors for RICU infection with an adjusted odds ratio (OR) of 1.65 (95% CI: 1.15~2.37), 5.22 (95% CI: 2.63~10.38), 2.32 (95% CI: 1.19~4.65), 8.93 (95% CI: 3.17~21.23), 31.25 (95% CI: 11.80~63.65) and 2.70 (95% CI: 1.33~5.35), respectively.

Alrubaiee, G in 2017 said that The highest percentage of nurses were males (61.2%) and aging between 25 and above (71.8%) and had 3 years nursing diploma (60%), less than 5 years of employment in the hospitals (56.5%), relatively high training course about nosocomial infections (NIs) (64.7%), and working experience in infection control (78.8%). Most of the nurses (87%) had a fair level of knowledge, while only 4% of them had a good level of knowledge of preventive measures of nosocomial infections. The results also revealed that the majority of the nurses (71%) had fair practices about nosocomial infections whereas 26% of them had good practices and only 3% of them had poor practices.

As per **Anirban Hom Choudhuri** and researchers in **2017**, the 153 patients enrolled in the study, 87 had an ICU-acquired nosocomial infection (58.86%). The most common organism responsible for infection was *Klebsiella pneumoniae* (37%), and the most common infection was pneumonia (33%). The duration of mechanical ventilation and length of ICU stay were significantly prolonged in patients developing nosocomial infections. There was no difference in mortality between the groups. The multivariate analyses identified intubation longer than 7 days, urinary catheterization >7 days, duration of mechanical ventilation more than 7 days, and ICU length of stay longer than 7 days as independent risk factors for nosocomial infections. The study demonstrated a high incidence of nosocomial infection in the ICU and identified the risk factors for acquisition of nosocomial infections in the ICU.

According to **Vikramjeet Dutta** in **2017**, 276 patients [126 (AICU), 47 (ICCU), 101 (PICU), 2 (CTVS ICU)] were included in the study of which 8% developed NI. Respiratory Tract Infections (RTI; 43%) were highest followed by Urinary Tract Infections (UTI; 34%), Blood Stream Infections (BSI; 11%), Wound Infections (WI; 10%), Sterile Site Infections (SSI; 2%). Incidences of NI were – AICU – 14%, ICCU – 4% and PICU – 8%. *Pseudomonas aeruginosa* was the predominant organism isolated. Possibility of reducing resistance by controlling the use of antibiotics is a logical approach, but implementation of effective policies is difficult. Hence, community awareness, antibiotic restriction, effective surveillance and good infection control practices are essential to overcome resistance. sources of hospital acquired infection are infecting microorganisms from fellow patients which may be multidrug resistant, infecting organisms from hospital staff, infecting organisms from instrument, blood products, intravenous fluid, from patient's normal flora, etc, insects are also source multidrug infection, organism may be present in air, dust, water, antiseptic solution, food, surfaces contaminated by patient's secretions, blood fluid, etc.

Keshni Naidu in 2014: A retrospective study in Fiji's largest ICU (2011-12) reported that 114 of a total 663 adult ICU admissions had bacteriological culture-confirmed nosocomial infection. The commonest sites of infection were respiratory and bloodstream. Gram negative bacteria were the commonest pathogens isolated especially *Klebsiella pneumoniae* (extended-spectrum β -Lactamase producing), *Acinetobacter*, and *Pseudomonas* species. Mortality for those with a known outcome was 33%. Improved surveillance and implementation of effective preventive interventions are needed.

In **2014**, **H Mythri** depicts that incidence of nosocomial infections in MICU patients was 17.7% (23/130). Of which 34.8% (8/130) was urinary tract infection (UTI) being the most frequent; followed by pneumonia 21.7% (5/130), 17.4% (4/130) surgical site infection, 13.0% (3/130) gastroenteritis, 13.0% (3/130) blood stream infection and meningitis. The nosocomial infection was seen more in the 40-60 year of age. The male were more prone to nosocomial infections than the female. The most frequent nosocomial infections (urinary, respiratory, and surgical site) were common in geriatric patients in the MICU setting and are associated with the use of invasive device. Large-scale studies are needed to be carried out in Indian population to plan long-term strategies for prevention and management of nosocomial infections.

IV.

METHODOLOGY

- **Research Design:** The research design used in this study is descriptive and analytical in nature
- **Sampling Design:** Cluster Sampling
- **Sample Size:** 150
- **Nature of respondents:** Nurses, Hospital administrators and Patients
- **Data Collection:** Primary data was collected from nurses, hospital administrators and patients of the hospitals. Secondary data was collected from hospital records, articles and journals.
- **Tools and techniques:** Percentage analysis, Chi Square.

V. STANDARD PROCEDURES OR STANDARD OPERATING PROCEDURES (SOPs)

1. The organization should have a well designed, comprehensive and coordinated infection control programme aimed at reducing / eliminating risks to patients, visitors and providers of care.
2. The organization must have infection control manual, which should be periodically updated.
3. The infection control team is responsible for surveillance activities in identified areas of the hospital.
4. The organization should take actions to prevent, reduce the risk of Hospital Acquired Infections (HAI) in patients and employees.
5. Proper facilities and adequate resources are to be provided to support the infection control programme.
6. The organization must take appropriate actions to control outbreaks of infections.
7. There should be documented procedures for sterilization activities in the organization.
8. Statutory provisions with regard to Bio Medical Wastes (BMW) should be complied with.
9. The infection control programme has to be supported by the organization's management and should train staffs of employee health.

VI.

DATA ANALYSIS

Table 6.1 Infection Control Surveillance and Reporting- 2017-2019
Blood Stream Infection (BSI)

MONTHS	NO. OF. BSI CASES (Bench mark - 1.8)
Jan - Mar 2017	0.98
April - Jun 2017	1.60
July - Sep2017	1.04
Oct - Dec 2017	1.14
Jan - Mar 2018	4
April - Jun 2018	1.4
July - Sep 2018	0.30
Oct - Dec 2018	0.31
Jan - Mar 2019	1.64
April - Jun 2019	1.20
July – Sep 2019	1.30
Oct - Dec 2019	0.68

Source: Primary Data**Inference:** Blood Streamline Infections during the month of January to March in 2018 are high in all three years. This is due to newly employed staffs. It can be rectified with effective training for newly employed staffs.Table 6.2 Infection Control Surveillance and Reporting- 2017-2019
Surgical Site Infection (SSI)

MONTHS	NO. OF. SSI CASES (Bench mark – 2)
Jan - Mar 2017	0.44
April - Jun 2017	0.9
July - Sep2017	0.9
Oct - Dec 2017	1
Jan - Mar 2018	0.97
April - Jun 2018	0.94
July - Sep 2018	1.08
Oct - Dec 2018	1.49
Jan - Mar 2019	1.22
April - Jun 2019	1.46
July – Sep 2019	0.89
Oct - Dec 2019	1.47

Sources: primary data**Inference:** Surgical Site Infection is below bench mark. Infection is quiet high during October to December in 2018 and 2019.Table 6.3 Infection Control Surveillance and Reporting 2017- 2019
Urinary Tract Infection (UTI)

MONTHS	NO. OF. UTI CASES (Bench mark – 4.5)
Jan - Mar 2017	2.22
April - Jun 2017	2.26
July - Sep2017	1.89
Oct - Dec 2017	3.57
Jan - Mar 2018	4.1
April - Jun 2018	1.72
July - Sep 2018	2.12
Oct - Dec 2018	5.66
Jan - Mar 2019	2.33
April - Jun 2019	4.51
July – Sep 2019	0.84
Oct - Dec 2019	3.41

Source: Primary data**Inference:** UTI exceeds bench mark during the month of October.

Table 6.4 Infection Control Surveillance and Reporting 2017-2019
Ventilated Associated Pneumonia (VAP)

MONTHS	NO. OF. VAP CASES (Bench mark – 2.5)
Jan - Mar 2017	3.61
April - Jun 2017	1
July - Sep 2017	3.81
Oct - Dec 2017	5.48
Jan - Mar 2018	5.5
April - Jun 2018	1.48
July - Sep 2018	3.01
Oct - Dec 2018	4.88
Jan - Mar 2019	0.48
April - Jun 2019	1.42
July - Sep 2019	1.67
Oct - Dec 2019	1.69

Source: Primary data

Inference: VAP exceeded the bench mark during October to December.

Table 6.5 Staffs Following Hand Hygiene
(Percentage Analysis)

	Frequency	Percent (%)	Valid Percent
Strongly agree	141	93.7	93.7
Agree	9	6.3	6.3
Disagree	0	0	0
Total	150	100	100

Source: Primary data

From the above table it is inferred that 93.7 percent staffs strongly agree that they follow hand hygiene before and after treating patients.

Table 6.6 Single Used Equipments are Discarded
(Percentage Analysis)

	Frequency	Percent (%)	Valid Percent
Strongly agree	146	97.0	97.0
Agree	4	3.0	3.0
Disagree	0	0	0
Total	150	100	100

Source: Primary data

The above table shows that 97 percent strongly agree that they dispose the equipment that is meant for single use purpose.

Table 6.7 Personal Protective Equipments Are Provided For Staff, Patient and Visitors
(Percentage Analysis)

	Frequency	Percent (%)	Valid Percent
Strongly agree	120	80.0	80.0
Agree	28	20.0	20.0
Disagree	2	1.3	1.3
Total	150	100	100

Source: Primary data

From the above table it is inferred that 80.0 percent of staffs and patients strongly agree that Personal Protective Equipments (PPE) are provided to them.

Table 6.8 Hand Hygiene Is Effective In Infection Control
(Percentage Analysis)

	Frequency	Percent	Valid Percent
Strongly agree	121	80.7	80.7
Agree	27	18.0	18.0
Disagree	2	1.3	1.3
Total	150	100	100

Source: Primary data

It is seen for the above calculation 80.7 percent of the respondents strongly agree that hand hygiene is effective in infection control.

WASTES ARE DISCARDED ACCORDING TO CLASSIFICATION AND WASTE MANAGEMENT IS DONE IN SAFE AREA (Chi square)

- **H₀**: There is no significant relationship on discarding wastes according to classification and waste management done in safe area.
- **H₁**: There is significant relationship on discarding wastes according to classification and waste management done in safe area.

	Value	Df	Asymp.sig.(2 –sided) P
Pearson Chi square	13.585 ^a	4	.009

Inference: at 5% level of significance, $P=.009$, therefore P value is less than 0.05. Hence H_0 is rejected.

The study shows that there is significant relationship on discarding wastes according to classification and waste management in safe area.

PATIENTS ARE INFORMED ABOUT HOSPITAL ACQUIRED INFECTIONS AND ALL PROCEDURES DONE WITH PATIENT'S CONSENT (Chi square)

- **H₀**: There is no significant relationship on patients informed about hospital acquired infections and all procedures done with patient's consent.
- **H₁**: There is significant relationship on patients informed about hospital acquired infections and all procedures done with patient's consent.

	Value	Df	Asymp.sig.(2 –sided) P
Pearson Chi square	9.328 ^a	4	.053

Inference: at 5% level of significance, $P=.053$, therefore P value is greater than 0.05. Hence H_0 is accepted.

The study shows that there is no significant relationship on patients informed about hospital acquired infections and all procedures done with patient's consent.

INFECTIOUS PATIENTS ARE ISOLATED AND TREATED AND PERSONAL PROTECTIVE EQUIPMENTS ARE PROVIDED TO STAFFS AND VISITORS

- **H₀**: There is no significant relationship on isolating and treating infectious patients and personal protective equipments provided to staffs and visitors.
- **H₁**: There is significant relationship on isolating and treating infectious patients and personal protective equipments provided to staffs and visitors.

	Value	Df	Asymp.sig.(2 –sided) P
Pearson Chi square	3.549 ^a	2	0.170

Inference: at 5% level of significance, $P=.053$, therefore P value is greater than 0.05. Hence H_0 is accepted.

The study shows that there is no significant relationship on isolating and treating infectious patients and personal protective equipments provided to staffs and visitors.

HOSPITAL INFECTION CONTROL

1. The organization has a well-designed, comprehensive and coordinated infection control programme aimed at reducing/eliminating risks to patients, visitors and providers of care:

- Currently there is a working committee on infection control. They meet once in two months. This meeting can be made once in a month so that measures on infection controls can be made effective.
- There is a documented infection control programme.
- There is an infection control team. They are involved in surveillance activities.
- There is designated infection control nurse.

2. The organization has an infection control manual which is periodically updated:

- There is infection control manual. It has all policies and procedures related to infection control activities in the hospital and identify high risk areas in the same.
- Even though surveillance activities like swab culture is done in various areas like OT & ICU there is a need of strengthening the surveillance activities by including rounds, air and water quality checks in high risk areas like CSSD & kitchen. So there must

be policies and procedures on surveillance activities in the hospital.

- c) Policies and procedures related to CSSD activities must be prepared and included in the manual.
- d) Policies and procedures on engineering controls to prevent infection are not documented.

3. The infection control team is responsible for surveillance activities in identified areas of the hospital:

- a) There is data collected on surveillance activities. The infection control nurse maintains the surveillance data on infection control.
- b) This is being uniformly done.
- c) Information is sent to appropriate authorities.
- d) Monitoring the effectiveness of housekeeping services (infection control) is being done.

4. The organization takes actions to prevent reduce the risk of Hospital Acquired Infections (HAI) in patients and employees:

- a) The infection control nurse collects the data and monitors the rate.
- b) It is suggested to provide the feedback regarding rates to medical and nursing staffs (can be through circulars, newsletters etc)

5. Proper facilities and adequate resources are provided to support the infection control programme:

- a) Hand washing facility is adequate. Scrubs are provided with elbow/foot operating tap. Also drier/tissue papers provided. Hand washing pictures are displayed. Also hand washing areas are kept clean.
- b) Hand washing should be monitored regularly.
- c) Policies and procedures on isolation and barrier are available. Staffs are aware of isolation/barrier activities, who are the patients to be admitted in isolation room. Isolation rooms are available in wards. These rooms are more organized and cleaned. They are displayed „ISOLATED ROOM“.
- d) Adequate gloves, masks and disinfectants are available. The usage must be monitored by infection control team.

6. The organization takes appropriate actions to control outbreaks of infections:

- a) Hospital has documented procedures on handling such outbreaks. It is prepared and implemented.

7. There are documented procedures for sterilization activities in the organization:

- a) There is an established documented procedure.

8. Statutory provisions with regard to Bio Medical Wastes (BMW) are complied with:

- a) The hospital is authorized by GJ for management and handling of bio-medical waste.
- b) Biomedical waste segregation is done at the source unlike in OT. The color codes and instructions are properly displayed in waste segregation areas. This is displayed uniformly throughout the hospital.
- c) The waste is cleared at least twice in a day. Trolleys are used with covered bins of different color to transport waste. Also the staffs are trained to use protective measures.
- d) All the wastes must be weighed before handling over to the outsourcing service.
- e) Bio-medical waste treatment is outsourced which is authorized to treat biomedical waste.

9. The infection control programme is supported by the organisation's management and includes training of staffs and employee health:

- a) Designated infection control nurse is there.
- b) Facilities like gloves, mask etc is available.
- c) Elbow taps are provided in patient care services.
- d) Soap solutions are provided in all hand washing areas instead of soap
- e) There should be initial orientation for new staffs on infection control
- f) Proper system of pre and post exposure prophylaxis is implemented throughout the organization.
- g) This must be applicable to all staffs working in the organization including outsourced services.

VII. SUGESSTIONS AND RECOMMENDATION

- The existing system of Infection Control measures in this Hospital has been in practice for over a long period of time.
- There is only one infection control nurse. Employing two more nurses for infection control team will minimize the work load of IC nurse, so that work is made effective.
- There is infection control manual. It has all policies and procedures related to infection control activities in the hospital and identify high risk areas in the same.
- Quality check in air and water should be done regularly. Water sample should be sent for lab to check the presence of micro organisms.
- Policies and procedures related to CSSD activities must be prepared and included in the manual.
- Policies and procedures on engineering controls to prevent infection should also be added.
- The infection control nurse maintains the surveillance data on infection control. Each ward in-charge should also maintain the same.
- It is suggested to provide the feedback regarding rates to medical and nursing staffs (can be through circulars, newsletters etc)
- Hand washing should be monitored regularly.
- Experienced and well trained staffs only should be allowed to treat “ISOLATED” patients.
- Adequate gloves, masks and disinfectants are available. The usage must be monitored by infection control team.
- Regular validation tests on validation carried out should be reported to the Infection Control Team regularly.

- Employees should be well educated about color codes so that waste segregation is done correctly.
- All the wastes must be weighed before handling over to the outsourcing service.
- Outsourcing staffs should also be educated about infection control so that development of infection can be minimized to the least.
- There should be initial orientation for new staffs on infection control
- Training and educating newly recruited staffs will minimize infections in and around hospital.

VIII. CONCLUSION

The study revealed that current physical facilities available for infection control are good and meets the ISO standard level. If the measures followed are continuously updated and upgraded the infection level can be further reduced. This can be done by giving training awareness Training Programme on Standard Requirements, guidance on implementation of infection control programmes. The awareness about infection control should also be developed among visitors. The awareness about the infection has to be created that will help in decrease of infections and control of the same.

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