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Research Article

EVALUATION OF ANTIBIOTIC SENSITIVITY TEST RESULTS IN CLINICAL ISOLATES FROM VARIOUS ICU AT TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: The objectives of this study were to study bacteriological profile of clinical isolates, to study Antibiotic sensitivity patterns of isolates from various intensive care unit (ICU), and to provide Antibiotic sensitivity pattern to clinicians.

Methods: Different samples were received from all ICU from which different microorganisms grown by culture. Identification of microorganisms done by different biochemical reactions and antibiotic sensitivity testing done by manual Kirby disk diffusion method as standard manual protocol.

Results: In the present our study, Acinetobater is more prevalent that is 28% followed by *Escherichia coli* (22%), *Pseudomonas* spp (18%), and *Klebsiella* spp (17%). *Acinetobacter* species was highest in Neonatal ICU (25%) and Medical ICU (40%), while *E. coli* was highest in Pediatric ICU (39%) and Surgical ICU (39%), *Pseudomonas* spp. (28%) was highest in Idaho Central Credit Union patients. Most effective drugs are Levofloxacin, Imipenem, Piperacillintazobactam, and Amikacin.

Discussion and Conclusion: Antimicrobial resistance is emerging problem worldwide especially in ICU. Hence, it is very important to know resistant pattern and to formulate antibiogram of antibiotics for better management care of patient in all clinical set up, which may help to patient escalation and de-escalation of antibiotics.

Keywords: Antibiotic sensitivity test, clinical isolates, ICU

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INTRODUCTION

Transfer of resistance among different bacteria by various natural gene transfer mechanism has resulted in global spread of resistance at high rate and has created a worldwide problem [1,2].

Patients admitted to intensive care units (ICU) are frequently colonized with (antibiotic-resistant) bacteria, which may lead to healthcare associated infections. Antimicrobial-resistant bacteria, such as in Gram-positive-Methicillin resistance in *Staphylococcus aureus*, Vancomycin resistance in *Enterococci* and Gram-negative organisms – beta-lactamase resistance in *Enterobacteriaceae*, multidrug resistance in *Pseudomonas aeruginosa* and *Acinetobacter* species, and Fluroquinolone resistance in *Escherichia coli* are among the most common issues, to which clinician's must face in managing infection and are associated with inappropriate therapy or failure of therapy.

Rapidly, increase in Antimicrobial-resistant bacteria necessitates more effective control measures in ICU. As antibiotic resistance increase, it will lead to increase hospital stay and cost and will rise to morbidity and mortality. Especially, it is true for ICU, whereas antibiotics consumption is higher than wards.

In this study, we studied different antibiotic resistance pattern of isolates in ICU patients and tried to make an antibiotic policy for patient care.

METHODS

The present study titled is performed on "Evaluation of antibiotic sensitivity test results in clinical isolates from various ICU at tertiary care hospital." Total 350 clinical isolates from different patients of all ICUs.

Different samples were received from all ICU, proceed, and cultured from which different microorganisms grown by culture. Different medias such as Macconkey, Blood agar, and Nutrient Agar are used and bacterial colonies subjected to study their Gram Stain, colony morphology, and different biochemical reactions (Different tests such as Indole, Methyl Red, VogusProscure, Citrate. Triple Sugar Iron, Motility, Urease, Phenylpyruvic Acid, Catalase, Coagulse, Oxidase also sugar fermentation like Dextrose, Lactose, Maltose, Mannitol, and Sucrose), on the result, of which they are confirmed and identified as Clinical and Laboratory Standards Institute (CLSI) standard protocol [3].

Table 1: Age-wise distribution of patients

Age	No. of patients
Neonate (0–30 days)	96 (30%)
Pediatric (1 month–15 years.)	35 (11%)
Adult+Elder (>15 years.)	185 (59%)
Total	316

Table2: Total number of isolates from different samples received

Samples	Number of isolates from different samples
Blood	118
ET secretion	92
Swab	50
Sputum	34
Urine	21
Various body fluid	21
Pus	14
Total	350

Table 3: Sensitivity pattern of different Gram-negative isolates

No.	Antibiotics	*Acinetobacter* spp.			*E. coli*			*Klebsiella* spp.			*Enterobacter* spp.			*Citrobacter* spp.			*Proteus mirabilis*			*Stenotrophomonas maltophilia*		
		S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
1	Ampicillin	-	-	-	5	1	61	-	-	-	-	-	-	-	-	-	1	0	1	-	-	-
2	Cotrimoxazole	36	4	57	18	1	48	30	1	22	3	1	5	4	0	0	1	0	1	7	0	0
3	Amikacin	60	10	27	52	1	14	36	1	16	2	0	7	3	0	1	1	0	1	4	1	2
4	Gentamicin	48	7	42	45	4	18	33	1	19	3	0	6	3	0	1	1	0	1	7	0	0
5	Levofloxacin	88	5	4	63	0	3	50	1	2	9	0	0	4	0	0	2	0	0	7	0	0
6	Ciprofloxacin	39	13	45	12	7	48	20	4	29	1	4	6	2	0	2	1	1	0	7	0	0
7	Cefepime	35	7	55	28	6	33	27	3	23	2	4	3	3	0	1	2	0	0	6	1	0
8	Cefoperazone	25	5	67	21	3	43	20	2	31	2	0	7	2	0	2	1	1	0	7	0	0
9	Cefuroxime	28	5	64	10	3	54	9	0	44	2	0	7	2	0	2	1	1	0	1	0	6
10	Imipenem	69	8	20	57	6	4	41	5	7	5	2	2	4	0	0	1	0	1	-	-	-
11	Piperacillin+Tazobactam	78	3	16	48	1	18	38	2	13	5	0	4	4	0	0	2	0	0	-	-	-
12	Amoxycillin+Clavulanic acid	-	-	-	5	2	60	8	1	44	-	-	-	0	0	4	1	0	1	-	-	-

Table 4: Sensitivity pattern of *Pseudomonas* spp.

No.	Antibiotics	Sensitivity pattern		
		S	I	R
1	Ceftazidime	27	1	26
2	Gentamicin	34	4	16
3	Amikacin	40	1	13
4	Piperacillin	41	1	12
5	Piperacillin+Tazobactam	50	0	4
6	Cefepime	34	4	16
7	Aztreonam	30	0	24
8	Cefoperazone	36	3	15
9	Ciprofloxacin	35	3	16
10	Levofloxacin	49	0	5
11	Imipenem	42	0	12
12	Meropenem	43	0	11

Table 5: Sensitivity pattern of various antibiotics for Gram-positive isolates

S. No.	Antibiotics	*Staphylococcus aureus*			*Enterococci* spp.		
		S	I	R	S	I	R
1	Levofloxacin	22	0	0	5	0	2
2	Ciprofloxacin	20	1	1	3	0	4
3	Cotrimoxazole	11	1	10	4	0	3
4	Penicillin	5	1	16	1	0	6
5	Cefuroxime	16	0	6	2	0	5
6	Linezolid	21	0	1	4	1	2
7	Teicoplanin	20	0	2	5	1	1
8	Erythromycin	4	3	15	2	0	5
9	Amoxicillin + Clavulanic acid	3	3	16	0	0	7
10	Cefoxitin	22	0	0	2	5	0
11	Cefazolin	16	0	6	1	0	6

All antibiotics were obtained from Hi-media Laboratory. Different antibiotics for different group for different microorganisms such as Gram-positive, Gram-negative, and Urinary isolates have been also kept as CLSI standard Protocol [3]. Microorganisms identification and its antibiotic sensitivity testing were done by manual method. Kirby Disk diffusion method has been followed for antibiotic sensitivity testing. For quality control, American type culture collection strain had been used which is satisfactory with result.

RESULTS

From 316 different patients, total 350 isolates were obtained from Neonatal ICU (NICU), Pediatric ICU (PICU), Medical ICU (MICU), Idaho Central Credit Union (ICCU), and Surgical ICU (SICU).

Table 1 shows that in the present study, maximum numbers of patients were from age group 16 to 85 years (185 patients). Out of 316 patients, 187 were male and 129 were female.

Fig. 1 shows that most common organism isolated in present study was *Acinetobacter* spp. (total 99, 28%). Out of 99, maximum *Acinetobacter* was isolated from swab (total 48, 34%) followed by 34 in blood (29%).

Second most common organism isolated was *E. coli* (76, 22%) followed by Pseudomonas spp. (62, 18%), *Klebsiella* spp. (61, 17%), *Staphylococcus aureus* (22, 6%), *Enterobacter* spp. (9, 3%), *Enterococci* spp. (8, 2.2%), *Stenotrophomonas maltophilia* (7, 2%), *Citrobacter* spp. (4, 1.3%), and *Proteus mirabilis* (2, 0.5%).

Fig. 2 shows that maximum number of isolates were found in NICU (99, 28%) followed by MICU (78, 22%), ICCU (76, 21%), SICU (66, 19%), and PICU (31, 9%)

Acinetobacter species was highest in NICU (25%) and MICU (40%), while *E. coli* was highest in PICU (39%) and SICU (39%), *Pseudomonas* spp. (28%) was highest in ICCU patients.

Table 4 shows sensitivity pattern of *Pseudomonas* spp. *Pseudomonas* spp. was highly sensitive to Piperacillin+Tazobactam (total 50) and Levofloxacin (total 49) followed by Imipenem (total 42) and Meropenem (total 43), they showed more resistant to Ceftazidime (total 26) and Aztreonam (total 24), followed by Gentamicin (total 16) and Ciprofloxacin (total 16).

As shown in Fig. 3, Amoxicillin+Clavulanic acid was highly resistant (89%), followed by Ampicillin (88%), Cefuroxime (74%), and Cefoperazone (62%) which were also resistant to various Gram-negative isolates, while Levofloxacin (4%), Imipenem (14%), and Piperacillin+Tazobactam (21%) showed least resistance for the same.

Table 6 among urinary isolates, highest number were *E. coli* (total 09) followed by *Pseudomonas* spp. (total 05), *Klebsiella* spp. (total 04), *Acinetobacter* (total 02) and *Enterococci* (total 01).

Among different urinary isolates, Levofloxacin was most effective agent (total 15) followed by Netilmicin (total 10), Teigecycline (total 11), and Norfloxacin (total 07), while Ampicillin+Sulbactam (total 19), Cotrimoxazole (total 15), Ceftizoxime (total 15), and Lomefloxacin (total 16).

DISCUSSION

Antimicrobial resistance is emerging problem worldwide, especially in ICU. Hence, it is must to know resistant pattern for better management part of patient care in all hospital. As compare to ICU patient, risk

Table 6: Sensitivity pattern of urinary isolates

No.	Antibiotics	*Acinetobacter* spp. (n=2)			*E. coli (n=9)*			*Pseudomonas* spp. (n=5)			*Klebsiella* spp. (n=4)			*Enterococci* spp. (n=1)		
		S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
1	Carbenicillin	0	0	2	1	0	8	2	0	3	0	0	4	0	0	1
2	Levofloxacin	2	0	0	6	0	3	3	1	1	3	0	1	1	0	0
3	Ciprofloxacin	1	0	1	1	0	8	2	1	2	1	0	3	1	0	0
4	Lomefloxacin	1	0	1	0	0	9	1	1	3	1	1	2	0	0	1
5	Nitrofurantoin	0	0	2	4	0	5	2	0	3	2	0	2	0	0	1
6	Natilmicin	2	0	0	2	0	7	3	0	2	3	0	1	0	0	1
7	Teigecycline	1	0	1	4	0	5	4	0	1	2	0	2	0	0	1
8	Norfloxacin	1	0	1	2	0	7	3	0	2	1	0	3	0	0	1
9	Cotrimoxazole	1	0	1	2	0	7	2	0	3	1	0	3	0	0	1
10	Ceftizoxime	1	0	1	2	0	7	2	0	3	1	0	3	-	-	-
11	Ampicillin + Sulbactam	0	0	2	0	0	9	1	0	4	0	1	3	0	0	1

Table 7: Frequency of organisms isolated in the present study

No	Organisms	Present study (%)	Mohammadi-mehr *et al.* [4]	ZaveriJitendra *et al.* [5]	Kiicukates *et al.*[6] (%)
1	*Acinetobacter* spp.	99 (28)	17 (9.1%)	20 (16)	198 (24)
2	*E. coli*	76 (22)	60 (32%)	32 (25)	53 (6.4)
3	*Pseudomonas* spp.	62 (18)	21 (13%)	17 (13)	271 (32.7)
4	*Klebsiella* spp.	61 (17)	58 (31%)	18 (14)	192 (23.3)
5	*Staphylococcus aureus*	22 (6)	-	3 (2)	
6	*Enterobacter* spp.	9 (3)	12 (6.4%)	2 (1.5)	48 (5.8)
7	*Enterococci* spp.	8 (2.2)	-	3 (2.3)	-
8	*Stenotrophomonas maltophilia*	7 (2)	-	-	-
9	*Citrobacter* spp.	4 (1.3)	-	3 (2.3)	50 (6)
10	*Proteus mirabilis*	2 (0.5)	8 (4%)	3 (2.3)	2 (0.24)
	Total	350	176	128	827

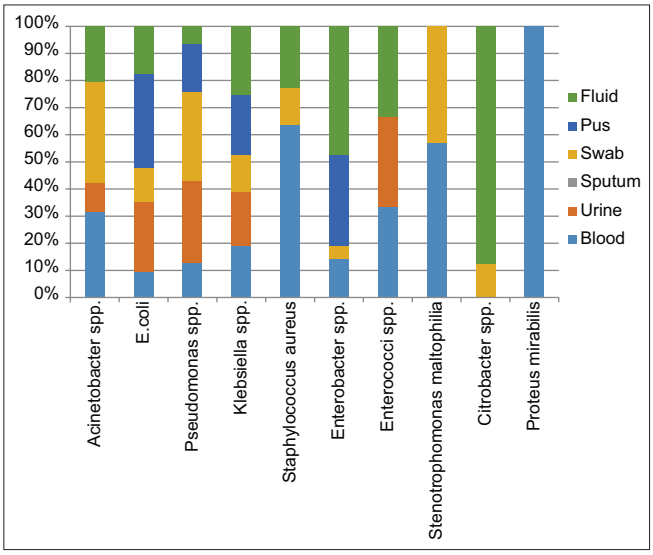

Fig. 1: Pattern of organisms distribution obtained

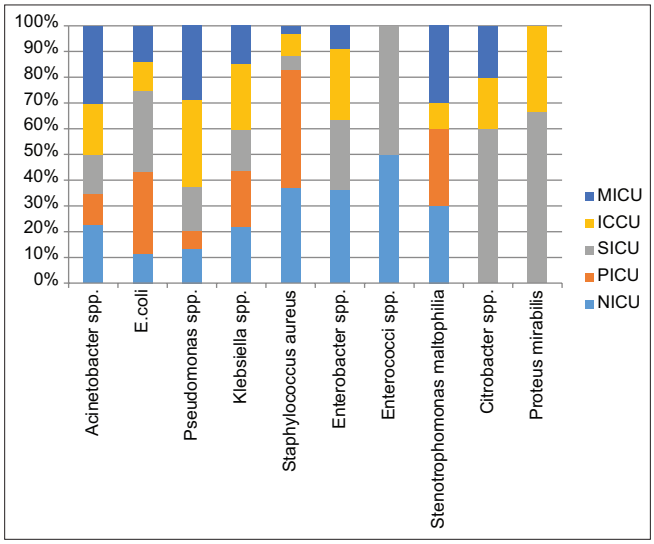

Fig. 2: Pattern of organisms distribution among various ICUs

of nosocomial infection to ICU patients is five to seven fold higher than ward patients and ICU infections contributes to 20–25% of all nosocomial infections in a hospital [1].

In the present study, the most common organism isolated was *Acinetobacter* (28%), followed by *E. coli* (22%), *Pseudomonas* (18%), and *Klebsiella* (17%), while Mohammadi-mehr *et al.* [4] found *E. coli* (32%) as the most common isolate, followed by *Klebsiella* (31%), *Pseudomonas* spp. (13%), and *Acinetobacter* (9.1%); Zaverijitendra *et al.* [5] found *E. coli* (25%) as the most common isolates, followed by *Acinetobacter* (16%), *Klebsiella* (14%), and *Pseudomonas* (13%); Kiicukates *et al.* [6] found *Pseudomonas* spp. (32.7%) as the most common isolates, *Acinetobacter* (24%), *Klebsiella* (23.3%), and *E. coli* (6.4%).

In present our study, *Acinetobater* is more prevalent that is 28% followed by *E. coli* (22%), *Pseudomonas* spp (18%), and *Klebsiella* spp (17%), whereas *E. coli* is most prevalent in Mohammadi-Mehr *et al.* and ZaveriJitendra *et al.* study, while *Pseudomonas* spp is found (32.7%) in Kiicukates *et al.*

Specimen wise organism distribution

In Blood, we found *Acinetobacter* spp. (29%) as predominant isolates which are similar (40%) to study done by Mohammadi-Mehr *et al.* [4].

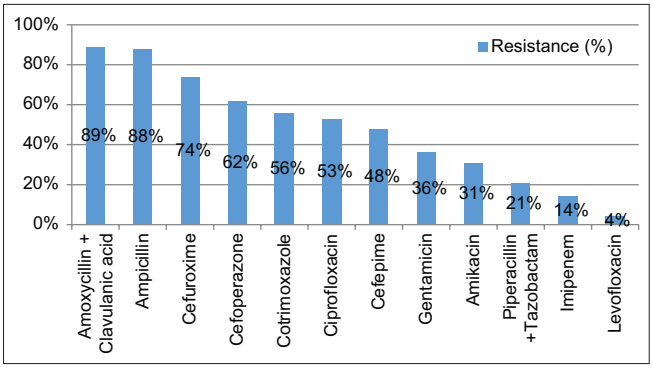

Fig 3: Resistant pattern of various drugs for Gram-negative isolates

From Urine, Pus, and other body fluids, we got *E. coli* as common isolates 42%, 57%, and 29%, respectively, which correlates with ZaveriJitendra *et al*. [5], they reported 29%, 46%, and 80% for same.

From swab (including ET secretion), we found *Acinetobacter* spp. as common (34%) which is also similar to ZaveriJitendra *et al*. 5 for same.

We noticed that sputum showed Acinetobacter spp. (32%) commonly, while ZaveriJitendra *et al*. [5] reported Pseudomonas spp.as predominant organism isolated from sputum (27%).

Sensitivity pattern of different isolate

They were more resistant to Ampicillin (83%) and Cefuroxime (67%). In study done by Patwardhan *et al*. [7], they found 96% of Ampicillin and 100% of Cefuroxime resistant to same organism. In our study, we found 17% of Acinetobacter spp. as resistant to many drugs.

In the present study, *Klebsiella* spp. was highly sensitive to Levofloxacin (94%) and Imipenem (88%), while in Maksum *et al.* [8], it showed similar sensitivity to Imipenem (93%) but less sensitive to Levofloxacin (38%).

In our study, we observed that a majority of the isolates were susceptible to Levofloxacin (96%), Imipenem (86%), and Piperacillin+Tazobactam (89%). In all the studies, Amikacin also much higher sensitive against Gram-negative bacteria as compared to other antibiotics. Therefore, these drugs are effective drug for the multiple drug resistant bacteria.

We also found that Gram-negative isolates were highly resistant to Cefuroxime and Cefoperazone (Cephalosporin group) and Amoxicillin+Clavulanic acid and Ampicillin.

CONCLUSION

Out of 350 samples from various clinical samples, the most common organism isolated was *Acinetobacter* spp. followed by *E. coli*, *Pseudomonas* spp. and *Klebsiella* spp.

Gram-negative organisms were highly sensitive to Levofloxacin, Piperacillin+Tazobactam, and Imipenem. They were more resistant to Ampicillin, Amoxicillin+Clavulanic acid, Cefuroxime, and Cefoperazone (third generation Cephalosporin). Gram-positive isolates were highly sensitive to Levofloxacin, Linezolid, Ciprofloxacin, Teicoplanin, whereas Amoxicillin+Clavulanic acid, Erythromycin, Penicillin were highly resistant to same spp.

It has been felt that there is a need to formulate strategies to detect and prevent the emergence of β-Lactamase producing strains for the effective treatment of infections which are caused by them.

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AUTHORS' CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare that there is no conflicts of interest.

FUNDING

None. Data Availability all data sets generated or analyzed during this study are included in the manuscript.

ETHICS STATEMENT

This study was approved by the Institute Ethics Committee, SMIMER, Surat India.

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