European Journal of Clinical Pharmacy

Print ISSN: 2385-409X **Online ISSN:** 3105-0409

Website: https://farmclin.es/

Original Researcher Article

A Study Of Antibiotic Resistance And Sensitivity Pattern Of Nosocomial Infection (Bacterial) In Medical Intensivecare Unit In N.S.C.B. Medical College, Jabalpur

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Received: 02/11/2025
Revised: 27/11/2025
Accepted: 19/12/2025
Published: 28/12/2025

Abstracts: ***Background and Aims****:* "Nosocomial infection also referred to as Health care-associated infection (HCAI), " or "hospital" infection, is an infection occurring in a patient during the process of care in a hospital or other health care facility (more than 48 hours after admission)but was not present or incubating at the time of admission. The aim of our study was to find out which bacteria is involved in hospital acquired infection, its antibacterial resistance and sensitivity pattern. The secondary objective was to review the traditional antibiotic use and its susceptibility in preventing nosocomial infections. ***Methods****:* 120 patients who were admitted in Medicine Intensive Care Unit, N.C.S.B. Medical College, Jabalpur were taken up for the study. 1st sample was collected on admission before providing antimicrobial medication and the second sample was obtained 48 hours after admission. The collected samples were subjected to antibiotic sensitivity and testing. ***Results****:* The samples were predominantly collected from endotracheal aspirate. The predominant isolate was Klebsiella pneumoniae (44.1%), followed by Pseudomonas aeruginosa (18.3%), Escherichia coli (14.1%). Acinetobacter baumannii, Non lactose fermenting gram negative bacilli isolates and Staphylococcus aureus contributed to 10% of the isolates and mixed cultures were obtained in the remaining patients. Klebsiella pneumoniae showed resistance towards antibiotic Amoxicllin +clavulanate combination, Ampicillin, Cefazolin, Ceftazidime, Ceftriaxone, Cefotaxime, Gentamicin, Aztreonam, Aztreonam, Amikacin and Doxycycline. It showed sensitivity towards Piperacillin +Tazobactam, Imipenem and Colistin. ***Conclusion****:* It has been concluded that in M-ICU setup keep watch on patient symptoms and early diagnosis of nosocomial infection and to select appropriate empirical antibiotic therapy to prevent complications in admitted

patients. Also know the common isolates to be collected and bacteria resistance and sensitivity pattern to available antibiotics for further definitive management of Nosocomial infection.

Keywords: Nosocomial Infection, antibiotic Therapy, Bacteria Resistance

INTRODUCTION

Nosocomial infection also referred to as Health care-associated infection (HCAI), or "hospital" infection, is an infection occurring in a patient during the process of care in a hospital or other health care facility (more than 48 hours after admission) but was not present or incubating at the time of admission. (1)

The most common types of nosocomial infections were Catherter associated urinary tract infection (CAUTI), Central line associated blood stream infection (CLABSI), Hospital acquired pneumonia (HAP) or nosocomial pneumonia.

CAUTI was most commonly acquired nosocomial infection as almost all the patients admitted to Intensive care units and even wards are catheterized for vwrious purposes. E. Coli was most commonly found CAUTI agent (2). CLABSI occurs when bacteria on the skin proliferate along the external portion of the catheter toward the

intravascular part (3). Contamination of the CVC during insertion or manipulation

process or by hematogenous seeding are other ways CLABSI can occur. Bacterial and fungal pathogens were frequently responsible. HAP is the second most common nosocomial infection occuring 48-72 hours after admission and accounts for mortality (4).

The aim of the present study is to find out the common bacteria that is involved in causing nosocomial infection, its antibacterial resistance and sensitivity pattern. The secondary objective was to review traditional antibiotic use and its susceptibility in preventing nosocomial infections.

MATERIAL AND METHODS

After obtaining ethical committee approval, the present study was carried out in Department of General Medicine and Microbiology, at Netaji Subhash Chandra Bose Medical College & Hospital, in the city of Jabalpur of state Madhya Pradesh, India. 120 patients who were admitted in Medical Intensive Care Unit were taken up for the study. Informed and written consent was obtained from the patients' attendants.

Patients who were newly admitted or were admitted for more than 48 hours, irrespective of their primary illness; those requiring intravenous medications; patients with new onset chest infection, fever or burning micturition after 48 hours of admission to the hospital were taken up for our study. Patients who were referred from other hospitals; patients having definitive focus of infection, or fever, or investigations suggesting infection at the time of admission were excluded from our study.

First sample was obtained on admission into ICU before administering antibiotics and the second sample was obtained 48 hours after admission.

These samples mostly obtained were venous blood, endotracheal aspirate in intubated patients and urine sample in catheterized patients. The most commonly obtained sample in our study was endotracheal sample. The samples obtained were transported in suitable media and were incubated in suitable culture media and observed for bacterial growth for 48-72 hours. Antibiotic culture and sensitivity testing was done using Kirby-bauer method.

RESULTS

In the present study, there were 120 study patients, from which 74 were male (61.7%) and 46 were female (38.3 %), maximum number of patients were belonging to age 46-60 years (34.2%). 50% of the patients did not have any co-morbidities. The common co-morbidites patients were having were diabetes mellitus (6.6%), hypertension (4.16%) and coronary artery disease (1.16%).

The majority of patients have been received initial single empirical Antibiotics i.e., ceftriaxone (73.33%) and, Amoxicillin +clavulanate (11.6%) before culture reports were available. Due to delay in culture test reports, study patients hence been given combination antibiotics therapy as per underlying illness as Ceftriaxone along with Metronidazole, Ceftriaxone along with

clindamycin and Piperacillin +Tazobactam and Clindamycin.

In our study, single culture was isolated from 110 patients i.e., 24 blood culture isolates (20%), 47 Endotracheal aspirate culture isolates (39.1%), 3 sputum culture isolates (2.5%) and 36 urine culture isolates (30%).From remaining 10 patients cultures were isolated from 2 different sites i.e., from Blood along with Endotracheal aspirate from 4 patients (3.33%), from Blood along with Sputum culture is obtained from 1 patient (0.8%), from Blood along with urine culture is obtained from 1 patient (0.8%) and from Endotracheal aspirate along with urine culture is obtained from 4 patients (3.33%). It was observed that, single cultures were collected are of Acinetobacter baumannii from 4 patients (3.33%),

Escherichia coli from 17 patients (14.1%), Klebsiella pneumoniae from 53 patients (44.1%), Non lactose fermenting gram negative bacilli from 3 patients (2.5%), Pseudomonas aeruginosa from 22 patients (18.3%) and from Staphylococcus aureus from 5 patients (4.16%). Mixed cultures isolated were of Enterobacter sp.+ Klebsiella pneumoniae from 2 patients (1.66%), Escherichia coli (2 different sites) from 1patient (0.8%), Non lactose fermenting gram negative bacilli+ Escherichia coli from 1patient (0.8%), Escherichia coli+ Pseudomonas aeruginosa from 3 patients (2.5%) and Pseudomonas aeruginosa+ Klebsiella pneumoniae from 3 patients (2.5%). (Table 1)

S.No	**Organism**	**Frequency of Patients (n=120)**	**Percentage%**
1	Acinetobacter baumannii	4	3.33%
2	Escherichia coli	17	14.1%
3	Enterobacter sp.	6	5%
4	Klebsiella pneumoniae	53	44.1%
5	Non lactose fermenting gram negative Bacilli	3	2.5%
6	Pseudomonas aeruginosa	22	18.3%
7	Staphylococcus aureus	5	4.16%
8	Enterobacter sp.+ Klebsiella pneumoniae	2	1.66%
9	Escherichia coli (2 different sites)	1	0.8%
10	Non lactose fermenting gram negative bacilli+ Escherichia coli	1	0.8%
11	Escherichia coli+ Pseudomonas Aeruginosa	3	2.5%
12	Pseudomonas aeruginosa+ Klebsiella Pneumoniae	3	2.5%

Table 1 Distribution of bacterial isolates

It was observed from the study that patients in whom Acinetobacter baumanni was found(4), 2(50.0%) got discharged and 2(50.0%) expired . Escherichia coli were found in 18 total cases of

which 14(77.8%) discharged, death in 2(11.1%) cases ,1(5.6%) patient took LAMA, 1(5.6%) patient took DAMA. Enterobacter sp. were found 7 discharged of which 4(57.1%), death 2 (42.7%). Klebsiella pneumoniae were found in 53 cases, of which 26 (49.1%) discharged, death 25 (47.2%) cases, 2 (3.8%) took LAMA. Klebsiella pneumoniae along with Enterobacter sp. were found in got 2 discharged 2(100.0%). Non lactose fermenting gram negative bacilli found in 3, of which death in all 3 (100%). Non lactose fermenting gram negative bacilli along with Escherichia coli found in 1 and death 1 (100.0%) of that case. Pseudomonas aeruginosa found in 22 of which 9 discharged (40.9%), 1 4.5%) took LAMA and 2(9.1%) patients took DAMA. Pseudomonas aeruginosa along with Escherichia coli found in 3 cases, 3(100.0%) death. Pseudomonas aeruginosa, Klebsiella pneumoniae were found in 3 cases got discharged3/3(100.0%). Staphylococcus aureus found in 5 cases, of which 1 discharged (20.0%) ,death of 3 (60.0) %and 1 patient took LAMA 1/5(20.0%) .

Table 2 shows that bacteria associated with high mortality are non-Lactose fermenting gram negative bacilli, Staphylococcus aureus, Klebsiella pneumoniae and pseudomonas aeruginosa.

Table 2 Outcome of bacterial isolates

Organism	LAMA	DAMA	Discharge	Death	Total (n=120)
Acinetobacter baumannii	-	-	2/4(50.0%)	2/4(50.0%)	4
Escherichia coli	1/18 (5.6%)	1/18(5.6%)	14/18 (77.8%)	2/18(11.1%)	18
Enterobacter sp.	-	-	4/6(66.6%)	2/6 (33.3%)	6
Klebsiella Pneumoniae	2/53 (3.8%)	-	26/53 (49.1%)	25/53 (47.2%)	53
Klebsiella pneumoniae Enterobacter		-	2/2(100.0%)	-	2
Non lactose fermenting gram negative Bacilli	-	-	-	3/3(100.0%)	3
Non lactose fermenting gram negative bacilli , Escherichia Coli	-	-	-	1/1(100.0%)	1
Pseudomonas Aeruginosa	1/22(4.5%)	2/22(9.1%)	10/22(45.5%)	9/22(40.9%)	22

Pseudomonas, Escherichia coli	-	-	-	3/3(100.0%)	
Pseudomonas aeruginosa, Klebsiella Pneumoniae	-	-	3/3(100.0%)	-	3
Staphylococcus Aureus	_	1/5(20.0%)	1/5(20.0%)	3/5(60.0%)	5

It has been observed from Table 3 that bacteria isolates which showed 100% resistance towards Cephalosporins were, Acinetobacter baumannii, Escherichia coli, Enterobacter sp., Klebsiella pneumoniae, Non-Lactose fermenting gram negative bacilli, Pseudomonas aeruginosa and staphylococcus aureus. Bacteria isolates which showed 100% resistance towards Fluroquinolones were Acinetobacter baumannii, Enterobacter sp., pseudomonas aeruginosa. Bacteria isolates which showed 100% resistance towards Carbapenems was Acinetobacter baumannii. Bacteria isolates which showed 100% resistance towards Co-Trimoxazole were Enterobacter sp.and Klebsiella pneumoniae.

Antibiotics	***Acinetobacter baumanni 4(3.07%)***	***Escherichia coli 23(17.7%)***	***Enterobacter sp. 8(6.15%)***	***Klebsiella pneumoniae 58(44.61%)***	***Non lactose fermenting gram negative bacilli 4(3.07%)***	***Pseudomonas aeruginosa 28(21.5%)***	***Staphylococcus aureus 5(3.8%)***
AMIKACIN	4/4 (100%)	-	8/8 (100%)	34/58 (58.6%)	-	28/28(100%)	-
CEFEPIME	4/4 (100%)	-	-	-	-	-	-
CEFTAZADIME	4/4 (100%)	-	-	58/58 (100%)	4/4(100%)	28/28(100%)	-
CEFOTAXIME	4/4 (100%)	23/23(100%)	8/8 (100%)	58/58 (100%)	4/4(100%)	28/28(100%)	-
CEFTRIAXONE	-	-	-	58/58 (100%)	4/4(100%)	28/28(100%)	-
CIPROFLOXACIN	4/4 (100%)	-	8/8 (100%)	28/58 (48.27%)	1/4(25%)	28/28(100%)	3/5 (60%)
LEVOFLOXACIN	4/4 (100%)	-	8/8 (100%)	35/48 (72.9%)	-	28/28(100%)	1/5 (20%)
GENTAMICIN	4/4 (100%)	-	-	58/58 (100%)	-	28/28(100%)	4/5 (80%)
IMIPENAM	4/4 (100%)	-	-	6/58 (10.3%)	-		-
MEROPENAM	4/4 (100%)	-	-	-	-	3/28 (10.7%)	-
DOXYCYCLINE	1/4 (25 %)	23/23(100%)	-	32/58 (55.17%)	2/4 (50%)	13/28 (46.4%)	-
AMOXICLLIN+ CLAVULANATE	-	14/14 (100%)	-	58/58 (100%)	4/4(100%)	25/25 (100%)	-

CEFIXIME	-	23/23 (100%)	-	-	4/4(100%)	-	-
CEFUROXIME	-	23/23(100%)	-	58/58 (100%)	-	28/28(100%)	-
CEFAZOLIN	-	-	-	58/58 (100%)	-	-	-
NORFLOXACIN	-	4/9 (44.4%)	-	-	-	-	-
CO-TRIMOXAZOLE	-	-	1/1 (100%)	15/15(100%)	-	-	-
PIPERACILLIN+TAZOBACTAM	-	-	-	5/58(8.6%)	-	3/28 (10.7%)	-
AMPICILLIN	-	-	-	58/58 (100%)	-	-	-
AZTREONAM	-	-	-	58/58(100%)	-	-	-
NETILMICIN	-	-	-	56/58(96.5%)	1/4(25%)	-	3/5 (60%)
FOSFOMYCIN	-	-	-	-	-	10/16 (62.5%)	-
CLARYTHROMYCIN	-	-	-	-	-	-	5/5 (100%)
ERYTHROMYCIN	-	-	-	-	-	-	2/5 (40%)
VANCOMYCIN	-	-	-	-	-	-	3/5 (60%)
PENICILLING	-	-	-	-	-	-	5/5 (100%)

Table 3 Distribution of antibiotic resistance pattern

Table 4 shows that Colistin is sensitive in *Acinetobacter baumannii,* klebsiella pneumoniae and Pseudomonas aeruginosa in all cases of it. Imipenem in is sensitive to Escherichia coli, Enterobacter sp,, Pseudomonas aeruginosa in all cases of it. Doxycycline is sensitive to *non-lactose fermenting gram negative bacilli* in all cases of it.

Table 4 Antibiotic sensitivity pattern

Antibiotics	*Acinetobacter baumannii 4(3.07%)*	*Escherichia coli 23(17.7%)*	*Enterobacter sp. 8(6.15%)*	*Klebsiella pneumoniae 58(44.61%)*	*Non-lactose fermenting gram negative bacilli 4(3.07%)*	*Pseudomonas aeruginosa 28(21.5%)*	*Staphylococcus aureus 5(3.8%)*
AMIKACIN	_	-	-	31/58 (53.4%)	-	-	-
NETILMICIN	_	-	-	7/58(12.06%)	-	-	2/5(40%)
PIPERACILLIN+TAZOBACTAM	_	-	8/8(100%)	53/58 (91.3%)	-	28/28(100%)	-
NORFLOXACIN	-	5/9(55.5%)	-	-	-	-	-
CIPROFLOXACIN	-	-	-	13/58 (22.4%)	3/4(75%)	-	2/5(40%)
LEVOFLOXACIN	-	-	-	13/58(22.4%)	-	-	4/5(80%)
GENTAMICIN	-	-	-	-	-	-	1/5(20%)
ERYTHROMYCIN	-	-					3/5(60%)
IMIPENAM	-	23/23 (100%)	8/8(100%)	54/58(93.1%)	-	28/28(100%)	-
MEROPENAM	-	-	-	31/33(93.9%)	-	25/28(89.2%)	-
DOXYCYCLINE	3/4(75%)	-	-	24/58(42.8%)	4/4(100%)	15/28 (53.5%)	5/5 (100%)
COLISTIN	4/4 (100%)	-	-	58/58(100%)	-	28/28(100%)	-
FOSFOMYCIN	-	-	-	-	-	6/16	-
VANCOMYCIN	-	-	-	-	-	-	2/5(40%)

Table 3 Distribution of antibiotic resistance pattern

DISCUSSION

Nosocomial infections or hospital acquired infections form a major cause of mortality in patients getting admitted in ICU. It is of utmost importance to start with appropriate empirical antibiotic therapy to prevent complications. Since bacteria gets resistant to various antibiotics over time, it is essential to identify the sensitivity pattern and treat the patients to obtain better outcome.

In the present study, out of 120 subjects male predominance was reported in 74(61.7%) in comparison to females 46 (38.3%). The study by **Umar Rashid Khan et** in 2020, in 32 study subject salso had males (62.5%) more than females (32.5%) which coincides with study. (5)

In present study majority of patients were in the age group of 46-60 years

i.e. 41(34.2%) subjects followed by 31 - 45 years i.e. 28 (23.3%) subjects. In the age group 15 -25 years

belongs to 22(18.3%), age group 61-75 years belongs to 21(17.5%) and 76 - 90 years belongs to 8(6.7%) subjects. The mean age was calculated as-48.97 ±17.91 years. Study by **P Sreenivasulu Reddy et al** in 2015 also had Majority of patients belongs to age group >66 yrs had44 subjects (44%) and 55-65 years had 16 subjects (16%) respectively which almost coincides with the study. (6)

In present study, majority of patients have been received as empirical antibiotic therapy Ceftriaxone in 88 patients (73.33%), Amoxicillin+clavulanate given to 14 patients (11.6%), Piperacillin +Tazobactam to 5 patients (4.16%), Ceftriaxone along with Clindamycin given 3 patients (2.5%), Ceftriaxone along with Metronidazole given to 3 (2.5%), Amoxicillin+clavulanate along with Vancomycin to 1 patients 0.8% and Piperacillin+Tazobactam along with Clindamycin to 2 patients (1.66%),4 patients (3.3%) has not received initial antibiotic therapy.

Study by **Neeta P. Pradhan et al in 2013,** this study there has been 32 study subjects in majority of patients antibiotic used Penicillin's37.9 %, cephalosporins

29.7%, Macrolides (11.3%), Aminoglycoside (12.1%), Quinolones 5%, Vancomycin 5% and Carbapenems 1.9% patients. (7)

Reason for this difference in above study might be due to study was conducted at different step up, location and different years. It might be also due to selection bias.

In present there were 120 patients (n=120),single culture isolates was obtained from 110 patients i.e., 47 Endotracheal aspirate culture isolates (39.1%), 36 urine culture isolates (30%) ,24 blood culture isolates (20%) and 3 sputum culture isolates (2.5%) .From 10 patients ,and cultures were isolated from 2 different sites i.e., from Blood along with Endotracheal aspirate from 4 patients (3.33%), from Blood along with Sputum culture is obtained from 1 patient (0.8%), from Blood along with urine culture is obtained from 1 patient (0.8%) and from Endotracheal aspirate along with urine culture is obtained from 4 patients (3.33%).

Study by **Hadi Hamishekar et al** in 2016 in 328 subjects most common isolates were of endotracheal aspirate in (51.7%) followed by urinary (24.8%) and blood (10.4%). Which almost coincides with study. (8)

In present study, there were 120 study patients of which single cultures were collected are Klebsiella pneumoniae from 53 patients (44.1%), Pseudomonas aeruginosa from 22 patients (18.3%) and Escherichia coli from 17 patients (14.1%). Acinetobacter baumannii isolates from 4 patients (3.33%), Non lactose fermenting gram negative bacilli isolates from 3 patients (2.5%), and from Staphylococcus aureus from 5 patients (4.16%).Mixed cultures isolated were of Enterobacter sp.+ Klebsiella pneumoniae from 2 patients (1.66%), Escherichia coli (2 different sites) from 1patient (0.8%), Non lactose fermenting gram negative bacilli+ Escherichia coli from 1patient (0.8%),Escherichia coli+ Pseudomonas aeruginosa from 3 patients (2.5%) and Pseudomonas aeruginosa+ Klebsiella pneumoniae from 3 patients (2.5%).Majority of samples isolated were of gram negative bacteria i.e. Klebsiella pneumoniae followed by Pseudomonas aeruginosa and Escherichia coli respectively.

Study by **Umar Rashid et al in 2020 ,**study population of 32 patients.Majority of isolates were of Gram negative bacteria i.e Acinetobacter baumannii in 12 isolates (33.4%),Klebsiella pneumoniae in 7 isolates (19.4%),Escherichia coli in 6 isolates (16.6%) ,Pseudomonas aeruginosa in 2 isolates (5.5%) , Providentia in 1 isolate (2.8%) and Burkholderia cepacie in 1 isolate (2.8%) .Gram positive isolates were staphylococcus aureus in 5 isolates (8.4%) and staphylococcus epidermidis 1 isolate (2.8%) . which almost coincides with study.(5).

In the present study out of 120, Acinetobacter baumannii is isolated from 4 patients and showed resistance towards majority of antibiotics Amikacin, Cefepime, Ceftazidime, Cefotaxime, ciprofloxacin, levofloxacin, gentamicin and is susceptible to Colistin. Study **by Mohan B. et al in 2021** in study **population of** 1890 subjects. The Acinetobacter baumannii was resistant to amikacin, gentamicin ciprofloxacin, imipenem, meropenem, and piperacillin-tazobactam ceftazidime and ceftriaxone. Acinetobacter baumannii is sensitive to colistin in this study, which coincides with study. (9)

In the present study Escherichia coli was isolated from 23 samples showed resistance to antibiotic Cefixime, Cefuroxime, Cefotaxime, Doxycycline and Norfloxacin in cases. Study by **P Sreenivasulu Reddy et** al in 2015 in 100 study subjects Escherichia coli isolated in 44 patients, of which showed resistance Ampicillin, Doxycycline,

Ceftriaxone and showed sensitivity to piperacillin-tazobactam, Colistin and Imipenem. (6)

In the present study Klebsiella pneumoniae is found in 58 isolates, all isolates showed resistance towards antibiotic Amoxicllin +clavulanate combination, Ampicillin, Cefazolin, Ceftazidime, Ceftriaxone, Cefotaxime, Gentamicin, Aztreonam, Aztreonam, Amikacin and Doxycycline. It showed sensitivity towards Piperacillin +Tazobactam, Imipenem and Colistin.

Study by Sneha S Savanur in 2019et al in 167 subjects, Klebsiella pneumoniae showed high resistance to cephalosporins amikacin, gentamicin and meropenem and imipenem. Klebsiella pneumoniae showed sensitivity to Colistin. (10)

In the present study Pseudomonas aeruginosa samples was isolated in 28 samples, all 28 isolates showed resistance towards antibiotics Amoxicillin+ clavulanate, Amikacin, Ceftazidime, ceftriaxone, cefuroxime, cefotaxime ciprofloxacin, levofloxacin and Gentamicin. It showed sensitivity towards Imipenem, Meropenem and colistin

Study by **Rasool Sultani et al in 2019**, there were 449 infections,

Pseudomonas aeruginosa was associated in 41 cases. Pseudomonas aeruginosa were resistant to antibiotics Ceftazidime, Ciprofloxacin, Levofloxacin and Meropenem. It showed sensitivity towards Colistin. (11)

In present study gram negative bacteria is associated with high mortality are Non -Lactose fermenting gram negative bacilli, Staphylococcus aureus, Klebsiella and Pseudomonas aeruginosa.

In study by **Ghanshani et at in 2015**, on 487 study subjects. In his study there is high mortality of patients in which bacteria Acinetobacter baumannii, Klebsiella pneumoniae, Pseudomonas aeruginosa and Enterobacter sp. was found (10) and were resistant to meropenem and imipenem. Klebsiella pneumoniae showed sensitivity to Colistin.

In the present study Pseudomonas aeruginosa samples was isolated in 28 samples, all 28 isolates showed resistance towards antibiotics Amoxicillin+ clavulanate, Amikacin, Ceftazidime, ceftriaxone, cefuroxime, cefotaxime ciprofloxacin, levofloxacin and Gentamicin. It showed sensitivity towards Imipenem, Meropenem and colistin

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CONCLUSION

From the present study, it can be concluded that it is of utmost importance to keep a watch on every patient for the symptoms and early diagnosis of nosocomial infections is required for the prompt treatment. It is also important to select empirical antibiotic therapy for the prevention of complications amongst the patients. It is also essential to know the common isolates to be collected and bacteria resistance and sensitivity pattern to available antibiotics for further definitive management of Nosocomial infection.

The limitations of our study were limited sample size and duration of our study and inability to calculate the response after definitive antibiotics were administered to the patients.

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