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Antimicrobials Sensitivity and Resistance Pattern of Bacterial Isolates at a Tertiary Care Hospital in Jharkhand, India

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ABSTRACT

To find out the antimicrobial drug susceptibility in a tertiary care center, data were collected from the department of microbiology and retrospective study was carried out. Out of 1217 culture-sensitivity reports, 764 (62.7%) reports were found culture positive. Culture positive microorganisms were Pseudomonas 33%, E.coli 22.15%, Staphylococcus 16.30%, Klebsiella 13.25%, Streptococcus 5.53% and others 8.92%. Drug sensitivity were as follows, Staphylococcus highly sensitive to gatifloxacin (34.52%), ofloxacin (32.69%) and amikacin (32.69%), resistant to cotrimoxazole (92.91%), cefotaxime (82.69%), and ampicillin (67.31%). Streptococcus highly sensitive to ofloxacin (56.25%), gatifloxacin (50%); resistant to cefotaxime (81.25%), cotrimoxazole (62.5%) and ampicillin (56.26%). Pseudomonas highly sensitive to amikacin (23.71%), levofloxacin (6.18%), gatifloxacin (21.65%). Resistant to cefotaxime (90.72%), cefadroxil (88.66%), cotrimoxazole (85.57%), ampicillin (69.07%) and levofloxacin (49.48%). E. coli highly sensitive to ceftriaxone (40.98%), amikacin (34.43%); resistant to cefotaxime (90.16%), cefadroxyl (88.52%), cotrimoxazole (80.33%), pefloxacin (80.33%), and ciprofloxacin (54.10%). Klebsiella highly sensitive to amikacin (43.24%), ceftriaxone (40.54%) and gatifloxacin (16.22%); resistant to cefadroxyl (86.49%), Cotrimoxazole (83.78%), cefotaxime (84%), pefloxacin (81.08%), and norfloxacin (62.16%). On the basis of above sensitivity and resistance we concluded that clinicians should choose antimicrobials based on culture & sensitivity data to avoid emergence of resistance.

Key words: antimicrobials, sensitivity, microorganism, resistant.

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INTRODUCTION

Antimicrobial agents are among the most commonly used and misused of all drugs. The inevitable consequence of the widespread use of antimicrobial agents has been the emergence of antibiotic-resistant pathogens. Reducing inappropriate antibiotic use is the best way to control resistance. Although awareness of the antibiotic misuse is increasing, overprescribing remains widespread, driven largely by patient demand, time pressure on clinicians, and diagnostic uncertainty. If the gains in the treatment of infectious diseases are to be preserved, clinicians must be more selective in the use of antimicrobial agents [1].

Emergence of antibiotic resistance in bacterial pathogens is a very serious problem. Presently more than 70% of the bacteria associated with hospital-acquired infections in the United States are resistant to one or more of the drugs previously used to treat them. In some European countries penicillin-resistant strains of pneumococci account for 50% or more of isolates. The worldwide emergence of*Haemophilus* and gonococci that produce β-lactamase is a major therapeutic problem. *Methicillin*-resistant strains of *Staphylococcus aureus* are endemic in hospitals and are isolated increasingly from community-acquired infections [2-3]. Multiple-drug-resistant strains of *S. aureus* with intermediate susceptibility to antibiotics and high-level resistance to vancomycin have been reported [4-6].

The spread of antibiotic resistance mandates a responsible approach to antibiotic use. Important components to prevent or diminish antimicrobial resistance are appropriate use of vaccination, judicious use and proper attention to indwelling catheters, early involvement of infectious disease experts, choosing antibiotic therapy based on local patterns of susceptibilities of organisms, proper antiseptic technique to ensure infection rather than contamination, appropriate use of prophylactic antibiotics in surgical procedures, infection control procedures to isolate the pathogen, and strict compliance to hand hygiene [7].

Antimicrobial study on resistant pattern provides information and insight into the changing pattern of antimicrobials variation with time and over use, misuse or underuse of drugs. Data accumulated also support in comparing resistant organisms in further study. Hospital antimicrobial study on resistant pattern may provide insight into the sources and extent of outbreaks and alerts to take necessary measure to control promptly the spread of resistant organisms. Goetz et al [8]. showed that health-care workers bring resistant organisms home. Outpatient dialysis units, rehabilitation centers, and outpatient intravascular devices have been shown to be reservoirs of colonization with methicillin resistant staphylococcus aureus (MRSA) and vancomycin-resistant *Enterococcus* in many patients in the community [9-12]. Generally organisms resistant to multiple antibiotics are largely confined to hospital settings and revealed through studies involving hospitals or intensive care units (ICUs).

Information related to periodical microbial susceptibility and resistance (antibiogram) are often used by clinicians to assess local susceptibility rates, as an aid in selecting empiric antibiotic therapy, and in monitoring resistance trends over time within an institution. It can also used to compare susceptibility rates across institutions and track resistance trends.

Antibiotic policy is one of the mandatory requirements for accreditation. Making an antibiogram is an important step in framing the antibiotic policy. The future of antibiograms would be the incorporation of patient related data to make information more reliable and for predicting outbreaks [13].

Nowadays, medical researchers are increasingly realizing that evolutionary processes are involved in immediate threats associated with not only antibiotic resistance but also emerging diseases [14-15]. The evolution of antimicrobial resistance has resulted in 2 to 3 fold increase in mortality of hospitalized patients. It has increased the length of hospital stay, and has also increased the costs of treatment [16-17]. Ignoring it can have lethal results.

Considering all these facts we conducted a study to evaluate the antibiotic sensitivity and resistance in selected bacteria isolated from different sample came for culture sensitivity in RIMS Ranchi, to define the utility, limitations, and potential areas of improvement in a tertiary hospital

MATERIALS AND METHODS

Methods

Samples were obtained in the department of microbiology from indoor and outdoor patients who were advised culture sensitivity (C/S) test by treating physician in various clinical departments of RIMS Ranchi. Two samples were obtained from each patient before administration of any antibiotics. One sample was subjected to direct gram smear examination to determine the organism and the second utilized for drug sensitivity test.

All bacterial strains recovered from microbiology department records from January 2009, to March 2009 were studied and data prepared. For each isolate, data were filled for organism type and susceptibility pattern.

Hospitals used Kirby-Bauer disk-diffusion techniques for the evaluation of susceptibility profiles of microorganisms.

Data Analyses

Sample obtained were urine, cerebrospinal fluid (CSF), pus, conjunctival swab, throat swab, vaginal swab, aural swab, sputum, skin, ear swab and blood culture. The number of isolates was tabulated for the entire study period. For each organism, sensitivity and resistance to antimicrobial drugs were calculated in percentage.

RESULTS

1217 sets of cultures were processed in two and half months and 62.7 % (764) of these were positive for bacterial species.

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Percentage distribution of micro Organisms

Pseudomonas sp. (33%) was the most frequently isolated gram-negative bacilli, followed by *E. coli* (22.15%) and *Klebsiella sp.* (13.25%).

Gram positive microorganisms isolated were Staphylococcus (aureus & pyogens) 16.30% *and streptococcus (pyogens, viridans) 5.53%. Others were 8.92%.*

Resistance pattern of Gram-Positive Organisms

Among *streptococci* isolates, resistance to cefotaxime 81.25% , trimethoprim-sulfamethoxazole 62.5%, sparfloxacin 62.5%, ampicillin 56.26% , erythromycin 43.75% and ciprofloxacin 43.75%.

Among staphylococcus isolates, resistance to trimethoprim-sulfamethoxazole was 92.91%, cefotaxime was 82.69%, ampicillin 67.31%, pefloxacin 67.31% and for cefadroxil 65.38%.

Resistance Pattern of Gram-Negative Organisms

Table1. Resistance patterns of microorganisms isolated in this study (in percentage)

	Pseudomonas	E coli	klebsella	streptococcus	Staphylococcus
Ampicillin	69.07	32.79	24.32	56.26	67.31
Amoxycillin	44.33	52.47	51.35	31.25	32.69
Cefadroxil	88.66	88.52	86.49	75	65.38
Cefotaxime	90.72	90.16	83.78	81.25	82.69
Ceftriaxone	45.36	19.67	27.027	25	30.769
Erythromycin	40.21	3.28	5.406	43.75	51.923
Clarithromycin	12.37	19.67	18.919	-	-
Cotrimoxazole	85.57	80.33	83.78	62.5	92.31
Nalidaxic acid	15.46	62.30	69.46	-	3.85
Norfloxacin	17.52	57.38	62.16	-	5.77
Ciprofloxacin	46.39	54.10	56.77	43.75	36.54
Ofloxacin	30.93	49.18	29.73	6.25	28.85
Pefloxacin	71.13	80.33	81.08	50	67.31
Levofloxacin	49.48	47.54	48.65	37.5	32.69
Sparfloxacin	65.98	66.57	67.57	62.5	53.85
Gatifloxacin	29.90	34.43	40.54	18.75	23.08
Amikacin	36.08	21.31	29.73	31.25	30.77
Gentamicin	9.28	24.59	29.73	25	34.62
Chloramphenicol	26.80	39.34	35.14	31.25	26.92

Pseudomonas isolates showed resistance to cefotaxime(90.72%), cefadroxil (88.66%), trimethoprim sulfamethoxazole (85.57%), ampicillin(69.07%), and levofloxacin (49.48%).

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Among *E. coli* isolates, resistance to cefotaxime 90.16%, cefadroxil 88.52%, trimethoprim-sulfamethoxazole, and pefloxacin was 80.33% for each, sparfloxacin 66.57% and ciprofloxacin 54.1%.

Among Klebseilla isolates, resistance to cefadroxil 86.49%, cefotaxime 83.78% and trimethoprim-sulfamethoxazole (83.78%) for each, pefloxacin was 81.08% and norfloxacin 62.16%.

Sensitivity pattern of microorganism

Table -2.Sensitivity patterns of microorganisms isolated in this study (in percentage).

	PSEUDOMONAS		E. COLI		KLEBSELLA		STREPTOCOCCUS		STAPHYLOCOCCUS	
	H	M	H	M	H	M	H	M	H	M
Ampicillin	-	2.06	-	-	-	-	12.5	18.76	3.86	5.77
Amoxycillin	-	3.09	-	-	-	-	-	6.25	-	5.77
Cefadroxil	2.06	6.18	1.64	8.20	5.41	8.11	6.25	12.5	11.54	15.38
Cefotaxime	1.03	5.15	-	6.56	-	10.81	12.5	6.25	3.85	7.69
Ceftriaxone	21.65	25.77	40.98	31.15	40.54	32.43	50	18.75	19.23	32.69
Erythromycin	1.03	4.12	-	-	-	2.71	12.6	18.75	9.62	17.31
Cotrimoxazole	3.09	7.22	3.28	11.48	8.11	2.70	18.75	-	1.92	5.77
Nalidaxic acid	-	1.03	-	1.64	-	8.11	-	-	-	-
Norfloxacin	2.06	2.06	6.56	9.84	2.70	8.11	-	-	3.85	5.77
Ciprofloxacin	11.34	32.99	8.20	18.03	10.81	24.32	12.5	43.75	13.46	40.38
Ofloxacin	15.46	50.52	8.20	39.34	18.92	51.35	56.25	37.5	32.69	36.54
Pefloxacin	6.18	19.59	1.64	16.39	8.11	8.11	12.5	31.26	7.69	19.23
Levofloxacin	6.18	39.18	4.92	39.34	10.81	37.84	12.5	50	17.31	44.23
Sparfloxacin	3.09	11.34	1.64	8.20	5.40	16.22	12.5	18.75	11.54	17.31
Gatifloxacin	21.65	44.33	6.56	54.10	16.22	40.64	50	18.75	34.52	36.54
Gentamicin	-	10.31	6.56	11.48	5.40	10.81	6.25	18.75	3.85	19.23
Amikacin	23.71	36.08	34.43	42.62	43.24	21.62	50	12.5	32.69	36.54
Chloramphenicol	6.18	6.18	16.39	34.43	24.32	32.43	-	-	3.85	-

H- Highly sensitive microorganisms, M-Moderately sensitivity microorganisms.

The drugs which shows better drug sensitivity in comparison to other tested drug for each microorganisms were as follows-

Pseudomonas was highly sensitive to amikacin, levofloxacin and gatifloxacin.
E.coli was highly sensitive to ceftriaxone and amikacin.
Klebseilla was highly sensitive to amikacin, and ceftriaxone.
Streptococcus was highly sensitive to ofloxacin, and gatifloxacin.
Staphylococcus was highly sensitive to gatifloxacin, amikacin and ofloxacin.

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DISCUSSION

The study of bacterial sensitivity and resistance is very useful to a hospital because it not only helps the clinician to choose appropriate antimicrobials but also helps in avoiding microbial resistance. Antimicrobial resistant bacteria increasingly spread from hospital to hospital and into the community and increases mortality, hospital stay, and costs of the treatment.

In this study we found that Staphylococcus was highly sensitive to gatifloxacin, amikacin and ofloxacin and resistant to cefotaxime, trimethoprim-sulfamethoxazole, ampicillin, pefloxacin and cefadroxil. Staphylococcal resistance to most antibiotic families, including β-lactams, aminoglycosides, fluoroquinolones, and glycopeptides, has increased. Although the quinolones are reasonably active against staphylococci in vitro, the frequency of staphylococcal resistance to these agents has increased progressively, especially among methicillin-resistant isolates. The choice of antimicrobial agents to treat staphylococcal infections has become increasingly problematic because of the prevalence of multidrug-resistant strains. Resistance to the quinolones is most commonly chromosomal and results from mutations of the topoisomerase IV or DNA gyrase genes, although multidrug efflux pumps may also contribute [18]. High percentage of resistant from cefotaxime, cefadroxil and pefloxacin indicate the need to further detailed study for tracing about the high risk factor involved in the development of resistance and which department of the hospital have the highest percentages of resistance.

In this study we found streptococcus highly sensitive to ofloxacin, and gatifloxacin and resistance to cefotaxime, trimethoprim-sulfamethoxazole, sparfloxacin, ampicillin, erythromycin, and ciprofloxacin. Resistance to erythromycin and other macrolides is common among isolates from several countries, including Spain, Italy, Finland, Japan, and Korea. Macrolide resistance becoming more prevalent with the increasing use of this class of antibiotics [19].

P. aeruginosa is a significant cause of infections in hospitalized patients and is notorious for antibiotic resistance. Piperacillin/carbenicillin, aminoglycoside, ciprofloxacin, imipenem are the common drug for the treatment of this microorganism. We found it resistant in high percentase from cefotaxime, cefadroxil, cotrimoxazole, ampicillin and levofloxacin; and susceptible in very less percentage from commonly used drugs (table 1 &2). Cytotoxic chemotherapy, mechanical ventilation, and broad-spectrum antibiotic therapy probably paved the way for increasing numbers of patients colonized and infected by this organism. This situation has also been compounded by the lack of development of new classes of antipseudomonal drugs for nearly two decades [20].

In the past, most *E. coli* isolates were highly susceptible to a broad range of antimicrobial agents. Unfortunately, this situation has changed, and, of the Enterobacteriaceae, *E. coli* is the species in which resistance is evolving most rapidly [21]. We found high percentage of resistance from trimethoprim-sulfamethoxazole, norfloxacin, ciprofloxacin, amoxicillin, ampicillin, and gentamicin from Escherichia coli in this study. The antimicrobial resistance

profiles of gram negative bacilli vary by species, geographic location, regional antimicrobial use, and hospital site. The high percentage resistant to above mentioned drug raises questions about the empiric treatment of infections in patients at high risk for bacteremia or urosepsis.

Presently norfloxacin, ciprofloxacin, cotrimoxazole, gentamicin with ampicillin, amoxicillin with clavulinic acid and aztreonam are the common antimicrobial agents used for the treatment of Escherichia coli infections. We found it highly sensitive to ceftriaxone(40.98% of cases) and amikacin (34.43%of cases) and moderately sensitive to gatifloxacin, amikacin, ofloxacin, levofloxacin etc.(table-2).

Cephalosporin, imipenem, cephalosporin and gentamicin, mezlocillin, piperacillin, aminoglycoside, fluoroquinolone, aztreonam, amoxicillin and clavulinic acid are the antimicrobial used for klebsiella infection. We found that klebsiella developed resistance from large number of drugs like cefadroxyl, trimethoprim and sulfamethoxazole, sparfloxacin, norfloxacin, nalidixicacid, cefotaxim, ciprofloxacin, amoxicillin in high percentage. This suggests that organisms developing resistance to above mentioned drugs. This is due to irrational and inappropriate use of the drugs. It deserves attention and reaction. Both the above mentioned Gram negative bacilli were highly sensitive with amikacin and ceftriaxone (table-2).

Awareness related to drug sensitivity can guide us in preventive measures such as swabbing and isolation precautions [22] in wards, OT, and ICU [23-24]. It can help to reassess the therapy. It provides a mean to identify and confirm resistant pathogens.

These data may be used to distinguish hospital changes in resistance patterns, and enabling infection control efforts. With awareness programs, sensitivity and resistant pattern data can broaden physicians' knowledge in prescribing appropriate drugs for microorganisms.

We did not confirm isolates; our results reflect microbiologic data actually advised by physicians. Organisms were tested against limited antibiotics of interest. We have not provided information on antibiotic use, which is known to be a major determinant of bacterial antibiotic resistance.

Computerized microbiologic data storage may help in identification of unusually resistant organisms. Variability also exists in laboratory practices. Therefore standardization of these practices would help in improving the information and practices related to antimicrobials drug sensitivity and resistance pattern.

CONCLUSION

Knowledge of proper antimicrobials will greatly help in judicious use of them for empirical treatment of infections. Regular surveillance programmes for monitoring the sensitivity pattern in the tertiary care hospital is essential. Preferably clinicians should choose antimicrobials based on culture & sensitivity data to avoid emergence of resistance.

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