



## CLINCO-MICROBIOLOGICAL PROFILE OF RHINOSINUSITIS IN ADULTS

## ENT

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## ABSTRACT

**Introduction:** Rhinosinusitis is the condition in which sinonasal mucosa inside the paranasal sinuses gets inflamed and its clinical manifestation is represented by various sinonasal and extra-nasal symptoms. Hence, the present study was planned with an aim to study the clinic-microbial profile of rhinosinusitis in adults. **Methodology:** This cross-sectional analytical study included 300 rhinosinusitis patients. Detailed clinical and demographic data were collected. All the patients underwent plain radiography to assess the sinus involvement. Nasal endoscopy was performed in all the cases. During nasal endoscopy, nasal swabs were collected from all the patients. For all the culture positive cases, antibiotic susceptibility assessment was done. **Results:** The majority of cultures (61.3%) were negative for pathogens. 34% had a positive bacterial pathogen culture, while 4.7% had a positive fungal culture. Methicillin-resistant *Staphylococcus aureus* (MRSA) was the most prevalent gramme-positive isolate (55.9%). Simultaneously, *Citrobacter* spp. (3.9%) was the most prevalent gramme-negative isolate. *Candida* spp. accounted for 71.4% of the fourteen positive fungal specimens, while *Aspergillus flavus* accounted for the remaining 28.6%. The majority of patients were only administered antibiotics. Cefoperazone-Sulbactam, Linezolid, Piperacillin-tazobactam, Ceftriaxone, Tobramycin, Meropenem, and Clindamycin exhibited one hundred percent sensitivity. The three most resistant antibiotics used in more than half specimen were Tetracycline (60.7%), Erythromycin (17.4%) and Penicillin (13.7%) respectively. **Conclusion:** The most prevalent organism causing rhinosinusitis was found to be *Staphylococcus aureus* and most sensitive antibiotics were Cefoperazone-Sulbactam, Linezolid, Piperacillin-tazobactam, Ceftriaxone, Tobramycin, Meropenem, and Clindamycin.

## KEYWORDS

Rhinosinusitis, Gram Positive, Gram Negative, Nasal Endoscopy, Radiological Diagnosis, Direct Microscopy.

## INTRODUCTION

A sinus is defined as "a channel that is not a blood or lymphatic vessel that allows the passage of blood or lymph, such as in the placenta, sinuses, or cerebral meninges; a cavity or hollow space in bone or other tissue; a dilation in a blood vessel; or a fistula or tract that transforms into a cavity." [1] There are numerous sinuses in the human body, and they are generally designated by their location and orientation. For instance, the heart is surrounded by the paranasal sinuses of the cranium, the dural sinuses of the cerebral meninges, and the pericardial sinuses. Paranasal sinus is an umbrella term for a number of sinuses located throughout the body; however, the term sinus is typically reserved for the cavities within the cranium. Rhinosinusitis is the inflammation of the sinonasal mucosa within the paranasal sinuses, and its clinical manifestations include craniofacial pain, sleep disturbances, and mood changes. [2,3] Rhinosinusitis is a common clinical condition that accounts for between 2 and 10 percent of visits to primary care and ENT clinics for acute presentations. Regarding chronic rhinosinusitis, its exact burden is not completely understood; however, national surveys in the United States indicate that its prevalence ranges from 2.1 to 13.8%. In India, the incidence of sinusitis has been estimated to be approximately 14.6%. 5-15% of the urban Indian population is afflicted by chronic rhinosinusitis. [10]

Numerous investigations have examined the mucus biofilms in rhinosinusitis cases. Both fungal and bacterial pathogens have been isolated from biofilm samples obtained from patients with rhinosinusitis. *Staphylococcus aureus*, *Pseudomonas aeruginosa*, coagulase negative *Staphylococci*, *Streptococcus pneumoniae*, *Moraxella catarrhalis* and *Haemophilus influenzae* are the most common bacterial biofilms in rhinosinusitis. *Aspergillus* spp., *Zygomycetes*, and Dematiaceous fungi comprise the underlying pathogens of fungal Rhinosinusitis. [11,12] Despite this agreement, there is no consensus concerning the diversity of microorganisms discovered in affected patients. In addition, the relationship between the diversity of microorganisms and the volume of microbial load and the clinical condition of the affected patients remains poorly supported. To determine the function of microorganisms in the aggravation of rhinosinusitis and its symptoms, it is necessary to identify the organism responsible so that appropriate prevention and treatment strategies can be developed. Hence, the present study was planned to study the clinic microbiological profile of rhinosinusitis in adults.

## MATERIAL AND METHODS

This study was conducted at the Department of ENT, Hind Institute of Medical Sciences (HIMS), Safedabad, Barabanki, for fifteen months. After obtaining HIMS-B ethical clearance, a total of 300 patients both male and female subjects of 18-60 years of age with diagnosed cases of rhinosinusitis were included in the study. Whereas, congenital anomaly of the nose, foreign body nose, uncontrolled chronic illness, and patients with clinical, radiological or histopathological evidence of any neoplastic tumours of the nose or paranasal sinus were excluded from the study. A pre-designed proforma was used to record the relevant information (particulars of patients, clinical findings and investigation reports) from the individual patients selected on basis of inclusion and exclusion criteria. Detailed history, the examination was done which included demographic data consisting of age, sex, occupation, bowel habits, personal history including dietary history and alcohol or tobacco consumption. Presenting complaints, general examination & ENT examination were done. Routine investigations included haematology (Hb, TLC, DLC). All the patients underwent plain radiography to assess sinus involvement. Wherever feasible, computed tomographic evaluation was done for this purpose. Nasal endoscopy was performed in all the cases. During nasal endoscopy, nasal swabs were collected from all the patients under aseptic and sterile conditions and were subjected to direct microscopy, KOH mount and culture sensitization. For all the culture-positive cases, an antibiotic susceptibility assessment was done. Standard treatment given to the patients was noted.

## Statistical Analysis:

Data were analyzed using IBM SPSS Stats version 26. Data has been presented as frequencies (numbers) and proportions (percentages). For the depiction of central tendency, mean±standard deviation and median [interquartile range] has been used. Chi-square, ANOVA and independent samples 't'-tests were used to compare the data.

## RESULTS

The majority of patients were aged between 18 and 30 years (54.7%). The mean age of patients was 32.83±12.77 years. The sex ratio of the study population was 0.91:1. The majority of patients (70%) preferred a mixed diet. There were 27.3% tobacco users and 12.7% alcohol users. Ear pain/fullness was the most common presenting complaint (58.7%). 63.7% had bilateral involvement. We calculated the

haematological parameters. On nasal endoscopy, deviated nasal septum (DNS) (39.3%) was the most common finding. Frontal sinusitis (37.7%) was the most common diagnosis. 69% of cases did not show any abnormal findings on direct microscopy. 61.3% of cultures were negative for any pathogen. There was a 38.7% culture-positive specimen. Of these, 34% were positive for the bacterial pathogen. The majority of bacterial pathogens isolated were Gram-positive (94.1%) and only 6 were Gram-negative. Among Gram-positive isolates, Methicillin-sensitive *Staph. aureus* (MSSA) was the most common isolate (55.9%) followed by Methicillin-resistant *Staph. aureus* (MRSA) (20.6%) and coagulase negative *Staph. aureus* (CONS) (17.6%), respectively. Among Gram-negative isolates, *Citrobacter spp.* (3.9%) are more common than *Klebsiella spp.* (2%). Out of 14 fungal positive specimen, 10 (71.4%) were identified as *Candida spp.* and remaining 4 (28.6%) were identified as *Aspergillus flavus*. [Table-1] Culture-positive patients as compared to culture-negative patients had a significantly higher proportion of patients with bilateral involvement ( $p=0.006$ ), clinical diagnosis of pansinusitis ( $p<0.001$ ), complaints like purulent discharge ( $p<0.001$ ), nasal obstruction ( $p=0.001$ ), significantly lower mean Hb and lymphocyte count ( $p=0.008$ ), higher TLC, neutrophil and eosinophil count ( $p<0.001$ ), the significantly lower detection rate of hypertrophy on endoscopy, significantly higher proportion of mucopurulent discharge and DNS on endoscopy ( $p<0.05$ ). The majority of patients were kept on antibiotics only (72.3%). [Table-2; Figure-1] CFS, LZ PIT, CTR, TOB, MRP and CL were 100% sensitive. Among antibiotics assessed in more than half (>51) culture-positive specimens, CFS and LZ were 100% sensitive followed by AK (95.7%), VA (93%), CIP (91.8%) and LE (91.5%) being sensitivity above 90%. The three most resistant antibiotics used in more than half specimens were TE (60.7%), E (17.4%) and PN (13.7%), respectively. [Table-3] For Gram positive strains, for antibiotics tested in more than half (>48 cases), LZ and CFS had 100% sensitivity while AMC (90.6%), VA (93%), CIP (91.3%), LE (90.9%) and AK (95.3%) had sensitivity above 90%. Among cases tested in more than half cases, PN was most resistant (86.3%) followed by TE (41.8%), TEI (25.4%) and GEN (25.3%) respectively. Ampicillin (AMP) was tested in 31 cases and showed a resistance of 74.2%. For all the other antibiotics the resistance was below 25%. [Figure-2]. For Gram negative pathogens, among antibiotics tested against more than half (>3) specimen PI, TE, CIP, LE, TOB, GEN, AK and MrP were 100% sensitive whereas AMP and CZ were most resistant (50%). [Figure-3]

## DISCUSSION

This study examined the age and sex profile of adult rhinosinusitis patients, excluding both paediatric and elderly patients. The mean age of patients was  $32.83 \pm 12.77$  (median 30) years, with the majority of patients being females (52.3%). The mean age of patients in the present study was comparable to another studies, however, in their studies reported male dominance. [9-13] In the present study, the majority of patients preferred a mixed diet and did not use tobacco (72.7%) or alcohol (87.3%). Compared to the present study, a study showed a much higher proportion of smokers (47.6%). [15] However, in another study only 17.1% were smokers. [12] Habits like smoking and tobacco use are known to be associated with different etiologies of rhinosinusitis apart from affecting the spectrum of microbial flora. [16] In the present study, ear pain/fullness (58.7%) and fever (53.3%) were the most common presenting complaints seen in the majority of patients. Cough, Purulent discharge, halitosis and headache and nasal obstruction were other common complaints affecting >25-50% of patients. The less common complaints affecting less than 25% of patients included facial pain, hyposmia and dental pain. Several studies have showed that nasal discharge [17,14], nasal obstruction [11,13], nasal congestion and post-nasal drip [9] were reported to be the most common presenting complaints. In the present study, most of the cases had bilateral involvement (63.7%). As for laterality, the left side was more commonly involved (22.7%) than the right side (13.7%). Compared to the present study, numerous studies reported dominance of unilateral cases (55.4%) and involvement of the right side. [13,14] In the present study, the average haematological profile and blood counts of the patients generally did not show any particular abnormality except for mean haemoglobin levels which were much below the normal range [18], thus depicting the generalized anaemic profile of the study population. Low haemoglobin in our population could be a socioeconomic problem rather than an indicator of susceptibility to rhinosinusitis. However, in a recent study, an association between anaemia and nasal symptoms has also been reported. [19] In the present study, deviated nasal septum (DNS),

mucopurulent discharge and polyposis were the three most common nasal endoscopic findings. [11-14,17] The clinico radiological evaluation in our study revealed frontal and ethmoid sinusitis (37.7% and 34%) to be the most common sites of involvement. This is contrary to the findings of a previous studies, in which it was found, the maxillary sinus and ethmoid sinus were the most commonly involved sites. [13,14] The present study found that the bacterial culture positivity rate of rhinosinusitis was 76.3%. However, the bacterial pathogens were also isolated in 34% of cases. [20] This could be due to differences in inclusion criteria and screening methods used. The present study included patients with clinical suspicion, [21] but excluded some risk groups like those with chronic illness and those having clinical, radiological or histopathological evidence of any neoplastic tumours of the nose or paranasal sinus. It may also be noted that the present study included all the cases of rhinosinusitis irrespective of their acute or chronic nature, contrary to another study. [15] Concerning the spectrum of bacterial pathogens isolated in the present study, it was dominated by Gram-positive pathogens (94.1%) as compared to Gram-negative pathogens (5.9%). Among Gram-positive pathogens too, all the pathogens were variants of *Staphylococcus aureus*, the maximum being Methicillin-sensitive *Staph. aureus* (55.9%), followed by Methicillin-resistant *Staph. aureus* (20.6%) and Coagulase negative *Staph. aureus* (17.6%) respectively. Among Gram-negative isolates, 4 (3.9%) were *Citrobacter spp.* and 2 (2.0%) were *Klebsiella sp.* Compared to the present study, the spectrum of bacteriological pathogens in different studies shows a variation. The dominance of Gram-positive pathogens and that of *Staph. aureus* has also been documented in other studies too. [9-12, 21,23] However, a study, despite reporting a dominance of Gram-positive pathogens, found *H. influenza*, a Gram-negative pathogen to be the most common isolate. [19] As far as the profile of Gram-negative pathogens is concerned, they comprise only a small proportion of isolates in different studies and do not show any specific trend. In a study, none of the Gram-negative pathogens was isolated in more than one specimen. [21] Another study showed, *E. coli* was the most common isolate followed by *Klebsiella*. [23] Another study found the most common isolate was *Klebsiella*. [17] A study found in a series of 700 chronic rhinosinusitis cases highlighted the dominance of *Pseudomonas aeruginosa* followed by *Klebsiella spp.* as the most dominant Gram-negative pathogens. Incidentally, in their study, they also isolated anaerobes in a sizeable proportion of cases (17.1%). [15] On the contrary, no anaerobic bacterial pathogen was identified in our study. Among fungal pathogens isolated, *Candida spp.* (71.4%) dominated over *Aspergillus flavus* (28.6%). Similar pattern was reported in another study. [21] However, few studies found *Aspergillus* to be the dominant fungal isolate. [10,13,15,17]

We also evaluated the risk factors associated with culture positivity and found bilateral involvement, clinical diagnosis of pansinusitis, complaints like purulent discharge, nasal obstruction, significantly lower mean Hb and lymphocyte count, higher TLC, neutrophil and eosinophil count, the significantly lower detection rate of hypertrophy on endoscopy, significantly higher proportion of mucopurulent discharge and DNS on endoscopy. In the present study, most patients were kept on antibiotics only (72.3%). There were 17.7% of the patients who were given antibiotics with steroids and 7.3% of the patients were given a combination of antibiotics with antifungals, while 2.7% of the patients were given a combination of antibiotics with antifungals and steroids. It may be seen that the antibiotic prescription was higher as compared to the culture positivity rate. The findings suggest that keeping in view the culture positivity rate and identification of risk factors associated with culture positivity, the use of antibiotics should be rationalized. In the present study, on overall antibiotic susceptibility assessment, Cefoperazone-Sulbactam (CFS), Linezolid (LZ), Piperacillin-tazobactam (PIT), Ceftriaxone (CTR), Tobramycin (TOB), Meropenem (MRP) and Clindamycin (CL) were 100% sensitive, followed by Amikacin (AK) (95.7%), Vancomycin (VA) (93%), Ciprofloxacin (CIP) (91.8%) and Levofloxacin (LE) (91.5%). The three most resistant antibiotics used in more than half specimens were Tetracycline (TE) (60.7%), Erythromycin (E) (17.4%) and Penicillin (PN) (13.7%) respectively. As such overall antibiotic susceptibility profile was the same for Gram-positive strains only. Although susceptibility studies for Gram-negative were also performed yet they cannot be generalized as we had only six Gram-negative pathogens, and among antibiotics tested against more than half (>3) specimens Piperacillin (PI), Tetracycline (TE), Ciprofloxacin (CIP), Levofloxacin (LE), Tobramycin (TOB), Gentamycin (GEN), Amikamycin (AK) and Meropenem (MRP) were 100% sensitive

whereas Ampicillin (AMP) and Ceftazidime (CZ) were most resistant (50%). Compared to the present study, a study reported MSSA exhibited relatively fewer sensitivity rates to amoxicillin-clavulanic acid and macrolides. [23] On the other hand, a study found Ciprofloxacin & Vancomycin as the most sensitive against Gram-positive and Cefoperazone+sulbactam & imipenem to be most sensitive against Gram-negative isolates. [17] A study also found that Gram-positive isolates were most sensitive to Linezolid (96.1%) however they found them to be least sensitive to Ampicillin and Clindamycin (54.4%). For Gram-negative isolates, they witnessed absolute sensitivity for Piperacillin-Tazobactam (100%). [11] However, in a study, *Staph. aureus* was found to be most sensitive to cefixime (63.7%). In their study Gram-negative strains like *E. coli* were found to be most sensitive to cotrimoxazole (100%). [14] As such the first-line antibiotics seem to be less effective whereas the advanced line of antibiotics seems to be more effective in different studies. The antibiotic susceptibility pattern in the present study thus shows a slight shift as compared to previous studies. A similar change in antibiotic sensitivity patterns was also reported another study. [12]

**CONCLUSION**

The findings of the study provided the clinic-microbiological profile and antibiotic susceptibility pattern of rhinosinusitis patients at a facility in North India that showed a culture positivity rate of 38.7% where the most common organism causing rhinosinusitis is *Staphylococcus aureus*. The findings also showed that a sizeable proportion of cases had fungal pathogens whereas bacterial pathogens were predominantly Gram positive in nature. The antibiotic susceptibility pattern was highly dependent on the Gram stain pattern of the pathogen. These findings might help in understanding the nature and microbial pattern of rhinosinusitis patients in this region that could help in their effective management.

**Table-1: Clinico-demographic Parameters Of Enrolled Patients**

Age Group	No. of patients	Percentage
18-20 Years	57	19.0
21-30 Years	107	35.7
31-40 Years	56	18.7
41-50 Years	40	13.3
51-60 Years	40	13.3
Mean age±SD (Range) in years [Median age; IQR]	32.83±12.77 (18-60)	[30; 22-42]
Sex		
Male	143	47.7
Female	157	52.3
Variable		
Dietary preference		
Mixed	210	70.0
Vegetarian	59	19.7
Non-vegetarian	31	10.3
Tobacco use	82	27.3
Alcohol use	38	12.7
Presenting Complaints		
Ear pain/fullness	176	58.7
Fever	160	53.3
Cough	131	43.7
Purulent discharge	106	35.3
Halitosis	91	30.3
Headache	91	30.3
Nasal obstruction	85	28.3
Facial pain	55	18.3
Hyposmia	36	12.0
Dental pain	4	1.3
Laterality		
Bilateral	191	63.7
Unilateral	109	36.3
Left	68	22.7
Right	41	13.7
Nasal Endoscopy Findings		
Mucopurulent discharge	84	28.0
Mucoid deposition	18	6.0
Hypertrophy	11	3.7
DNS	118	39.3
Polyposis	40	13.3
Clinico radiological Diagnosis		
Frontal sinusitis	113	37.7
Ethmoid sinusitis	102	34.0
Maxillary sinusitis	33	11.0
Pansinusitis	25	8.3
Ethmoid maxillary sinusitis	15	5.0

	Ethmoid, frontal sinusitis	11	3.7
	Frontal, maxillary sinusitis	1	0.3
Direct Microscopy	No abnormality	207	69.0
	Budding yeast cell	10	
	Few pus cells	12	4.0
	Few pus cells with epithelial cells	6	2.0
	Suspected of bacterial pathogens	65	
Fungal/Bacterial Culture	Culture negative	184	61.3
	Culture positive	116	38.7
	Bacterial	102	34.0
	Fungal	14	4.7
Spectrum of Fungal/Bacterial Pathogens isolated	Gram positive (n=96; 94.1%)		
	Staph. aureus MSSA	57	55.9
	Staph. aureus MRSA	21	20.6
	Coagulase negative Staph. aureus (CONS)	18	17.6
	Gram negative (n=6; 5.9%)		
	Citrobacter spp.	4	3.9
	Klebsiella	2	2.0
	Fungal Pathogens (n=14; %)		
	Candida spp.	10	71.4
	Aspergillus flavus	4	28.6

**Table-2: Association Of Culture Positivity Status With Different Clinicodemographic Variables**

Variable/Parameter	Culture Positive (n=116)	Culture Negative (n=184)	Statistical significance
Mean age±SD (in years)	31.36±12.15	33.76±13.09	2=1.585; p=0.114
Male:Female	53 (45.7%): 63 (54.3%)	90 (48.9%): 94 (51.1%)	2=0.296; p=0.586
Diet			
Mixed	83 (71.6%)	127 (69.0%)	2=1.656; p=0.437
Non-veg	14 (12.1%)	17 (9.2%)	2=1.656; p=0.437
Veg	19 (16.4%)	40 (21.7%)	2=0.372; p=0.542
Tobacco use	34 (29.3%)	48 (26.1%)	
Alcohol use	16 (13.8%)	22 (12.0%)	2=0.217; p=0.641
Bilateral involvement	85 (73.3%)	106 (57.6%)	2=7.549; p=0.006
Diagnosis			
Frontal sinusitis	33 (28.4%)	80 (43.5%)	2=42.61; p<0.001
Ethmoid sinusitis	33 (28.4%)	63 (34.2%)	2=42.61; p<0.001
Maxillary sinusitis	10 (8.6%)	23 (12.5%)	2=0.402; p=0.526
Pansinusitis	24 (20.7%)	1 (0.5%)	
Ethmoid maxillary sinusitis	4 (3.4%)	11 (6.0%)	
Ethmoid, frontal sinusitis	6 (5.2%)	5 (2.7%)	
Frontal, maxillary sinusitis	0	1 (0.5%)	
Cough	48 (41.4%)	83 (45.1%)	
Facial pain	19 (16.4%)	36 (19.6%)	2=0.482; p=0.487
Halitosis	32 (27.6%)	59 (32.1%)	2=0.675; p=0.411
Headache	35 (30.2%)	56 (30.4%)	2=0.002; p=0.962
Purulent discharge	70 (60.3%)	36 (19.6%)	2=51.782; p<0.001
Ear pain/fullness	68 (58.6%)	108 (58.7%)	2=0.000; p=0.990
Fever	61 (52.6%)	99 (53.8%)	2=0.042; p=0.837
Nasal obstruction	45 (38.8%)	40 (21.7%)	2=10.190; p=0.001
Hyposmia	12 (10.3%)	24 (13.0%)	2=0.491; p=0.484
Dental pain	2 (1.7%)	2 (1.1%)	2=0.220; p=0.639

Mean Hb±SD (g/dl)	10.32±1.47	10.79±1.54	t=2.658; p=0.008
Mean TLC±SD ('000/mm <sup>3</sup> )	10.70±2.25	8.37±2.49	t=8.104; p<0.001
Mean N±SD (%)	58.78±9.37	50.71±9.08	t=7.403; p<0.001
Mean L±SD (%)	34.73±9.78	43.27±9.69	t=7.399; p<0.001
Mean M±SD (%)	3.43±2.30	3.57±2.31	t=0.510; p=0.610
Mean E±SD (%)	3.06±1.94	2.46±1.95	t=2.622; p=0.009
Hypertrophy	0 (0%)	11 (6%)	z=7.198; p=0.007
Mucoid deposition	10 (8.6%)	8 (4.3%)	z=2.303; p=0.129
Mucopurulent	60 (51.7%)	24 (13.0%)	z=52.80; p<0.001
DNS	69 (59.5%)	49 (26.6%)	z=32.179; p<0.001
Polyposis	18 (15.5%)	22 (12.0%)	z=0.781; p=0.377

Table-3: Antibiotic Susceptibility Pattern (overall) (n=102)

Antibiotics	Antibiotic	Total tested	Resistant		Sensitive	
			No.	%	No.	%
PN	73	63	86.3	10	13.7	
AMP	35	25	71.4	10	28.6	
AMC	67	7	10.4	60	89.6	
AS	67	7	10.4	60	89.6	
CFS	60	0	0	60	100	
PIT	4	0	0	4	100	
CTR	2	0	0	2	100	
CAZ	4	2	50	2	50	
CPM	6	4	66.7	2	33.3	
CX	86	30	34.9	56	65.1	
E	86	71	82.6	15	17.4	
CD	79	16	20.3	63	79.7	
TE	84	33	39.3	51	60.7	
VA	86	6	7.0	80	93.0	
LZ	71	0	0	71	100	
CIP	98	8	8.2	90	91.8	
LE	94	8	8.5	86	91.5	
TOB	6	0	0	6	100	
GEN	87	21	24.1	66	75.9	
AK	70	3	4.3	67	95.7	
MRP	6	0	0	6	100	
IPM	6	2	33.3	4	66.7	
TEI	62	15	24.2	47	75.8	
CL	2	0	0	2	100	

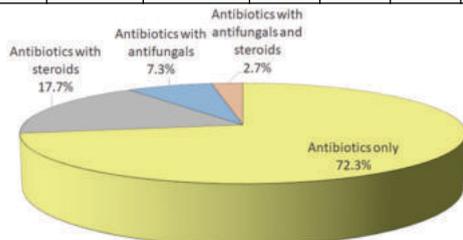


Figure-1: Distribution of patients according to treatment offered

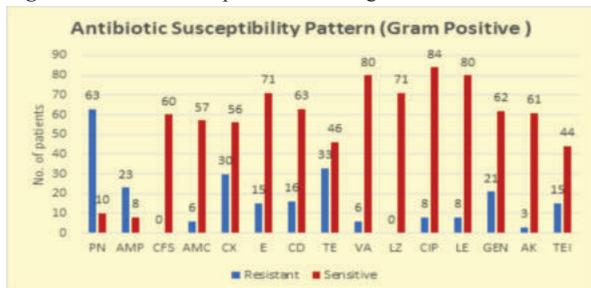


Figure-2: Antibiotic Susceptibility Pattern (Gram Positive) (n=96)

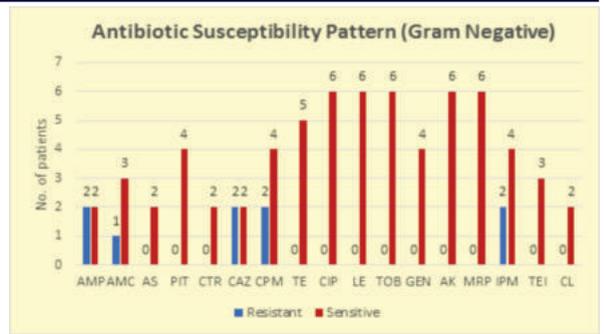


Figure-3: Antibiotic Susceptibility Pattern (Gram Negative) (n=6)

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