RESEARCH

A CLINICO-ETIOLOGICAL AND ANTIBIOTIC SENSITIVITY PROFILE OF MICU INFECTIONS, AT A SUBURBAN TERTIARY CARE HOSPITAL, WESTERN INDIA

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Abstract

Background: Global prevalence of healthcare associated infections (HAI) ranges between 7% and 12% as per WHO estimates. The most important types of ICU-AIs are ventilator associated events/ respiratory infections/pneumonia (VAE/VAP), central line-associated bloodstream infections/ septicemia (CLABSI), and catheter-related urinary tract infection (CAUTI). The aims and objectives are to isolate and identify pathogens in MICU patients and study their antimicrobial susceptibility pattern. **Materials and Methods:** Laboratory records of all clinical samples received from MICU of our hospital, during the study period, in Microbiology laboratory, were analysed by the following parameters: clinical presentation, type of sample (blood culture, sputum, CSF, fluids, urine, endotracheal aspirate, central line tip etc),risk factors (including invasive procedures and underlying disease condition), microbiological laboratory results (including primary smear, culture isolates and their antibiotic sensitivity) and outcome of patients. All laboratory procedures were performed, in Microbiology laboratory, using standard protocol. **Result:** 70/286(24%) of the total samples received, were culture positive. Blood samples were highest followed by urine, pus and endotracheal secretions. The most common infection was central line-associated bloodstream infections/ septicemia (CLABSI) followed by catheter-related urinary tract infection (CAUTI) and ventilator associated events/ respiratory infections/pneumonia (VAE/VAP). Organismwise majority were Gram negative in 44/70; followed by fungi in 14/70 and Gram positive 12/70. Predominant organism was Pseudomonas 13/70.Gram negative isolates showed maximum sensitivity to amikacin, gentamicin, imipenem and clindamycin followed by piperacillin tazobactum, meropenem and polymyxin. Gram positive isolates showed maximum sensitivity to vancomycin and linezolid followed by moderate sensitivity to ampicillin, penicillin, levofloxacin and doxycycline. Among the MDR organisms: Gram negative ESBL were 35/44(80%), MRSA½(50%) and VRE 2/6(30%).Mortality was 22/70 (31%) patients. **Conclusion:** An analysis of contemporary hospital data is required to determine the current trends in ICU infections and antibiotic sensitivity.

INTRODUCTION

Nosocomial infections are an important cause of morbidity and mortality in intensive care units.[1] Global prevalence of healthcare associated infections (HAI) ranges between 7% and 12% as per WHO estimates.[2] Patients admitted to the intensive care unit (ICU) are prone to develop nosocomial infections due to multidrug-resistant (MDR) organisms, which cause life-threatening infections.[3] Intensive care units (ICU) are a major source of device-associated infections in tertiary care hospitals.[4] Empirical use of antimicrobial agents was identified as a strong risk factor for resistance development and excessive mortality.[5] Appropriate strategies are required to combat the augmented rate of these infections and MDR bacteria among ICUs.[6] Antimicrobial stewardship (AMS) is an essential step

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to optimize consumption of antimicrobials and thus reduce bacterial resistance.[7,8] In the present scenario methicillin-resistant Staphylococcus aureus and vancomycin-resistant enterococci among Gram-positive organisms and MDROs: Klebsiella pneumoniae, Acinetobacter baumannii complex, Pseudomonas aeruginosa, extended spectrum beta-lactamase production in Escherichia coli, Enterobacter spp. and Citrobacter spp. among the gram-negative organisms are most worrisome pathogens.[9,10] Therefore antibiotic use should be optimized in ICUs as the antibiotic resistance is on a steep rise and due to lack of newer antimicrobial in the pipeline. A multi-pronged approach including early and accurate microbiological diagnosis, narrowing and de-escalation of antibiotics based on culture reports and antibiotic stewardship along with strict implementation and compliance of infection control practices can go a long way in preventing the emergence of MDR nosocomial pathogens.[11,12]

Aims and Objectives of the Study

To isolate and identify bacterial pathogens in MICU patients and to study their antimicrobial susceptibility patterns.

MATERIALS AND METHODS

Study Design: Retrospective study
Study Site: Microbiology department
Study Duration: Total samples received during June 2021 to May 2022.All the data was collected in a period of one to two months from the laboratory records and from Medical Record Department (MRD).

Inclusion Criteria

All clinical samples received from MICU of our hospital, in the Microbiology laboratory.

Exclusion Criteria

Records with incomplete data.

Methodology

Laboratory records of all clinical samples received from MICU of our hospital, during the study period, in Microbiology laboratory, were analyzed by the following parameters: age, sex, clinical presentation, type of sample received (blood culture, sputum, CSF, fluids, urine, endotracheal aspirate, central line tip etc), risk factors (including invasive procedures and underlying disease condition), microbiological laboratory results (including primary smear, culture isolates and their antibiotic sensitivity) and outcome of patients. All laboratory procedures were performed, in Microbiology laboratory, using standard protocol. The isolated microorganisms' recognition was done according to colony morphology, Gram stain, and standard confirmatory biochemical tests. Gram-positive bacteria were further identified by testing the hemolytic activity on blood agar and biochemical tests such as catalase reaction, slide and tube coagulase tests, bile esculin, bacitracin sensitivity etc. Gram-negative bacteria were identified by biochemical tests such as oxidase, triple sugar iron, motility indole, citrate and urease tests. Antimicrobial susceptibility of the bacterial isolates by Kirby-Bauer disk diffusion method was performed and interpreted according to the Clinical Laboratory Standards Institute (CLSI) guidelines. ESBL producers were confirmed phenotypically by the double-disk synergy test using clavulanic acid and third-generation cephalosporins. Disks of third-generation cephalosporins and amoxicillin-clavulanic acid were kept 15–20 mm apart, centre to centre, on inoculated Mueller-Hinton agar. The plates were incubated at 35°C–37°C for 18–24 hours. A clear extension of the edge of the inhibition zone of any of the third-generation cephalosporins towards the amoxicillin-clavulanic acid disk was interpreted as positive for ESBL production. Escherichia coli ATCC 25922 was used for quality control.

Statistical Analysis & Outcome Measures: The data entry was made in Microsoft Excel sheet. Statistical analysis was performed using SPSS software. The chi square test was used for assessing association between categorical variables. The p value of 0.05 or less was considered to be significant.

RESULTS

Overall 70/289 (24%) of the total samples received, were culture positive. The samplewise distribution of growth is shown in [Table 1]. Blood samples were highest followed by urine, pus and endotracheal secretions. Respiratory samples included: endotracheal secretions, sputum, pleural fluid and tracheal aspirate. In our study the most common infection was central line-associated bloodstream infections/ septicemia (CLABSI) followed by catheter-related urinary tract infection (CAUTI) and ventilator associated events/ respiratory infections/pneumonia (VAE/VAP). Organism wise majority were Gram negative in 44/70; followed by fungi in 14/70 and gram positive 12/70. [Table 2]. Predominant Gram-negative organism was Pseudomonas 13/44. Gram negative isolates(n=44) were predominantly seen in endotracheal secretions, sputum, pleural fluid, and tracheal aspirate 19/44 and blood culture 12/44. Gram positive growth was observed in blood, urine and pus samples. Yeast growth was predominantly seen in urine samples 13/26. [Table 1] Gram negative isolates showed maximum sensitivity to amikacin, gentamicin, imipenem and clindamycin followed by piperacillin tazobactum, meropenem and Polymyxin. Gram positive isolates showed maximum sensitivity to vancomycin and linezolid followed by moderate sensitivity to ampicillin, penicillin, levofloxacin and doxycycline. In our study 38/70 (54%) were MDR organisms: ESBL 35/44 (80%), MRSA ½(50%) and

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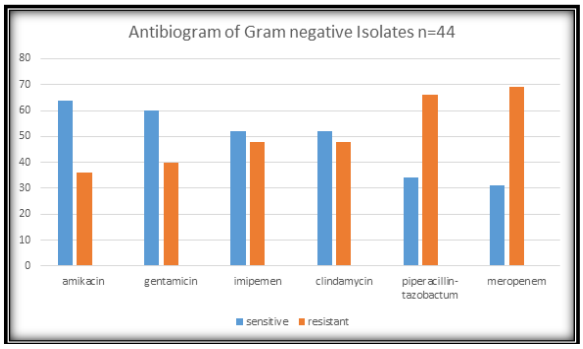
VRE 2/6 (30%). Clinically, the 70 infected patients revealed the following conditions: majority had diabetes 24, followed by hypertension 23, sepsis 19, respiratory 14, cardiovascular 9, neurological 7, tuberculosis 7, dengue 3 and leptospirosis 1. Spectrum of presentions included: 1. respiratory: ARDS, COPD, LRTI, chronic lung disease, pleural effusion, pulmonary hypertension, breathlessness, pneumonia, nasal mucormycosis, pulmonary embolism and pneumothorax; 2. neurologic: cerebrovascular accident, Parkinsons disease, seizures, encephalitis, altered sensorium, hydrocephalus, intracranial bleed, tuberculous meningitis. 3. cardiovascular: pericardial effusion, congestive cardiac failure, cardiogenic shock, atrial fibrillation, sudden cardiac arrest; 4. others: cellulitis, chemical consumption poisoning, multiorgan dysfunctional syndrome, diabetic ketoacidosis, epistaxis, haemetemesis and cholecystitis. Mortality occurred in 22/70 (31%) patients.

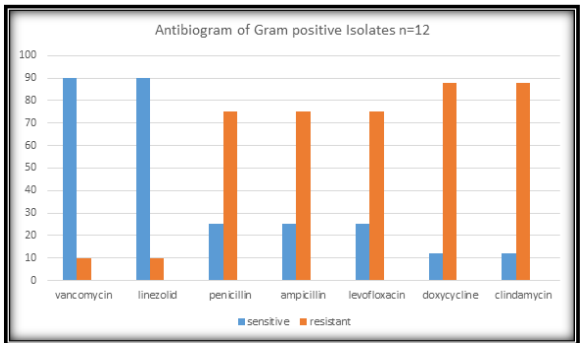
Table 1: Sample wise distribution of growth n=289

Samples	Blood	Urine	Respiratory	Pus	Total
Number	123	109	47	10	289
Culture positive	20	24	19	7	70
Gram negative	12	8	19	5	44
Gram positive	5	5	0	2	12
Yeast	3	11	0	0	14
No growth	103	85	28	3	219

Table 2: Organismwise distribution of Isolates n=70

Organism	Number
Gram negative n=44(63%)	
Pseudomonas	13
Klebsiella	11
Acinetobacter	8
E.coli	5
Nonfermenters	3
Providencia	2
Morganella	1
Serratia	1
Gram positive n=12(17%)	
Enterococcus	6
Streptococcus	4
Staphylococcus	2
Fungi n=14 (20%)	
Candida	12
Mucor	2





DISCUSSION

In our study the overall infection rate was 70/286 (24%). Similar rate was observed by Vincent et al 22%, Sushmita et al 24% and Gill et al 25%.[13,14,15] Higher rate was reported by Pattanayak et al 28%, Despotovic et al 33% Sharma M et al 40%, Mahendra et al 46%, Syal et al 50%, Kaur n et al 61%, Barma et al 63%, Choudhuri et al 66%, Ranjitha et al 74%,Venkataraman et al 90%.[16,17,18,19,20,21,22,23,24] Lower rate was seen by Chitralekha et al11%, Dasgupta et al 12%, Neda et al 17%, Mythri et al 18%.[25,26,27,28]

In our study samplewise distribution showed that blood samples were highest followed by urine, pus and endotracheal secretions. This was similar to Fahim et al: blood>urine>pus, whereas Mangala et al noted respiratory specimens>urine>blood, Apoorva et al: Pus>sputum>urine and Sharma M et al pus>blood> respiratory specimens.[18,29,30,31,32,33,34]

In our study the most common infection was central line-associated bloodstream infections/ septicemia (CLABSI) followed by catheter-related urinary tract infection (CAUTI) and ventilator associated events/ respiratory infections/pneumonia (VAE/VAP). Others studies observed following infections:

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Mangala et al VAP>UTI>BSI; Chaudhary et al BSI>VAP>CAUTI; Dasgupta et al VAP>CAUTI>BSI; Neda et al BSI>VAP>UTI and Venkataraman et al VAP>BSI>CAUTI.[24,26,27,29,31]

Organismwise majority were Gram negative in 44/70; followed by yeast in 16/70 and gram positive 10/70. Gram negative isolates were predominantly seen in endotracheal secretions, sputum, pleural fluid, and tracheal aspirate 19/44 and blood culture 12/44. Gram positive growth was observed in blood, urine and pus samples. Yeast growth was predominantly seen in urine samples 13/26. [Table 1]

Thus in our study Gram negative isolates (63%) > Gram positive isolates (14%). Similar finding was noted by Mangala et al, Jain AK et al, Kumar et al, Fahim et al, Kaur N et al, Garg et al, Vincent et al, Ranjitha et al.[9,12,13,23,32,33,34,35] As opposed to this Gram positive isolates > Gram negative isolates was noted by Khan et al, Chitralekha et al and Gill et al.[15,25,36]

In our study commonest organism was Pseudomonas, which was also noted by Kumar et al and Apoorva et al.[33,30] Others reported the following as the predominant organism: Ecoli by Pattanayak et al and Sharma M et al.[16,18] Acinetobacter by Jain et al, Venkataraman et al, Ranjitha et al, Mahendra et al, Gupta V et al and Bhandari et al.[19,23,24,32,37,38] Klebsiella by Fahim et al, Garg et al, Chaudhary et al, Chidambaram et al and CONS by Gill et al, Chitralekha et al.[15,25,31,34,35,39]

In our study Gram negative isolates showed maximum sensitivity to amikacin, gentamicin, imipenem and clindamycin followed by piperacillin tazobactum, meropenem and Polymyxin. Other studies observed the following sensitivity pattern with respect to gram negative organisms: Pattanayak et al -polymyxin, kumar-colistin, meropenem, tigecycline, fahim-amikacin, imipenem, meropenem, colistin; Garg et al-imipenem, meropenem, colistin; Mahendra et al-colistin; Despotovic et al-colistin, tigecycline, khan-colistin, minocycline; Chidambaram et al-imipenem, piperacillin tazobactum, cefoperazone sulbactum.[16,17,35,39]

In our study Gram positive isolates showed maximum sensitivity to vancomycin and linezolid followed by moderate sensitivity to ampicillin, penicillin, levofloxacin and doxycycline. High sensitivity of Gram positive isolates to vancomycin and linezolid was also noted by Kumar et al, Fahim et al, Garg et al, Khan et al and Chitralekha et al.[25,33,34,36]

In our study overall 38/70(54%) were MDR organisms: ESBL 35/44(80%), MRSA ½(50%) and VRE 2/6(30%).Similar findings were noted by Sharma M et al 77% ESBL, Gupta et al 50%MRSA and Saxena et al 60% MRSA.[17,37,40]

In our study mortality was 22/70(31%) which was similar to Vincent et al 30%; higher than Mahendra et al 18% and lower than Venkataraman et al 50%.[13,19,24] Despotovic et al further noted that diabetes with intubation was associated with increased mortality.[17]

CONCLUSION

The profile of bacteria causing infections and their antibiotic sensitivity pattern vary widely from one geographical region to another, one hospital to another and even among the ICUs within one hospital. Therefore, if the clinician has adequate information of the spectrum of microorganisms and the AMR patterns prevalent in that particular setting, appropriate empiric antibiotic therapy can be started.[35]

Active screening for resistant multidrug strains remains an important component of infection control policy in any healthcare setting irrespective of financial and logistical costs.[41]

REFERENCES

1. Kombade, D. S., & Agrawal, D. (2014). Study Of Drug Resistance In Isolates From ICU Infections In A Tertiary Care Hospital: Study Of Drug Resistance In Isolates From ICU Infections In A Tertiary Care Hospital. National Journal of Integrated Research in Medicine, 5(1), 97-102.
2. Wasi S, Daga MK, Mawari G, Kumar N, Sharma U, Hussain M, et al. Current Pattern and Clinico-Bacteriological Profile of Healthcare Associated Infections in an ICU Setting: A Study from a Tertiary Care Centre in Delhi. J Adv Res Med. 2022;9(1):1-10.
3. Alfouzan W, Dhar R, Abdo NM, Alali WQ, Rabaan AA. Epidemiology and Microbiological Profile of Common Healthcare Associated Infections among Patients in the Intensive Care Unit of a General Hospital in Kuwait: A Retrospective Observational Study. J Epidemiol Glob Health. 2021;11(3):302-309. doi: 10.2991/jegh.k.210524.001.
4. Sarvepalli AK, Dharana PK. Clinical profile, bacterial profile and outcomes in an intensive care unit of a tertiary care hospital in south India: one year study. IJAM. 2017;4(1):156-161.
5. Luna CM, Rodriguez-Noriega E, Bavestrello L, Guzmán-Blanco M. Gram-negative infections in adult intensive care units of latin america and the Caribbean. Crit Care Res Pract. 2014;2014:480463. doi: 10.1155/2014/480463.
6. Karn M, Bhargava D, Dhungel B, Banjara MR, Rijal KR, Ghimire P. The burden and characteristics of nosocomial infections in an intensive care unit: A cross-sectional study of clinical and nonclinical samples at a tertiary hospital of Nepal. Int J Crit Illn Inj Sci. 2021;11(4):236-245. doi: 10.4103/ijciis.ijciis_7_21.
7. Barlam TF, Cosgrove SE, Abbo LM, MacDougall C, Schuetz AN, Septimus EJ, et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clin Infect Dis. 2016;62(10):e51-77. doi: 10.1093/cid/ciw118.
8. Baur D, Gladstone BP, Burkert F, Carrara E, Foschi F, Döbele S, et al. Effect of antibiotic stewardship on the incidence of infection and colonisation with antibiotic-resistant bacteria and Clostridium difficile infection: a systematic review and meta-analysis. Lancet Infect Dis. 2017;17(9):990-1001. doi: 10.1016/S1473-3099(17)30325-0.
9. Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. Cochrane Database Syst Rev. 2017;2(2):CD003543. doi: 10.1002/14651858.CD003543.pub4.
10. Zaveri JR, Patel SM, Nayak SN, Desai K, Patel P. A study on bacteriological profile and drug sensitivity and resistance pattern of isolates of the patients admitted in intensive care units of a tertiary care hospital in Ahmadabad. Nat J Med Res. 2012;2:330-4.
11. Ducel G, Fabry J, Nicolle L, editors. Prevention of Hospital Acquired Infections: A Practical Guide. 2nd ed. Geneva:

ISSN (O): 2687-5365; ISSN (P): 2753-6556

World Health Organization; 2002. Available from: http://www.who.
int/csr/resources/publications/whocdscsreph200212.pdf.
12. Kaur N, Sharma P, Sharma S. Antimicrobial Resistance Profile in ICUs of Tertiary Care Hospital—A Worrisome State of Affairs. Curr Trends Diagn Treat. 2018;2(1):1-3.
13. Vincent JL, Sakr Y, Singer M, Martin-Loeches I, Machado FR, Marshall JC, et al. Prevalence and Outcomes of Infection Among Patients in Intensive Care Units in 2017. JAMA. 2020;323(15):1478-1487. doi: 10.1001/jama.2020.2717.
14. SJ Sushmita Ann et al., Utilisation Pattern, Safety Profile and Cost Analysis of Antimicrobials Prescribed in an Intensive Care Unit. Journal of Clinical and Diagnostic Research. 2020 Mar, Vol-14(3): FC01-FC05
15. Gill MK, Sharma S. Bacteriological profile and antibiotic resistance pattern in blood stream infection in critical care units of a tertiary care hospital in North India. Indian J Microbiol Res. 2016;3(3):270-274.
16. Pattanayak, Chaitali & Patanaik, Sunil & Datta, Pratyay Pratim & Panda, Parbaty. (2013). A study on antibiotic sensitivity pattern of bacterial isolates in the intensive care unit of a tertiary care hospital in Eastern India. Int J Basic Clin Pharmacol.. 2. 153-159. 10.5455/2319-2003.ijbcp20130307
17. Despotovic A, Milosevic B, Milosevic I, Mitrovic N, Cirkovic A, Jovanovic S, et al. Hospital-acquired infections in the adult intensive care unit-Epidemiology, antimicrobial resistance patterns, and risk factors for acquisition and mortality. Am J Infect Control. 2020;48(10):1211-1215. doi: 10.1016/j.ajic.2020.01.009.
18. Sharma M, Sahai S, Sharma R. Bacteriological Profile and Antibiotic Susceptibility Pattern of Intensive Care Unit Patients in a Tertiary Care Institute: An Observational Study. Int Arch BioMed Clin Res. 2021;7(2):MB1–MB3.
19. Mahendra M, Jayaraj BS, Lokesh KS, Chaya SK, Veerapaneni VV, Limaye S, et al. Antibiotic Prescription, Organisms and its Resistance Pattern in Patients Admitted to Respiratory ICU with Respiratory Infection in Mysuru. Indian J Crit Care Med. 2018;22(4):223-230. doi: 10.4103/ijccm.IJCCM_409_17.
20. Syal K, Singh D, Thakur A, Goyal A (2018) Micro-Organism profile and Antibiotic Susceptibility pattern in General ICU of Tertiary Care Hospital Situated in Hills. J Intensive Crit Care. Vol.4 No.1:7.
21. Barma MM, Nasir IA, Babayo A. Bacterial pathogens and their antibiotic susceptibility pattern in Intensive Care Units of the University of Maiduguri Teaching Hospital, Nigeria. J Med Trop. 2017;19:16-20
22. Choudhuri AH, Ahuja B, Biswas PS, Uppal R. Epidemiology of Multidrug Resistant Infections after Inter-ICU Transfer in India. Indian J Crit Care Med. 2019;23(1):1-6. doi: 10.5005/jp-journals-10071-23103.
23. Ranjitha Shankare Gowda, Sowmya G.S., Pavithra N., Raghavendra Rao M., Krishna Karthik M. and Satya Sai B., Bacteriological Profile of Endotracheal Aspirates and their Antibiotic Susceptibility Pattern, J Pure Appl Microbiol., 2018; 12(4): 2283-2287. http://dx.doi.org/10.22207/JPAM.12.4.69
24. Venkataraman R, Divatia JV, Ramakrishnan N, Chawla R, Amin P, Gopal P, et al. Multicenter observational study to evaluate epidemiology and resistance patterns of common intensive care unit-infections. Indian J Crit Care Med. 2018;22:20-6
25. Chitralekha Saikumar, M. Nishanthy, "A study on extended spectrum beta lactamase producing gram negative bacilli among blood culture isolates and their antibiotic susceptibility pattern from intensive care units in a tertiary care hospital" World journal of pharmaceutical research", Volume 9, Issue 12, 1408-1414.
26. Dasgupta S, Das S, Chawan NS, Hazra A. Nosocomial infections in the intensive care unit: Incidence, risk factors, outcome and associated pathogens in a public tertiary teaching hospital of Eastern India. Indian J Crit Care Med. 2015;19:14-20
27. Izadi N, Eshrati B, Mehrabi Y, Etemad K, Hashemi-Nazari SS. The national rate of intensive care units-acquired infections, one-year retrospective study in Iran. BMC Public Health. 2021;21(1):609. doi: 10.1186/s12889-021-10639-6.
28. Mythri H, Kashinath K. Nosocomial infections in patients admitted in intensive care unit of a tertiary health center, India. Ann Med Health Sci Res. 2014;4(5):738-41. doi: 10.4103/2141-9248.141540.
29. Harbade MS, Iravane JA, Gaikwad AA. Bacterial Infections and Antibiogram in Device Associated Infections in MICU, ICU of Hospital. Int J Curr Microbiol App Sci. 2019;8(3): 182-187.
30. Apoorva B, Mohan S, Manjhi M, Kakru D. Comparison of antibiotic susceptibility pattern of Pseudomonas aeruginosa from critical and non-critical areas at tertiary care hospital. J Evid Based Med Healthc. 2021;8(12):677-681.
31. Chaudhry D, Prajapat B. Intensive care unit bugs in India: How do they differ from the western world?. J Assoc Chest Physicians. 2017;5:10-7.
32. Jain AK, Jain SB, Ranjan KP, Misra V. Microbiological profile of infection in intensive care unit and their antimicrobial susceptibility pattern with special reference to metallo β-lactamases and AmpC. Int J Med Sci Public Health. 2018;7(3):229-234.
33. Kumar A, Tanwar S, Chetiwal R, Kumar R. Nosocomial infections-related antimicrobial resistance in a multidisciplinary intensive care unit. MGM J Med Sci. 2022;9:12-8
34. Fahim NAE. Prevalence and antimicrobial susceptibility profile of multidrug-resistant bacteria among intensive care units patients at Ain Shams University Hospitals in Egypt-a retrospective study. J Egypt Public Health Assoc. 2021;96(1):7. doi: 10.1186/s42506-020-00065-8.
35. Garg VK, Mishra S, Gupta N, Garg R, Sachidanand B, Vinod K, et al. Microbial and Antibiotic Susceptibility Profile among Isolates of Clinical Samples of Cancer Patients Admitted in the Intensive Care Unit at Regional Tertiary Care Cancer Center: A Retrospective Observational Study. Indian J Crit Care Med. 2019;23(2):67-72. doi: 10.5005/jp-journals-10071-23119.
36. Khan RA, Khan FA, Iqbal M, Nigar H. Prevalence and antibiotic susceptibility of methicillin resistant Staphylococcus aureus and Acinetobacter baumannii in clinical samples from intensive care unit patients in a tertiary care hospital at Peshawar (Pakistan). Anaesth Pain & Intensive Care. 2014;18(3):231-236
37. Gupta V, Singla N, Gombar S, Palta S, Chander J. Prevalence of multidrug-resistant pathogens and their antibiotic susceptibility pattern from late-onset ventilator-associated pneumonia patients from a tertiary-care hospital in north India. J Assoc Chest Physicians. 2018;6:4-11.
38. Bhandari P, Thapa G, Pokhrel BM, Bhatta DR, Devkota U. Nosocomial Isolates and Their Drug Resistant Pattern in ICU Patients at National Institute of Neurological and Allied Sciences, Nepal. Int J Microbiol. 2015;2015:572163. doi: 10.1155/2015/572163.
39. Chidambaram, et al. Antimicrobial Profile of Clinical Isolates in Intensive Care Unit at a Tertiary Care Hospital.Int J Med Res Health Sci 2019, 8(2): 160-166
40. Saxena S, Priyadarshi M, Saxena A, Singh R. Antimicrobial consumption and bacterial resistance pattern in patients admitted in I.C.U at a tertiary care center. J Infect Public Health. 2019;12(5):695-699. doi: 10.1016/j.jiph.2019.03.014.
41. Zaha DC, Kiss R, Hegedűs C, Gesztelyi R, Bombicz M, Muresan M, et al. Recent Advances in Investigation, Prevention, and Management of Healthcare-Associated Infections (HAIs): Resistant Multidrug Strain Colonization and Its Risk Factors in an Intensive Care Unit of a University Hospital. Biomed Res Int. 2019;2019:2510875. doi: 10.1155/2019/2510875.

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