



Microbiology Newsletter

Sir Ganga Ram Hospital

Volume 11, No. 2 June 2006

CIPROFLOXACIN RESISTANT ENTERIC FEVER

Enteric fever is a public health problem worldwide. It is caused by *Salmonella enterica* serotype Typhi and also by *Salmonella enterica* serotype Paratyphi A. Rapid diagnosis of enteric fever is important since appropriate and timely antibiotic therapy is essential to reduce morbidity and mortality. *Salmonella enterica* serotype Typhi are endemic in developing countries in Africa, South & Central America and the Indian subcontinent. Incidence in developed countries is low and most cases are in travelers returning from endemic areas.

From 1948 to mid 1970s, chloramphenicol was the drug of choice for enteric fever. In early and mid 1970s chloramphenicol resistance was seen in extensive outbreaks of typhoid fever in Mexico and India.^{1,2} The emergence of multi-drug resistant (MDR) *Salmonella typhi* (Ampicillin, Chloramphenicol and Cotrimoxazole-ACCo) led to the use of quinolones as the first line drug for treatment.³

In UK, 23% of *S. enterica* serotype Typhi isolates from patients in 1999 exhibited decreased susceptibility to ciprofloxacin (MIC 0.25-1 µg/ml).⁴ However isolates of *S. typhi* with reduced susceptibility to fluoroquinolones (as indicated in the laboratory by resistance to nalidixic acid to begin with and now ciprofloxacin as well) have now appeared in the Indian subcontinent and other regions. These nalidixic acid resistant, but ciprofloxacin sensitive, strains had increased MICs of ciprofloxacin, (0.12-0.5 µg/ml) although they were still within the existing CLSI range for susceptibility (1 µg/ml).⁵ In a study from Vellore, the MIC values of ciprofloxacin increased from below 0.031 µg/ml in 1991 to 0.25 µg/ml in 1995.⁶ Therapeutic failures to ciprofloxacin have been reported in these cases of typhoid fever.

At our hospital, ACCo resistance in *S. enterica* serotype Typhi isolates over past 7 years has varied and is presently

around 9.3%.⁷ Since April 2003, after noticing inadequate response to treatment with quinolones, Nalidixic acid susceptibility testing was started routinely for all *Salmonella* isolates.

In a study conducted from April to December 2003 on all isolates of *S. enterica* serotype Typhi and *S. enterica* serotype Paratyphi A. At SGRH, it was observed that MICs of ciprofloxacin in Nalidixic acid resistant strains ranged from 0.38 - 3 µg/ml. 18 out of 147 isolates (12.24%) were intermediate sensitive to ciprofloxacin (MIC 1.5 - 3 µg/ml).³

During a period of eleven months from August 2005 to June 2006, blood cultures at SGRH had 86 isolates of *S. enterica* serotype Typhi and *S. enterica* serotype Paratyphi A. Disc diffusion testing was done by Kirby Bauer method using CLSI guidelines. The ACCo resistance and Nalidixic acid resistance observed was 9.3% and 89.5%, respectively (Fig. 1).

Till recently it was seen in various Indian and international studies that MICs of ciprofloxacin have increased but recently it has been observed at SGRH that 15/86 *S. typhi* and Para A were resistant and 2 were moderately sensitive to ciprofloxacin (19.8%). The MICs of these 15 isolates were determined by E-test (AB Biodisk, Sweden). 14 out of 15 resistant isolates had an MIC of > 32 µg/ml and 1 isolate had an MIC of 16 µg/ml. Both moderately sensitive ciprofloxacin strains had an MIC of 1.5 µg/ml (Table 1).

Fig. 1: Antibiogram - *S. enterica* serotype Typhi and Paratyphi A

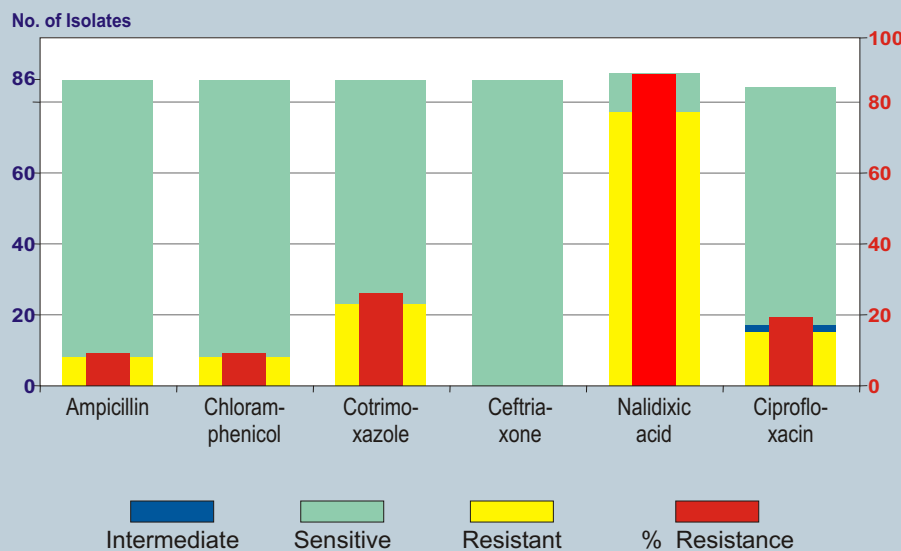


Table 1: Ciprofloxacin resistant (19.8%)

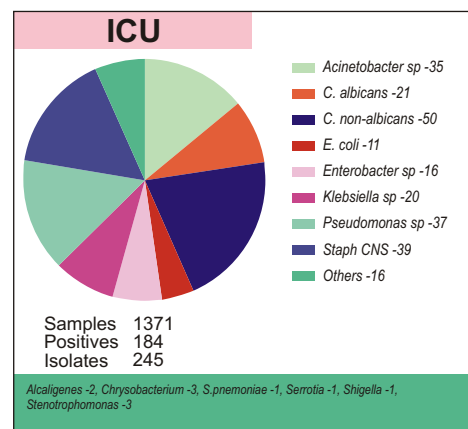
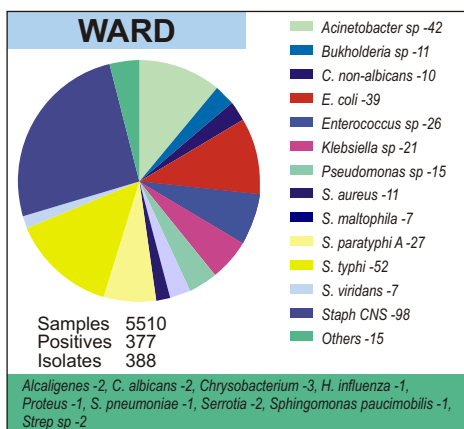
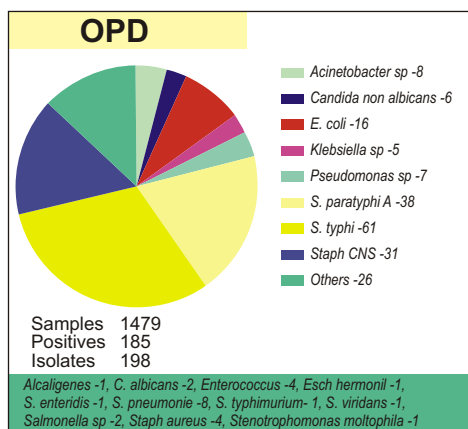
S. enterica serotype Typhi and Paratyphi A

MICs	1.5 µg/ml	16 µg/ml	32 µg/ml
No. of Isolates	2	1	14

contd. on page 8

BLOOD

July - December 2005



PERCENTAGE RESISTANCE

OPD
WARD
ICU

GPC	No. of Isolates	Penicillin	Oxacillin	Ampicillin	Clindamycin	Gentamicin	HLAR Gentamicin	Vancomycin	Linezolid
Staph aureus	4	66	0	-	0	0	-	0	0
	11	73	9	-	9	18	-	0	0
	4	75	50	-	50	50	-	0	0
Staph CNS	31	80	48	-	20	39	-	0	0
	98	82	67	-	36	63	-	0	0
	39	85	71	-	55	76	-	0	0
Enterococcus sp	4	-	-	-	-	-	-	0	-
	26	100	-	45	-	-	66	1	0
	6	100	-	60	-	-	75	0	0

* HLAR: High Level Aminoglycoside Resistance.

** Oxacillin sensitivity can be extrapolated for all -lactams and -lactam-inhibitor combinations; and Teicoplanin sensitivity for Vancomycin.

*** One isolate of VRE.

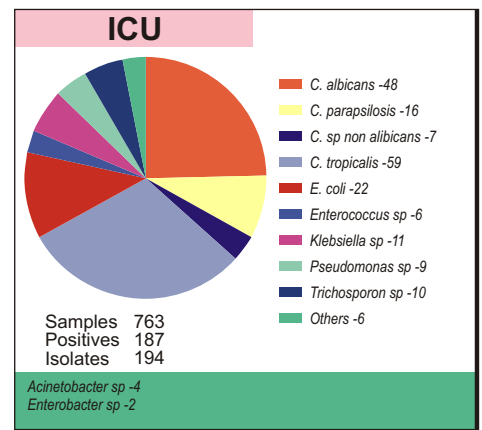
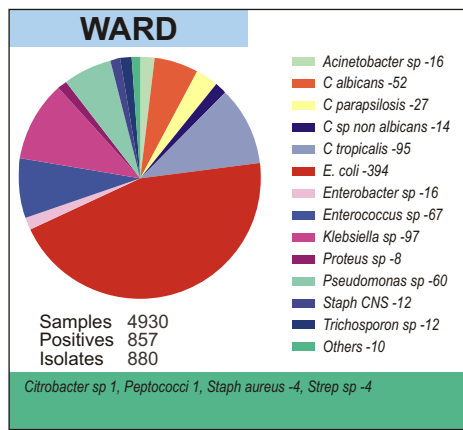
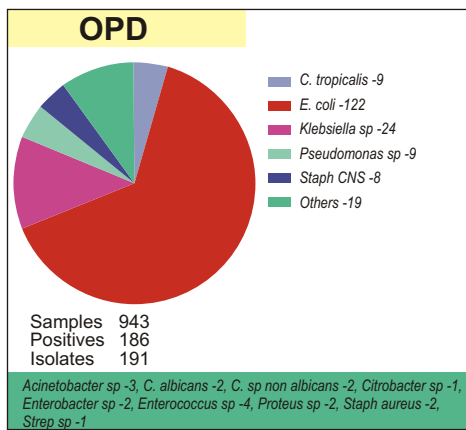
GNB	No. of Isolates	Ampicillin	Cefuroxime	Ceftriaxome	Ceftazidime*	Gentamicin	Nalidixic acid	Amikacin	Ciprofloxacin	Ofloxacin	Co-trimoxazole	Chloramphenicol	Piperacillin+ Tazobactam*	Cefoperazone+ Sulbactam*	Meropenem*	Colistin
S. enterica serotype Typhi	61	23	0	-	-	-	95	-	2**	-	37	24	-	-	-	-
	52	12	0	-	-	-	90	-	4**	-	26	10	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. enterica serotype Paratyphi A	38	0	-	-	-	-	100	-	0	-	0	0	-	-	-	-
	27	4	-	-	-	-	96	-	0	-	0	0	-	-	-	-
	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E. coli	16	80	64	67	-	75	-	21	100	90	-	-	43	33	0	-
	39	95	93	77	-	77	-	87	100	100	-	-	71	47	0	-
	11	90	78	82	-	73	-	45	75	80	-	-	60	25	0	-
Klebsiella sp	5	100	100	100	-	80	-	50	67	10	-	-	50	100	0	-
	21	100	80	89	-	85	-	53	0	-	-	-	68	72	0	-
	20	100	100	100	-	100	-	50	100	50	-	-	50	84	0	-
Pseudomonas sp	7	-	-	25	43	9	-	43	33	-	-	-	29	0	0	17
	15	-	-	83	43	80	-	-	20	0	-	-	25	47	42	31
	36	-	-	88	85	77	-	-	94	100	-	-	51	77	70	8
Acinetobacter sp	8	75	50	38	-	66	-	57	25	-	-	-	25	50	17	0
	42	93	69	49	50	75	-	81	55	-	-	-	27	67	23	0
	35	94	88	92	100	86	-	84	70	100	-	-	56	44	81	0
Burkholderia sp	-	-	-	-	-	-	-	-	67	-	-	-	0	-	100	28
	11	-	-	100	29	-	-	100	-	-	-	-	-	0	60	100
	5	-	-	-	0	100	-	100	-	-	-	-	0	-	-	-

*Percentage Resistance may indirectly appear higher than actual, because 2nd line drugs are tested only in multi-drug resistant isolates.

** Moderately susceptible (Kirby Bauer disc diffusion).

URINE

July - December 2005



PERCENTAGE RESISTANCE

OPD
WARD
ICU

GPC

	No. of Isolates	Penicillin	Oxacillin*	Clindamycin	Gentamicin	Nitrofurantoin	Norfloxacin	Teicoplanin	HLAR** Gentamicin	Ampicillin
<i>Enterococcus sp</i>	4	-	-	-	-	-	-	-	-	-
	67	-	-	-	-	15	92	***	62	56
	6	-	-	-	-	0	80	0	75	50
<i>Staph CNS</i>	8	75	63	0	75	0	86	0	-	-
	12	91	83	50	75	0	90	0	-	-
	0	-	-	-	-	-	-	-	-	-

* Oxacillin sensitivity can be extrapolated for all -lactams and -lactam-inhibitor combinations; and Teicoplanin sensitivity for Vancomycin.

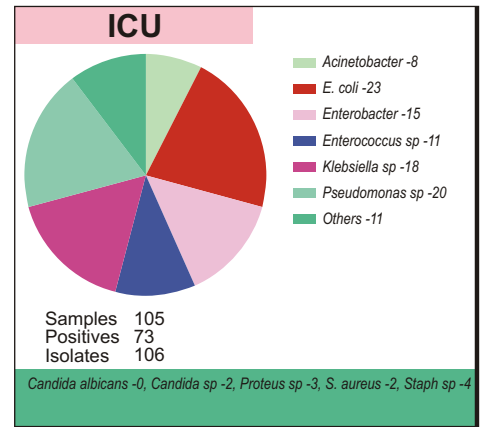
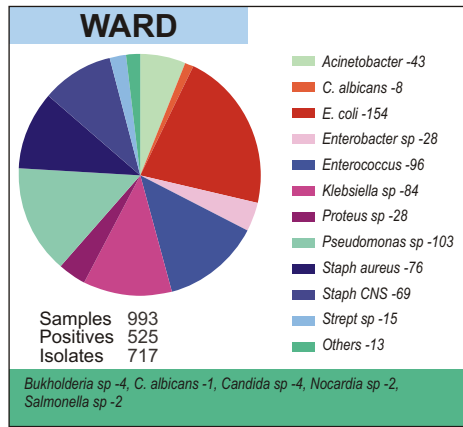
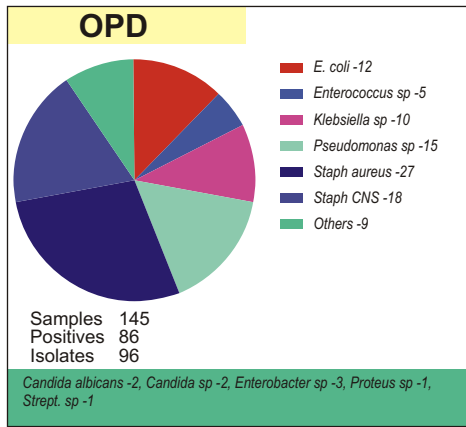
** HLAR: High Level Aminoglycoside Resistance.

*** Six isolates of VRE.

GNB

	No of isolates	Ampicillin	Nalidixic acid	Gentamicin	Netilmicin	Amikacin	Ciprofloxacin	Ofloxacin	Co-trimoxazole	Piperacillin+ Tazobactam*	Cefepime+ Sulbactam*	Meropenem*	Norfloxacin	Cefotaxime	Ceftazidime*	Nitrofurantoin	Colistin
<i>E. coli</i>	122	82	90	55	38	33	74	73	83	30	18	0	74	50	-	26	-
	394	92	96	64	52	39	86	88	79	49	39	1	88	71	-	35	-
	22	95	95	57	40	24	90	83	53	52	52	0	91	90	-	41	-
<i>Pseudomonas sp</i>	9	-	-	-	60	55	40	-	-	50	44	38	-	-	65	-	0
	60	-	-	87	84	81	78	69	-	57	70	57	-	-	69	-	2
	9	-	-	88	100	89	86	80	-	63	63	43	-	-	88	-	14
<i>Klebsiella sp</i>	24	100	76	58	47	42	77	-	75	45	43	0	77	52	-	35	-
	97	100	93	81	74	60	91	90	91	67	66	0	94	82	-	65	-
	11	100	92	82	86	36	78	78	91	71	55	0	82	82	-	64	-
<i>Enterobacter</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16	100	94	81	75	47	69	63	85	69	50	0	79	75	-	60	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Acinetobacter sp</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16	82	93	81	50	75	73	75	62	64	57	64	87	71	80	87	0
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Percentage Resistance may indirectly appear higher than actual, because 2nd line drugs are tested only in multi-drug resistant isolates.



PERCENTAGE RESISTANCE

OPD
WARD
ICU

GPC

	No. of Isolates	Penicillin	Oxacillin*	Clindamycin	Erythromycin	Gentamicin	Ciprofloxacin	Tetracycline	Co-trimoxazole	HLAR Gentamicin**	Vancomycin
<i>Staph aureus</i>	27	89	14	3	-	18	-	-	-	-	0
	76	82	30	14	67	40	50	-	50	-	0
	2	100	50	50	-	100	-	-	-	-	0
<i>Staph CNS</i>	18	78	61	33	-	44	-	-	-	-	0
	69	65	56	26	100	69	67	-	100	-	0
	4	75	75	100	-	75	-	-	-	-	0
<i>Enterococcus sp</i>	5	40	-	-	-	-	-	-	-	0	0
	96	64	-	-	-	-	-	-	-	73	15***
	1	63	-	-	-	-	-	-	-	72	-

* Oxacillin sensitivity can be extrapolated for all -lactams and -lactam-inhibitor combinations; and Teicoplanin sensitivity for Vancomycin.

** HLAR: High Level Aminoglycoside Resistance.

*** Eight isolates of VRE in wards.

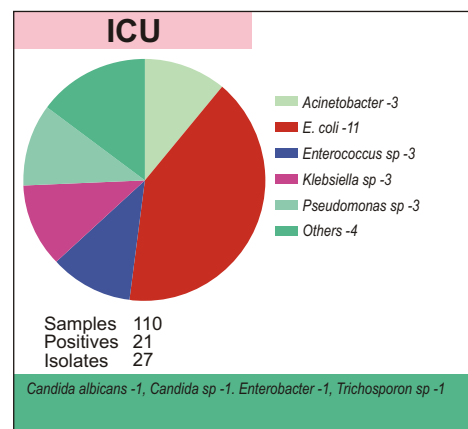
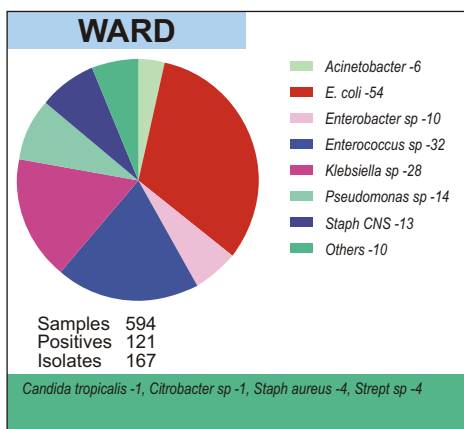
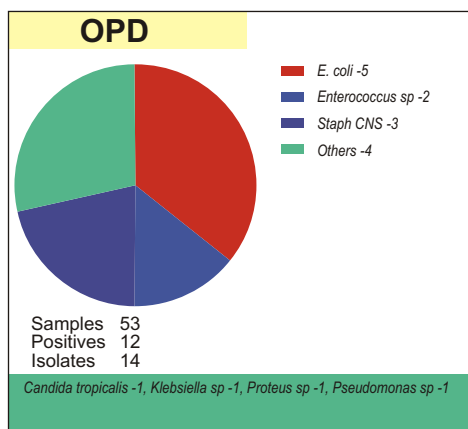
GNB

	No. of Isolates	Ampicillin	Cefotaxime	Ceftriaxone	Ceftazidime*	Gentamicin	Netilmicin	Amikacin	Ciprofloxacin	Ofloxacin	Co-trimoxazole	Piperacillin + Tazobactam*	Cefoperazone + Subbactam*	Meropenem*
<i>E. coli</i>	12	100	80	80	-	67	60	50	92	90	87	45	36	0
	154	95	69	90	-	61	100	44	82	82	81	56	48	0
	23	100	91	86	-	83	47	55	91	86	59	61	73	0
<i>Pseudomonas sp</i>	15	-	-	-	45	54	51	28	29	65	-	30	33	5
	103	-	-	-	97	99	45	91	35	85	-	16	42	39
	20	-	-	-	92	100	100	70	60	82	-	75	79	70
<i>Klebsiella sp</i>	10	100	80	50	-	60	44	40	66	73	66	44	54	0
	84	100	73	77	-	62	61	57	80	73	80	51	50	2
	18	100	86	80	-	61	40	42	76	71	82	72	67	0
<i>Enterobacter</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	100	81	78	75	73	61	75	75	62	68	56	56	0
	15	100	92	71	100	87	80	73	71	62	83	61	73	7
<i>Acinetobacter sp</i>	9	89	83	80	100	78	86	88	87	88	62	100	55	87
	43	81	69	86	57	67	43	77	62	58	59	50	36	58
	8	100	100	100	100	71	75	89	83	88	66	87	87	50
<i>Proteus sp</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	78	52	54	100	71	71	53	59	55	84	4	7	0
	3	-	-	-	-	-	-	-	-	-	-	-	-	-

*Percentage Resistance may indirectly appear higher than actual, because 2nd line drugs are tested only in multi-drug resistant isolates.

BODY FLUIDS

July - December 2005



PERCENTAGE RESISTANCE

OPD
WARD
ICU

GPC	No. of Isolates	Penicillin	Oxacillin*	Clindamycin	Erythromycin	Gentamicin	Ciprofloxacin	Tetracycline	Vancomycin	HLAR Gentamicin**
<i>Enterococcus sp</i>	2	-	-	-	-	-	-	-	-	-
	32	100	-	-	-	-	0	0	9***	47
	3	-	-	-	-	-	-	-	-	-
<i>Staph CNS</i>	3	-	-	-	-	-	-	-	-	-
	13	69	38	0	0	38	0	0	0	-
	0	-	-	-	-	-	-	-	-	-

* HLAR: High Level Aminoglycoside Resistance.

** Oxacillin sensitivity can be extrapolated for all -lactams and -lactam-inhibitor combinations; and Teicoplanin sensitivity for Vancomycin.

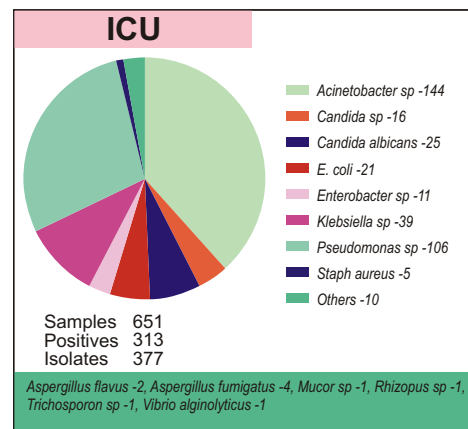
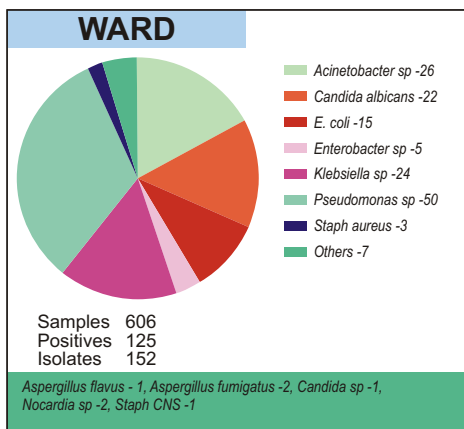
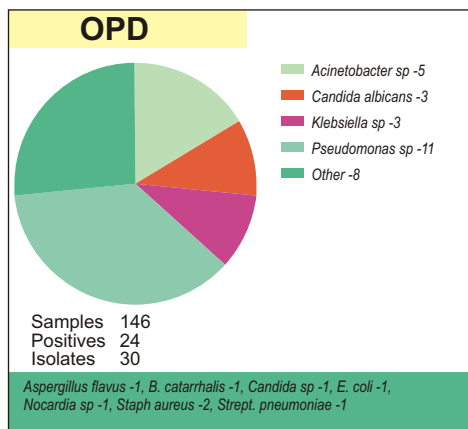
*** Three isolates of VRE.

GNB	No of isolates	Ampicillin	Cefotaxime	Ceftriaxone	Ceftazidime*	Piperacillin	Gentamicin	Netilmicin	Amikacin	Ciprofloxacin	Ofloxacin	Co-trimoxazole	Piperacillin+ Tazobactam*	Cefoperazone+ Sulbactam*	Meropenem*
<i>E. coli</i>	5	100	100	100	-	-	80	75	40	100	100	75	25	60	0
	54	100	92	96	-	-	72	60	40	98	92	73	39	57	0
	11	100	89	86	-	-	67	16	33	91	83	80	63	55	0
<i>Pseudomonas sp</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	-	-	-	57	50	80	16	50	55	66	-	18	57	43
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Klebsiella sp</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	96	89	93	-	-	74	52	39	92	95	90	58	61	0
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Enterobacter</i>	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	100	75	80	100	100	81	60	75	77	75	85	66	66	0
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Acinetobacter sp</i>	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	100	100	80	100	100	50	0	85	66	50	0	66	60	66
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Percentage Resistance may indirectly appear higher than actual, because 2nd line drugs are tested only in multi-drug resistant isolates.

RESPIRATORY ISOLATES

July - December 2005



PERCENTAGE RESISTANCE

OPD
WARD
ICU

GPC	No. of Isolates	Penicillin	Oxacillin*	Clindamycin	Erythromycin	Gentamicin	Ciprofloxacin	Tetracycline	Co-trimoxazole	Vancomycin	Teicoplanin
Staph. aureus	2	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-
	5	100	40	0	-	40	-	-	-	0	0
Strept. pneumoniae	1	-	-	-	-	-	-	-	-	-	-
	5	50	67	-	0	-	40	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-

* Oxacillin sensitivity can be extrapolated for all -lactams and -lactam-inhibitor combinations; and Vancomycin sensitivity for Teicoplanin.

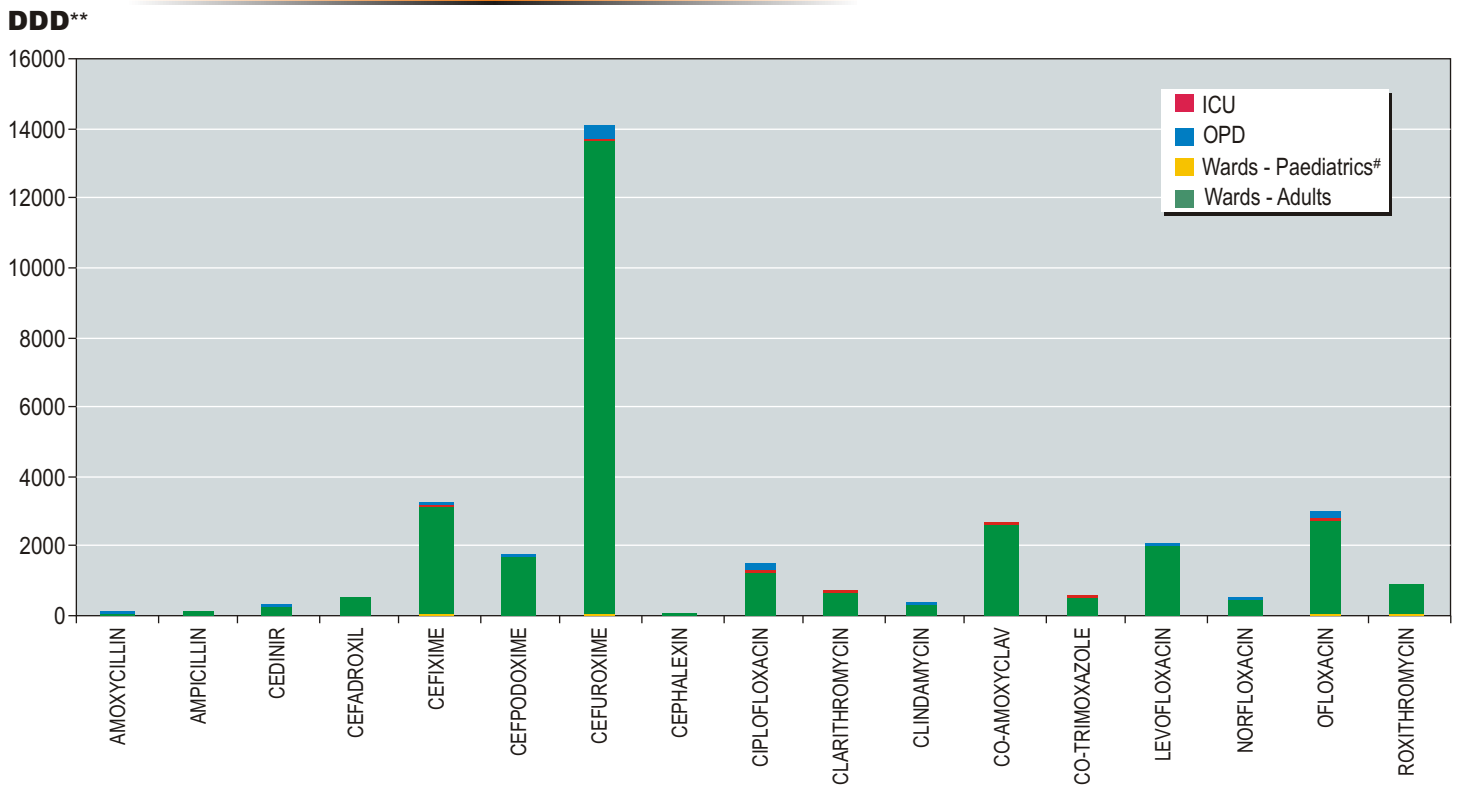
GNB	No of isolates	Ampicillin	Ceftazidime*	Ciprofloxacin	Co-trimoxazole	Gentamicin	Amikacin	Netilmicin	Cefoperazone+ Sulbactam*	Piperacillin+ Tazobactam*	Meropenem*
E. coli	1	-	-	-	-	-	-	-	-	-	-
	15	100	-	78	67	73	37	64	40	60	0
	21	95	-	90	78	86	48	55	43	44	0
Pseudomonas sp	11	-	45	60	-	73	60	55	70	33	13
	50	-	72	70	-	80	62	80	67	50	66
	106	-	83	86	-	87	84	75	63	84	55
Klebsiella sp	3	-	-	-	-	-	-	-	-	-	-
	24	100	-	75	84	79	41	68	60	48	0
	39	100	-	79	97	89	61	87	65	68	0
Enterobacter sp	-	-	-	-	-	-	-	-	-	-	-
	5	100	100	67	83	83	28	-	33	50	0
	11	100	-	82	67	70	58	88	58	67	0
Acinetobacter sp	5	100	100	80	60	100	100	60	100	60	100
	26	100	100	96	86	85	92	57	72	88	60
	144	100	95	94	64	91	98	64	63	84	82

*Percentage Resistance may indirectly appear higher than actual, because 2nd line drugs are tested only in multi-drug resistant isolates.

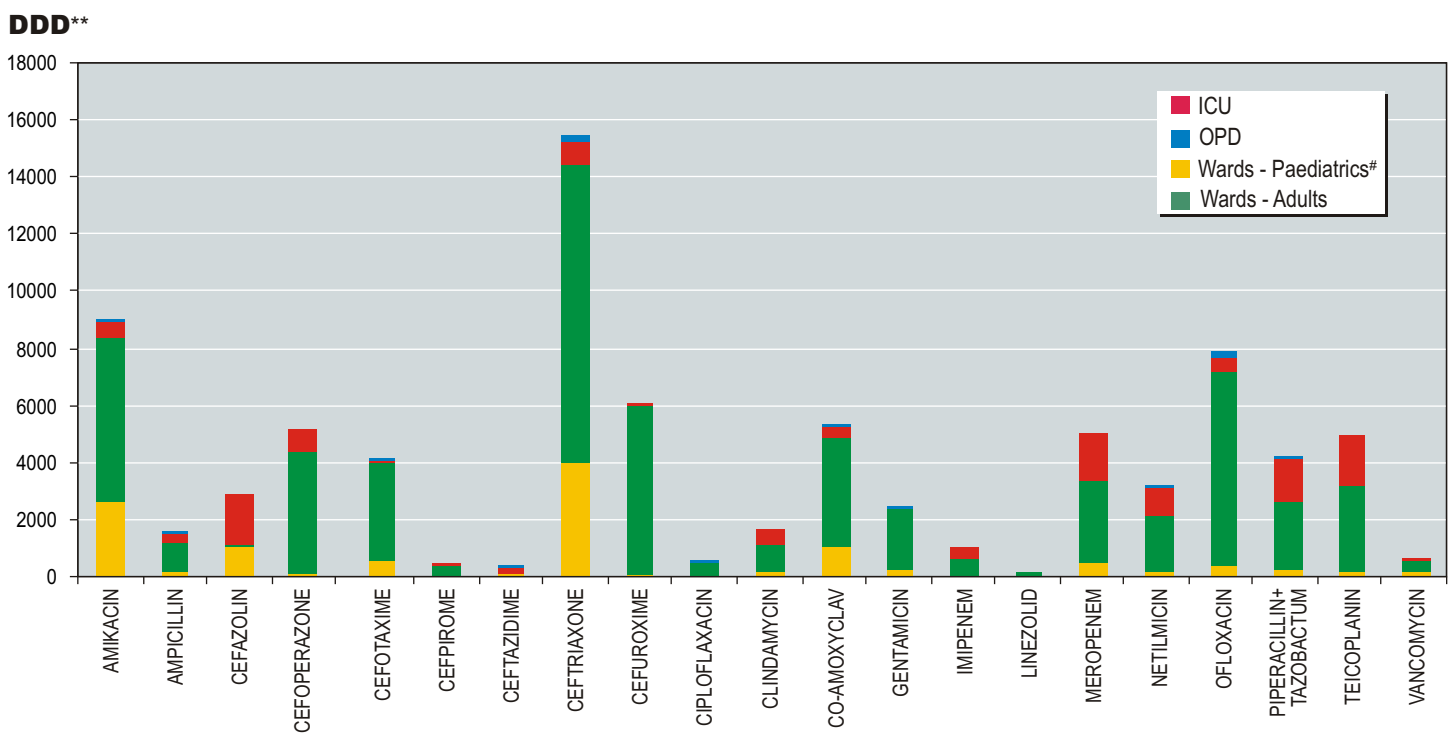
PRESCRIPTION AUDITING

July - December 2005*

ORAL



PARENTRAL



* Based on the hospital pharmacy data of the antibiotics dispensed.

** DDD - Daily Defined Doses; calculated as per the Anatomical Therapeutic Chemical (ATC) classification index, WHO Collaborating Centre for Drug Statistics Methodology, Oslo, Norway.

In paediatric group of patients and for certain antibiotics, consumption calculated as per the "Guide to antimicrobial therapy" by Sanford et al, USA (2005) presuming 10 kg as the average body weight for paediatric patients.

CIPROFLOXACIN RESISTANT..... (contd. from page 1)

Resistance to quinolones is due to spontaneously occurring mutations in the chromosomal genes (*gyr A*, *gyr B*) which alter the enzymes that are targets for quinolone drugs. Nalidixic acid is the prototype quinolone and screening for nalidixic acid resistance could be useful in predicting decreased fluoroquinolone susceptibility. Identification of nalidixic acid resistance by disk diffusion method provided a sensitivity of 100% and specificity of 87.3% as a tool to screen isolates where the MICs of ciprofloxacin were 0.125 µg/ml⁸.

In the last few years, treatment failures with ciprofloxacin and other quinolones have been observed in conjunction with an increase in the MIC of *S. enterica* serotype Typhi and Paratyphi A to ciprofloxacin.

This implies that quinolones may no longer be the drug of choice in treating enteric fever and clinicians may have to look for other alternatives, like third generation cephalosporins (Ceftriaxone) to treat typhoid fever.

REFERENCES

1. Anderson ES, Smith HR. Chloramphenicol resistance in the typhoid bacillus. *BMJ* 1972; 3:329-31
2. Paniker CKJ, Vilma KN. Transferable chloramphenicol resistance in *Salmonella typhi*. *Nature* 1972; 239:109-10
3. Joshi S, Watal C, Sharma A. Quinolones – Drug of choice for Enteric fever? *IJMM*, Vol22(4) Oct 2004: 271-72.
4. Threlfall EJ, Ward LR. Decreased susceptibility to ciprofloxacin in *Salmonella enterica* serotype Typhi, United Kingdom. *Emerg Infect Dis* 2001; 7:448-50.
5. Madhulika U, Garish BN, Parija SC. Current pattern in antimicrobial susceptibility of *Salmonella typhi* isolates in Pondicherry. *Indian J Med Res* 2004; 120:111-4
6. Jesudason MV, Malathy B, John TJ. Trend of increasing levels of minimum inhibitory concentration of ciprofloxacin to *Salmonella typhi*. *Indian J Med Res* 1996; 103:247-9
7. Sir Ganga Ram Hospital, Microbiology Newsletters, May 2000 to October 2005 <<http://www.sgrh.com/nletter/news1.htm>> (4 June 2006)
8. Hakanen A, Kotilaainen P, Jalava J, Siitonen A, Huovinen P. Detection of decreased fluoroquinolone susceptibility in *Salmonellas* and validation of Nalidixic acid screening test. *J Clin Microbiol* 1993; 37:3572-3577.

REFLECTION

It was nice to receive Microbiology Newsletter of your hospital. I have gone through volume 11, Number 1, October 2005 carefully and as usual find it interesting. I must congratulate you in bringing out informative Newsletters, their quality has improved over the years.

Your article "Should gold standard for TB diagnosis be redefined?" made interested reading.

Lt. Gen. D.Raghunath

*Sir Dorabji Tata Centre for Research in Tropical Diseases,
Banglore*

PUBLICATIONS FOR THE YEAR 2005

CHAPTERS IN BOOKS

- Nimrat Bawa, Neeraj Goel, Ruchi Sood, Aditi Mathur, Chand Watal, Ashok Rattan. Laboratory diagnosis of Mycobacterial infection in children. In "Essentials of Tuberculosis in children" Prof. Vimlesh Seth's book 3rd Ed. J.P. Brothers, N. Delhi, 2005, pg. 356-374.
- Ruchi Sood, Aditi Mathur, Chand Watal, Neeraj Goel, Nimrat Bawa, Ashok Rattan. Non Tuberculous Mycobacteria: An update. In "Essentials of Tuberculosis in children" Prof. Vimlesh Seth's book 3rd Ed. J.P. Brothers, N. Delhi, 2005, pg.66-75.

PAPERS

- Watal C, Joshi S, Sharma A, Oberoi JK, Prasad KJ et al. Prescription Auditing and antimicrobial resistance at a tertiary care hospital at New Delhi, India. *J. Hospital Infection* 2005 Vol 59/2 pp 156-158
- Watal C and Datta S. "Diagnosis of MDR Tuberculosis". *J Int Med Sc Acad* 2005. 18:2;99-103.
- N Behbehani, A Mahmood, EM Mokaddas, Z Bittar, B Jayakrishnan, M Khadadah, AS Paesa, R Dar, TD Chugh. Significance of atypical pathogens among community-acquired pneumonia adult patients admitted to hospital in Kuwait. *Medical Principles and Practice* 2005; 14:235-240.

ABSTRACTS

- Watal C, Kotwani A, Sharma A, Raveendran R, Bhandari SK, Khanna S, Chaudhury RR, Kathaleen Hollaway and Tomas Sorensen. "Surveillance of antimicrobial resistance and antimicrobial use "Clinical Microbiology & Infection (Blackwell Publishers), Volume 11, Supplement 2, R 2000, page 665, April 2005.
- Oberoi JK, Watal C, Sharma A, Prasad KJ, Raveendran R, Sanghamitra D. Comparison of Bact/ALERT 3D System with LJ medium for recovery of Mycobacteria from Clinical Samples. XXIX Annual Congress of the Indian Association of Medical Microbiologists at Chennai, November 2005.
- Sanghamitra D, Watal C, Sharma A, Jaswinder O, Prasad KJ, Reena R, Chugh TD. Utility of Differential time to positivity using automated culture system in diagnosis catheter related blood stream infections. XXIX Annual Congress of the Indian Association of Medical Microbiologists at Chennai, November 2005.
- R Raveendran, C Watal, A Sharma, JK Oberoi, KJ Prasad, S Datta. Implementation of latest guide lines on antimicrobial susceptibility pattern testing of GPC. IAMM Delhi Chapter meet, October 2005.

REFLECTION

Thanks for sending me the Newsletter of your hospital, which has come out extremely well. The Newsletter is highly informative and is useful to know the current antibiotic sensitivity status in this part of the country. Please accept my heartiest congratulations for the same.

Professor R.C. Mahajan
PGIMER, Chandigarh

DEPARTMENT OF CLINICAL MICROBIOLOGY

Faculty

Dr C. Watal
MD
Sr. Consultant & Chairman

Dr Anuj Sharma
MD
Sr. Consultant

Dr J.K. Oberoi
MD
Jr. Consultant

Dr K.J. Prasad
Ph.D
Sr. Research Officer

Dr S. Datta
MD
Jr. Consultant

Dr R. Raveendran
MD
Sr. Resident

DNB students

Dr Priyanka Anand
Dr Leena Mahindra
Dr Priyanka Banerjee
Dr. Shipli S. Khanna