INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE & TECHNOLOGY
© VISHWASHANTI MULTIPURPOSE SOCIETY (Global Peace Multipurpose Society) R. No. MH-659/13(N)
www.vmsindia.org

Antibiotic susceptibility pattern of *Pseudomonas aeruginosa* isolated from urine samples of urinary tract infection patients in Nagpur region of Maharashtra state

M. A. Nimbalkar[1] and C. J. Chandekar[2]
[1]Dept. of Microbiology. L.A.D College.Nagpur.
[2]Dept.of Microbiology.Shri.Shivaji Science College. Nagpur

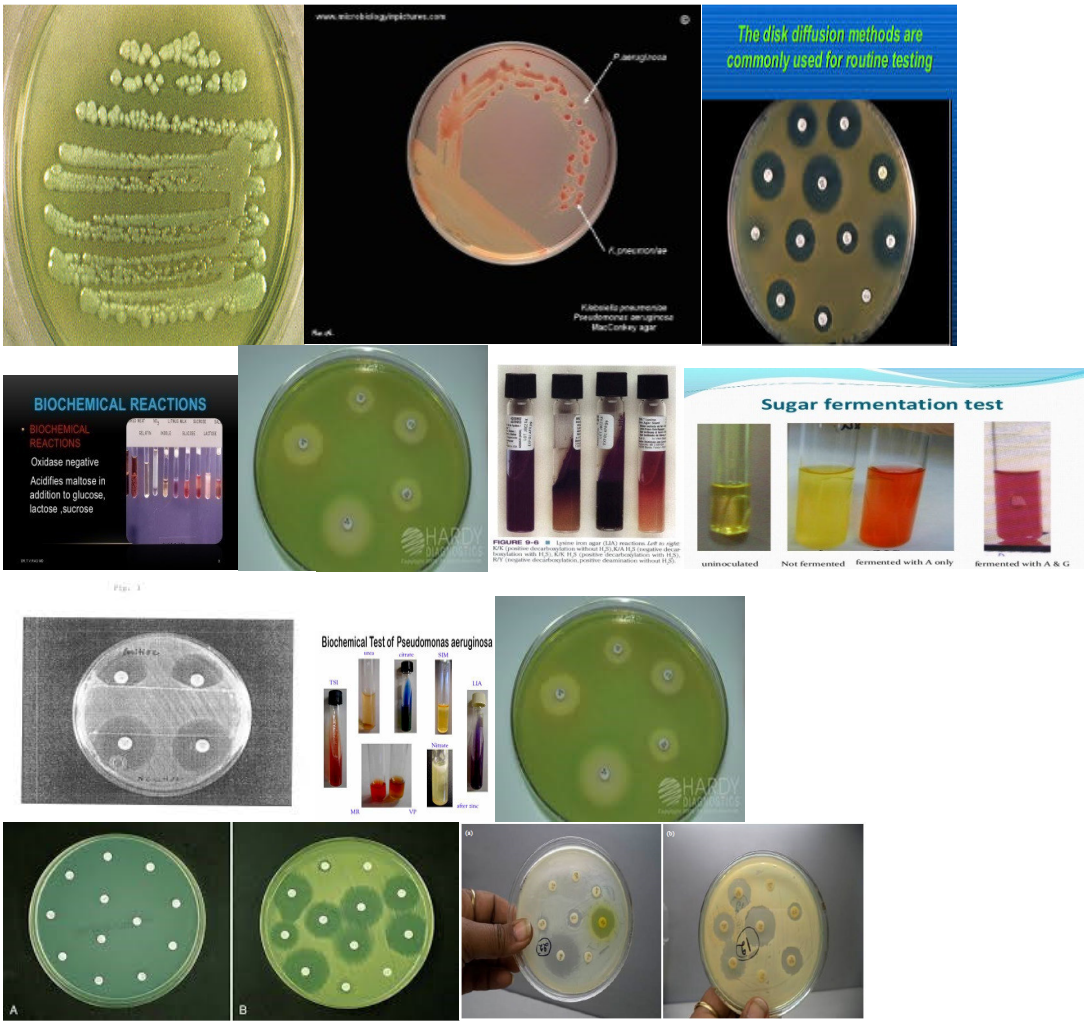
Abstract:
*Pseudomonas aeruginosa*is often encountered in urinary tract infection (UTI) worldwide and has shown varied antibiotic susceptibility patterns.This study was therefore designed to ascertain the antibiotic susceptibility patterns of the organism in tertiary care hospital of Nagpur region. Data on antimicrobial susceptibility of *P. aeruginosa* generated from urine samples collected from indoor and outdoor patients for the period of one year(October 2014 to October 2015).Samples were collected, stored and processed using standard laboratory procedures. Many different bacteria are isolated from the different 648 urine samples out of which 245(44%)*pseudomonas aeruginosa* samples were confirmed.147(60%) species of *pseudomonas* were isolated from females and 97(40%) were isolated from male patients.Antimicrobial susceptibility of all the isolates was performed by the disc-diffusion (Modified-Kirby Bauer disc diffusion method) according to CLSIsguidelines.The isolated cultures were sensitive toamikacin (82.6%),azotreonam(88%), piperacillin-tazobactum (78.2%), nitrofurantoin (82.1%) and imipenem (98.9%).The sensitivity to ampicillin(49%), cefuroxime(62%), ceftriaxone(61%), norfloxacin(57%), ciprofloxacin(59%), kanamycin(63%), tobramycin(76%), Gentamycin(51%), neomycin(55%), ciprofloxacin(59%), cefuroxime(62%), levofloxacin(65%), Ceftrixone(61%), ceftazidime(64%),ampicillin(39%),Cefurozime(70%),Cefoxitin(68%).
In conclusion, the rate of antibiotics resistance against *P. aeruginosa* is extremely high. Prudent and more justifiable reasons for antibiotics consumption both for prophylactic and therapeutic use against UTI should be critically weighed against the side effect of resistance development. Furthermore, antimicrobialsusceptibility testing should be performed as a basic laboratory procedure among hospitals and clinics so as to aid in the choice of antibiotics prescriptions inhealth Centre.

Introduction:
Pseudomonas aeruginosa is one of the important bacterial pathogen isolated from various samples. Despite advances in medical and *surgical* care and introduction of wide variety of antimicrobial agents against having *anti-pseudomonal* activities, life threatening infection caused by *Ps. aeruginosa* continues to cause complications in hospital acquired infections. Several different epidemiological studies indicate that antibioticresistance is increasing in clinical isolates.*Pseudomonas aeruginosa* is a bacterium that is often encountered in urinary tract infection (UTI) worldwide and has shown varied antibiotic susceptibility patterns. This study was therefore designed to ascertain the antibiotic susceptibility patterns of the organism in tertiary care hospital of Nagpur region. Data on antimicrobial susceptibility of *P. aeruginosa* generated from urine samples collected from indoor and outdoor patients in the hospital in microbiology department of present hospital for the period of one year(October 2014 to October 2015).Samples were collected, stored and processed using standard laboratory procedures. Among the most common infectious diseases urinary tract infections UTIs are common encountered disease in developing countries. UTIs refer to the presence of microbial pathogens within the urinary tract and it is usually classified by the infectionsite: bladder (cystitis), kidney (pyelonephritis) or urine and also can be asymptomatic. Many different bacteria are isolated from the different 648 urine samples out of which 245 pseudomonas aeruginosa samples were confirmed.147 species of pseudomonas were isolated from females and 97 were isolated from male patients.
Pseudomonas aeruginosa has emerged as a major cause of infection in the last few decades. It is an increasingly prevalent opportunistic pathogen and is the fourth most frequently isolated nosocomial pathogen rate was 19.69%.[23]*P. aeruginosa* were more sensitive to combination drugs like piperacillin+tazobactum (93.5%) and cefoperazone+sulbactum (92.3%) followed by imipenem (88.2%), meropenem (87.1%). Sensitivity to amikacin, tobramycin, gentamicin and ceftazidime ranges from 35% to 55%. Highest resistance rate was seen for amoxicillin followed by doxycycline. From our study, we concluded that *P. aeruginosa* is one of the most common nosocomial pathogen.
It is sensitive to combination drugs like piperacillin+tazobactum and cefoperazone+sulbactum. It is also sensitive to carbapenems like imipenem, meropenem and aminoglycosides like amikacin, tobramycin, gentamicin, and cephalosporins like ceftazidime. Rational use of these drugs is necessary to prevent further spread of antimicrobial resistance among *P. aeruginosa* strains and also emergence of multi drug resistance. Hence this study was designed to ascertain the antibiotic susceptibility patterns of the organism in tertiary care hospital of Nagpur region.
Material and Method: Materials and methods: The present study was conducted during October 2014 to October 2015. The samples were collected and stored and then processed using the

standard procedure for isolation and identification of the *pseudomonas species*. A total of 245 *pseudomonas aeruginosa* strains are isolated from 648 urine samples from indoor and outdoor patients.The study was carried out in microbiology department of tertiary care hospital of Nagpur region.Out of 648 samples 547sample showed growth of bacteria(84%), 245(44%)were *Pseudomonas aeruginosa*.53(10%) samples show no growth and 51(9%) samples showed mixed growth.

The samples were selected on the basis of their growth on routineMacConkey medium which showed lactose non-fermenting pale colonies which were oxidase test positive and on nutrient agar pigmented and non-pigmented colonies with oxidase positive. Antimicrobial susceptibility of all the isolates was performed by the disc-diffusion (Modified-Kirby Bauer disc diffusion method) according to CLSIsguidelines. . Antimicrobial disc for susceptibility test were procured from Hi-Media Mumbai. Muller Hinton agar was used application of antibiotic discs to the inoculatedagar plates: Antimicrobial susceptibility of all the isolates wasperformed by the disc-diffusion (Modified-Kirby Bauerdisc diffusion method) according to CLSIs guidelines. The following antibiotics were tested by disc diffusion method.Amikacin(30µg)Ciprofloxacin(30µg) , Norfloxacillin(30µg), Levofloxacin (30µg), Ceftriaxone (30µg),Ceftazidime (30µg) , Cefuroxime (30µg), Cefoxitin (30µg), Kanamycin (30µg), Tobramycin (30µg), Gentamycin (30µg), Neomycin (30µg), Augmentin (30µg), Aztreonam (30µg), Piperacillin (30µg), Nitrofurotoin (30µg), Nalidixic acid (30µg), Tazobactam (30µg), Imepenem (10µg), Meropenem (10µg), Ticarcillin (30µg) were used forantibiotic susceptibility test.

Fig:1 Pseudomonas colonies in Nutrient Agar Fig :2Psudomonas colonies on Mac conkey agar
Fig:3 Antibiotic sensitivity against antibiotic Fig :4Biochemical reactions
Fig:5 Triple sugar iron slant Fig:6Sugar Fermentation reaction Reactions
Fig :7Antibiotic sensitivity test Fig:8 IMVIV on Muller Hinton Agar



Observation Table:

Sr.no	Name of the antibiotic	No of female patients showing susceptibility in %	No of male patients showing susceptibility in %	Total % showing susceptibility
1	Amikacin	82%	80%	84%
2	Ciprofloxacin	60%	55%	43%
3	Norfloxacin	64%	60%	57%
4	Levofloxacin	66%	61%	66%
5	Ceftriaxone	68%	67%	63%
6	Ceftazidime	65%	62%	65%
7	Cefuroxime	58%	49%	75%
8	Cefoxitin	78%	71%	68%
9	Kanamycin	54%	49%	57%
10	Tobramycin	58%	55%	65%
11	Gentamycin	60%	51%	49%
12	Neomycin	53%	49%	45%
13	Augmentin	69%	68%	75%
14	Amoxicillin	53%	45%	33%
15	Ampicillin	34%	41%	35%
16	Aztreonam	79%	71%	68%
17	Piperacillin	86%	75%	66%
18	Nitrofurantion	69%	63%	73%
19	Nalidixic acid	76%	67%	69%
20	Tazobactam	92%	93%	83%
21	Imepenem	97%	90%	89%
22	Meropenem	84%	81%	87%
23	Ticarcillin	89%	82%	78%
24	piperacillin	86%	86%	75%

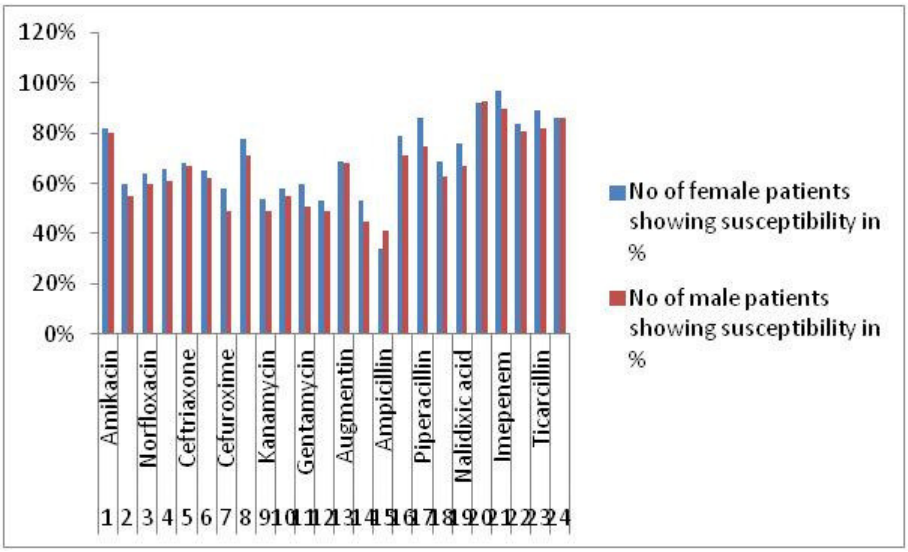


Figure : 9 Bar Diagram showing the male, female ratio for antibiotic susceptibility test.

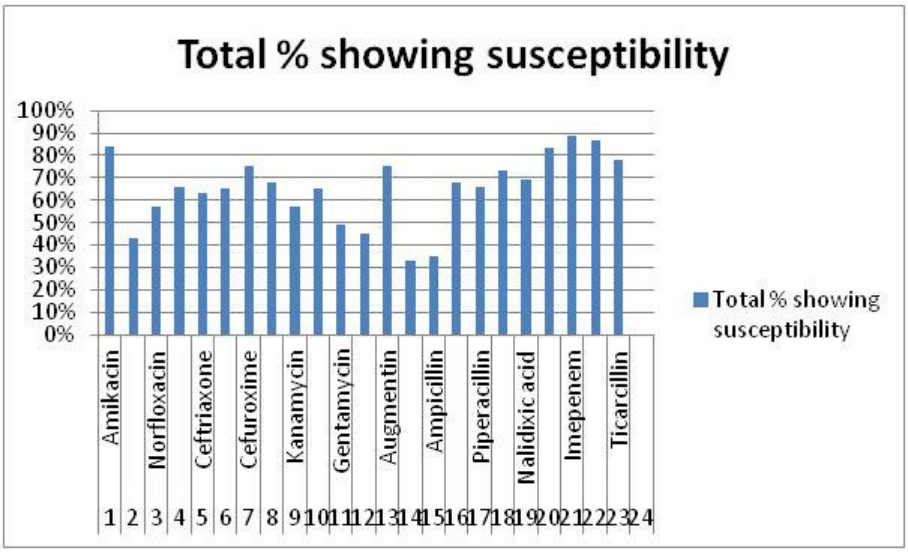


Figure :10 BarDiagram showing total antibiotic susceptibility values for given no of sample

Results:

In the present study we have used near about 20 different generation antibiotics along with beta lactam antibiotics which are given in some of the cases.

A total of 648 urine samples were received for culture and sensitivity during the study period. Among these, 547 samples (84%) yielded significant growth57 samples (10.1%) showed no growth and 53samples (10%) showed mixed growth. From various organisms isolated from urine culture only *Pseudomonas aeruginosa,* was selected for the study and all were uropathogens. After obtaining the pure strains of *pseudomonas aeruginosa* , the strains were subjected to biochemical identification tests to identify*Pseudomonas spp*. For this purpose samples were inoculated in Triple Sugar Iron media (TSI), Citrate media, Peptone water, Urease media and kept in anincubator for 18 hrs at 37°C. Next day the results werenoted on TSI, Citrate media and Urease media. Part ofgrowth on Peptone water was subjected to Indole test with Kovac's Reagent and part for motility test byHanging drop' method. A strain of *Pseudomonas* inthe TSI medium showed alkaline slant, no reaction inbutt. It showed negative reaction for indole test,negative urease test and positive citrate test. Glucose isutilized oxidatively, forming acid only.

After confirmation the isolates were further subjected to antibiotic sensitivity test. These isolated were found to be sensitive to amikacin (84.6%),azotreonam(79%), piperacillin-tazobactum (78.2%), nitrofurantoin (73.1%) and imipenem (98.9%).The sensitivity to ampicillin(41%), cefuroxime(75%),ceftriaxone(63%),norfloxacin(57%),ciprofloxacin(59%),kanamycin(57%),tobramycin(67%),gentamycin(53%),neomycin(55%),cefuroxime(72%),levofloxacin(66%),ceftrixone(61%),ceftazidime(64%),amoxicillin(39%),cefoxitin(68%).

During the analysis it was observed that empirical therapy was started in 50 cases. In 32 cases ceftriaxone was used, in 20 ciprofloxacin, in seven cases norfloxacin and in the remaining few ampicillin, amoxicillin, cephalexin and doxycycline were used in the study.

Discussion:

All the isolates of *P. aeruginosa* (100%) in the present study were resistant to number of antibiotics, ampicillin, amoxicillin, neomycin ,kanamycin, ciprofloxacin while the highest sensitivity rate of 92% was recorded with Tazobactam,97%with imepenem. Antibiotics like meropenem, ticarcillin, piperacillin,nalidixic acid shows the sensitivity in the range of 80%to 90%. The antibiotics ceftazidime, tobramycin, augmentin , levofloxacin, norfloxacin,nitrofurantoin all shows the antibiotic susceptibility in the range of 55% to 75%.

These findings compare favorably with that of: Goniugur *et al* (2003) in Turkey on 249 isolates of *P.aeruginosa* in a teaching hospital where 100% resistance to ampicillin and penicillin was recorded; Sule *et al,* (2002) in Sagamu, Nigeria who reported a sensitivity of *P. aeruginosa* to aminoglycosides in the range of 61.8%- 75%, fluoroquinolones, 82.8%-89.2% and ampicillin, and tetracycline, 1.7%- 46.8%; Taiwo *et al,* (2002) inIllorin who reported *P. aeruginosa* to be sensitive in the range 70%- 94% to ofloxacin and ciprofloxacin,and 55%- 90% to gentamicin, ceftriaxone, azithromycin, and ampicillin; and Olayinka, *et al,* (2004), in Zaria who reported a 27.8% of the 92isolates of *P. aeruginosa* to be of Ceftazidime +gentamicin + pefloxacin + ofloxacin resistance pattern. Also in Pakistan (Ogundipeju, & Nwobu,2004), *P. aeruginosa* was similarly reported to be75%, 30%, and 10% susceptible to

gentamicin, streptomycin and tetracycline respectively; while in Japan, Ogiwara, *et al* (1999) as well reported a high resistance (over 90%) of the organisms to tetracycline, nalidixic acid, nitrofurantoin and ampicillin. Similar susceptibility patterns of *P. aeruginosa* were also reported in Saudi Arabia and Kuwait (Rotimi, *et al,* 1998), Canada and Brazil (Pfaller, *etal,* 1998), and South Korea (Cane, & Walsh, 1999).

Findings from this study also compares well with that from Egypt which showed a resistance of about 95%*P. aeruginosa* isolates against ampicillin (Elkholy, *etal*, 2003). This high resistance of *P. aeruginosa* is believed to be as a result of the ability of the organism to undergo mutation and acquire resistant genes at a faster rate compared to *Enterobacteriaceae* (Woods, *et al,* 1986).

Administration of antibiotics as a prophylacticmeasure against UTI should always be analyzedcritically and the benefits seen to be well above theside effects of which resistance is one of them, beforechoosing such a management option (Struelens,1998). Prolonged or permanent urethral catheterizations are notable scenarios often encountered and their benefits need be periodically reviewed. Also, health personnel should be aware of the prevailing antimicrobial activity pattern of, at least, the locally available antibiotics against *P.aeruginosa* so as to make correct or near correct prescriptions in the absence of a comprehensive antimicrobial susceptibility report (Swedish-Norwegian Consensus Group, 1998). This would help reduce the external stimuli from inappropriate drug prescriptions towards the development and acquisition of resistance genes by bacteria (Ayliffe,1996).

In view of the current rate of antimicrobial resistance of *Pseudomonas* as found in the present study, antimicrobial susceptibility testing by Microbiology laboratories of hospitals and clinics should be made a routine practice in such health centers. Also the procurement of reagents and materials for susceptibility testing along with the requisite personnel should be considered a basic laboratory requirement in order to boost this conventional practice. In conclusion, this study has shown that, the rateof antibiotics resistance against *P. aeruginosa* is extremely high. Prudent and more justifiablereasons for antibiotics consumption both forprophylactic and therapeutic use against UTI shouldbe critically weighed against the side effect ofresistance development. Furthermore, antimicrobialsusceptibility testing should be performed as a basiclaboratory procedure among hospitals and clinics so as to aid in the choice of antibiotics prescriptions.

References

Acar JF. Consequencesof bacterial resistance to antibiotics in medical practice. Clin Infect Dis 1997;24(suppl1):S17-S18.

Ahmed SM, Jakribettu RP, Kottakutty S, Arya B, rShaki VPA. An emerging multi-drug resistant pathogen in a tertiary care centre in North Kerala. Annals Biol Res 2012;3(6):2794-99.

Al-Kabsi AM, Yusof MYBM, Sekaran SD. Antimicrobial resistance pattern of clinical isolates of Pseudomonas aeruginosa in the University of Malaya Medical Center, Malaysia. Afr J Microbiol Res 2011;5(29):5266-72

Al-Tawfiq JA. Occurrence and antimicrobial resistance pattern of inpatient and outpatient isolates of *Pseudomonas aeruginosa* in a Saudi Arabian hospital: 1998-2003. Int J Infect Dis 2007;11:109-14.

Anjum F, Mir A. Susceptibility pattern of *Pseudomonas aeruginosa* against various antibiotics. Afr J Microbiol Res 2010;4(10):1005-12.

Arora D, Jindal N, Kumar R, Romit. Emerging antibiotic resistance in Pseudomonas aeruginosa.Int J Pharm Pharm Sci 2011;3(2):82-4.

Barnett, B. J. and Stephens, D. S., 1997. Urinary tract infection: An overview. *Am. J. Med. Sci.* 314:245-249.

Behzadiyan-Nejad, Q., Souri, E. and Owhia, P.(1989). *In vitro* effects of sub-inhibitory concentrations of gentamicin on *P. aeruginosa* alginate production.*Pharm. Pharmacol.Commun.*4: 489-491.

Bhandari S, Banjara MR, Lekhak B, Bhatta DR, Regmi SR. Multi-drug and pan-drug resistant Pseudomonas aeruginosa: a challenge in post-antibiotic era. Nepal J Sci Tech 2012;13(2):197-202.

Bousseimi, K., Thabet, L., Ouesiat, S., Jaber, O. B., Ouchtati, A., Cherif, S., Redjeb, S. B. and Messadi, A. (2005). Epidemiological profile and antibiotic susceptibility of *Pseudomonasaeruginosa* isolates within the hospitalized burned patient. *Critical care* 9(suppl. 1): 10-11.

Bonfiglio, G., Carciotta, V., Russo, G., Stefani, S.,Schito, G. C., Debbia, E. and Nicoletti, G.(1998). Antibiotic resistance in *Pseudomonas aeruginosa*: an Italian survey. *J. Antimicrob.Chemother.* 41: 307-310.

Chen HY, Yuan M, Livermore DM. Mechanisms of resistance to beta-lactam antibiotics amongst Pseudomonas aeruginosa isolates collected in the United Kingdom in 1993. J Med Microbiol 1995;43: 300-09.

Collee JG, Miles RS, Watt B. Tests for identification of bacteria. In: Collee JG, Duguid JP, Fraser AG, Marmion BP, eds. Mackie and MacCartney Practical Medical Microbiology. 14th ed. New York: USA: Churchill Livingstone;1996, p. 131-149.

Edinburgh: Churchill Livingstone, 1-10. Elkholy, A., Baseem, H., Hall, G. S., Procop, G. W.and Longworth, D. L. 2003). Antimicrobial resistance in Cairo, Egypt 1999-2000: a survey of five hospitals. *J. Antimicrob. Chemother.*51:625-630

Elkholy, A., Baseem, H., Hall, G. S., Procop, G. W.and Longworth, D. L. (2003). Antimicrobial resistance in Cairo, Egypt 1999-2000: a surveyof five hospitals. *J. Antimicrob. Chemother.*51:625-630.

Fazlul MKK, Zaini MZ, Rashid MA, Nazmul MHM. Antibiotic susceptibility profile s of clinical isolates of Pseudomonas *aeruginosa* from Selayang Hospital, Malaysia. Biomed Res 2011;22(3):263-66.

Ferede, D., Geyid, A., Lulseged, S. and Melaku, A. (2001). Drug susceptibility pattern of bacterialisolates from children with chronic suppurative otitis media.*Ethiopian J. Health Development* 2001; 15: 89- 96.

Franco BE, Martinez MA, Rodriguez MAS, Wertheimer AI. The determinants of the antibiotic resistance process. Infect Drug Resist 2009;2:1-11.

Franco BE, Martinez MA, Rodriguez MAS, Wertheimer AI. The determinants of the antibiotic resistance process. Infect Drug Resist 2009;2:1-11.

Goniugur, U., Bakici, M. Z., Ozdemir, L., Akkurt, I., Icagasiogh, S. and Gultekin, F. (2003).Retrospective analysis of antibiotic susceptibility patterns of respiratory isolates of *Pseudomonas aeruginosa* in a Turkish University Hospital. *Ann. ClinMicrobio Antimicrobials*. 2: 2-5.

Gupta V, Datta P, Agnihotri N, Chander J. Comparative in vitro Activities of Seven New beta-Lactams, Alone and in Combination with beta-Lactamase Inhibitors, Against Clinical Isolates Resistant to Third Generation Cephalosporins. *Braz J Infect Dis.* 2006;**10**:2225.

Hodges, N. A. and Gordon, C. A. (1991). Protection of *P. aeruginosa* against ciprofloxacin and betalactams by homologous alginate.*Antimicrob.Agents and Chemother.*35: 2450-2452.

Ichimiya, T., Yamasaki, T. and Nasu, M. (1994). In vitro effects of antimicrobial agents on*Pseudomonas aeruginosa* biofilm formation.*J. Antimicrob. Chemother.*34: 331-341.

Javiya JA, Ghatak SB, Patel KR, Patel JA. Antibiotic susceptibility patterns of Pseudomonas aeruginosa at a tertiary care hospital in Gujarat, India. Indian J Pharmacol 2008;40(5):230-34.

Jones, R. N. (1999). Contemporary antimicrobial susceptibility patterns of bacterial pathogenscommonly associated with febrile patients with neutropenia. *Clin. Infect. Dis.* 29: 495- 502.

Jones, R. N., Ballow, C. H. and Biedenbach, D. J., *et al, (*1998). Antimicrobial activity ofquinupristin-dalfopristin (RP59500, Synercid)tested against over 28,000 recent clinicalisolates from 200 medical centers in the United states and Canada. *Diag. Microbiol. Infect. Dis.* 31: 437- 451. 27.Kerr KG, Snelling AM. Pseudomonas aeruginosa: a formidable and ever-present adversary. J Hosp Infect 2009;73:338-44.

Kiska DL, Gilligan PH. *Pseudomonas*. In: Murray PR, Baron EJ, Jorgensen, JH, Pfaller MA, Yolken RH, editors. Manual of clinical microbiology. 8th ed. Washington, DC: American Society for Microbiology, 200. p. 719728.

Mohanasoundaram KM. The antibiotic resistance pattern in the clinical isolates of Pseudomonas aeruginosa in a tertairy care hospital; 2008-2010 (A 3 year study). J Clin Diagn Res 2011;5(3):491-94.

Moazami-Goudarzi S, Eftekhar F. Assessment of carbapenem susceptibility and multidrug-resistance in *Pseudomonas aeruginosa* burn isolates in Tehran. Jundishapur J Microbiol 2013;6(2):162-65.

National Committee for Clinical Laboratory Standards. NCCLS document M2-A8 Vol. 23 No. 1, Performance standards for antimicrobial disk susceptibility tests, approved standard, 8th ed. 2003. National Committee for Clinical Laboratory Standards, VillanovaPa.

Nwankwo EOK, Shuaibo SA. Antibiotic susceptibility patttern of clinical isolates of *Pseudomonas aeruginosa* in a tertairy health institution in Kano, Nigeria. J Med Biomed Sci 2010;37-40.

Ogiwara, M., Ishibashi, K., Yoshida, H., Imafuku,Y., Murai, M. and Igari, J., *et al,* (1999).Comparative studies on activities ofantimicrobial agents against the causativeorganisms isolated from patients with urinarytract infections (1997). III. Secular changes insusceptibility. *Jpn. J. Antibiot.*52: 177-267.

Ogundipeju, O. O., Nwobu, R. A. U. (2004).Occurrence of *Pseudomonas aeruginosa* inpost-operative wound infection. *Pak. J. Med.*20: 187-191.

Olayinka, A. T., Onile, B, A. and Olayinka, B. O.(2004). Prevalence of multi-drug resistance(MDR) *Pseudomonas aeruginosa* isolates insurgical units of Ahmadu Bello UniversityTeaching Hospital, Zaria, Nigeria: An indication effective control measures. *Ann. Afri. Med.*3: 13-16.

Orrett FA. Antimicrobial susceptibility survey of Pseudomonas aeruginosa strains isolated from clinical sources. J Natl Med Assoc 2004;96(8):1065-69.

Pathmanathan SG, Samat NA, Mohamed R. Antimicrobial susceptibility of clinical isolates of *Pseudomonas aeruginosa* from a Malaysian hospital. Malays J Med Sci 2009;16(2):27-32.

Pfaller, A. M., Jones, R. N., Doern, G. V. andKugler, K., *et al, (*1998). Bacterial pathogensisolated from patients with bloodstreaminfection: frequencies of occurrence andantimicrobial susceptibility patterns from theSENTRY Antimicrobial surveillance program.(United states and

Canada, 1997). *Antimicrob.Agents Chemother.*42: 1762-1770.

Poole K. Pseudomonas aeruginosa: resistance to the max. Front Microbiology 2011;2:1-13.

Rajat RM, Ninama GL, Mistry K, Parmar R, Patel K, Vegad MM. Antibitic resistance pattern in *Pseudomonas aeruginos*a species isolated at a tertiary care hospital, Ahmadabad. National J Med Res 2012;2(2):156-59.

BV, Chaudhury A. Antibiotic resistance pattern of *Pseudomonas aeruginosa* isolated from healthcare associated infections at a tertiary care hospital. J Sci Soc 2012;39:78-80.

Rashid A, Chowdhury A, Rahman SHZ, Begum SA, Muazzam N. Infections by *Pseudomonas aeruginosa* and antibiotic resistance pattern of the isolates from Dhaka Medical College Hospital. Bangladesh J Med Microbiol 2007;1(2):48-51.

Rotimi, V. O., al-Sweih, N. A. and Feteih, J. (1998).The prevalence and antibiotic susceptibilitypattern of gram-negative bacterial isolates intwo ICUs in Saudi Arabia and Kuwait. *Diagn.Microbiol. Infect. Dis.* 30: 53-59

Savas L, Duran N, Savas N, Onlen Y, Ocak S. The prevalence ans resistance patterns of Pseudomonas aeruginosa in intensive care units in a university hospital. Turk J Med Sci 2005;35:317-22.

Shenoy S, Baliga S, Saldanha DR, Prashanth HV. Antibiotic sensitivity patterns of Pseudomonas aeruginosa strains isolated from various clinical specimens. Indian J Med Sci 2002;56(9):427-30.

Struelens, M. J. (1998). The epidemiology ofantimicrobial resistance in hospital-acquiredinfections: problems and possible solutions.*BMJ* 317: 652-654.

Sule, A. M., Thanni, L. O. A., Sule-Odu, O. A. andOlusanya, O. (2002). Bacterial pathogensassociated with infected wounds in Ogun stateUniversity Teaching Hospital, Sagamu, Nigeria.*Af. J. Clin. & Experim.Microbiol.*3(1): 13-16.Swedish-Norwegian Consensus Group, (1998).Antibiotic prophylaxis in surgery: Summary ofa Swedish-Norwegian Consensus Conference.*Scand. J. Infect. Dis.* 30: 547-557.

Taiwo, S. S., Okesina, A. B. and Onile, B, A. (2002).Invitro antimicrobial susceptibility pattern ofbacterial isolates from wound infections in aUniversity of Ilorin Teaching Hospital. *Af. J.Clin. & Experim.Microbiol.*3(1): 6-10.

Woods, D. E., Schaffer, M. S., Rabin, H. R.,Campbell, G. D. and Sokol, P. A. (1986).Phenotypic comparison of *Pseudomonasaeruginosa* strains isolated from a variety ofclinical sites. *J. Clin. Microbiol.*24: 260-264.

❖❖❖❖