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NOSOCOMIAL INFECTIONS IN THE PATIENTS ADMITTED IN THE MEDICINE WARD OF A TERTIARY CARE HOSPITAL IN NORTH INDIA: AN EPIDEMIOLOGICAL STUDY

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ABSTRACT

Objective: Nosocomial infections are of serious problems in hospital. In addition, they are imposed heavy costs on hospitals, causing increased hospitalization time, increased morbidity and mortality. In this study, we aimed to determine the epidemiological status of nosocomial infections in the Medical Ward of a tertiary care hospital.
Study design: Descriptive-analytical study.
Study site: Department of Medicine, CSM Medical University, Lucknow.
Patients: The patients admitted in the Department of Medicine were included in this study.
Results: The present study has been done on 80 patients of Medicine Wards (MW) including Medical Intensive Care Unit (MICU) of CSSMU, Lucknow. Among them, 65 (81.3%) were from Medical Ward and 15 (18.7%) were from MICU. This study was conducted between January to June, 2011. The average patient's stay in both MW and MICU was 13.56 days. All the 80 patients were clinically examined and only 18 patients were selected for the study of nosocomial infection on clinical grounds. A total of 42 different types of specimens were collected from 18 nosocomially infective patients. In 5 specimens, there was no yield of any bacterial organism. The predominant bacterial isolates both in MW and MICU were *Escherichia coli* (40.5%) followed by *Staphylococcus aureus* (18.9%), *Acinetobacter spp* (13.5%), *Pseudomonos aeruginosa* (10.8%), *Enterococcus faecalis* (8.1%) and *Klebsiella pneumoniae* (8.1%).
Conclusions: Bacterial isolates in MW and MICU were similar meaning thereby that it is auto infection. Nosocomial infection was more common in patients who stayed for longer period in hospital. Escherichia coli and Staphylococcus aureus are predominant to cause nosocomial infection.

KEY WORDS: Incidence, Nosocomial infections, Hospital stay, Medical ward, Medical Intensive Care Unit

INTRODUCTION

Health-care-associated infections are deemed the most frequent adverse event threatening patients' safety worldwide. [1-3] However, reliable estimates of the global burden are hampered by paucity of data adequately describing endemic infections at national and regional levels, particularly in resource-limited settings. [4] In countries where less than 5% of the gross national product is spent on health care, and workforce density is less than five per 1000 population [5] other emerging health problems and diseases take priority. [6] The epidemiological gap leading to the absence of reliable estimates of the global burden of Nocosomial infection is mainly because surveillance of health-care-associated infection takes time and resources and needs expertise in study design, data collection, analysis, and interpretation. Very few countries of low and middle income countries have national surveillance systems for health-care-associated infections. Data from the International Nosocomial Infection Control Consortium [7], and findings of two systematic reviews on hospital-acquired neonatal infections [8] and ventilator-associated pneumonia [9] suggested not only that the risk of health-care-associated infection are significantly higher in developing countries but also that the effect on patients and health-care systems is severe and greatly underestimated.

In a study conducted in India by Ganguly et al on 422 patients, the prevalence of nosocomial infections was reported as 38.8%. [10] The authors reported the ages more than 60 years as an important risk factor for nosocomial infections. Another study in India by Orrett in the country on 629 patients admitted in ICU showed that the rate of nosocomial infections was 21% and the most common infection reported was pneumonia (with a rate of 29.5%) and Gram negative bacilli detected as the most common pathogenic microbial agents. [11]

The present study investigated the incidence of nosocomial infections among those admitted for various diseases in the medical wards of a tertiary care hospital.

MATERIALS AND METHODS

Study design: Cross-sectional hospital based.
Study site:
Department of Medicine, CSM Medical University, Lucknow.

Patients:
The patients admitted in the Department of Medicine and Medical ICU were included in the study.

Nosocomial Infection:
Patients who had not infected or had not been in incubation period at the time of admission and had positive culture after third day of admission, were defined as patients with nosocomial infections in the present study.

Data Collection
Blood, urine, catheter, sputum, endotracheal tube (ET) and skin swab were taken after 48 hours of admission and the patients were followed till discharge from the hospital.

Strain identification
Bacterial strain was identified with the help of gram staining and biochemical tests. Mainly, facultative anaerobes and aerobic bacteria such as *Staphylococcus aureus, Enterococcus facealis, Escherichia coli, Klebsiella pneumoniae, Pseudomonas species* and *Acinetobacter species* were taken into consideration as per guidelines of CDC (2008).

Antimicrobials susceptibility testing
This was done by the Kirby-Bauer disk diffusion method.

Analysis
The data collected was entered in the Microsoft Excel computer program and checked for any inconsistency. The results are presented in proportions/percentages.

Ethical consideration
Ethical clearance was taken from the Ethical Committee of CSM Medical University, Lucknow. The consent was taken from each patients included in the study.

RESULTS
A total of 80 patients were observed from the Medical Ward and Medical Intensive Care Unit (MICU) of the Department of Medicine between January-June, 2011. Out of these, 65 (81.3%) patients were from Medical Ward (MW) and 15 (18.8%) patients were from MICU. A total of 18 (22.5%, 95%CI=13.3-31.7) patients developed nosocomial infections [MW-14 (21.5%) and MICU-4 (26.7%)]. From 18 patients, 42 specimens were taken of which 27 (64.3%) were from medical ward (MW) and 15 (35.7%) from MICU. Out of 42 specimens, organisms were found in 37 (88.1%) specimens and in 5 (11.9%) specimens, no organism was found

Out of the total patients infected, females (43.8%) were significantly ($p<0.05$) more affected than males (17.2%). The incidence of NI was highest in those patients whose age was above 55 years (35.7%) and lowest in below 25 years (13.2%) and this trend was statistically significant ($p<0.05$) (Table-1). The nosocomial infection was higher in the patients of MICU (26.7%) as compared to the patients of MW (21.5%) (Fig.1).

Blood stream infections, UTI were 33.3% and LRTI, VAP & SSTI were 33.3%, 16.7%, 11.1% and 5.6% respectively (Fig.2).

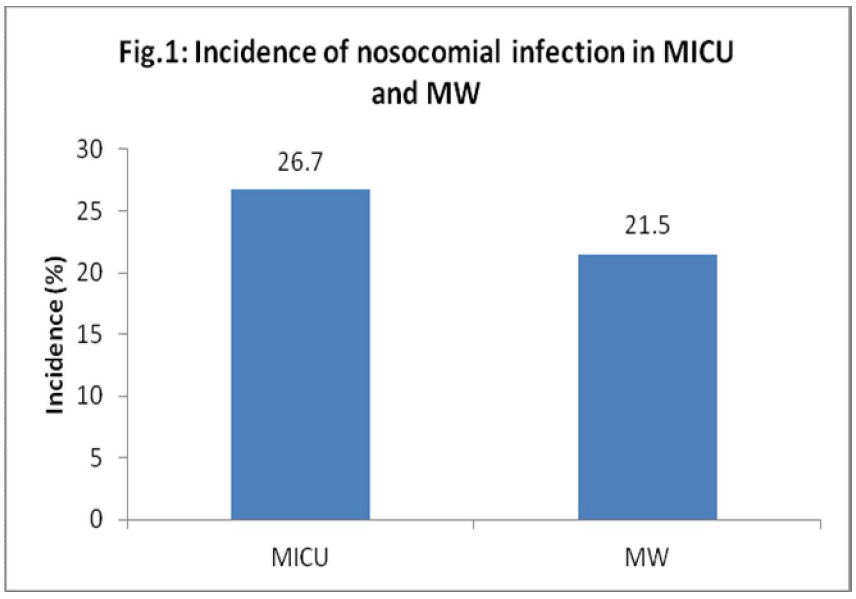
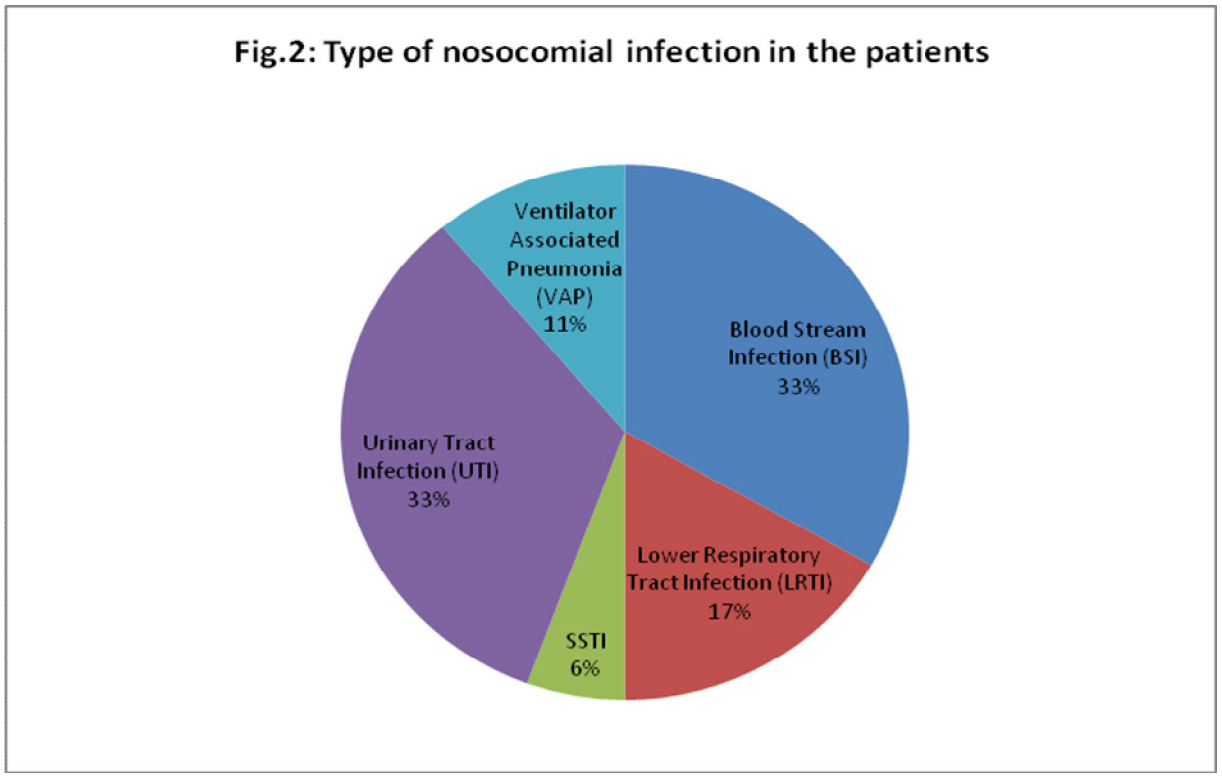


Table-1: Incidence of nosocomial infection and association with age and sex

	No. of patients	No. of patients infected	%
Overall incidence	80	18	22.5
Age*			
<25	38	5	13.2
25-35	5	1	20.0
36-45	11	3	27.3
46-55	12	4	33.3
>55	14	5	35.7
Sex**			
Male	64	11	17.2
Female	16	7	43.8

P_{trend}<0.05, **p<0.05



The *Escherichia coli* organism was observed in 40.5% specimen and *Staphylococcus aureus* organism in 18.9% specimen. However, *Acinetobacter spp* was seen in 13.5% specimen and *Pseudomonos aeruginosa* organisms was observed in 10.8% specimen. The *Acinetobacter spp* was observed in 33.3% of blood specimens. However, each *Enterococcus faecalis* and *Pseudomonos aeruginosa* organisms were observed in 22.2% of blood specimen. The *Escherichia coli* was observed in 77.8% of urine specimens and *Staphylococcus aureus* organisms were found in 22.2% of urine specimen. The *Escherichia coli* organism was found in 63.6% of catheter specimens. The *Staphylococcus aureus* organism was found in 60% of sputum specimens and *Klebsiella pneumonia*e was found in 40% of sputum specimens. In all the specimens of ET and skin swab, only *Acinetobacter spp* and *Staphylococcus* organisms were found respectively (Table-2)

Table-2: Type of isolates by specimen (n is the number of tested isolates)

Isolates	Type of specimen													
	Blood (n=9)		Urine (n=9)		Catheter (n=11)		Sputum (n=5)		ET (n=2)		Skin swab (n=1)		Total (n=37)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Acinnetobacter spp	3	33.3	0	0.0	0	0.0	0	0.0	2	100.0	0	0.0	5	13.5
Escherichia coli	1	11.1	7	77.8	7	63.6	0	0.0	0	0.0	0	0.0	15	40.5
Enterococcus faecalis	2	22.2	0	0.0	1	9.1	0	0.0	0	0.0	0	0.0	3	8.1
Klebsiella pneumonia	1	11.1	0	0.0	0	0.0	2	40.0	0	0.0	0	0.0	3	8.1
Pseudomonos aeruginosa	2	22.2	0	0.0	2	18.2	0	0.0	0	0.0	0	0.0	4	10.8
Staphylococcus aureus	0	0.0	2	22.2	1	9.1	3	60.0	0	0.0	1	100.0	7	18.9

Table-3: Distribution of isolates and specimen by Gram's staining characteristics (n is the number of tested solates in brackets)

Isolates	Type of specimen											
	Blood		Urine		Catheter		Sputum		ET		Skin swab	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Gram positive	n=2		n=2		n=2		n=3		n=0		n=1	
Enterococcus faecalis	2	100.0	0	0.0	1	50.0	0	0.0	0	0.0	0	0.0
Staphylococcus aureus	0	0.0	2	100.0	1	50.0	3	100.0	0	0.0	1	100.0
Gram negative	n=7		n=7		n=9		n=2		n=2		n=0	
Acinnetobacter spp	3	42.9	0	0.0	0	0.0	0	0.0	2	100.0	0	0.0
Escherichia coli	1	14.3	7	100.0	7	77.8	0	0.0	0	0.0	0	0.0
Klebsiella pneumoniae	1	14.3	0	0.0	0	0.0	2	100.0	0	0.0	0	0.0
Pseudomonos aeruginosa	2	28.6	0	0.0	2	22.2	0	0.0	0	0.0	0	0.0

Table-3 shows the percentage of gram staining isolates by type of specimen. Among Gram positive isolated in blood specimens, *Enterococcus faecalis* organism was found in all the blood specimens. *Staphylococcus aureus* organism was also found in all the specimens of urine, sputum and skin swab. However, *Enterococcus faecalis* and *Staphylococcus* organisms were found in 50% each of catheter specimen. Among gram negative isolates, *Acinetobacter spp* contributed in 42.9% followed by *Pseudomonas aeruginosa* (28.6%) and *Klebsiella pneumoniae* and *Escherichia coli* (14.3%) in blood specimens. However, *Escherichia coli* was 100% in sputum specimen and 77.8% in catheter specimens. The *Acinetobacter spp* was found in 100% ET specimens.

Tables-4 and 5 shows the frequency of antimicrobial susceptibility of the most frequently isolated Gram-negative and Gram-positive bacteria, respectively. The *Acinnetobacter spp* organism was resistance to gram-negative organism were 100% for amikacin, piperacillin/tazobactum and streptomycine. However, this was 60% for most of the drugs.

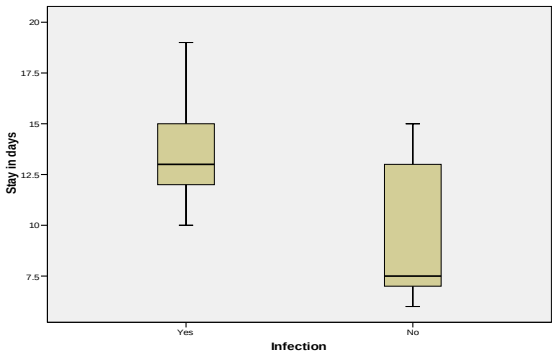
Table-4: Percentage of gram-negative bacterial isolates resistant to antimicrobial agents (n is the number of tested isolates in brackets)

Gram Negative	Acinnetobacter spp (n=5)		Escherichia coli (n=15)		Klebsiella pneumonia (n=3)		Pseudomonos aeruginosa (n=4)	
Drugs	No.	%	No.	%	No.	%	No.	%
Imipenem	3	60.0	10	66.7	2	66.7	2	50.0
Gentamicin	3	60.0	12	80.0	2	66.7	3	75.0
Amikacin	5	100.0	10	66.7	3	100.0	2	50.0
Levofloxacin	3	60.0	9	60.0	0	0.0	2	50.0
Norfloxacin	4	80.0	10	66.7	1	33.3	2	50.0
Nitrofuraution	4	80.0	9	60.0	1	33.3	3	75.0
Ceftriaxone	3	60.0	10	66.7	1	33.3	3	75.0
Cefaperazone	3	60.0	12	80.0	1	33.3	3	75.0
Sulbactum	4	80.0	10	66.7	2	66.7	2	50.0
Amoxi/clav	3	60.0	9	60.0	0	0.0	2	50.0
Meropenem	4	80.0	10	66.7	1	33.3	3	75.0
Piperacillin/Tazobactum	5	100.0	9	60.0	1	33.3	3	75.0
Ciprofloxacin	3	60.0	10	66.7	1	33.3	2	50.0
Colistin	3	60.0	9	60.0	1	33.3	3	75.0
Ampicillin	4	80.0	10	66.7	1	33.3	2	50.0
Erythromycin	3	60.0	12	80.0	2	66.7	2	50.0
Oxacilin	4	80.0	10	66.7	0	0.0	2	50.0
Linzolid	3	60.0	9	60.0	1	33.3	3	75.0
Tetracycline	3	60.0	10	66.7	2	66.7	3	75.0
Septran	3	60.0	10	66.7	0	0.0	3	75.0
Streptomycine	5	100.0	9	60.0	1	33.3	2	50.0

Table-5: Percentage of gram-positive bacterial isolates resistant to antimicrobial agents (number of tested isolates in brackets)

Gram Positive	Enterococcus faecalis (n=3)		Staphylococcus aureus (n=7)	
Drugs	No.	%	No.	%
Imipenem	1	33.3	5	71.4
Gentamicin	2	66.7	5	71.4
Amikacin	3	100.0	4	57.1
Levofloxacin	1	33.3	2	28.6
Norfloxacin	1	33.3	3	42.9
Nitrofuraution	3	100.0	4	57.1
Ceftriaxone	1	33.3	5	71.4
Cefaperazone	1	33.3	4	57.1
Sulbactum	1	33.3	3	42.9
Amoxi/clav	1	33.3	5	71.4
Meropenem	3	100.0	4	57.1
Piperacillin/ Tazobactum	1	33.3	2	28.6
Ciprofloxacin	1	33.3	3	42.9
Colistin	3	100.0	4	57.1
Ampicillin	1	33.3	4	57.1
Erythromycin	1	33.3	5	71.4
Oxacilin	1	33.3	4	57.1
Linzolid	1	33.3	3	42.9
Tetracycline	1	33.3	4	57.1
Vancomycin	2	66.7	5	71.4
Septran	3	100.0	4	57.1
Streptomycine	1	33.3	3	**42.9**

Fig.3: The boxplot graph, depicting the relationship between Medical ward stay time and the rate of nosocomial infections in the patients studied



Escherichia coli, Klebsiella pneumoniae and *Pseudomonas aeruginosa* displayed multiple resistance to many antimicrobials. Almost similar findings were observed for gram positive organism.

The mean hospital stay was higher in the infected patients (13.56±2.23, 95%CI=12.45-14.66) as compared to non-infected patients (9.66±3.13, 95%CI=8.87-10.46) (Fig.3).

DISCUSSION

The incidence of nosocomial infections in our study was found to be 22.5% as compared to 33.5% reported by Beaujean and Blok. [12] However, our study population consisted of 80 patients is a relatively small specimen size. The prevalence of nosocomial infections in our study was 22.5%, which is almost consistent with the values mentioned in reference books of infection diseases as 5-20%, and almost double with the results of Su *et al* as 11.4%. [13] But our results were in agreement with the results of a study in India reporting the rate as 21% Orrett et al [11], and the study of Luzzati *et* al [14] who reported it as 30.4% and also agreed with the report of Mollasadeghi et al [15] as 25%, Anbari et al [16] as 34.4%. We suppose that the causes of this disagreement and difference between our data and the formers are the followings: less usage of central vein catheterization, appropriate usage of procedures such as disinfections, using disposable suctions, observing the expiry dates of the devices, and using a standard mouthwash solution. In our study, we did not find a significant relationship between the age of the patients and occurrence of nosocomial infections. This is also disagreed with the results of the study conducted in Rasul-e-Akram Hospital of Teheran [17] and in a study it was reported that there is a significant relationship between the age of the patients and occurrence of nosocomial infections. [10,18] Similar results have also been found in our study. The older patients have higher percentage of nosocomial infection than the younger patients.The general distribution pattern of the nosocomial infections that emerged in our study showed blood stream infections & urinary tract infections (33.3%) to be the most common, followed by lower respiratory tract infection (16.7%), VAP (11.1%%) and SSTI (5.6%). In a similar study done by Richards et al [19], the distribution was found to be urinary tract infections (31%), pneumonia (27%), bloodstream infection (19%) and remaining others to be 23 %. Lee et al [20] reported their findings as UTI (47%), pneumonia (26%) and skin infections (14%).

It was observed that the most common pathogenic agents as gram negative organism, which is in agreement with the results in the literature. [11,17,18] In the present study, the most common pathogenic agents were *Escherichia coli* (40.5%), *Staphylococcus aureus* (18.9%) and *K. pneumoniae* (8.1%), which are in agreement with the results of the studies done in USA [18] who reported the most common pathogenic agents as *Pseudomonas aeroginosa* (21%) and *Staphylococcus aureus* (20%), and the results of the study done in Italy [14] reporting *Pseudomonas aeroginosa* and staphylococci as the most common pathogenic agents. In the study conducted in India, the most common pathogenic agents were reported as *Pseudomonas aeroginosa* (36.6%) and *Klebsiella pneumoniae* (20.6%).

In this study, however, the average days of hospital stay for the patients with infection was 13.56 (±2.23) (95%CI=12.45-14.66). This result is in disagreement with the results of studies conducted in USA Michael et al [18] who reported a period of more than one week as a risk factor, in Thailand and Sanandaj [21,22] and reported a period more than two weeks as a risk factor, and in Tabriz Imam Hospital [17] reporting 8.5 days as a risk factor. This inconsistency may be due to measurements with less invasive procedures and better controlling the nosocomial infections.

This study provides insights into the problem of resistance in bacterial isolates in Northern Indian population. Our results demonstrated that, in general, isolates have high rates of resistance to antibiotics commonly used in developing countries. It was also found that a high rate of resistance to most of the antibiotics both in blood and pus specimens. Therefore, cheap antibiotics such as amoxicillin, tetracyclin and cotrimoxazol are now of limited benefit in the treatment of infections. Due to fewer specimen size a definitive statement cannot be made from our study in the use of different antibiotics.

CONCLUSIONS

The important finding is that the bacterial isolate in nosocomially infected patients both in MW and MICU are similar meaning thereby that it is mostly auto

infection. Another observation is that the yield of bacterial organism is more in patients who stayed for longer period in the hospital. Obviously, *Escherichia coli* and *Staphylococcus aureus* are predominantly causative organisms in nosocomial infection. The nosocomial infection is one of leading problems in the medical wards. Although, our sample size is small, but a large percentage of infections is found. The average hospital stay of infected patients was more than one week which gives economic burden on the patients. We suggest large scale studies be carried out on elderly Indian population for prevention and management of nosocomial infections. There is an urgent need for creation of centralized surveillance groups in India.

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