DOI: https://doi.org/10.53350/pjmhs22169340

ORIGINAL ARTICLE

Susceptibility Pattern of Bacteria Isolated from Patients Admitted in Medical ICU with Pneumonia

RIFAT YASMIN[1], LUBNA GHAZAL[2], SYEDA TURAB FATIMA ABIDI[3], TAZAEEN HINA KAZMI[4], HUMA HUSSAIN[5], MUHAMMAD FAREED AZAM[6]

[1,4]Assistant Professors, Department of Medicine, POF Hospital, Wah Medical College (affiliated with NUMS), Wah Cantt
[2]Assistant Professor, Department of Pathology, Wah Medical College (affiliated with NUMS) Wah Cantt
[3]Associate Professor, [5]Assistant Professor, Emergency Department, POF Hospital, Wah Medical College (affiliated with NUMS), Wah Cantt
[6]Assistant Professor, Department of Anesthesia, Wah Medical College (affiliated with NUMS) Wah Cantt
Correspondence to: Rifat Yasmin, Email: rifatomer7@gmail.com, Cell: 0300-5397170

ABSTRACT

Background: Patients in ICU presenting with severe disease suffer from multidrug-resistant bacteria, resuting in reduced therapeutic options which cover ICU pathogens spectrum. Identification of causative organism and its antibiotics sensitivity pattern has become cornerstone for antibiotic selection. β-Lactams i.e. cephalosporins, carbapenems, penicillins, and monobactams constitute 60% of total antibacterials used, however; with high usage of such antibiotics the emergence of resistance.

Aim: To determine prevalence of local type of bacterial isolates and their antibiotic susceptibility.

Study Design: Cross sectional study

Place and Duration of Study: Medical ICU, Pakistan Ordinance Factories Hospital, Wah Cantt from 1st January 2020 till 31st July 2021.

Methodology: One hundred patients were enrolled. Samples were taken from blood, sputum, bronchoalveolar lavage and tracheal secretions of the patient and sent to microbiologist for culture and sensitivity reports.

Results: The mean age was 57.52+13.427 years, 47 females and 53 male patients. 72 patients were shifted out and remaining 28 died. In 57 patients, sputum specimen was taken, blood specimen of 24 patients, tracheal secretion of 8 patients and 11 patients bronchoalveolar lavage was taken. 33 were positive for Klebsiella pneumoniae, 29 patients were positive for acinetobacter baumanii. Pseudomonas aeuriginosa was positive in 18 patients, 05 patients for E. coli. In gram positive category; 05 patients were positive for staph aureus, 06 patients for MRCONS, 3 to MRSA and 1 patient for coagulase negative staphylococcus species.

Conclusion: The high levels of antibiotic resistance are seen among both gram negative and gram positive isolates. Presence of elevated resistance to multiple drugs is an indicator for high prevalence of multi-drug resistant gram positive as well as gram negative organisms, so proper identification of organism in order to ascertain administration of emperical drugs most effective against the isolated organism is recommended in severe cases.

Keywords: Antibiogram, Bacterial isolate, Pneumonia, Sensitivity

INTRODUCTION

Modern day medical treatment evolved over the years with advant of antibiotics; resulting in improved health care, improved patient survival rate and successful treatment of diseases which were previously life threatening and resulted in mortality of patient.[1] Patients in ICU presenting with severe disease suffer from multidrug-resistant bacteria, resulting in reduced therapeutic options which cover ICU pathogens spectrum.[2] Identification of causative organism and its antibiotics sensitivity pattern has become cornerstone for antibiotic selection.[3] Occurrence of multidrug resistant bacteria is faced over last 20 years with development of broad and extended spectrumantibiotics.[4,5]

S. aureus is most common organism also part of normal dermal flora and anterior nares, therefore working as main source of contamination in respiratory tract infections. S. Aureus species adaptibility over the times resulting in development of modified new virulence factors causing high virulence and infectivity as compared to other bacteria.[6] Coagulase identification in staphylococci is basis for species identification. On basis of coagulase presence or absence organisms are classified as coagulase positive and coagulase negative staphlococci. Staph. aureus is most common coagulase positive and Staph. epidermidis is most common coagulase negative gram positive organism. Coagulase negative staph. Species are mostly found on implanted appliances and devices and especially in patients of extreme age and immunocompromised conditions.[7]

β-Lactams i.e. cephalosporins, carbapenems, penicillins, and monobactams constitute 60% of total antibacterials used. Main reason for increased use of such drugs is high level of safety and extended spectrum of bacterial coverage resulting in high efficacy. However; with high usage of such antibiotics the emergence of resistance has resulted in major set back.[8] Since early 2000, methicillin-resistant Staphylococcus aureus (MRSA) was described as first multi-drug resistant organism, but over the years recently gram-negative bacteria have also been reported as muliti-drug resistant.[9] Organism isolates have shown extended spectrum beta lactamases (ESBLs) resistance, carbapenem-resistance and even colistin-resistance. Carbapenems have been shown to be effective against resistant nosocomial infections and community-acquired diseases.[10]

The purpose of this study is to determine prevalence of local type of bacterial isolates and their antibiotic susceptibility in our medical setup to help improve patient care as no such study has been carried out in our institute.

MATERIALS AND METHODS

This cross sectional study was carried out after approval of ethical committee at Medical ICU, Pakistan Ordinance Factories Hospital, Wah Cantt from January 2020 till July 2021. Total of 100 patients, selected by non-consecutive probability sampling, of both gender, age >18 years, presenting with severe lower respiratory tract symptoms and yielding bacterial growth were included in study. Patients with age <18 years, no bacterial growth on culture report and those who were already taking antibiotics were excluded from study. Informed consent was taken from every patient before inclusion in the study. Samples were taken from blood, sputum, bronchoalveolar lavage and tracheal secretions of the patient and sent to microbiologist for culture and sensitivity reports. 1-3 ml of blood sample was taken for that purpose.

The specimens were inoculated on appropriate culture medium like blood agar, MacConkey agar, chocolate agar and incubated at 35-37˚C under aerobic conditions for 24 hours. After overnight incubation, the agar plates were examined for growth of bacteria and their colonial morphology. The Gram-negative rods were identified based on Gram staining, catalase test, oxidase test and motility. Microbact Gram-negative 24E identification kits were

used for confirmation of isolates. For Gram positive cocci identification catalase test, coagulase test and DNAase test were applied.

The bacterial suspensions of isolates equivalent to 0.5 McFarland standard turbidity were applied on Mueller-Hinton agar. The antimicrobial susceptibility tests were performed by modified Kirby and Bauer disc diffuse methods. The susceptibility results were interpreted as sensitive, intermediate and resistant according to recommendations of clinical laboratory standards institute. The results of culture were reported by the Department of Microbiology within 5 days. All the data was entered and analyzed in SPSS-21. Association of antibiotic sensitivity pattern and type of organism was determined by Chi-square test. P-value <0.05 was considered significant.

RESULTS

Forty seven were female and 53 were male patients. The mean age was 57.52±13.427 years. Seven were below the age of 35, there were 4 patients in the category of 35-44 years with minimum number of patients. While 15 patients fell in the category of 45-54 years old, highest number of patients fell in the category of 55-64 years old which were 34 in total, 2nd highest number of patients fell in the category of 65-74 years old which included 25 patients, remaining 11 belonged to the category of 75-84 years old and 4 patients fell in the age category of greater than 85 years old. Seventy two patients were shifted out and remaining 28 died. 57 patients sputum specimen were taken, on 2nd number was the blood specimen category which included 24 patients, thirdly; tracheal secretion was taken from 8 patients and in 11 patients bronchoalveolar lavage was taken. Community acquired pneumonia cases and nosocomial pneumonia cases are equal that is 34 and 34 were in each category, 26 belonged to ventilator acquired pneumonia category and remaining 6 to aspiration pneumonia category. The highest number of patients i.e. 33 were positive for klebsiella pneumoniae, 2nd highest 29 patients belonged to acinetobacter baumanii category, Pseudomonas aeuriginosa was positive in 18 patients, 5 patients belonged to E. coli bacteria category among gram negative organisms. In gram positive category 05 patients were positive for staph aureus, 06 patients fell in the MRCONS category, 3 to MRSA and 1 patient was from coagulase -ve staph species category (Table 1).

Ampicillin sensitivity was present in 04/34 patients, cotrimoxazole 3/67 patients and co-amoxiclave 05/67 patients. Ciprofloxacin was sensitive in 09/85 patients, gentamicin in 08/85 patients and amikacin in 29/85 patients. While cefotaxime sensitivity was seen in 11/85 patients, ceftriaxone in 04/85 patients, piperacillin/tazobactum in 25/85 patients and cefoperazone/sulbactum in 25/85 patients. Similarly; high sensitivity in imipenem and meropenem was seen i.e. 26/85 and 32/85 patients respectively. However low sensitivity was reported in tetracycline (05/67 patients), ceftazedime (19/85 patients), cefoperazone (23/85 patients) and levofloaxacin (10/85 patients). High antibiotic sensitivity was reported form Moxifloaxacin in 27/85 patients and colistin 22/85 patients. For gram +ive organism sensitivity recorded was penicillin 03/15, erythromycin 02/15, clindamycin 04/15, vancomycin 05/15 linezolid 04/15 azithromycin 05/15 and teicoplanin 4/15. (Table No.02)

Frequency statistics of antibiotics sensitivity for gram –ve organism showed that Klebsiella pneumoinae was highly resistant against cotrimoxazole, co-amoxiclave, gentamicin, cefotaxime, and ceftriaxone however improve sensitivity was recorded for amikacin (51.5%), piperacillin-tazobactam (27.2%), cefoperazone-sulbactum (39.3%), imipenem (36.3%) and meropenem (45.4%). Similarly; high resistance was seen against tetracycline (93.9%), ceftazidime (81.8%) levofloaxcin (90.9%) however improved sensitivity was seen for cefoperazone (27.2%), moxifloaxacin (33.33%) and colistin (30.3%). E. coli was highly resistant against ampicillin, cotrimoxazole, co-amoxiclave, ciprofloxacin, ceftriaxone, piperacillin/tazobactam, cefoperazone-sulbactam and imipenem. However improved sensitivity was recorded for amikacin (40%), gentamicin (40%), moxifloaxacin (40%), imipenem (36.3%) and meropenem (45.4%). Similarly; high resistance was seen against imipenem, meropenem, tetracycline, ceftazidime, Levofloaxcin, Cefoperazone and colistin.

Pseudomonas aeruginosa was highly resistant against gentamicin, ciprofloxacin and ceftriaxone. However improved sensitivity was recorded for amikacin (33.3%), piperacillin-tazobactam (66.6%), imipenem (27.7%) and meropenem (27.7%). Improved sensitivity was recorded for ceftazidime (38.9%) and cefoperazone (38.9%).

Acinetobacter baumanii was highly resistant against cotrimoxazole, gentamicin, cefotaxime, ciprofloxacin, ceftriaxone, cefoperazone-sulbactum and meropenem. However improved sensitivity was recorded for colistin (93.1%) and imipenem (27.58%). Similarly; high resistance was seen against tetracycline (89.7%), ceftazidime (82.7%) and levofloaxcin (93.1%). However improved sensitivity was seen for tigecyline (24.1%) and moxifloaxacin (34.4%).

Table 1: Demographic information of the patients (n=100)

Variable	No.	%
Gender		
Male	47	47.0
Female	53	53.0
Age (years)		
< 35	7	7.0
35 – 44	4	4.0
45 – 54	15	15.0
55 – 64	34	34.0
65 – 74	25	25.0
75 – 84	11	11.0
> 85	4	4.0
Mortality		
Mortality	28	28.0
Shifted out	72	72.0
Type of specimen		
Sputum	57	57.0
Blood	24	24.0
Tracheal secretion	8	8.0
Bronchoalveolar lavage	11	11.0
Diagnosis		
Community acquired pneumonia	34	34.0
Nosocomial pneumonia	34	34.0
Ventilator acquired pneumonia	26	26.0
Aspiration pneumonia	6	6.0
Organism isolated		
E. coli	5	5.0
Klebsiella pneumoniae	33	33.0
Pseudomonas aeruginosa	18	18.0
Acinetobacter baumanii	29	29.0
MRSA	3	3.0
Coagulase -ve Staph species	1	1.0
Gram +ve Staph. aureus	5	5.0
MRCONS	6	6.0

Table 2: statistics of overall antibiotics sensitivity/resistance of organism Gram –ve

Antibiotics	Sensitive	Resistant
Ampicillin (N = 34)	4	30
Cotrimoxazole (N = 67)	3	64
Co-amoxiclave (N = 67)	5	62
Ciprofloxacin (N= 85)	9	76
Gentamicin (N= 85)	8	77
Amikacin (N= 85)	29	56
Cefotaxime (N= 85)	11	74
Ceftriaxone (N= 85)	4	81
Piperacillin/Tazobactum (N= 85)	25	60
Cefoperzone/Sulbactum (N= 85)	25	60
Imipenum (N= 85)	26	59
Meropenum (N= 85)	32	53
Tetracycline (N= 67)	05	62
Ceftazidime (N= 85)	19	66
Cefoperazone (N= 85)	23	62
Levofloaxcin (N= 85)	10	75
Moxifloaxacin (N= 85)	27	58
Colistin (N= 85)	22	63

Frequency statistics of antibiotics sensitivity for gram +ve organism showed that staph. aureus was sensitive to all antibiotics i.e. penicillin, erythromycin, clindamycin, tigecycline, vancomycin, linezolid, azithromycin and teicoplanin. MRSA was highly resistant to penicillin and azithromycin however it showed moderate sensitivity to erythromycin, clindamycin, vancomycin, linezolid and teicoplanin (40%). CONS (coagulase -ve staph. Species) were highly resistant to penicillin, erythromycin, linezolid and teicoplanin (100%). However; azithromycin (100%) showed improved sensitivity. MRCONS were highly resistant to erythromycin (100%), clindamycin (83.3%) and azithromycin (83.3%). However; drugs like penicillin showed sensitivity of (50%), vancomycin (33.3%), linezolid (33.3%) and teicoplanin (33.3%).

Table 3: Statistics of overall antibiotics sensitivity/ resistance of organism Gram +ive

Antibiotics	Sensitive	Resistant
Penicillin	3	12
Erythromycin	2	13
Clindamycin	4	11
Vancomycin	5	11
Linzolid	4	11
Azithromycin	5	10
Teicoplanin	4	11

Table 4: Frequency statistics of antibiotics (sensitivity/resistance) on basis of type of organism Gram -ive

Antibiotics	Klebsiella pneuminae (R/S)	E. coli (R/S)	Pseudomonas aeruginosa (R/S)	Acinetobacter baumanii (R/S)	P-Value
Ampicillin	-	05/0	-	-	0.044
Cotrimoxazole	32/01	05/0	-	27/02	0.851
Co-amoxiclave	30/03	05/0	-	-	0.862
Ciprofloxacin	29/04	05/0	17/01	25/04	0.689
Gentamicin	30/03	03/02	16/02	28/01	0.080
Amikacin	16/07	03/02	12/06	25/04	0.020
Cefotaxime	31/02	03/02	14/04	26/03	0.103
Ceftriaxone	31/02	04/01	18/0	28/01	0.292
Piperacillin/Tazobactam	24/09	04/01	06/12	26/03	0.001
Cefoperazone-Sulbactam	20/13	05/0	15/03	25/04	0.164
Imipenem	21/12	04/01	13/05	21/08	0.808
Meropenem	18/15	05/0	13/05	24/05	0.187
Tetracycline	31/02	05/0	-	26/03	0.809
Ceftazidime	27/06	04/01	11/07	24/05	0.306
Cefoperazone	24/09	05/0	11/07	22/07	0.354
Levofloaxcin	30/03	05/0	13/05	27/02	0.354
Moxifloaxacin	22/11	03/02	14/04	19/10	0.789
Colistin	23/10	04/01	13/05	02/27	0.833

Table 5: Frequency Statistics of Antibiotics (Sensitivity / Resistance) on Basis of type of Organism Gram +ive (n = 15)

Antibiotics	Staph. aureus (R/S)	MRSA (R/S)	CONS (R/S)	MRCONS (R/S)	P-Value
Penicillin	01/0	05/0	03/0	03/03	0.131
Erythromycin	01/0	03/02	03/0	06/0	0.202
Clindamycin	01/0	03/02	02/01	05/01	0.755
Vancomycin	01/0	03/02	02/01	04/02	0.896
Linezolid	01/0	03/02	03/0	04/02	0.563
Azithromycin	01/0	04/01	0/03	05/01	0.054
Teicoplanin	01/0	03/02	03/0	04/02	0.563

DISCUSSION

In our study, thirty three were positive for Klebsiella pneumoniae, 2nd highest 29 patients belonged to acinetobacter baumanii category, Pseudomonas aeuriginosa was positive in 18 patients, 5 patients belonged to E. coli. A cross sectional study, was carried out at Shifa International Hospital, Islamabad from August 2015 to August 2016 including 802 patients. Most common reported organism was E. coli (15.3%) followed by Pseudomonas aeruginosa (13%) and Klebsiella pneumoniae (10.2%) among gram negative patients. However, among gram positive patients MRSA was most prevalent (6.2%). Pseudomonas was sensitive to cloistin (93%), Klebsiella pneumoniae was sensitive to tigecycline (100%) and mincycline (84%). Overall ICU mortality rate was31.2%.[11]

Rajan et al[12] showed that most common organism was Klebsiella pneumoniae. However, Ziab et al[13] study showed Pseudomonas aeruginosa to be most prevalent organism in ICU. Pradhan et al[14] showed Acinetobacter to be most prevalent organism. A study was done in pathology department POF Hospital, Wah Cantt regarding gram negative bacilli antibiotic susceptibility pattern. 144 isolates were studied from April 2015 to March 2016 showed that commonest organism was E. coli (47.3%), secondly Pseudomonas aeruginosa (17.36%) and Acinetobacter baumannii (13.19%).[15]

In the present study Klebsiella pneumoniae sensitivity was recorded for amikacin (51.5%), piperacillin-tazobactam (27.2%), cefoperazone-sulbactum (39.3%), imipenem (36.3%) and meropenem (45.4%), cefoperazone (27.2%), moxifloaxacin (33.33%) and colistin (30.3%). Bahashwan et al. in his study results reported that among patients positive for Klebsiella pneumoniae; 53.3% patients were resistant against imipenem and meropenem, for Proteus mirabilis positive patients 50% resistance was recorded against imipenem and meropenem.[16]

In our study CONS (coagulase -ve staph. Species) were highly resistant to penicillin, erythromycin, linezolid and teicoplanin (100%). However; azithromycin (100%) showed improved sensitivity. MRCONS were highly resistant to erythromycin (100%), clindamycin (83.3%) and azithromycin (83.3%). However; drugs like penicillin showed sensitivity of (50%), vancomycin (33.3%), linezolid (33.3%) and teicoplanin (33.3%). A study was carried out in Egypt in neonatal ICU on coagulase-negative Staphylococcus species. Results showed that only vancomycin, ciprofloxacin and amikacin were effective against coagulase negative Staphlococci species. These organisms were highly resistant to commonly used first-line antimicrobial drugs for such organisms.[17] Tehseen et al[18] conducted a study on both gram positive and gram negative bacteria and showed that gram negative bacteria were sensitive to vancomycin and gram positive bacteria were sensitive toamikacin.

Li et al[19] in their study studied sensitivity of organism against meropenem showed that gram negative organisms were mostly resistant (54%) to meropenem and gram positve organism had less resistance to meropenem (38.5%). A study was conducted in Ethiopia; antibiotic sensitivity of isolated bacteria showed high resistance to erythromycin, amoxicillin and tetracycline but improved sensitivity to nitrofurantoin.[20] Study conducted in 2014 by Yakha et al[21] showed 96% sensitivity to imipenem, 86.6% sensitivity to amikacin and 70.7% sensitivity to pipercillin-Tazobactam. Rao et al[22] reported 80% sensitivity to imipenem,

amikacin and pipercillin-tacobactam. In our study E. coli was highly resistant against ampicillin, cotrimazole, co- amoxiclave, ciprofloxacin, ceftriaxone, piperacillin/tazobactam, cefoperazone-sulbactam and imipenem. However improved sensitivity was recorded for amikacin (40%), gentamicin (40%), moxifloaxacin (40%), imipenem (36.3%) and meropenem (45.4%). Results carried out on E. coli showed 91% resistance to Ampicillin & Ciprofloxacin, 82% to Cefotaxime & Ceftriaxone, 72.7% resistant to Cotrimoxazole. High sensitivity to Amikacin (100%) and Gentamicin (54.5%) was reported in the study.[21,22]

In our study Pseudomonas aeruginosa was highly resistant against gentamicin, ciprofloxacin and ceftriaxone. However improved sensitivity was recorded for amikacin (33.3%), piperacillin-tazobactam (66.6%), imipenem (27.7%) and meropenem (27.7%). Improved sensitivity was recorded for ceftazidime (38.9%) and cefoperazone (38.9%). Amatya et al[23] in 2015 conducted a study on Pseudomonas isolate sensitivity showed 87.9 percent sensitivity for imipenem and 64.6% sensitivity for amikacin. Another study was conducted on Klebsiella pneumoniae by Chowdhury et al[24] showed organism to be highly sensitive to Imipenem (100%). High resistance was recorded against antibiotics like ceftazidime andceftriaxone.

In Egypt a study was conducted on 186 clinical specimens for bacteriological examination and antimicrobial susceptibility testing. Klebsiella pneumoniae was most common organism isolated among gram negative bacteria. (40.9%), followed by Acinetobacter baumannii (18.8%), Pseudomonas aeruginosa (17.3%), Escherichia coli (15.4%), Enterobacter aerogenes (5.3%), and Proteus mirabilis (2.4%). Antibiotic sensitivity reports showed carbapenem-resistance upto 36.1% however, 86.5% sensitivity to colistin.[25]

CONCLUSION

The high levels of antibiotic resistance are seen among both gram negative and gram positive isolates. Presence of elevated resistance to multiple drugs is an indicator for high prevalence of multi-drug resistant gram positive as well as gram negative organisms, so proper identification of organism in order to ascertain administration of emperical drugs most effective against the isolated organism is recommended in severe cases.

REFERENCES

1. Gajdács M, Urbán E, Stájer A, Baráth Z. Antimicrobial resistance in the context of the sustainable development goals:a brief review. Eur J Investig Health Psychol 2021; 11: 71-82.
2. Randhawa V, Sarwar S, Walker S, Elligsen M, Palmay L, Daneman N: Weighted-incidence syndromic combination antibiograms to guide empiric treatment of critical care infections: a retrospective cohort study. Crit Care 2014, 18:R112.
3. Parvizi J, Erkocak OF, Della Valle CJ. Culture-negative periprosthetic joint infection. J Bone Joint Surg Am 2014;96(5):430-6.
4. Brust K, Evans A, Plemmons R: Tigecycline in treatment of multidrug-resistant Gram-negative bacillus urinary tract infections: a systematic review. J Antimicrob Chemother 2014, 69:2606-10.
5. Olesen SW, Barnett ML, MacFadden DR, Brownstein JS, Hernández-Díaz S, Lipsitch M, Grad YH. The distribution of antibiotic use and its association with antibiotic resistance. eLife 2018; 7: e39435.
6. Chalya PL, Mabula JB, Dass RM, Kabangila R, Jaka H, McHembe MD, et al. Surgical management of diabetic foot ulcers: a Tanzanian university teaching hospital experience. BMC Res Notes 2011;4:365.
7. Carroll KC, Hobden JA. The staphylococci. In: Brooks Carroll KC, Hobden JA, Miller S, Morse SA, Mietzner TA, Detrick B, Mitchell TG, McKerrow JH, Sakanari JA, eds. Jawetz, Melnick, & Adelberg's medical microbiology. 27th ed. New York: McGraw Hill, 2016. 203-12
8. Algammal AM, Mabrok M, Sivaramasamy E, et al. Emerging MDR-Pseudomonas aeruginosa in fish commonly harboropr L and tox A virulence genes and blaTEM, blaCTX- M, and tetA antibiotic-resistance genes. Sci Rep 2020; 10(1):15961.
9. Cui X, Zhang H, Du H. Carbapenemases in enterobacteriaceae: detection and antimicrobial therapy. Front Microbiol 2019; 10: e1823.
10. Rapoport M, Faccone D, Pasteran F, Ceriana P, Albornoz E, Petroni A, Corso A, The MCR Group. First description of mcr-1-Mediated colistin resistance in human infections caused by escherichia coli in Latin America. Antimicrob Agents Chemother 2016; 60: 4412-3.
11. Qadeer A, Akhtar A, Ain Q, et al. Antibiogram of medical intensive care unit at tertiary care hospital setting of Pakistan. Cureus 2016; 8(9): e809.
12. Rajan R, Rao AVR: Antibiogram of gram-negative bacterial isolates from intensive care unit at a tertiary care hospital. IJAR. 2016,6:344-47.
13. Al-Ahmadey ZZ, Mohamed SA: Antimicrobial susceptibility pattern of bacterial isolates in the intensive care unit of Al-Ansar Hospital,Saudi Arabia. Eur J Adv Res Bio Life Science 2013,1:17-26.
14. Pradhan NP, Bhat SM, Ghadage DP: Nosocomial infections in the medical ICU: a retrospective study highlighting their prevalence, microbiological profile and impact on ICU stay and mortality. J Assoc Physicians India 2014; 62:18-21.
15. Ghazal L, Qureshi AH, Iqbal N. Antibiotic Susceptibility pattern of Gram NegativeBacilli Isolated from different Clinical Specimens in a Tertiary Care Hospital. JIMDC 2018; 7(2):112-7.
16. Bhat V, Gupta S, Kelkar R, Biswas S, Khattry N, Moiyadi AA, et al. Bacteriological profile and antibiotic susceptibility patterns of clinical isolates in a tertiary care cancer center. Indian J Med Paediatr Oncol 2016; 37(1): 20-4.
17. Tehseen T, Qureshi AH, Ghazal L. Bacterial Isolates of Neonatal Sepsis and their susceptibility Pattern in POF Hospital Wah Cantt. IDJ 2018;27(3):70-73.
18. Shehab El-Din EMR, El-Sokkary MA, Bassiouny MR, Hassan R. Epidemiology of Neonatal Sepsis and Implicated Pathogens: A Study from Egypt. BioMed Res Int 2015, 2015:11-21.
19. .LiJ Y, Chen SQ, Yan YY, Ying Hu Y, Wei J, Lin ZL, et al. Identification and antimicrobial resistance of pathogens in Neonatal septicemia in China - a meta-analysis. Int J Infect Dis 2018; 71: 89-93.
20. Melaku S, Kibret M, Abera B, Gebre-Sellassie S. Antibiogram of nosocomial urinary tract infections in Felege Hiwot referral hospital from Ethiopia. Afr Health Sci 2012; 12: 134-9.
21. Yakha JK, Sharma AR, Dahal N, Lekhak B and Banjara MR. Antibiotic susceptibility pattern of bacterial isolates causing wound infection among the patients visiting B & B Hospital. Nepal J Sci Technol 2014; 15:91-6.
22. Rao R, Ranjan B and Debika RB. Aerobic bacterial profile and antimicrobial susceptibility pattern of Pus isolates in a South Indian Tertiary Care Hospital. IORS-JDMS 2014; 13(3):59-62
23. Amatya J, Rijal M and Baidya R. Bacteriological study of the postoperative wound samples and antibiotic susceptibility pattern of the isolates in B & B Hospital. JSM Microbiol 2015; 3:1019.
24. Chowdhury D, Jhora ST, Shah MR, Nahar N. Antibacterial resistance pattern of common bacterial pathogen in tertiary care hospitals in Dhaka City. Bangladesh J Med Microbiol 2013; 7:13-6.
25. Makharita RR, El-Kholy I, Hetta HF, Abdelaziz MH, Hagagy FI, Ahmed AA, Algammal AM. Antibiogram and genetic characterization of carbapenem-resistantgram-negative pathogens incriminated in healthcare-associated infections. Infec Drug Resistance 2020;13:3991.