Original Article

Assessment and Management of Hospital Acquired Infections in a Tertiary Care Hospital

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ABSTRACT

Aim: To assess hospital acquired infections and its management in a tertiary care hospital. **Materials and Methods:** A cross-sectional study of six months was carried out. Utilizing SPSS Version 25 and Microsoft Office Excel, statistical analysis was carried out, after the collected data were imported into Excel. **Results:** In our investigation, the prevalence of hospital acquired infections was discovered to be 6.1%. Male patients made up 70% of study's total participants while female made up 30%. The highest distribution of Hospital Acquired Infections (HAI) was found to be Bloodstream Infection (BSI) (41.80%), followed by Hospital-Acquired Pneumonia (HAP) (17.20%), Respiratory tract infections (RTI) (13.90%) and other HAI. (Hospital Aquired Infections). Most common causative organism was found to be as *Klebsiella pneumoniae* (15.46%). According to lab investigations, Leukocytosis (61.47%), Neutrophilia (59.83%), Lymphopenia (78.68%), Hyperglycaemia (53.3%) and elevated level of CRP (81.13%) was found in majority patients. Most of the patients were treated with Meropenem (17.55%), Linezolid (15.98%) and others. **Conclusion:** Hospital acquired infections are a significant risk to medical facilities and one of the most often avoidable negative patient outcomes. They make a major contribution to hospital expenses and mortality rates. The basis of effective infection control programmes in hospitals can be the monitoring of antibiotic resistance in conjunction with tracking physician prescribing patterns.

Keywords: Hospital Acquired Infections (HAI), Nosocomial infections, Causative organism, Prevalence.

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INTRODUCTION

A hospital acquired infection sometimes known as "Nosocomial Infection", arises in patients who were not already infected or incubating when they were admitted to the hospital. Included are infections acquired in the hospital that manifest 48 hr or after discharge, as well as occupational infections among staff.[1]

According to the World Health Organization –at any given time, 7 in developed and 10 in developing nations out of every 100 hospitalized patients will contract at least one health care-associated infection.

Incidence of HAI varies from 3.6 to 19.1%, over the world. Low-as well as Middle-Income Countries (LMICs) account for 5.7 to 19.1% of these, whereas High-Income Countries (HICs) account for 3.6–12%. Studies state that the prevalence rate in US is upto 4.5% and 5.7-7.1% in European countries, while prevalence rate ranges between 5.7% and 19.2% in low-and middle-income countries.[2]

The Different Types of Nosocomial Infection

Thirteen different forms of nosocomial infections are generally categorised into based on their site of infection, according to the Centre for Disease Control (CDC) and National Healthcare Safety Network

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(NHSN). These types are determined by their clinical and biological criteria. There are many different types of nosocomial infections including surgical site infections, bloodstream infections, respiratory tract infections, nosocomial pneumonia, nosocomial fungal infections, urinary tract infections, and those caused by Mycobacterium tuberculosis.[3]

The following are some plausible primary explanations of greater HAIs rates in developing nations:

- In certain nations, hospital accreditation not required.
- Hospital overcrowding; a lack of medical supplies, inadequate infection control training for nurses and other health care professionals.
- A formal infection control policy and procedures are lacking in many hospitals.
- It has been established that low nurse-to-patient staffing ratios are associated with increased HAI rates.
- There are still no regulations that make infection control programs mandatory (e.g., national infection control guidelines).
- If a legal framework is present, adherence to and compliance with the guidelines is improper.

Impact on the outcomes and care of patients

The following factors can be used to measure the impact of Hospital Acquired Infection (HAI):

- Extensive hospital stays
- Increased resistance to antibiotics
- Long-term impairment
- Financial strain on the health system increased
- Expensive for both patients and their family
- Mortality

In terms of cost of medicine, a study done in the cardiothoracic unit of a North Indian tertiary care hospital found that the costs of hospital treatments for patients with HAIs were six times more expensive than those for controls without HAIs, in terms of price of medications, hospital stay, consultation charges, price of antibiotics and investigations. Therefore, the added financial strain by these infections has major implications on the patients. With the rise of medical tourism, medication resistance in hospitals has the potential to spread globally.[4] Recent studies conducted at multiple locations worldwide have reported HAI prevalences ranging from 4% to 47%.[5]

MATERIALS AND METHODS

Study Design: Cross-sectional study design.

Study Period: The study duration from January 2022 through June 2022 for 6 months.

Study Setting: 500 bedded Tertiary Care Hospital, Kannur, Kerala.

Study Methodology

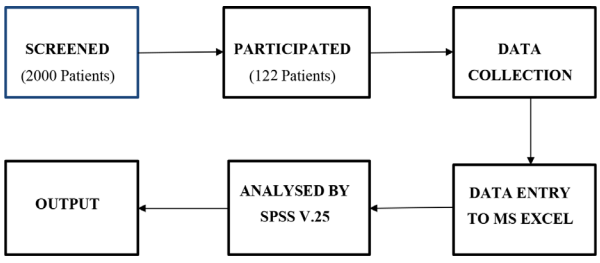
Participants receiving treatment at tertiary care hospital were provided detailed information about the study. Participants who are willing to participate complete an informed consent form. The data collection process makes use of a predefined case record form. The patient medication profile and an interview with the patient were used to gather data on the patient's demographics, life style and medication. From laboratory investigation reports included in the clinical records, biochemical data were recorded.

Utilizing SPSS Version 25 and Microsoft Office Excel, statistical analysis was carried out.

Ethics and Consent

The Institutional Human Ethical Committee at Crescent College of Pharmaceutical Sciences gave its approval to the study, filed under 005/2021/CCOPS/IEC. The chairperson of the Institutional Human Ethics Committee granted permission for the study to be carried out.

Method of Study



RESULTS

The study lasted 6 months and all the information was gathered from the 500 bedded Tertiary care hospital in Kannur. 122 patients in total were included after meeting the inclusion and exclusion criteria of the study.

Characteristics of Sample

Among 122 patients, 70% were males (n=85) and 30% were females (n=37). In this study, majority of the study population with hospital acquired infection comes under

the age group of 60-70 years (36.1%).

The most commonly seen co-morbidity was found to be Hypertension (32.4%), followed by Diabetes mellitus (30.8%). Multidrug Resistance was found to be 11.5% in Methicillin-Resistant *Staphylococcus aureus* (MRSA), followed by 7.4% in Methicillin-Resistant Coagulase-Negative *Staphylococci* (MRCoNS). These findings are shown below in Table 1.

Type of Hospital Acquired Infection

The highest distribution of HAI was found to be Bloodstream Infection (BSI) (41.80%), followed by Hospital-Acquired Pneumonia (HAP) (17.20%) and other HAI, findings shown in Table 2.

Table 1: Characteristics of sample.

Variables	Characteristics	No.	(%)
Gender (*n*=122)	Male	85	70%
	Female	37	30%
Age groups (years)	20-30	1	0.8
	31-40	11	9.0
	41-50	13	10.7
	51-60	13	10.7
	61-70	44	36.1
	Above 80	40	32.8
Co-morbidities	HTN	60	32.4
	DM	57	30.8
	CAD	25	13.5
	CKD	15	8.1
	COPD	13	7.02
	Dyslipidemia	8	4.32
	CVA	7	3.78
Bacteriological Testing done for such infections	Yes	112	91.8%
	No	10	8.2%
Drug Resistance	MRSA	14	11.5%
	MSSA	1	0.8%
	MRCoNS	9	7.4%
	None	98	80.3%
Covid Status	Positive	52	42.6%
	Negative	70	57.4%
POST Covid Status	Yes	17	13.9%
	No	105	86.1%

Table 2:Distribution of sample according to HAI.

Hospital Acquired Infection	Frequency	Percentage
Surgical Site Infection (SSI)	1	0.80%
Catheter-Associated Urinary Tract Infection (CAUTI)	1	0.80%
Septicaemia	2	1.60%
Ventilator-Associated Pneumonia (VAP)	5	4.10%
Catheter-Related Bloodstream Infection (CRBSI)	7	5.70%
Urinary Tract Infection (UTI)	8	6.60%
Bacteraemia	9	7.40%
Respiratory Tract Infections (RTI)	17	13.90%
Hospital-Acquired Pneumonia (HAP)	21	17.20%
Bloodstream Infection (BSI)	51	41.80%

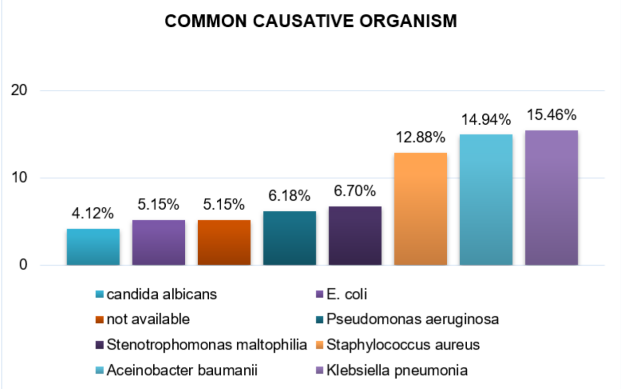


Figure 1: Distribution of sample according to common causative organism.

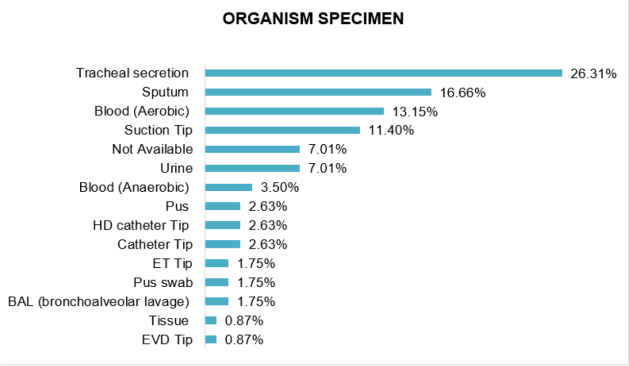


Figure 2: Distribution of sample according to specimen.

Causative Organism

The most common causative organism was found to be *Klebsiella pneumonia* (15.46%), followed by *Klebsiella pneumoniae* (14.94%), as depicted in Figure 1. As indicated in Figure 2, the majority of the organism was discovered to be in the tracheal secretion.

Table 3: Distribution of sample according to type of antibiotic prescribed.

Drugs	F.	%	Drugs	F.	%	Drugs	F.	%
Meropenem	56	17.55	Ceftriaxone + Sulbactam	6	1.88	Cefepime	2	0.62
Linezolid	51	15.98	Cefoperazone + Sulbactam	5	1.56	Teicoplanin	2	0.62
Piperacillin + Tazobactam	35	10.97	Cefuroxime	4	1.25	Minocycline	2	0.62
Levofloxacin	21	6.58	Ceftazidime	4	1.25	Imipenem + cilastatin	2	0.62
Doxycycline	15	4.70	Amikacin	4	1.25	Nitrofurantoin	2	0.62
Polymixin B	13	4.07	Clindamycin	4	1.25	Itraconazole	2	0.62
Vancomycin	12	3.76	Amoxicillin + Clavulanate	4	1.25	Faropenem	2	0.62
Ceftriaxone	10	3.13	Voriconazole	4	1.25	Moxifloxacin	1	0.31
Trimethoprim + Sulfamethoxazole	10	3.13	Azithromycin	4	1.25	Ceftazidime + Avibactam	1	0.31
			Cefixime	3	0.94	Rifampicin	1	0.31
Fluconazole	10	3.13	Gentamicin	3	0.94	Fusidic Acid + Betamethasone	1	0.31
Metronidazole	8	2.50	Clarithromycin	3	0.94	Rifaximin	1	0.31
Ciprofloxacin	7	2.19	Aztreonam	3	0.94	Cefpodoxime + Ofloxacin	1	0.31

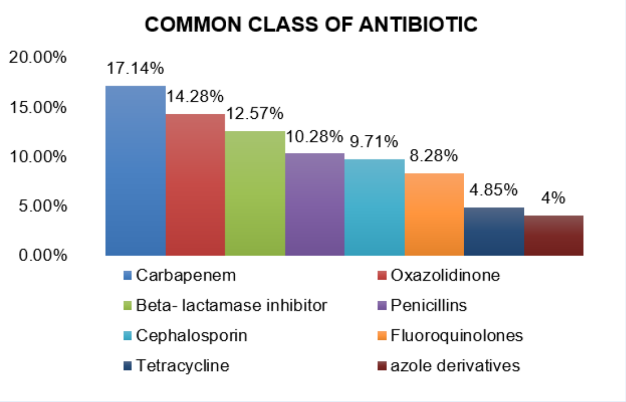


Figure 3: Distribution of sample according to common class of antibiotic prescribed.

Microbial Profile

Gram Negative Bacilli (57.14%) dominated the pathogen spectrum, followed by Gram Positive Bacilli (28.04%).

Lab Investigation

Most patients were found to have leukocytosis (61.47%), neutrophilia (59.83%) and lymphopenia (78.68%). Also, patients had elevated level of C-reactive protein (88.5%) and blood sugar (53.3%).

Class of Antibiotic Prescribed

The most frequent class of antibiotics were Carbapenem (n =60, 17.14%), Oxazolidinone (n =50, 14.28%), and Beta-lactamase inhibitor (n =44, 12.57%), results depicted in Figure 3.

Table 4: Distribution of sample according to statistical test.

Variables Total		HAI	Chi-Square Value	*p*-Value
No. of Days in Hospital	>= 7days	91	22.703[a]	.007*
	< 7 days	31		
Gram Positive Bacilli	YES	48	30.318[a]	.034*
	NO	64		
	Not Available	10		
Gram Negative Bacilli	YES	75	30.035[a]	.037*
	NO	37		
	Not Available	10		
Klebsiella pneumonia	YES	30	11.087[a]	.270
	NO	92		
Klebsiella pneumoniae	YES	29	20.355[a]	.016*
	NO	93		
Carbapenem	YES	59	3.812[a]	.923
	NO	63		
Oxazolidinone	YES	49	7.364[a]	.599
	NO	73		
Beta Lactamase Inhibitors	YES	44	16.685[a]	.05*
	NO	78		

*statistically significant.**Type of Antibiotic Prescribed**
The most frequent antibiotics were Meropenem (n =56, 17.55%), Linezolid (n =51, 15.98%), and Piperacillin + Tazobactam (n = 35, 10.97%), as shown in Table 3.

Number of Days of Hospital Stay

The frequency of HAI was higher in patients who stayed in hospital for more than or equal to 7 days compared to less than to 7 days, which is statistically significant, results as enlisted in Table 4. For patients with HAI, a 15 day hospital stay was shown to be the mean length of stay.

Prevalence

The prevalence of Hospital Acquired Infection (HAI) was discovered to be 6.1%.

DISCUSSION

In an effort to determine the prevalence of HAI over the course of six months in a Tertiary Hospital, the prevalence was discovered to be 6.1% (Mehrdad Askarian, 2012). A prevalence rate of 11.7% was found in the study of Health Care-Associated Infections (HCAIs) in the tertiary care facility (Animesh Gupta, 2015).

With nearly 41.80% bloodstream infections were the most commonly identified nosocomial infections across all cases, followed by Hospital-Acquired Pneumonia (HAP) (17.20%) (Mehrdad Askarian, 2012). The high BSI frequency may be explained due to presence of multiple risk factors such as prolonged hospital stay, increased intravascular lines in wards and others. To enhance patient outcomes, monitoring of nosocomial infections is essential to be able to reduce hospital acquired infections.

Among 122 patients who were involved in this study, total number of male patients were 70% (n=85) and 30% females (n=37) showing that males were predominant for the development of hospital acquired infection. Majority of the study population with hospital acquired infection comes under the age group of 60-70 years (36.1%). In this study, Hypertension (32.4%) and Diabetes mellitus (30.8%) were the major co-morbid condition. Underlying conditions may compromise the immune system.

The most common causative organism was found to be *Klebsiella pneumoniae* (15.46%), followed by *Aceinobacter baumanii* (14.94%) (Deeebya R Mishra, 2020). Gram Negative Bacilli (57.14%) dominated the pathogen spectrum, followed by Gram Positive Bacilli (28.04%) (V. Narendranath, 2017).

Multidrug Resistance was found to be 11.5% in methicillin-resistant *Staphylococcus aureus* (MRSA) followed by 7.4% in methicillin-resistant coagulase-negative staphylococci (MRCoNS) (Degu Abate, 2018), (Shazia Damji, 2021).

The frequency of HAI was increased in patients who stayed in hospital for more than or equal to 7 days compared to less than to 7 days, which is statistically significant (Maumita De, 2018), (Animesh Gupta, 2015). For patients with HAI, a 15-day hospital stay was shown to be he mean length of stay. Nosocomial infections have caused patients to stay in hospital longer and thus requiring prolonged inpatient care.

The most frequent antibiotics were Meropenem (n =56, 17.55%) and Linezolid (n =51, 15.98%) (Pampita Chakraborty, 2016).

The most frequent class of antibiotics were Carbapenem (n=60, 17.14%), oxazolidinone (n=50, 14.28%), and Beta lactamase inhibitor (n=44, 12.57%).

The association between hospital acquired infection and no. of days, hospital acquired infection and beta lactam, hospital acquired infection and *Aceinobacter baumanii*, hospital acquired infection and gram-positive organism, hospital acquired infection and gram-negative organism were discovered to be statistically significant ($p \leq 0.05$) in the study. These findings are shown in Table 4.

Exposure to medical devices, extensive stay, immuno-suppressed conditions, comorbidities, surgery and antimicrobial therapy are some of the salient risk factors. Effective surveillance, antibiotic policies and scrutiny of epidemiological trends of these infections are required for better infection management with resistant organisms. There is an apparent necessity for multicenter studies to be carried out in our country to coordinate, organize and arrive at protocols based on antibiotic resistance. Alteration as well as rotation in antibiotic prescribing patterns would aid in declining the antibiotic resistance.

CONCLUSION

In our investigation, the prevalence of hospital acquired infections was discovered to be 6.1%. Male patients made up 70% of study's total participants while female made up 30%. Hospital acquired infection were more frequent in people 61 to 70 years old. The most acquired infection was blood stream infection (41.08%) and most common causative organism was found to be as *Klebsiella pneumoniae* (15.46%). The organism specimen was found to be higher in tracheal secretion (26.31%).

Most of the patients were treated with meropenem (17.55%), linezolid (15.98%) with other drugs. Majority of patients stayed in hospital for >=7 days (74.60%).

Hospital acquired infections are a significant risk

to medical facilities and one of the most often avoidable negative patient outcomes. They make a major contribution to hospital expenses and mortality rates. Globally healthcare infections linked to various hospitals are prevalent and have a negative impact on health. It is known that these infections have a negative effect pn the standard of healthcare.

The impact of HAI globally is very significant with regard to extra-costs, morbidity, mortality, emotional stress and other outcome markers according to various research found in the scientific literatures. The basis of effective infection control programmes in hospitals can be the monitoring of antibiotic resistance in conjunction with tracking physician prescribing patterns. With improved hospital infection control, a significant majority of these infections can be readily avoided.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

HAI: Hospital acquired infections; **BSI:** Bloodstream Infection; **HTN:** Hypertension; **DM:** Diabetes Mellitus; **CAD:** Coronary Artery Disease; **CKD:** Chronic Kidney Disease; **COPD:** Chronic Obstructive pulmonary Disease; **CVA:** Cerebrovascular Accident; **MRSA:** Methicillin Resistant Staphylococcus Aureus; **MSSA:** Methicillin Sensitive Staphylococcus Aureus; **MRCoNS:** Methicillin Resistant Coagulase Negative Staphyloccoci; **CRP:** C-Reactive Protein; **ET:** Endotracheal Tip; **HD:** Hemodialysis; **EVD:** External Ventricular Drain.

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