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# STUDY ON PREVALENCE AND SENSITIVITY PATTERN OF MICROORGANISMS AT A PRIVATE CORPORATE HOSPITAL

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## ABSTRACT

AMR (Antimicrobial Resistance) is a complex global public health challenge, and no single or simple strategy will be sufficient to fully contain the emergence and spread of infectious organisms that become resistant to the available antimicrobial drugs. The retrospective study was conducted for a period of 2 years at a700- bedded multi-speciality private tertiary care hospital at Coimbatore, Tamil Nadu. A total of 6591 cases were analyzed during retrospective study. Nineteen different micro-organisms were isolated of which major organisms identified were *S. pneumoniae*(27%), *Klebsiella species* (21.8%), *E. coli* (15.3%), *S.aureus* (10.6%), *Pseudomonas(*8.3%), *S.pyogenes*(7.3%). The retrospective data revealed that almost all organisms were highly sensitive to Imipenam.. The evidence obtained indicated that AMR has a significant adverse impact on clinical outcomes and leads to higher costs due to consumption of health-care resources.

**KEYWORDS:** AMR (Antimicrobial Resistance), *S. pneumonia, Klebsiella species, E. coli, S.aureus, Pseudomonas, S.pyogenes*.

## INTRODUCTION

Use of antibacterial drugs has become widespread over several decades (although equitable access to antibacterial drugs is far from being available worldwide), and these drugs have been extensively misused in humans in ways that favour the selection and spread of resistant bacteria. Consequently, antibacterial drugs have become less effective or even ineffective, resulting in an accelerating global health security emergency that is rapidly outpacing available treatment options. It is essential to preserve the efficacy of existing drugs through measures to minimize the development and spread of resistance to them, while efforts to

develop new treatment options proceed. The burden of morbidity and mortality resulting from AMR in many infections and settings has serious consequences for individuals and society in terms of clinical outcomes and added costs.

The development of AMR is a natural phenomenon in microorganisms, and is accelerated by the selective pressure exerted by use and misuse of antimicrobial agents in humans and animals. The current lack of new antimicrobials on the horizon to replace those that become ineffective brings added urgency to the need to protect the efficacy of existing drugs.

The World Health Assembly, through several resolutions over the years, has called for intensified implementation of the global strategy, stressing the need for strengthened surveillance of AMR and enhanced laboratory capacity to carry it out, and reduction in the inappropriate use of antimicrobial drugs. Antibacterial resistance (ABR) involves bacteria that cause many common and life threatening infections acquired in hospitals and in the community, for which treatment is becoming difficult, or in some cases impossible.

In 2011, the health ministers of the region's Member States articulated their commitment to combat AMR through the Jaipur Declaration on AMR.

Despite the importance of these infections, there are major gaps in information concerning the extent, spread, evolution and impact of ABR. Urgency is added in particular by the lack of new therapeutic options in the development pipeline to replace those that lose their efficacy as bacteria become resistant to them. The collection of reliable information about the ABR situation through well-conducted surveillance is essential to inform strategies and prioritize interventions to tackle the problem. ABR surveillance should generate data to support action at all levels:local, national, regional and global.

**STUDY BACKGROUND:** Wide reports in literatures from different parts of the world revealed that antibiotics are used both widely and indiscriminately. RTIs comprise the most common indication for consulting a general practitioner, and obtaining an antibiotic prescription.

**OBJECTIVES**

- To conduct a retrospective study for a period of two years (January 2012 to February 2014) on the sensitivity pattern of micro organisms prevailing in the study hospital.

- To compare the retrospective antibiotic sensitivity pattern of micro organisms.
- To know the resistance pattern & prepare guidelines.

**STUDY DESIGN:** Retrospective study

**STUDY DURATION:** Two years (from 2012 to 2014).

**STUDY SITE:** 700- bedded multi- specialty private corporate hospital in South India.

**PATIENT SELECTION**

**Inclusion criteria:** All the inpatients and outpatients for whom culture and sensitivity was done.

**Exclusion criteria:** Those unwilling to participate in the study.

**METHOD**

The study was carried out in 700 bedded multi-specialty private corporate hospital in Tamil Nadu. The study was planned to understand the sensitivity pattern of micro-organisms to various antibiotics used in the hospital.

To conduct a retrospective analysis on the sensitivity pattern of micro organisms towards antibiotics in the study hospital for a period of two years (from 2012 to 2014).

**RESULTS**

A total of 6591 cases were analyzed during retrospective study. Nineteen different micro-organisms were isolated of which major organisms identified were *S.pneumoniae*(27%), *Klebsiella species* (21.8%), *E. coli* (15.3%), *S.aureus*(10.6%), *Pseudomonas(*8.3%), *S.pyogenes*(7.3%). **Sriram *et al* (2013)** conducted similar study which also reported that *E.coli*(38.3%), *Klebsiella* species (19.25%), *S. pneumonia* (16%),*S.aureus*(11.6%), *Pseudomonas*(7.9%) were commonly isolated micro-organisms.

*S.pneumoniae* was highly prevalent in sputum specimen (68.6%), *E.coli* was common in urine specimen (76.4%), *S.pyogenes* was present more in throat swab specimen (56.3%), *Klebsiella* were more commonly isolated from urine sample (41.7%) and from tracheal sample (11.7%), *S.aureus* from pus culture (42.9%). **Khavane K *et al* (2010**), in a similar study reported that *E.coli* was highly prevalent in urine sample (n=17) and *Klebsiella* species were more common in sputum specimen (n=7).

The retrospective data revealed that almost all organisms were highly sensitive to Imipenem. It was found that Imipenem showed high sensitivity in *Salmonella sps*.(100%), *S.pneumoniae* (97.9%), *S.aureus*(97.6%), *Pseudomonas aeruginosa* (97.4%); *S.pyogenes* showed better activity to Linezolid(92.5%); *Proteus vulgaris* showed high sensitivity towards Cefepime/ tazobactum (100%).Similarly Cefaperazone/Sulbactum is highly efficient against *S.epidermidis*(100%). Similar study was conducted by Shamataj K et al (2012) which revealed that organisms like *Klebsiella* were highly sensitive to Imipenem(38.8%).

In the class of various cephalosporins prescribed to the patients, cefepime tazobactum was found highly effective against *S.pyogenes, S.pneumonia S.aureus, Klebsiella sps and Pseudomonas sps.* In the class of carbapenams, imipenam was highly active against the major organisms viz, *S.pyogenes(91.9%), S.pneumonia (97.9%), S.aureus (97.6%), Klebsiella sps(79.3) and Pseudomonas sps(97.4%)* followed by meropenam. Whereas in case of fluroquinolones, ofloxocin was found to be more active against *S.pyogenes(51.1%)and S.aureus(49.3%,* while levofloxacin showed more activity against *S.pneumoniae, Klebsiella sps and Pseudomonas sps.*

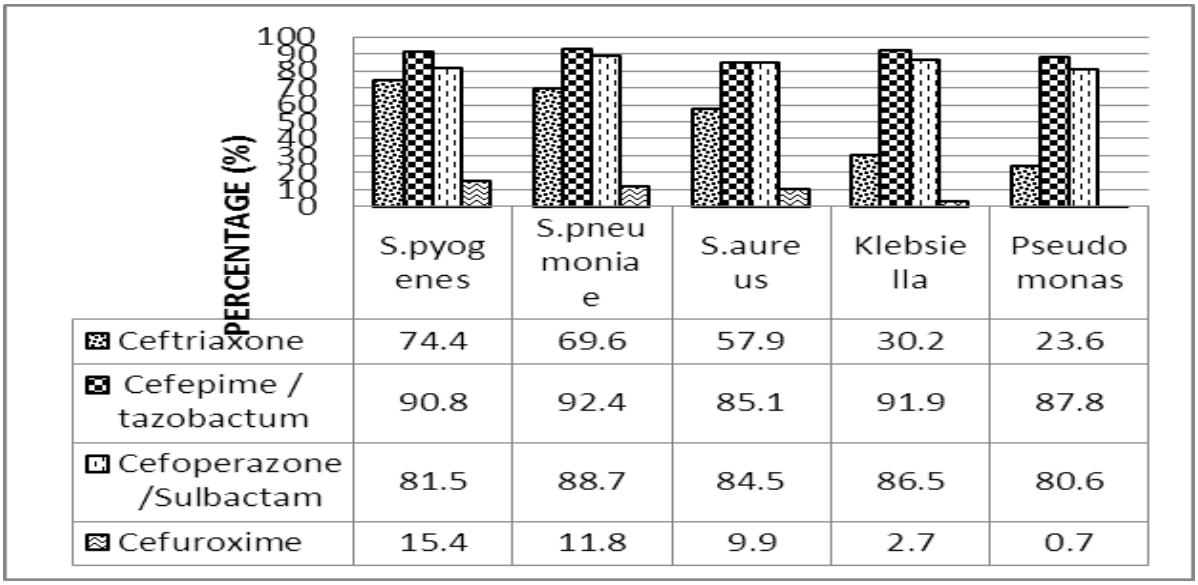
In penicillins, piperacillin tazobactum was found to have excellent activity against *S.pyogenes, S.pneumonia S.aureus Klebsiella sps and Pseudomonas sp* [CHART1,2,3].

According to **WHO Report on global status of ABR and Surveillance (2014)** –

- ✓ *E. coli*: resistance to third generation Cephalosporins, including resistance conferred by ESBLs and to FQ.
- ✓ *K. pneumonia*: resistance to third generation Cephalosporins, including resistance conferred by ESBLs and to Carbapenems.
- ✓ *S.aureus*: resistance to beta-lactam antibiotics (Methicillin, Methicillin resistant S. aureus).
- ✓ *S. pneumonia*: resistance or non-susceptibility to penicillin (or both).[51]

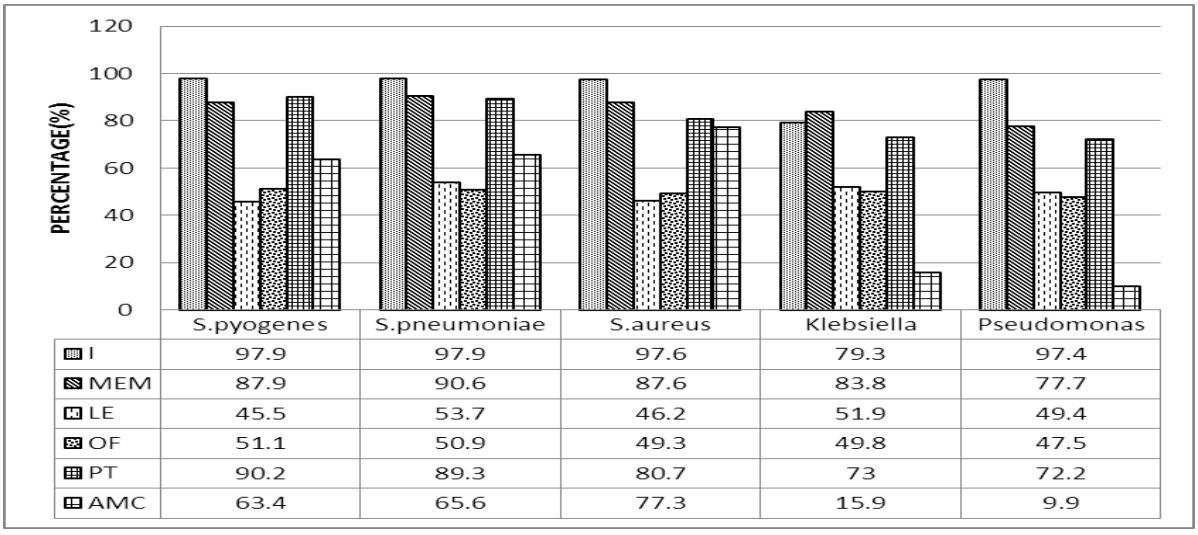
**Table:1. Sensitivity Pattern– Retrospective Study (January 2012 To Febuary 2014) (N= 6591)**

| Organism | No. of Patients Infected | Amikacin | Amoxicillin/ Clavulanic acid | Cotrimoxazole | Ceftriaxone | Ciprofloxacin | Ofloxacin | Netillin | Sparfloxacin | Cloxacillin | Piperacillin /Tazobactam | Cefepime / tazobactum | Cefoperazone/ Sulbactam | Meropenem | Imipenem | Vancomycin | Teicdpolanin | Levofloxacin | Polymixin B | Nalidixic acid | Azithromycin | Linezolid | cefuroxime | Nitrofurantoin | Norfloxacin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *E.coli* | 1011 | 810 | 166 | 226 | 320 | 204 | 454 | 708 | 252 | 0 | 829 | 926 | 708 | 728 | 818 | 4 | 4 | 346 | 405 | 23 | 336 | 9 | 34 | 481 | 90 |
| *K.pneumoniae* | 1439 | 1151 | 229 | 319 | 435 | 364 | 717 | 880 | 455 | 3 | 1050 | 1323 | 1246 | 1206 | 1141 | 26 | 13 | 747 | 745 | 52 | 647 | 26 | 39 | 418 | 96 |
| *S.pneumoniae* | 1783 | 1074 | 1170 | 210 | 1241 | 390 | 908 | 1195 | 554 | 63 | 1593 | 1648 | 1583 | 1616 | 1746 | 1606 | 636 | 957 | 16 | 2 | 1005 | 1647 | 211 | 15 | 11 |
| *P.aerogenosa* | 547 | 431 | 54 | 50 | 129 | 260 | 260 | 297 | 190 | 5 | 395 | 480 | 441 | 425 | 533 | 3 | 1 | 270 | 304 | 2 | 187 | 3 | 4 | 73 | 29 |
| *S.aureus* | 699 | 540 | 231 | 128 | 405 | 162 | 345 | 482 | 226 | 33 | 564 | 595 | 591 | 612 | 682 | 641 | 209 | 323 | 3 | 9 | 328 | 653 | 69 | 111 | 12 |
| *S.pyogenes* | 481 | 281 | 305 | 64 | 357 | 136 | 246 | 307 | 179 | 11 | 434 | 437 | 392 | 423 | 471 | 425 | 138 | 219 | 3 | 3 | 247 | 445 | 74 | 9 | 3 |
| *S.epidermidis* | 86 | 68 | 42 | 12 | 39 | 17 | 45 | 62 | 25 | 1 | 68 | 74 | 86 | 70 | 36 | 78 | 34 | 62 | 3 | 0 | 55 | 80 | 7 | 1 | 0 |
| *S.saprophyticus* | 179 | 146 | 81 | 31 | 67 | 25 | 94 | 184 | 57 | 5 | 138 | 141 | 157 | 159 | 177 | 160 | 81 | 108 | 7 | 1 | 97 | 157 | 7 | 101 | 7 |
| *Proteus vulgaris* | 23 | 20 | 11 | 5 | 13 | 10 | 15 | 11 | 7 | 0 | 17 | 23 | 15 | 20 | 22 | 0 | 0 | 6 | 3 | 1 | 1 | 0 | 0 | 8 | 2 |
| *Proteus mirabilis* | 28 | 21 | 11 | 6 | 19 | 11 | 16 | 11 | 9 | 0 | 22 | 23 | 25 | 28 | 28 | 0 | 0 | 19 | 8 | 1 | 6 | 0 | 1 | 5 | 5 |
| *Enterobacter* | 25 | 23 | 12 | 23 | 10 | 9 | 12 | 15 | 10 | 0 | 22 | 22 | 13 | 19 | 21 | 0 | 0 | 5 | 8 | 2 | 3 | 0 | 1 | 16 | 4 |
| *Actinobacter* | 148 | 74 | 29 | 12 | 14 | 15 | 49 | 15 | 76 | 0 | 67 | 122 | 121 | 71 | 143 | 0 | 0 | 50 | 79 | 0 | 31 | 0 | 2 | 4 | 2 |
| *Staphylococcus* | 34 | 28 | 13 | 5 | 15 | 11 | 11 | 21 | 15 | 4 | 23 | 33 | 22 | 24 | 34 | 33 | 7 | 12 | 0 | 0 | 4 | 32 | 0 | 4 | 0 |
| *Streptococci* | 66 | 31 | 46 | 10 | 38 | 16 | 32 | 37 | 18 | 0 | 58 | 49 | 57 | 59 | 65 | 51 | 20 | 32 | 0 | 0 | 42 | 61 | 13 | 1 | 0 |
| *Salmonella* | 21 | 17 | 5 | 5 | 11 | 8 | 13 | 14 | 7 | 0 | 14 | 19 | 18 | 19 | 21 | 0 | 0 | 14 | 5 | 0 | 9 | 0 | 0 | 11 | 3 |
| *Pneumococci* | 13 | 5 | 8 | 0 | 7 | 3 | 4 | 6 | 4 | 0 | 12 | 12 | 10 | 10 | 10 | 12 | 4 | 8 | 0 | 0 | 7 | 12 | 4 | 0 | 0 |
| *Gram negative bacilli* | 6 | 2 | 0 | 1 | 2 | 3 | 3 | 4 | 4 | 0 | 5 | 5 | 6 | 5 | 6 | 0 | 0 | 4 | 2 | 0 | 3 | 0 | 1 | 3 | 1 |
| *Nesseria* | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 2 | 2 | 2 | 2 | 0 | 0 | 1 | 1 | 0 | 2 | 0 | 1 | 0 | 0 |
| *Non Lactose Fermenters* | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |



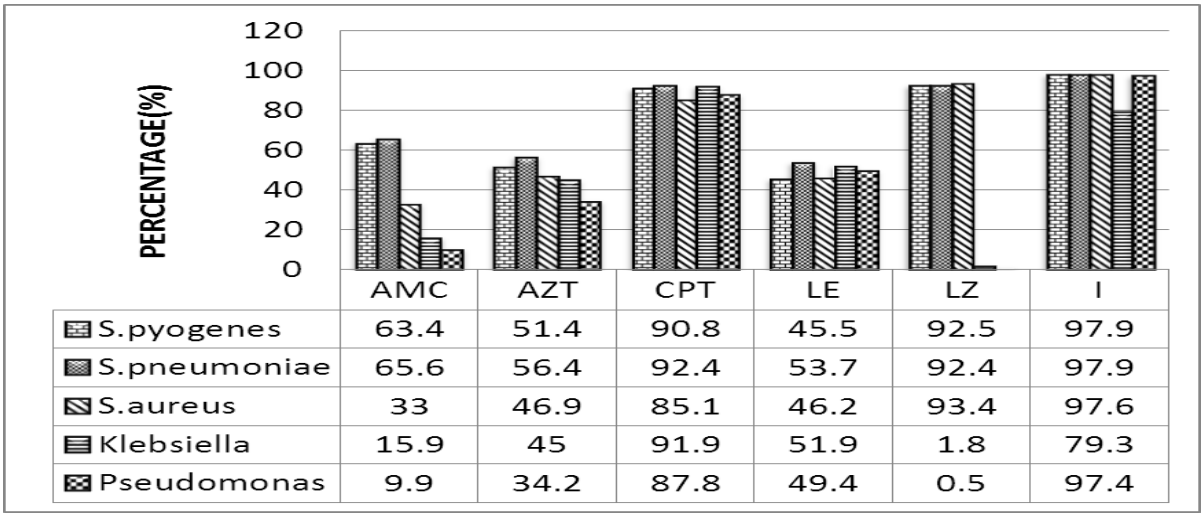

| | S.pyogenes | S.pneumoniae | S.aureus | Klebsiella | Pseudomonas |
|---|---|---|---|---|---|
| Ceftriaxone | 74.4 | 69.6 | 57.9 | 30.2 | 23.6 |
| Cefepime / tazobactum | 90.8 | 92.4 | 85.1 | 91.9 | 87.8 |
| Cefoperazone /Sulbactam | 81.5 | 88.7 | 84.5 | 86.5 | 80.6 |
| Cefuroxime | 15.4 | 11.8 | 9.9 | 2.7 | 0.7 |

**Chart: 1. Microbial sensitivity towards cephalosporins-retrospective (n=6591)**




| | S.pyogenes | S.pneumoniae | S.aureus | Klebsiella | Pseudomonas |
|---|---|---|---|---|---|
| I | 97.9 | 97.9 | 97.6 | 79.3 | 97.4 |
| MEM | 87.9 | 90.6 | 87.6 | 83.8 | 77.7 |
| LE | 45.5 | 53.7 | 46.2 | 51.9 | 49.4 |
| OF | 51.1 | 50.9 | 49.3 | 49.8 | 47.5 |
| PT | 90.2 | 89.3 | 80.7 | 73 | 72.2 |
| AMC | 63.4 | 65.6 | 77.3 | 15.9 | 9.9 |

**Chart: 2. Microbial sensitivity towards other antibiotics-retrospective (n=6591)**




| | AMC | AZT | CPT | LE | LZ | I |
|---|---|---|---|---|---|---|
| S.pyogenes | 63.4 | 51.4 | 90.8 | 45.5 | 92.5 | 97.9 |
| S.pneumoniae | 65.6 | 56.4 | 92.4 | 53.7 | 92.4 | 97.9 |
| S.aureus | 33 | 46.9 | 85.1 | 46.2 | 93.4 | 97.6 |
| Klebsiella | 15.9 | 45 | 91.9 | 51.9 | 1.8 | 79.3 |
| Pseudomonas | 9.9 | 34.2 | 87.8 | 49.4 | 0.5 | 97.4 |

**Chart: 3. Microbial susceptibility towards most effective antibiotics- retrospective (n=6591)**

**Table: 2. Specimen vs. Organism – retrospective study(January 2012-February 2014) (n=6591)**

| Organism | Number of patients infected | Urine | Tracheal | Semen | Throat swab | Pus cells | Sputum | Wound | Catheter tip | Blood | Bronchial fluid | Endotracheal | Ear swab | Pleural | CSF | Rectal | Vaginal | Umbilical | Motion | Suction tube | Aspiration fluid | Urethral |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *E.coli* | 1011 | 773 | 26 | 17 | 2 | 141 | 13 | 10 | 6 | 1 | 3 | 2 | 4 | 2 | 1 | 0 | 3 | 0 | 0 | 0 | 4 | 0 |
| *Klebsiella pneumonia* | 1439 | 600 | 169 | 13 | 63 | 216 | 245 | 23 | 7 | 0 | 6 | 22 | 2 | 2 | 3 | 0 | 4 | 1 | 0 | 0 | 1 | 0 |
| *S.pneumoniae* | 1783 | 3 | 16 | 0 | 510 | 8 | 1223 | 2 | 1 | 0 | 1 | 7 | 1 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| *Pseudomonas aeruginosa* | 547 | 172 | 52 | 9 | 22 | 169 | 72 | 18 | 2 | 1 | 6 | 3 | 11 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 |
| *S.aureus* | 699 | 153 | 20 | 19 | 63 | 300 | 73 | 18 | 3 | 10 | 1 | 1 | 8 | 1 | 0 | 0 | 5 | 0 | 14 | 0 | 1 | 0 |
| *S.pyogenes* | 481 | 5 | 4 | 6 | 271 | 21 | 167 | 3 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| *S.epidermidis* | 86 | 2 | 7 | 4 | 5 | 41 | 12 | 3 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *S.saprophyticus* | 179 | 167 | 0 | 10 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Proteus vulgaris* | 23 | 12 | 0 | 0 | 0 | 9 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Proteus mirabilis* | 28 | 15 | 0 | 0 | 0 | 12 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Enterobacter* | 25 | 19 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| *Acinetobacter* | 148 | 8 | 61 | 0 | 4 | 13 | 26 | 4 | 1 | 1 | 2 | 23 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Staphylococcus* | 34 | 6 | 4 | 1 | 3 | 5 | 6 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| *Streptococci* | 66 | 23 | 3 | 2 | 9 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| *Salmonella typhii* | 21 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| *Pneumococci* | 13 | 0 | 0 | 0 | 4 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Gram negative bacilli* | 6 | 4 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Nesseria* | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Non Lactose fermentor* | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table: 3. Frequency of multiple organisms isolated – retrospective (n= 6591)**

| ORGANISMS | NO. ISOLATED (n= 6591 ) |
|---|---|
| *Pseudomonas + E.coli* | 4 |
| *Pseudomonas + Klebsiella* | 9 |
| *Pseudomonas + S. aureus* | 4 |
| *S.pneumoniae + Klebsiella* | 16 |
| *Klebsiella + E.coli* | 1 |
| *Klebsiella + S. aureus* | 3 |
| *S. aureus + E.coli* | 3 |
| *S.pneumoniae + S.epidermidis* | 1 |
| *K.pneumoniae+ S.pyogenes* | 7 |
| *Pseudomonas + S.pneumoniae* | 1 |
| *E.coli + S.pneumoniae* | 1 |

## CONCLUSION

Antimicrobial resistance (AMR) threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi. Very high rates of resistance have been observed in bacteria that cause common health-care associated and community-acquired infections (e.g. urinary tract infection, pneumonia) in all WHO regions. AMR has a significant adverse impact on clinical outcomes and leads to higher cost due to consumption of health-care resources. The scarcity of new class of antibacterial drugs for Gram negative bacteria adds additional urgency.

## REFERENCES

1. Joseph T. Dipiro, Robert L. Talbert, Gary C. Yee, Gary R. Matzke, Barbara G. Wells, L. Michael Posey. Pharmacotherapy: A Pathophysiologic Approach. 8th Edition, China. McGraw-Hill Education, 2008; p.(1943-1976).
2. Roger Walker, Cate Whittlesea. Clinical Pharmacy and Therapeutics. 4th Edition. 2007. p. (496-507).
3. Antimicrobial resistance standing committee. National surveillance and reporting of antimicrobial resistance and antibiotic usage for human health in Australia. Common wealth of Australia, 2013; p.(3).
4. Braden R L. Surgical antibiotic prophylaxis. In: Herfindale E T, Gourley D R, Textbook of therapeutics: drug and disease management. 6th Edition. Maryland, USA: Williams and Wilkins, 1996; p.(1451-1456).
5. Tripathi KD. Essentials of medical pharmacology. 3rd Edition, New Delhi. India: Jaypee brothers, 2004; p. (624-630).

6. Laurence Brunton, Bruce A Chabner, BjornKnollman.Goodman and Gilman's the Pharmacological Basis of Therapeutics. 12th Edition, McGraw Hill Medical, 2011; p. (1029-1055).
7. Shanson D C. Microbiology in clinical practice. 3rd Edition. London, UK: Butterworth Heinemann; 1999.
8. Antimicrobial resistance fact sheet, 2014; 194.
9. Houvinen P. Control of antimicrobial resistance: Time for action. BMJ 1999; 14:953
10. Olumide, Cole. Combating resistance to antibiotics. Hosp.pharmacist, 2002; 9(1): 21-22.
11. James H. Jorgensen, Mary Jane Ferraro. Antimicrobial susceptibility testing: a review of general principles and contemporary practices. Clinical Infectious Diseases, 2009; 49(11): 1749
12. American Association for Clinical Chemistry [Internet]. 2014 [updated February 20 2014]. Available from: http://labtestsonline.org/understanding/analytes/sputum-culture/tab/faq
13. WHO. A report on antibiotic resistance, 2014 April 30;1.
14. D.G.Grahame-Smith, J.K. Aronson. Oxford Textbook of Clinical Pharmacology and Drug Therapy. 3rd Edition, OUP Oxford; 2002.p. 263-275.
15. Tripathi Purti C, Dhote Kiran. Lower respiratory tract infections: current etiological trends and antibiogram. JPBMS, 2014; 04(03): 249-255.
16. T.Sivakumar, R.Senthilkumaran R. Thamizhmani. Antimicrobial susceptibility patterns of gram negative and positive bacteria from respiratory tract infections in rural government hospital patients, Vandavasi, Tamil Nadu, South India. IJCRCPS, 2014; 1(2): 79-82.
17. Agmy G, Mohamed S, Gad Y, Farghally E, Mohammedin H, Rashed H. Bacterial profile, antibiotic sensitivity and resistance of lower respiratory tract infections in Upper Egypt. MJHID, 2013; 2: 5(1).
18. C. Manikandan, A. Amsath. Antibiotic susceptibility of bacterial strains isolated from patients with respiratory tract infections. IJPAZ, 2013; 1: 61-69.
19. K V Ramana, Anand Kalaskar, Mohan Rao, Sanjeev D Rao.Aetiology and Antimicrobial Susceptibility Patterns of Lower Respiratory Tract Infections (LRTI's) in a Rural Tertiary Care Teaching Hospital at Karimnagar, South India. AJIDM, 2013; 1: 101-105.
20. Shamungum Sriram, Varghese Aiswaria, Annie Eapen Cijo, Thekkinkattil MohanKumar. Antibiotic sensitivity pattern and cost-effectiveness analysis of antibiotic therapy in an Indian tertiary care teaching hospital, 2013; 2: 70-74.

21. TemitopeOlowokere, Mutiu A. Alabi, Bamidele S. Fagbohunka, Rita M. Sunday, Ekundayo T. Salami, FolakeOsanaiye et al. Antibiotic Sensitivity Pattern of Bacteria from Selected Hospitals in AkungbaAkoko, Ondo State, Southwest Nigeria. IOSR-JPBS, 2013; 8(1): 01-04.
22. Sriram S, Vidhya D, Gisha Mary George, Manjula Devi AS, Rajalingam BR, Shivasankhar V *et al*. Study on bacterial spectrum and antibiotic resistance of pathogens at a private corporate hospital. UJP, 2013; 02(03): 63-68.
23. Syed Mustaq Ahmed, Ramakrishna PaiJakribettu, Shaniya Koyakutty Meletath, Arya B, Shakir VPA. Lower respiratory tract infections (LTRIs): An insight into the prevalence and the antibiogram of the Gram negative, respiratory, bacterial agents. JCDR. 2013; 7(2): 253–256.

A. Banerjee, D. Pal, S. Pal, A. Naskar, M. Ghosh, S. Mallik et al. A study on prevalence and antibiotic sensitivity pattern of bacteria causing lower respiratory tract infections and their association with risk groups.

24. Trupti Bajpai**,** G Shrivastava**,** GS Bhatambare**,** AB Deshmukh**,**
25. V Chitnis. Microbiological profile of lower respiratory tract infections in neurological intensive care unit of a tertiary care centre from Central India. PMID, 2013; 4(3): 51-55.
26. Nakade Dhanraj B. Antibiotic sensitivity of common bacterial pathogens against selected Quinolones. ISCA J. Biological Sci, 2012; 1(1): 77-79.
27. MaksumRadji, SitiFauziah, NurganiAribinuko. Antibiotic sensitivity pattern of bacterial pathogens in the intensive care unit of Fatmawati Hospital, Indonesia. APJTB, 2011; 39-42.
28. Iffat Javeed, RubeenaHafeez, M.Saeed Anwar. Antibiotic susceptibility pattern of bacterial isolates from patients admitted to a tertiary care hospital in Lahore. Biomedical, 2011; 27: 19-23.
29. M. Shanthi, Uma Sekhar. Antimicrobial susceptibility pattern of Methicillin Resistant *Staphylococcus aureus* at Sri Ramachandra Medical Centre. SRJM, 2009; II(2): 1-4.
30. Zafar A, Hussain Z, Lomama E, Sibille S, Irfan S, Khan E.Antibiotic susceptibility of pathogens isolated from patients with community-acquired respiratory tract infections in Pakistan--the active study. J Ayub Med Coll Abbottabad, 2008; 20(1):7-9.
31. India Working Group. Rationalizing antibiotic use to limit antibiotic resistance in India. Indian J Med Res, 134; 2011: 281-294.

32. Global Respiratory Infection Partnership [Internet]. Available from: http:// www.grip-initiative.org/home.php.
33. Khavane K, Addepalli V, Bhusar K, Payghan S A, Patweaker S, Kate V. Prescribing pattern of antibiotic and sensitivity patterns of microorganisms towards different antibiotics in multi dispensary health care hospital. IJPBA. 2010; 1(2): 112-115.
34. Shamataj Kattalagere Rasak, Vishwanath Gurushantappa. Bacteriology of urinary tract infection and antibiotic susceptibility pattern in a tertiary care hospital in South India. IJMP. 2012; 1(2):109-112.
35. Shalini, Joshi M C, Rashid M K, Joshi H S. Study of antibiotic sensitivity pattern in urinary tract infection at a tertiary hospital. NJIRM. 2011; 2(3): 43-46.
36. World Health Organization 2014. Anti-microbial resistance global report on surveillance.