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ASSESSMENT OF HOSPITAL-ACQUIRED INFECTION AND ITS ASSOCIATED RISK FACTORS

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Abstract

Background: Globally, and particularly in emerging countries like India, the incidence of hospital-acquired infections are rising quickly. There is little information in the literature about hospital-acquired infections in the Indian context.

Aim: The purpose of this study was to evaluate hospital-acquired infections and the risk variables linked to them in patients who were admitted to a tertiary care facility.

Methods: Throughout their hospital stay, 508 admitted participants' risk variables, prevalence, and incidence were evaluated. Biological specimens were obtained and submitted to microbiological investigation in patients suspected of having contracted an infection while in the hospital. Data from clinical and laboratory settings were statistically examined.

Results: For every 1000 patient days, the incidence and prevalence of infections acquired in hospitals were 29% and 20% respectively. The ICU and ophthalmology departments had the greatest and lowest incidences, respectively, at 208.53 and 0.96 per 1000 patient days. High risk was observed in surgical patients with a history of prior hospitalisation, as well as in non-surgical participants with a chest tube, mechanical ventilation, and underlying illness. Inpatient-acquired infections caused study participants to remain longer (6.1 extra days) and had higher inpatient death rates.

Conclusion: The current study came to the conclusion that patients at the district's tertiary care institutions had a high discharge burden and poor discharge outcomes. The risk variables for participants who had surgery and those who did not are different. To get better results, efforts should be undertaken to reduce the high incidence of hospital-acquired infections.

Keywords: Hospital-acquired infection, hospital-associated infections, nosocomial infection, risk factor

INTRODUCTION

Hospital-acquired infections are conditions, either localised or systemic, that develop in patients who were admitted to the hospital without any symptoms due to an unpleasant reaction to an infectious agent or its toxins. Infections acquired in hospitals are a major cause of harm from healthcare systems in both developed and underdeveloped nations. Nonetheless, emerging and low-income countries report increased incidence and prevalence. Hospital-acquired infections are turning into serious health issues that endanger both patient and healthcare worker safety and well-being.1

Hospital-acquired infections afflict around 8% of patients in normal wards and over 50% of patients admitted to intensive care units (ICUs) in poor countries.

The issue of hospital-acquired infections is often overlooked and unrecognised in developing and low-income countries due to inadequate guidelines, insufficient or nonexistent surveillance, and the intricate nature of the diagnostic process. Data from earlier studies indicate that, contradictorily, 15 out of every 100 hospitalised patients may have developed an illness during their stay. This rate is greater than reports from North America and Europe. On the other hand, the majority of the data that is currently available in the literature relates to the prevalence of hospital-acquired infections, and there is a dearth of information about their occurrence.3

Blood infections, urinary tract infections, and surgical site infections are the most typical manifestations of these illnesses. The kind of operation, underlying systemic disorders, and ward type are the most often occurring related variables.4

The current literature-based therapies can effectively control over half of the reported hospital-acquired infections. Nevertheless, these infections represent a serious risk to the global and low-income healthcare systems. Inadequate infection control procedures are mostly caused by understaffing and overcrowding in developing country hospitals.5. The current study sought to evaluate hospital-acquired illnesses and the risk factors associated with them among patients admitted to tertiary care hospitals in India due to the paucity of literature data on these diseases.

MATERIALS AND METHODS

Assessing hospital-acquired infections and the risk factors associated with them among patients admitted to the several departments of the Institute, was the goal of the current longitudinal research. The research evaluated individuals who were admitted to the facility. All individuals gave their informed permission, both verbally and in writing, prior to research participation.

The research evaluated every patient, regardless of gender, admitted to the Institute's general medicine ward, ophthalmology, surgery, paediatrics, and gynaecology and obstetrics wards. Those who were admitted to the Institute without any indication of a bacterial illness were included in the research. Subjects with a history of bacterial infections and those who withheld consent to participate in the study were excluded.

Parental or guardian consent was obtained for paediatric individuals. Consent from the participants' attendants was obtained for unconscious subjects. The research participants' sociodemographic information and clinical data were recorded using a pre-made, structured questionnaire. Every participant in the trial was observed for two days, and those who became infected during that time frame were not allowed to continue. The remaining patients made up the total sample size, and an examiner followed them until they were discharged or passed away. Examiners with specialised knowledge from their individual wards verified the existence of hospital-acquired infections. Biological specimens were taken in accordance with the stringent aseptic and sterile methodology from people who were suspected of having the infection.

All the collected specimens were assessed using microbiological tests for isolation of the bacteria followed by the blood culture following the guidelines by WHO (World Health Organization). We evaluated the incidence of infection in patients who were hospitalised without symptoms or who were in the incubation phase 48 hours after they were admitted. Definitions for particular hospital-acquired illnesses were taken from Horan TC et al. (2008).Subjects who had at least one positive, uncontaminated blood culture and one of the following signs or symptoms—hypotension, rigours with chills, fever, or both—were judged to have had a bloodstream infection. A minimum of two or more of the symptoms and indicators observed during the hospital stay, such as the purulent sputum, cough, and/or chest radiography indicating the infection, were deemed indicators of hospital-associated pneumonia. Spreading cellulitis, an abscess, or purulent discharge at the surgical site in the month after infection were indicators of infection at the surgical site.

For urinary tract infection, subjects with pyuria of clean catch urine with (>10 WBC/high power field), positive dipstick for leukocyte esterase, catheter urine with >102 CFU/ml and maximum two species of microorganisms, and/or midstream urine showing culture with >105 CFUs (colony forming units) are considered. This is true whether or not there are any signs or symptoms associated with the infection.

The collected data were reviewed and input into Microsoft Excel spreadsheets. Statistical analysis was performed on the collected data using IBM Corp.'s SPSS software, version 25.0 (Armonk, NY, USA). The prevalence and incidence of nosocomial infections were evaluated, and risk variables linked to hospital-acquired infections were identified, using

the chi-square test. In order to determine related risk variables, multivariate and bivariate logistic regression analysis were used to evaluate the adjusted risk ratio (ARR) and risk ratio. A significance threshold of $p<0.05$ was used.

RESULTS

The current study had 534 participants; 26 of them were removed from the trial after exhibiting infection-related symptoms within 48 hours of entry. The other 508 patients had their chances of contracting an illness from the hospital monitored until they passed away or were released from the facility. Twelve of these fifty-eight patients were further eliminated because insufficient data could be obtained. Thus, 496 people made up the study's ultimate sample size.

34.27% (n=170) of the research respondents were between the ages of 18 and 30, followed by 26.81% (n=133) of subjects between the ages of 31 and 50, 23.58% (n=117) of people from over 50, and 14.91% (n=74) of subjects under the age of 18. In the current study, there were 55.24% (n=274) females and 44.75% (n=222) men. Farmers made up the largest group of participants, accounting for 37.5% (n=186). Students and businesspeople came in second and third, with 10.88% (n=186) and 10.28% (n=51) subjects, respectively, and 8.46% (n=42) subjects working on a daily basis. Of the 224 respondents, 45.16% were illiterate, whereas 11 subjects (2.21%) had completed graduate-level education. 70.56% (n=350) of the individuals were married, compared to 18.14% (n=90) who were single and 2.62% (n=13) who were each divorced and widowed.

Table 1 displays the number of study participants admitted to the general ward, ICU, paediatrics, ophthalmology, surgery, and obstetrics and gynaecology, respectively: 22.58% (n=112), 2/21% (n=11), 584% (n=29), 15.52% (n=77), 25.40% (n=126), and 28.42% (n=141). Chronic medical diseases were seen in 26.41% (n=131) study participants, with cardiovascular disease and hypertension being the most frequent conditions. Diabetes mellitus was observed in 6.85% (n=34), 5.64% (n=28), and 3.835 (n=19) participants, respectively.

For each 100 patient days, the research patients' mean beginning of a hospital-acquired infection was 4.62 with a 95% confidence interval of 14.44, or 8.84. 28.13 patient days were the overall incidence, with a 95% confidence interval (12.42–32.32), and 19.43 patient days were the overall prevalence, with a 95% confidence interval (16.95–21.83).

As shown in Table 2, the subjects from the Department of Ophthalmology had the lowest incidence rate, with 0.96 per 100 patient days and 95% CI of 0.07, 4.92. The subjects from the Paediatrics department had the highest incidence rate, with 16.18 per 100 patient days and 95% CI of 45.32, 101.32; the subjects from Surgery department had the lowest incidence rate, with 29.53 per 100 patient days and 95% CI of 23.3, 37.4; and the subjects from the General Ward had the lowest incidence rate, with 22.94 per 100 patient days and 95% CI of 16.66, 31.32.

In terms of the kind of infection, urinary tract infections (UTIs) were the most prevalent, occurring in 44.95% (n=223) of the individuals, surgical site infections in 12.90% (n=64), and mixed UTI and bloodstream infections in 10.08% (n=50) of the subjects, surgical site infection, and UTI in 9.87% (n=49) subjects, bloodstream infection in 7.05% (n=35) study subjects, bloodstream infection, and surgical site infection and intravenous site infection in 5.04% (n=25) study subject each, pneumonia in 3.02% (n=15) subjects, and UTI and pneumonia in 2.01% (n=10) study participants respectively (Table 3).

19.35% (n=96) of the participants had biological samples obtained, and they were evaluated in a lab to determine whether microorganisms were the cause. From these specimens, the study discovered 21 different kinds of bacteria, with a 61% culture positive rate. Of the microorganisms found, 28% (n=6) were gram-positive and 72% (n=15) were gram-negative. In 27%, 25%, and 18% of the research participants, respectively, E. Coli, Staph aureus, and Klebsiella species were the most frequently isolated bacteria.

Of the 496 participants in this trial, 11 required an ICU admission. Of the individuals admitted to the ICU, 54.54% (n=6) were younger than 23 years old. Of these patients, 54.54% (n = 6), 72.7% (n = 8), 54.54% (n = 6), and 54.54% (n = 6) had an indwelling urine catheter, a nasogastric tube, a peripheral IV line, and mechanical breathing, in that order.

Because statistical tests could not be applied, research participants who were hospitalised to the intensive care unit and had cataract surgery were not included. Therefore, risk factor analysis was performed on the 460 research participants that were left. These 460 participants were split up into two groups: 225 for surgery and 235 for nob-surgery. Table 4 presents the findings of a comparison of clinical demographic factors at baseline between the two groups. Within the surgical group, an adjusted risk ratio of 1.63, with a 95% confidence interval of 1.05 to 2.52, indicated that participants with a history of hospitalisation, clean-contaminated wounds, elective surgery, and male gender were predisposed to hospital-acquired infection. There were significant variations (p=0.01) in the mean age of study subjects between the surgery and non-surgery groups, which were 35.13±20.05 and 31.07±13.74 years, respectively.

With an adjusted risk ratio of 0.52 and 95% confidence intervals of 0.34, 0.91, it was shown that participants between the ages of 18 and 30 had a decreased risk of hospital-acquired infection. The presence of an indwelling urine catheter, mechanical ventilation, underlying illness, and chest tube were observed risk factors in the non-surgery group. The research participants in the non-surgery group who had a hospital-acquired infection had a lower mean age than those who did not, and there was a decreased risk in the age range of 31 to 50 and beyond 50, with a p-value of less than 0.05. Study participants with hospital-acquired infections had a mean hospital stay duration of 13.93±6.76 days, whereas those without such infections had a mean stay duration of 7.61±4.38 days, which was statistically significant with p=0.001.

Among the current investigation, 44 fatalities were observed, representing an overall mortality rate of 4%; however, the mortality rate increased to 8% among participants who had contracted an illness while hospitalised. Subjects with hospital-acquired infection had a significantly higher probability of dying (p=0.01) than did those without it.

DISCUSSION

Of the 496 subjects evaluated in this study, 34.27% (n=170) were between the ages of 18 and 30. Subjects from 31 to 50 years old, 23.58% (n=117) were over 50 years old, and 14.91% (n=74) were under the age of 18, respectively, made up the majority of the study subjects. In the current study, there were 55.24% (n=274) females and 44.75% (n=222) men.

Farmers made up 37.5% (n=186) of the subjects, followed by businesspeople and students with 10.28% (n=51) and 10.88% (n=186) subjects, respectively, and everyday labourers with 8.46% (n=42) subjects.45.16 (n=224) participants lacked literacy, whereas 2.21% (n=11) subjects had completed graduate-level schooling. 70.56% (n=350) of the individuals were married, compared to 18.14% (n=90) who were single and 2.62% (n=13) who were each divorced and widowed. The study participants who were admitted to the general ward, intensive care unit, paediatrics, ophthalmology, surgery, obstetrics and gynaecology, and 2/21% (n=11), 584% (n=29), 15.52% (n=77), 25.40% (n=126), and 28.42$ (n=141) were as follows. Chronic medical diseases were seen in 26.41% (n=131) of the research participants, with cardiovascular disease being the most frequent condition, followed by hypertension and diabetes mellitus. These findings were in line with research conducted in 2010 by Petersen MH et al7 and in 2013 by Gandhi NR et al8, whose authors evaluated participants using demographic information similar to that of the current study. The research participants' mean beginning of a hospital-acquired infection was found to be 4.62 with a 95% confidence interval of 14.44, or 8.84 per 100 patient days. 28.13 patient days were the overall incidence, with a 95% confidence interval (12.42–32.32), and 19.43 patient days were the overall prevalence, with a 95% confidence interval (16.95–21.83). Individuals hospitalised to the intensive care unit (ICU) had the greatest occurrence rate, 207.62 (133.42, 309.12), followed by individuals from the paediatrics department (16.18 per 100 patient days). The present study's results showed a correlation with the findings of Razine R et al. (2011) and Gosling R et al. (2010), who observed a comparable prevalence of hospital-acquired infections.

According to the study's findings, the most common type of infection was a urinary tract infection (UTI), which was observed in 44.95% (n=223) of the subjects. Other common infection types included surgical site infections (12.90% (n=64)), combined UTI and bloodstream infections (10.08% (n=50) subjects, surgical site infections and UTI in 9.87% (n=49) subjects, bloodstream infections in 7.05% (n=35) study subjects, surgical site infections and intravenous site infections in 5.04% (n=25) study subjects each, pneumonia in 3.02% (n=15) subjects, and UTI and pneumonia in 2.01% (n=10) study participants.

These findings were in line with earlier research by Beyene G et al. (2011) and Melaku S et al. (2012), who found that UTIs were the most prevalent hospital-acquired infections in the subjects they studied. Biological samples were obtained from 19.35% (n=96) of the research participants, and these samples were evaluated in a lab to identify the causal microorganisms. From these specimens, the study discovered 21 different kinds of bacteria, with a 61% culture positive rate. Of the microorganisms found, 28% (n=6) were gram-positive and 72% (n=15) were gram-negative. In 27%, 25%, and 18% of the research participants, respectively, E. Coli, Staph aureus, and Klebsiella species were the most frequently isolated bacteria.

These findings corroborated those of Vandepitte J et al. (2013) and Durando P et al. (2015), who found that E. coli was the most frequently isolated bacteria from hospital-acquired infections.

The study's findings revealed that 54.54% (n=6) of the participants who were hospitalised to the intensive care unit were younger than 23. Of these patients, 54.54% (n = 6), 72.7% (n = 8), 54.54% (n = 6), and 54.54% (n = 6) had an indwelling urine catheter, a nasogastric tube, a peripheral IV line, and mechanical breathing, in that order. Because statistical tests could not be applied, research participants who were hospitalised to the intensive care unit and had

cataract surgery were not included. Therefore, risk factor analysis was performed on the 460 research participants that were left.

These 460 participants were split up into two groups: 225 for surgery and 235 for nob-surgery. Within the surgical group, an adjusted risk ratio of 1.63, 95% confidence interval (CI) of 1.05, 2.52, indicated that participants with clean-contaminated wounds, prior hospitalisation, elective surgery, and male gender were predisposed to hospital-acquired infection. These findings were consistent with research published in 2015 by Kibret M et al. and in 2006 by Balkhy HH et al., who noted similar risk variables for hospital-acquired infections as those found in the current investigation. It was observed that there was a significant difference (p=0.01) in the mean age of study subjects between the surgery and non-surgery groups, which were 35.13±20.05 and 31.07±13.74 years, respectively.

With an adjusted risk ratio of 0.52 and 95% confidence intervals of 0.34, 0.91, it was shown that participants between the ages of 18 and 30 had a decreased risk of hospital-acquired infection. The presence of an indwelling urine catheter, mechanical ventilation, underlying illness, and chest tube were observed risk factors in the non-surgery group. The research participants in the non-surgery group who had a hospital-acquired infection had a lower mean age than those who did not, and there was a decreased risk in the age range of 31 to 50 and beyond 50, with a p-value of less than 0.05. These results were in line with research by Tesfahunegn Z et al. (2009) and Ige OK et al. (2011), whose study cohorts had comparable low- and high-risk characteristics for hospital-acquired infections.

The mean length of hospital stays for study participants with hospital-acquired infections was 13.93±6.76 days, according to the study data; in contrast, patients without hospital-acquired infections had a mean stay duration of 7.61±4.38 days, which was statistically significant (p=0.001). An overall mortality rate of 4% was observed from 44 fatalities; however, the mortality rate increased to 8% among participants who had contracted an infection while hospitalized. Subjects with hospital-acquired infection had a significantly higher probability of dying (p=0.01) than did those without it. These results were consistent with those of Forster AJ et al. (1912) and Yallew WW et al. (2016), whose research participants reported comparable mortality rates, death risks, and length of hospital stay.

CONCLUSION

Notwithstanding these limitations, the current study found that patients in tertiary care hospitals in the area had a high burden and poor outcomes upon release. Subjects who received surgery and those who did not have surgery had different risk variables. To get better results, efforts should be undertaken to reduce the high incidence of hospital-acquired infections.

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S. No	Characteristics	Number (n=496)	Percentage (%)
1.	**Age range**		
a)	<18	74	14.91
b)	18-30	170	34.27
c)	31-50	133	26.81
d)	>50	117	23.58
2.	**Gender**		
a)	Males	222	44.75
b)	Females	274	55.24
3.	**Occupation**		
a)	Students	54	10.88
b)	Farmers	186	37.5
c)	Employed	74	14.91
d)	Daily workers	42	8.46
e)	Businessmen	51	10.28
f)	Others	89	17.94
4.	**Education status**		
a)	Illiterate	224	45.16
b)	Primary schooling	63	12.70
c)	High school	76	15.32
d)	Intermediate	46	9.27
e)	Diploma	41	8.26
f)	Undergraduate	35	7.05
g)	Postgraduate	11	2.21

5.	**Marital status**		
a)	Single	90	18.14
b)	Married	350	70.56
c)	Divorced	13	2.62
d)	Widowed	13	2.62
6.	**Admission ward**		
a)	General	112	22.58
b)	ICU	11	2.21
c)	Pediatrics	29	5.84
d)	Ophthalmology	77	15.52
e)	Surgery	126	25.40
f)	Obstetrics and Gynecology	141	28.42

Table 1: Demographic and disease characteristics of the study subjects

S. No	Parameter	Rate/100 patient days (%)	95% CI
1.	**Mean onset**	4.62	14.44, 8.84
2.	**Overall incidence**	28.13	124.42, 32.32
3.	**Overall prevalence**	19.43	16.95, 21.83
4.	**Wards**		
a)	General	22.94	16.66, 31.32
b)	ICU	207.62	133.42. 309.12
c)	Pediatrics	69.18	45.32, 101.32
d)	Ophthalmology	0.96	0.07, 4.92
e)	Surgery	29.53	23.3, 37.4
f)	Obstetrics and Gynecology	28.99	22.1, 36.6

Table 2: Incidence rates of hospital-acquired infections in the study subjects

S. No	Infection type	Number (n=496)	Percentage (%)
1.	**Surgical site infection and UTI**	49	9.87
2.	**Bloodstream infection and Surgical site infection**	25	5.04
3.	**Intravenous site infection**	25	5.04
4.	**Surgical site infection**	64	12.90
5.	**UTI**	223	44.95
6.	**UTI and pneumonia**	10	2.01
7.	**UTI and Bloodstream infection**	50	10.08
8.	**Pneumonia**	15	3.02
9.	**Bloodstream infection**	35	7.05

Table 3: Type of infection in the study participants

Variable	Surgical cases (n=225)					Non-surgical cases (n=235)				
	hospital-acquired infection (n)	%	Total	Risk ratio	Adjusted risk ratio	hospital-acquired infection (n)	%	Total	Risk ratio	Adjusted risk ratio
Gender										
Males	26		84	1.83 (1.34, 3.64)	1.42 (0.95, 2.12)	16		116	0.82 (0.54, 1.24)	0.95 (0.62, 1.47)
Females	24		141			20		119		
Age (years)										

<18	10		30			10		36		
18-30	14		103	0.43 (0.23, 0.65)	0.52 (0.34, 0.91)	10		62	0.54 (0.34, 0.96)	0.63 (0.32, 1.05)
31-50	12		55	0.67 (0.44, 1.11)	0.92 (0.54, 1.53)	13		74	0.65 (0.42, 1.12)	0.52 (0.33, 0.91)
>50	13		37	1.03 (0.64, 1.67)	1.05 (0.64, 1.44)	4		13	0.22 (0.07, 0.44)	0.24 (0.12, 0.46)
Wound type										
Clean	28		159	1.96 (1.33, 2.87)	1.26 (0.83, 1.92)					
Clean contaminated	14		39	1.32 (0.75, 2.24)	0.83 (0.45, 1.44)					
Contaminated/ dirty	6		28							
Surgery type										
Emergency	20		114	1.56 (1.12, 2.24)	0.96 (0.63, 1.44)					
Elective	30		111							
Previous hospitalization										
Yes	10		23	2.26 (1.54, 3.32)	1.63 (1.05, 2.52)	3		13	1.51 (0.71, 3.17)	
No	40		203			33		222		
Chest tube										
Yes	1		6	0.73 (0.23, 2.72)		2		2	5.03 (2.73, 9.24)	4.12 (2.32, 7.44)
No	48		214			34		232		
IV line										
Yes	40		137	0.85 (0.54, 1.32)		15		74	1.52 (0.96, 2.27)	
No	10		38			22		161		

Table 4: Risk of hospital-acquired infection based on age, gender, and underlying diseases in study subjects