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Comparative Study on Antimicrobial Susceptibility in Clinical Isolates at a Tertiary Care Teaching Hospital in South India

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***Abstract**: Antimicrobial resistance is an issue of great significance for public health at global level. The purpose of study is to determine the susceptibility patterns of microrganisms to antibiotics and the prevalence of antibiotic resistance among common pathogens in a tertiary care teaching hospital. The study was conducted in a 1000 bedded multispecialty hospital in South India. The study was carried out in three phases as retrospective, prospective and comparative study. The major organism isolated was Klebsiella followed by Staphylococcus. E.coli and Klebsiella were found to be more sensitive to Amikacin. Specimen in which Klebsiella, Pseudomonas and Streptococcus were found to be more was in sputum. E.coli and Proteus were present more in urine. Staphylococcus was seen more in blood and sputum. Enterococci and Salmonella were majorly seen in blood.The sensitivity of E.coli to Gentamicin has decreased from 50.5 % to 30%. Klebseilla to Amikacin has decreased from 84.85% to 70.6%. Pseudomonas to Ofloxacin has decreased from 62.9% to 25%. Proteus to Ofloxacin 45.4% to 25% and Streptococcus to Amikacin from 53.9% to 40%. As there is increasing international concern regarding the escalating antibiotic resistance, periodical study on the control of antibiotic resistance in necessary. This can be achieved only when proper sensitivity pattern data are available. The pharmacist role in advising prescribers on antibiotic prescribing issues gained more impotence in adhering to rational drug therapy and complete patient care. The study revealed that clinical pharmacists play an important role in promoting optimal antibiotic prescribing practice among physicians, during their routine daily visit to wards.*

***Keywords**: Bacteria,Antimicrobial susceptibility,Resistance*

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I. Introduction

Anti-microbial resistance patterns can vary regionally and even among different hospitals within the same community. Over use of antibiotics contributes to antimicrobial resistance and puts the patients at greater risk of carrying and becoming infected with resistant bacteria. Infections are the most common reasons for patients to seek medical advice and for antibiotics to be prescribed[1].

Inappropriate or indiscriminate use of antibiotics can increase the cost of care by increasing drug cost, increasing toxicity, increasing resistance and increasing laboratory costs. Prophylactic antibiotic use in some hospitals remains a problem[2].

The majority of deaths result from respiratory tract infections occurs in developing countries with high poverty rates and inadequate medical care. The rise in anti-microbial resistance among the pathogens has been documented in many regions and now possesses a major challenge worldwide.

Combinations of antibiotics are often used to broaden the spectrum of coverage for empiric therapy, achieve synergistic activity against the infecting organism and prevent the emergence of resistance[3].

II. Methodology

A comparative study was done on the sensitivity pattern of microorganism and the antibiotic usage pattern was analyzed in detail. The study was conducted at a private tertiary care hospital at Coimbatore. It is a 1000 bedded multi-specialty institution, one of the largest hospitals at Coimbatore. The study was conducted in the department of General Medicine and Pulmonology.

Patient Selection:

Inclusion criteria: All the inpatients who were prescribed at least one antibiotic in the Pulmonology and General Medicine ward were included in the study.

Exclusion criteria: The outpatients, intensive care patients and those unwilling to participate in the study were excluded in the study.

A pilot study was carried out in the Department of Pulmonology and General Medicine to find the scope of the study in this department. All the cases containing antibiotic prescriptions were monitored to know the frequency and extend of antibiotic use and also for conditions in which it was prescribed. The consent form the hospital authority was obtained during this phase. The protocol of the study that includes the objectives, methodology etc. was submitted to the Dean of the study hospital, Coimbatore. The authorization from the Dean was procured as per SRH/EC9-10/2017-2018. The author was permitted to utilize the hospital facilities to make a follow up of the prescriptions in the selected department. Also prior permission was obtained from the Chief of the concerned department after having discussion regarding the study planned. All the health care professionals of the hospital were informed about the study program through Dean's official circular Literatures, which support the study, were collected and were reviewed, for study on importance of antibiotic prescribing patterns in hospitals. A standard data entry format for collecting patient details was designed and, during the ward rounds the entire patient data with special reference to the antibiotic prescribed and their costs were recorded in the format.

III. Results

A total of 1580 record were analyzed during the retrospective study. The major organisms isolated were E.coli (45.18%),Klebsiella (15%), Pseudomonas(53.17%), Staphylococcus (11.96%), Proteus(2.78%), Streptococcus(8.97%), Actinibacter (0.31%), Salmonella (0.12%), Enterococci (0.18%), Candida (0.25%). The retrospective sensitivity pattern studies showed that E.coli was more sensitive to Amikacin(82.3%), Meropenem(75.9%), Piperacillin/Tazobactum(66.3%) Imipenem(58.6%). Klebiella and Pseudomaonas were highly sensitive to Amikacin, Piperacillin/Tazobactam, Meropenem, Imipenem. Staphylococcus was sensitive to Doxycycilne(79.3%), Linezolid(78.3%), Vancomycin(77.7%). Actinobacter was sensitive to PolymixinB(80%), Colistin (80%). Salmonella was more sensitive to Amikacin, Gentamycin, Piperacillin/Tazobactam, Meropenem, Imipenem (62.5%). Enterococci was more sensitive to Piperacillin/Tazobactam, Meropenem, Imipenem, Linezolid, Vancomycin, Doxycline. Candida was more sensitive toAmikacin and Gentamycin. Similar study was conducted by Shamungam Sriram et al (2013) which revealed that organisms like E.Coli was highly sensitive to Amikacin (99.33%), Klebsiella to Amikacin (93.8%), Pseudomonas to Meropenem (97.6%) and Streptococcus pneumonia to Ofloxacin (93.85%). E.coli was present more in urine sample (81.09%), followed by blood(7.0%), pus cells (6.5%), sputum(2.6%).Klebseilla was present more in urine (32.9%),followed by trachea (24%), sputum (14.3%), pus cells(13.9%).Pseudomonas was present more in urine (25.9%) and blood (23%).Proteus (59%) and Streptococcus (62.5%) were majorly seen in urine. Salmonella was found more in blood(100%).

In the prospective study a total of 190 records were screened out which culture susceptibility test was done only in 51 cases.The major organisms isolated were E.coli(19.6%), Klebsiella(33.3%), Pseudomonas(7.8%), Staphylococcus(15.68%), Proteus(7.8%), Streptococcus(9.8%).The sensitivity pattern studies revealed that E.coli was highly sensitive to Amikacin(100%), Piperacillin/Tazobactam(100%), Meropenem(80%),Imipenem(80%).

Klebsiella was sensitive to Amikacin(70.6%),Piperacillin/Tazobactam(70.58%), Meropenem(64.7%), Imipinem(64.7%).Staphylococcus was more sensitive Vancomycin(100%), Doxycycline(75%), Linezolid(62.5%). Similar study was conducted by Ramana KV et al (2013) which revealed that Gram negative organism showed greater sensitivity to Amikacin (85.7%) and Imipenem (78.6%). Amikacin (85%), Ciprofloxacin (75%), Ofloxacin (85%) and Co-trimoxazole (85%) were found to be effective against Gram positive bacteria. Klebseilla was present more in sputum (58.82%), followed by blood (17.64%), trachea (11.76 %). E.coli was more in urine (50%) and in pus cells (30%). Staphylococcus (50%) was more seen in this blood and sputum. Streptococcus was found more in sputum. Pseudomonas was more found in sputum (50%), followed by pus cells and trachea (25%). Proteus was present more in urine (75%). Enterococci(100%) and Salmonella (100%) were majorly seen in blood. In Phase III study a comparison between the prospective and retrospective study is done. The sensitivity of E.coli to Gentamicin has decreased from 50.5 % to 30%. Klebseilla to Amikacin has decreased from 84.85% to 70.6%. Pseudomonas to Ofloxacin has decreased from 62.9% to 25%. Proteus to Ofloxacin 45.4% to 25% and Streptococcus to Amikacin from 53.9% to 40%. The details regarding the results obtained from the study, which were evaluated, were made as a report and were submitted to the concerned department, for their perusal.

Table 4.1

Sensitivity Pattern Studies (From January 2016 To December 2016)(N= 1580)

Antibiotics	**Percentage Microbial susceptibility towards Cephalosporins – Retrospective (n = 1580)**					
	E.coli	**Klebsiella**	**Pseudomonas**	**Staphylococcus**	**Proteus**	**Streptococcus**
Ceftriaxone	17.9	3.7	2.8	0.5	15.9	9.3
Cefoperazone/ Salbactum	18.9	11.3	5.3	-	9	10
Cefuroxime	-	-	-	16.4	-	38
Cefotaxime	18.6	16.5	0.8	-	13.6	34.5
Ceftazidime	19.7	12.6	10.2	-	40.9	2.8
Cefepime/ Tazobactum	18.7	5.4	2	-	-	-
Cefazolin	-	0.4	1.2	13.2	-	-

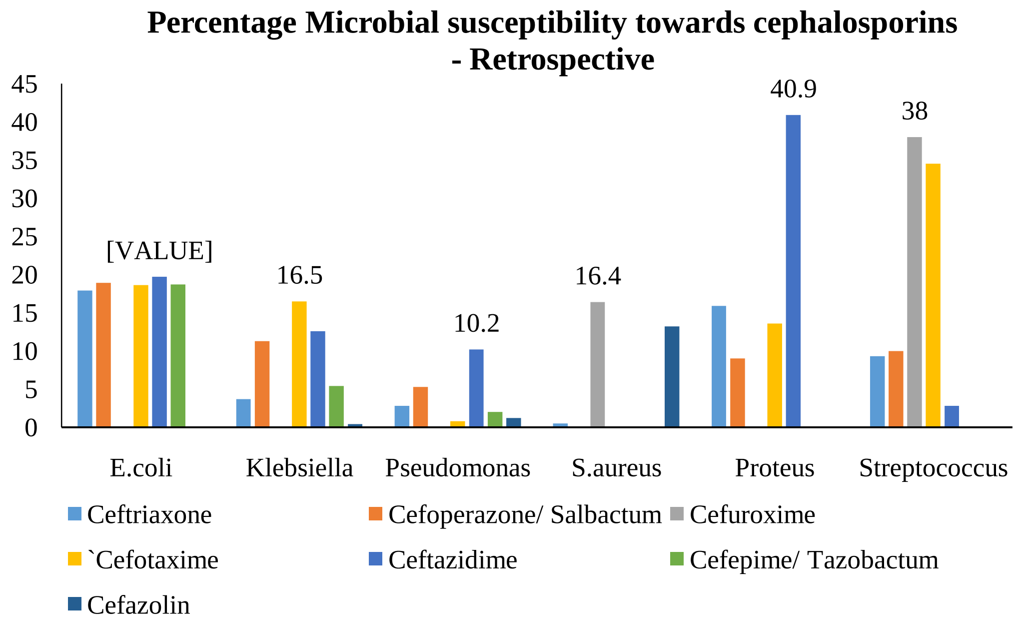


Table 4.2

Antibiotics	**Percentage Microbial Susceptibility towards Fluroquinolones – Retrospective (n = 1580)**					
	E.coli	**Klebsiella**	**Pseudomonas**	**Staphylococcus**	**Proteus**	**Streptococcus**
Ciprofloxacin	7.4	2.9	9.4	2.1	-	10
Ofloxacin	39.4	48.9	62.9	13.2	45.4	20.1
Levofloxacin	1.1	10.1	-	-	-	12.9
Norfloxacin	32.4	10.9	13.9	-	40.9	13.6

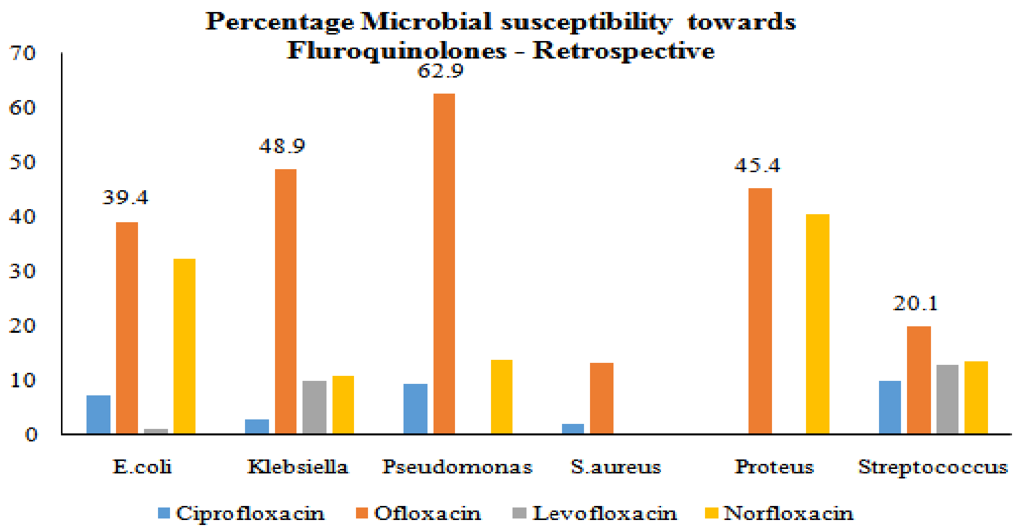


Table 4.3

Antibiotics	Percentage Microbial Susceptibility towards other antibiotics – Retrospective(n = 1580)					
	E. coli	*Klebsiella*	*Pseudomonas*	*Staphylococcus*	*Proteus*	*Streptococcus*
Amikacin	82.3	84.8	87.6	-	36.3	53.9
Gentamicin	50.5	53.1	56.7	23.8	40.9	35.2
Piperacillin/tazobactam	66.3	82.7	88	-	72.7	53.2
Imipenem	58.6	98.7	84.3	-	77.2	43.8
Meropenem	75.9	88.6	94.2	-	77.2	43.8

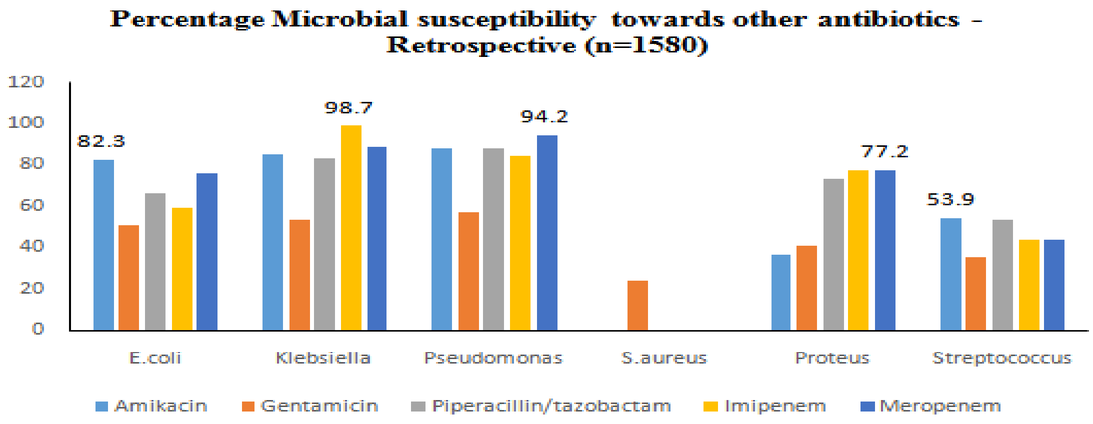


Table 4.4 Percentage Sensitivity Pattern - Retrospective (N = 1580)

Organism	No. of patients	Amikacin	Gentamicin	Piperacillin/ Tazobactum	Meropenem	Imipenem	Ofloxacin	Norfloxacin	Cotrimoxazole
E.coli	714	82.3	50.5	66.3	75.9	58.6	39.4	32.4	31
Klebsiella	237	84.8	53.1	82.7	88.6	98.7	48.9	10.9	34.5
Pseudomonas	243	87.6	56.7	88	94.2	84.3	62.9	13.9	2.8
Staphylococcus	189	-	23.9	-	-	-	13.2	-	-
Proteus	44	36.3	40.9	72.7	77.2	77.2	45.4	40.9	2.2

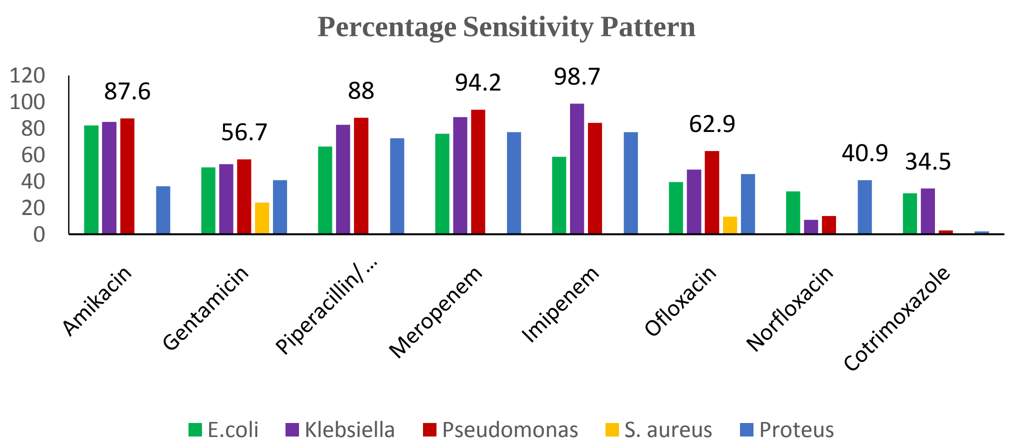


Table 4.5 Major Organism Isolated - Retrospective (N = 1580)

ORGANISM	No. of Patients
E. coli	714
Klebsiella	237
Pseudomonas	243

Staphylococcus	189
Proteus	44
Streptococcus	139
Actinobacter	5
Salmonella	2
Enterococci	3
Candida	4

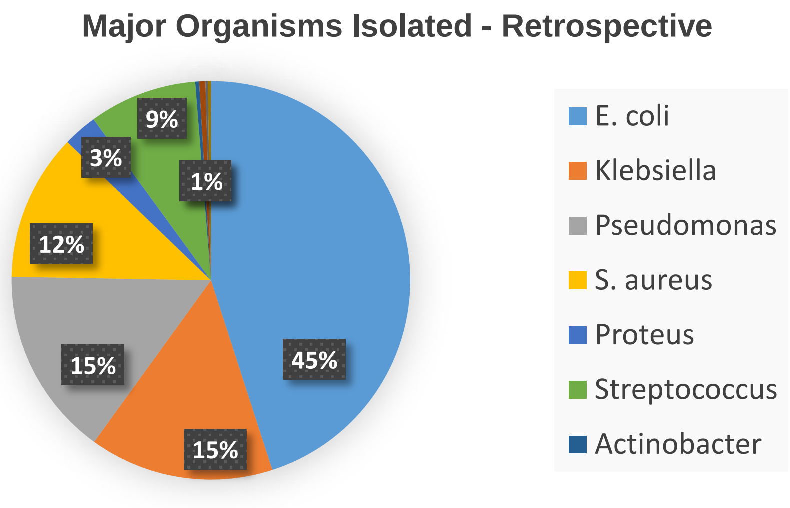
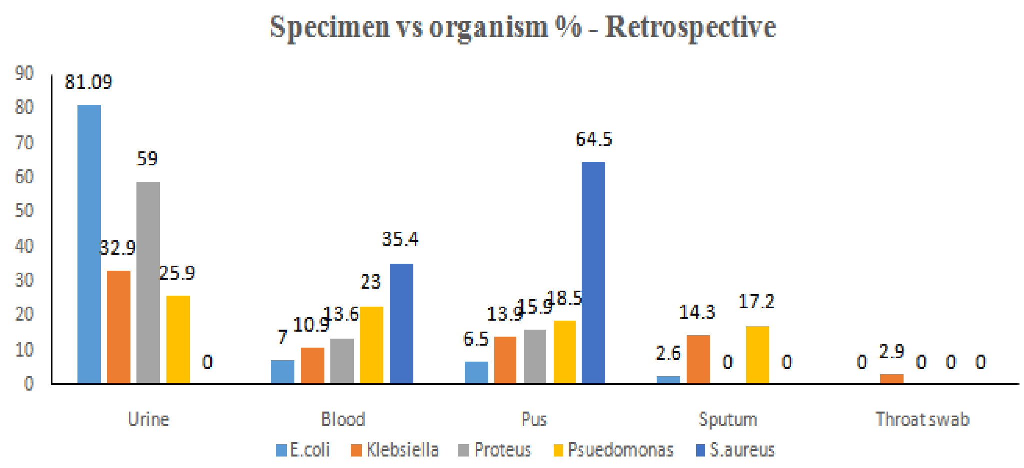


Table 4.6 Specimen Vs Organism % - Retrospective(N = 1580)

Organism	Urine	Blood	Pus	Sputum	Throat swab
E.coli	**81.09**	7.0	6.5	2.6	-
Klebsiella	**32.9**	10.9	13.9	14.3	2.9
Proteus	**59.0**	13.6	15.9	-	-
Psuedomonas	**25.9**	23	18.5	17.2	-
Staphylococcus	-	35.4	**64.5**	-	-



A prospective study for a period of 6 months was conducted (March 2017 to August 2017).

Table 4.7 Sensitivity Pattern Studies
(From March 2017 To August 2017) (N=51)

Organisms	**Percentage Microbial susceptibility towards Cephalosporins – Prospective(n = 51)**					
	Klebsiella	**E.coli**	**Staphylococcus**	**Streptococcus**	**Pseudomonas**	**Proteus**
Ceftriaxone	11.76	50	25	-	-	-

Cefoperazone/ Salbactum	-	-	-	-	-	25
Cefuroxime	5.88	-	25	60	-	-
Cefotaxime	-	10	-	-	-	25
Ceftazidime	-	10	-	-	-	-
Cefepime/ Tazobactum	-	-	-	-	-	-
Cefazolin	-	-	-	-	-	-

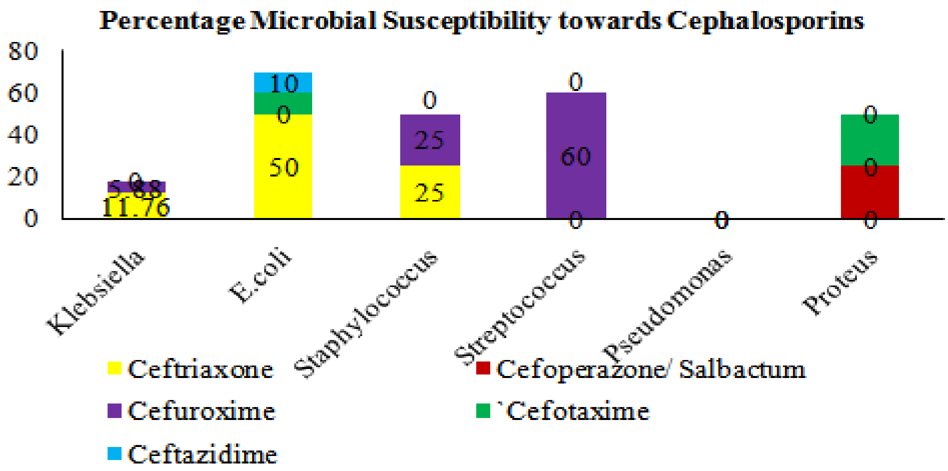


Table 4.8

Organisms	Percentage Microbial Susceptibility towards Fluroquinolones – Prospective(n = 51)					
	Klebsiella	**E.coli**	**Staphylococcus**	**Streptococcus**	**Pseudomonas**	**Proteus**
Ciprofloxacin	47.05	10	25	-	-	-
Ofloxacin	47.05	10	25	100	25	25
Levofloxacin	5.88	-	-	-	-	25
Norfloxacin	-	10	-	-	-	-

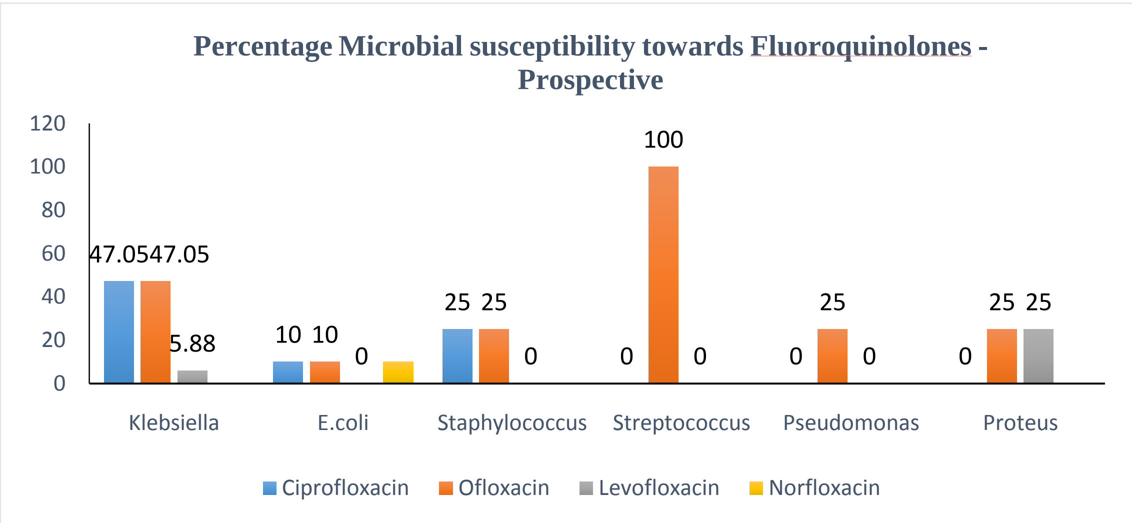


Table 4.9

Organism	Percentage Microbial Susceptibility to other antibiotics – Prospective(n = 51)					
	Klebsiella	**E.coli**	**Staphylococcus**	**Streptococcus**	**Pseudomonas**	**Proteus**
Amikacin	70.6	100	25	40	100	50
Gentamicin	47.05	30	50	100	50	-
Piperacillin/ tazobactam	70.58	100	12.5	40	100	50
Imipenem	64.7	80	-	40	75	50
Meropenem	50	50	50	50	50	50

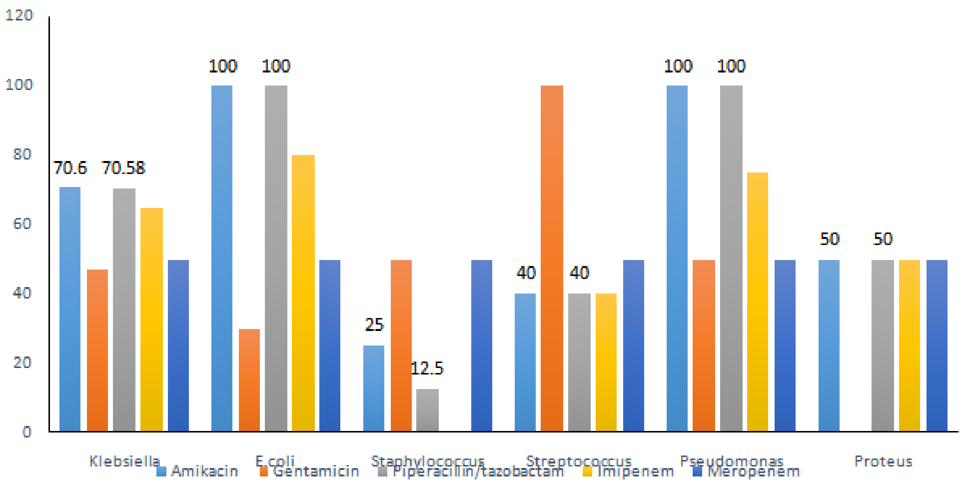
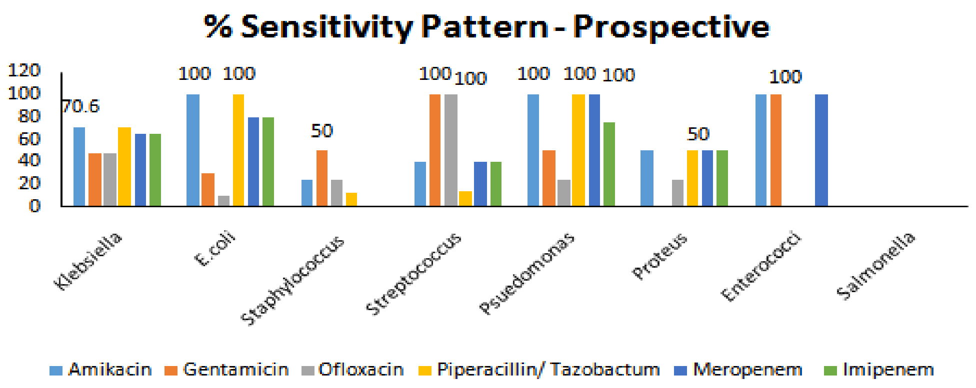


Table 4.10Percentage Sensitivity Pattern- Prospective (n = 51)

Organism	Amikacin	Gentamicin	Ofloxacin	Piperacillin/ Tazobactum	Meropenem	Imipenem
Klebsiella	70.6	47.05	47.05	70.58	64.7	64.7
E.coli	100	30	10	100	80	80
Staphylococcus	25	50	25	12.5	-	-
Streptococcus	40	100	100	14	40	40
Psuedomonas	100	50	25	100	100	75
Proteus	50	-	25	50	50	50
Enterococci	100	100	-	-	100	-
Salmonella	-	-	-	-	-	-



MAJOR ORGANISM ISOLATED (n = 51)

Table 4.11 Major Organism Isolated (N = 51)

ORGANISM	**No. of Patients**
Klebsiella	**17**
E.coli	**10**
Staphylococcus	**8**
Streptococcus	**5**
Psuedomonas	**4**
Proteus	**4**
Enterococci	**2**
Salmonella	**1**

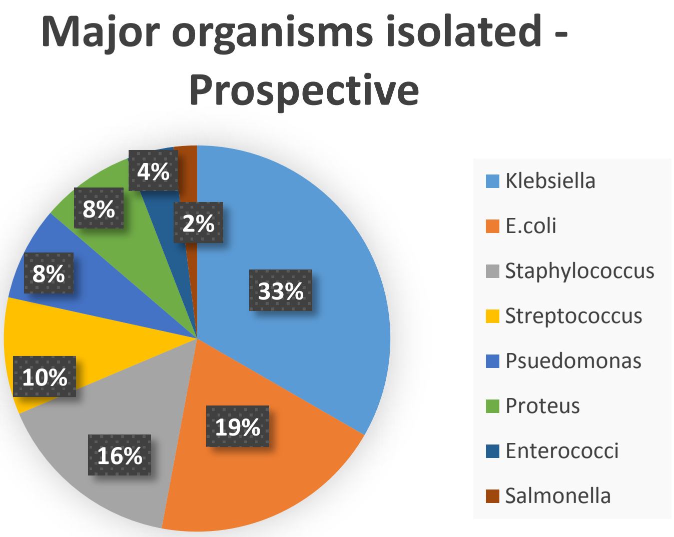


Table 4.12 Specimen Vs. Organism (%)(From March 2017 To August 2017) (N= 51)

Organism	**No. of patient infected**	**Blood**	**Sputum**	**Pus cells**	**Urine**	**Trachea**	**Stool**
Klebsiella	17	17.64	58.82	5.88	5.88	11.76	-
E.coli	10	10	-	30	50	-	10
Staphylococcus	8	50	50	-	-	-	-
Streptococcus	5	-	100	-	-	-	-
Pseudomonas	4	-	50	25	-	25	-
Proteus	4	25	-	-	75	-	-

Enterococci	2	100	-	-	-	-	-
Salmonella	1	100	-	-	-	-	-

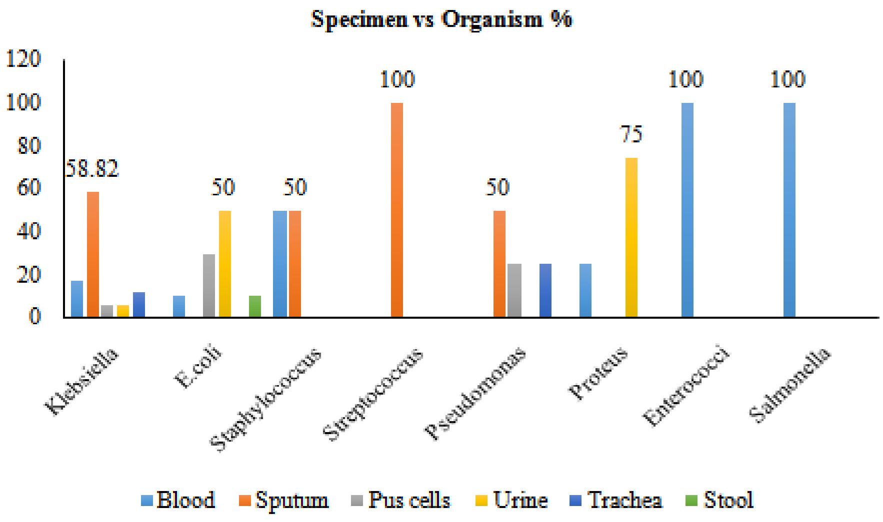


Table 4.13 Percentage Prevalence Of Microorganism – A Comparison

ORGANISM	RETROSPECTIVE (Jan 2016 – Dec 2016) (n = 1580)		PROSPECTIVE (Mar 2017 – Aug 2017) (n = 51)	
	No. of patients infected	Percentage (%)	No. of patients infected	Percentage (%)
E.coli	714	45.18	10	19.60
Klebsiella	234	15	17	33.3
Pseudomonas	243	53.17	4	7.8
S.aureus	189	11.96	8	15.68
Proteus	44	2.78	4	7.8
Streptococcus	139	8.97	5	9.8
Actinobacter	5	0.31	-	-
Salmonella	8	0.50	1	1.9
Enterococci	3	0.18	2	3.9
Candida	4	0.25	-	-

Table 4.14 Retrospective Vs Prospective Organism Prevelance (%)

ORGANISM	RETROSPECTIVE(Jan 2016 – Dec 2016)(n = 1580)	PROSPECTIVE(Mar 2017 – Aug 2017)(n = 51)
	Percentage(%)	Percentage (%)
E.coli	45.18	19.60
Klebsiella	15	33.3
Pseudomonas	53.17	7.8
S.aureus	11.96	15.68
Proteus	2.78	7.8
Streptococcus	8.97	9.8
Actinobacter	0.31	-
Salmonella	0.50	1.9
Enterococci	0.18	3.9
Candida	0.25	-

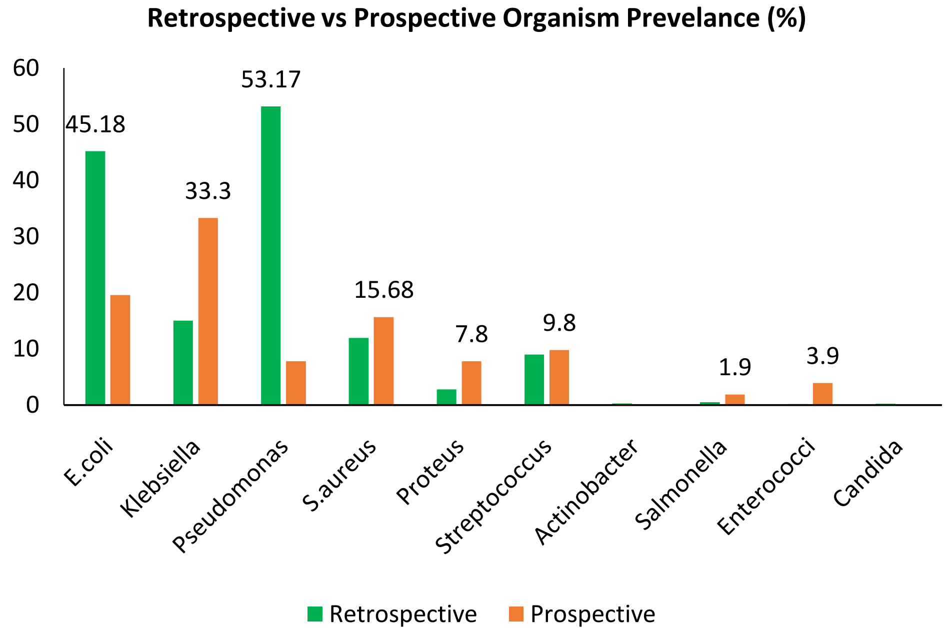


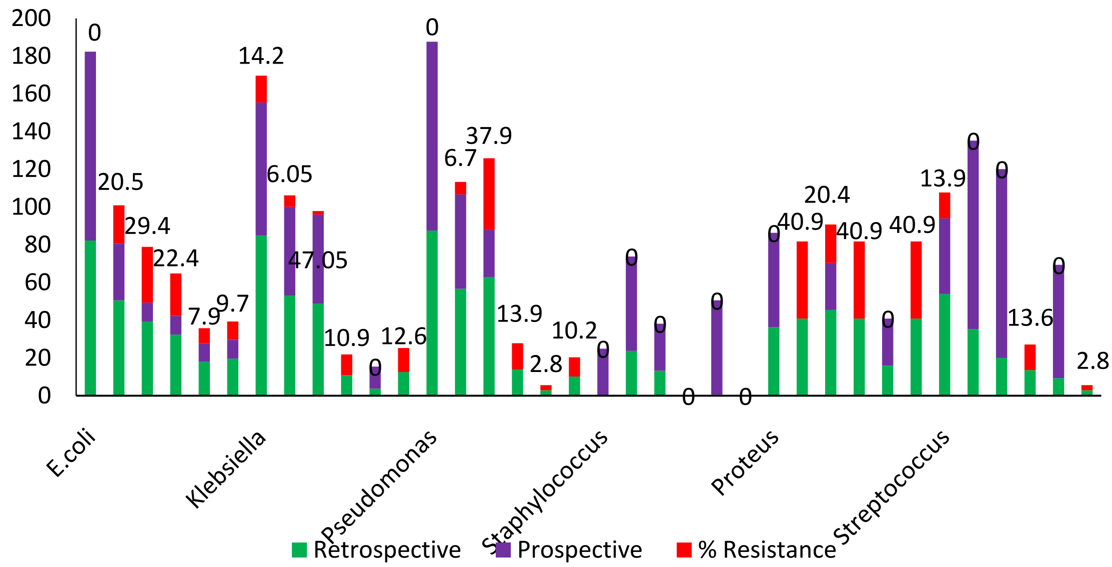
Table 4.15Emergence of resistance

Organism	Antibiotic	% sensitivity		% Resistance
		Retrospective	Prospective	
		N = 1566	N = 48	
E.coli	Amikacin	82.3	100	-
	Gentamicin	50.5	30	20.5
	Ofloxacin	39.4	10	29.4
	Norfloxacin	32.4	10	22.4
	Ceftrioxone	17.9	10	7.9
	Ceftazidine	19.7	10	9.7
Klebsiella	Amikacin	84.8	70.6	14.2
	Gentamicin	53.1	47.05	6.05
	Ofloxacin	48.9	47.05	1.85
	Norfloxacin	10.9	-	-
	Ceftrioxone	3.7	11.76	-
	Ceftazidine	12.6	-	-
Pseudomonas	Amikacin	87.6	100	-
	Gentamicin	56.7	50	6.7
	Ofloxacin	62.9	25	37.9
	Norfloxacin	13.9	-	-
	Ceftrioxone	2.8	-	-
	Ceftazidine	10.2	-	-

Organism	Antibiotic	% sensitivity		% Resistance
		Retrospective	Prospective	
		N = 1566	N = 48	
Staphylococcus	Amikacin	-	25	-
	Gentamicin	23.8	50	-
	Ofloxacin	13.2	25	-
	Norfloxacin	-	-	-
	Ceftrioxone	0.5	50	-
	Ceftazidine	-	-	-

Proteus	Amikacin	36.3	50	-
	Gentamicin	40.9	-	-
	Ofloxacin	45.4	25	20.4
	Norfloxacin	40.9	-	-
	Ceftrioxone	15.9	25	-
	Ceftazidine	40.9	-	-
Streptococcus	Amikacin	53.9	40	13.9
	Gentamicin	35.2	100	-
	Ofloxacin	20.1	100	-
	Norfloxacin	13.6	-	-
	Ceftrioxone	9.3	60	-
	Ceftazidine	2.8	-	-

Emergence of resistance



IV. Conclusion

In retrospective studya total of 1580 cases were analysed out of which the major organisms isolated was Pseudomonas followed by E.coli. E.coli, Klebsiella and Pseudomonas were more sensitive to Amikacin. Staphylococcus was sensitive to Doxycycline followed by Linezolid. Actinibacter was sensitive to Polymixin B and Colistin. Salmonella was more sensitive to Amikacin. Enterococci was sensitive to Piperacillin/Tazobactam. Candida was more sensitive to Amikacin and Gentamicin.

Specimen in which E.coli, Pseudomonas, Streptococcus and Klebsiella were more present in urine sample. Salmonella was found to be more in blood.

In prospective study a total number of 190 cases were analyzed for which culture susceptibility tests were performed on 51 cases. The major organism isolated was Klebsiella followed by Staphylococcus. E.coli and Klebsiella were found to be more sensitive to Amikacin.

Specimen in which Klebsiella, Pseudomonas and Streptococcus were found to be more was in sputum. E.coli and Proteus were present more in urine. Staphylococcus was seen more in blood and sputum. Enterococci and Salmonella were majorly seen in blood.

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