Original Research Article

Microbiological profile of blood culture Isolates in a Tertiary Care Hospital in Maharashtra

Poovvizhi.M[1*], Poojashri Sharma[2], Rupali S Mantri[3], Nitin A Ambhore[4]

[1]Post Graduate 2nd year, Department of Microbiology, Government Medical College, Akola, Maharashtra, India
[2]Assistant Professor, Department of Microbiology, Government Medical College, Akola, Maharashtra, India
[3]M.D, Associate Professor, Department of Microbiology, Government Medical College, Akola, Maharashtra, India
[4]Professor and Head, Department of Microbiology, Government Medical College, Akola, Maharashtra, India

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Abstract

Background:
Blood stream infections (BSI), ranging from self-limiting infections to life threatening septicaemia remain one of the most important cause of morbidity and mortality. BSI can be preceded, followed or be concomitant to a localized or disseminated infectious disease. Blood cultures remains the gold standard diagnostic test for detecting septicemia.Objective:1.To study the profile of microbiological isolates causing Blood Stream Infections in suspected cases of septicaemia2.To determine the antibiotic susceptibility pattern of bacterial isolatesMaterials and methods: The study was carried out in Department of Microbiology at GMC, Akola from January 2018 to December 2020. Blood samples from 2322 patients with a clinical diagnosis of sepsis were processed under standard protocol. Results:A culture positivity of 5.25% was observed. Of the total 122 isolates, 52 (42.59%) Gram-negative rods, 46 (37.7%) Gram-positive cocci and 24 (19.66%) Candida species were isolated. The predominant GNR were *Pseudomonas* spp. 16(13.11%) followed by *Klebsiella* spp. 14(11.47%) and *Escherichia coli* 12(9.83%). *E. coli* (16.66%) and *Klebsiella* spp. (28.57%) were found to be ESBL producers. Among Gram-positive cocci, *S. aureus* 32(26.22%) was commonest with MRSA (87.5%), followed by *Enterococci* spp. (4.9%) and *CONS* (4.9%). Conclusion:
Timely identification of pathogen and its susceptibility to antimicrobial agents is of great diagnostic and prognostic importance to decrease related mortality and morbidity. Antimicrobial stewardship programme on regular basis guides in decreasing antimicrobial resistance.
Key words:BSI, ESBL, MRSA.

Introduction

Septicaemia refers to presence of organism producing an infection in bloodstream. Blood stream infections, ranging from self-limiting infections to life threatening septicaemia remain one of the most important cause of morbidity and mortality. [1]

BSI can be preceded, followed or be concomitant to a localized infectious disease, like endocarditis, pneumonia, UTI, meningitis and others. [2]Globally, bloodstream infection affects about 30 million people leading to 6 million deaths, with 1.2 million children suffering from sepsis annually. [3]Blood cultures (BCs) remains the gold standard for detecting bacteraemia. [4] Early identification of pathogens in the blood can be a crucial step in assuring appropriate therapy and beginning effective antibiotic therapy will have a significant impact on the outcome of the disease. [5]The main concern of this study is identification of causative organism of septicaemia and to know the antibiotic susceptibility pattern of bacterial isolates.

Objective

1.To study the microbiological profile of isolates causing Blood Stream Infections in suspected cases septicaemia

2.To determine the antibiotic susceptibility pattern of bacterial isolates

Materials and methods:

Study design:This study is retrospective descriptive study.

Study setting:The study was carried out in Department of Microbiology at GMC, Akola from January 2018 to December 2020 (3-year study). A total of 2322 blood samples from patients with clinical diagnosis of septicaemia were received and processed in microbiology laboratory. The study was initiated after obtaining approval from the Institutional Ethical Committee.

Selection of cases

Inclusion criteria

All patients with unexplained or undiagnosed fever with clinical diagnosis of septicaemia were included in study. Socio demographic profile was studied. [6]

Exclusion criteria

Contaminated, mixed, duplicate and repeat samples were excluded from study.[6]

Sample processing

Blood was collected following aseptic precautions (70% alcohol and povidone-iodine). Approximately 1 – 3 ml of blood was collected in case of young children and diluted in 20 ml of broth (1:10 to 1:20) and 5 – 10 ml of blood was collected from adults and diluted in 50 ml of broth (1:5 to 1:10). [7]

Blood specimen was put into a blood-culture bottle immediately and processed in a bacteriology laboratory after collection (i.e., within 2 hours). [8]It was incubated at 37°C. Next day, if turbidity appeared, subculture was done or else also, blind subculture was done on Blood agar and MacConkey agar. In case of no turbidity, further incubation up to 7 days is done and blind subculture was done daily, and if growth occurred, microorganisms were identified by standard microbiological methods. [9]

The antibiotic susceptibility testing was done by Kirby-Bauer disc diffusion method and interpreted as per Clinical laboratory Standards Institute (CLSI 2019) guidelines. [10]

*Correspondence
Dr. Poovvizhi.M
Post graduate 2nd year, Department of Microbiology, Government Medical College, Akola, Maharashtra, India.
E-mail: sugirtha.m98@gmail.com

For Gram-positive cocci, following drugs were tested:
Amikacin (30 µg), Cefoxitin (30 µg), Ciprofloxacin (5 µg), Clindamycin(2 µg), Trimethoprim-sulfamethoxazole (1.25/23.75µg), Erythromycin(15 µg), Gentamicin (10 µg and 120 µg), Linezolid (30 µg), Penicillin (10U), Teicoplanin (30 µg) and Vancomycin (30 µg).
For Gram-negative bacilli, following drugs were tested:
Ampicillin (10 µg), Amoxiclav (30 µg), Tobramycin (10 µg), Gentamicin (10 µg), Ciprofloxacin (5 µg), Cefotaxime (30µg), Ceftazidime (30 µg), Amikacin (30 µg), Piperacillin-tazobactam (100/10 µg), Meropenem (30 µg) and Imipenem (10 µg).

Results

A total of 2322 blood samples were received from various wards and ICU's. Out of 2322 samples, Culture positivity was seen in 5.25% of the bacteraemia or septicaemic cases. Six isolates (0.25%) were contaminants, and 2200 cases (94.7%) did not show any growth. Out of 122 isolates, 82 were males (67.3%) and 40 were females (32.7%); male to female ratio was 2:1.

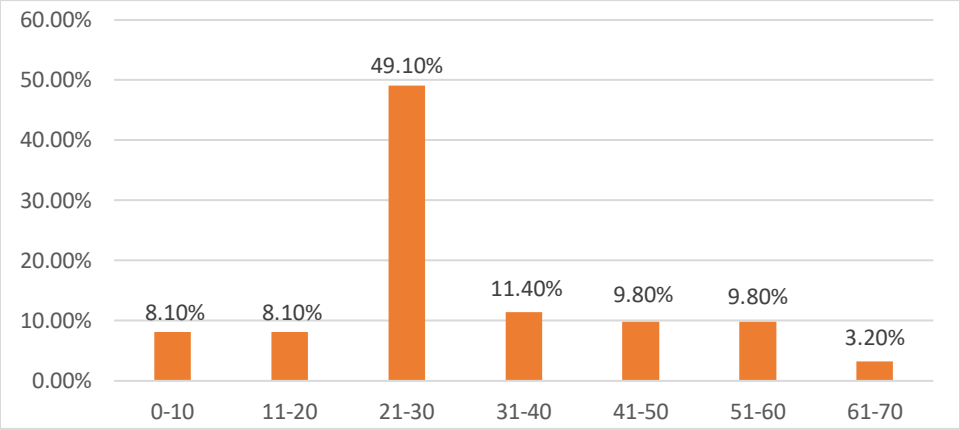

Fig. 1 : Showing Age wise Culture Positivity

The above figure 1 shows that out of 122 samples collected, the highest positivity (49.1%) was seen in 21-30 years age group. After that, higher infectivity rates are seen in 31- 40 years age group. The positivity decreases at extremes of age.

Table 1 : ICU and ward wise distribution of samples

SR.NO	WARD/ICU:	Number of blood samples
1.	ICU:	48
a)	MICU	26
b)	SICU	14
c)	NICU	8
2.	Wards:	74
a)	OBGY	28
b)	Medicine	14
c)	Skin	10
d)	Surgery	8
e)	Pediatrics	8
f)	Orthopedics	6
	Total	122

The predominant blood culture samples were sent from MICU contributing to 26 samples followed by OBGY and medicine department.

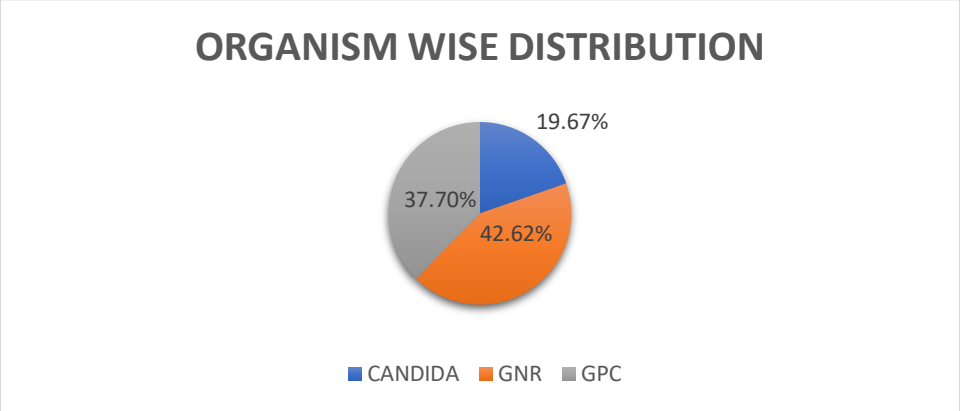

Fig. 2 : Organism wise distribution

Fig. 2 shows that out of 122 isolates, Gram-negative bacilli were the predominant agents (42.59%), following which gram-positive cocci accounted for 46 (37.75%) and candida species were seen in 24(19.66%).

Table 2 : Microbiological profile of blood culture isolates

Type of isolates	**Number**	**Percentage %**
1) Gram Positive cocci	46	37.75%
a) Staphylococcus aureus	32(MRSA=28)	26.22% (MRSA=87.5%)
b) Coagulase negative Staphylococcus (CONS)	6	4.91%
c) Enterococci spp	6	4.91%
d) Streptococcus pyogenes	2	1.63%
2) Gram Negative bacilli	52	42.59%
a) Pseudomonas aeruginosa	16	13.11%
b) Klebsiella pneumonia	14(ESBL = 4)	11.47% (ESBL = 28.57%)
c) *E. coli*	12(ESBL = 2)	9.83% (ESBL = 16.66%)
d) *Acinetobacter baumannii*	6	4.91%
e) *Citrobacter* spp	4	3.27%
3) Candida species	24	19.66%
a) Candida albicans	14	11.47%
b) Non albicans Candida	10	8.19%
Total isolates	122	100%

Out of 46 Gram positive cocci, 32(26.22%) were *Staphylococcus aureus* which mostly accounted for Methicillin Resistant *Staphylococcus aureus* (87.5%). Other GPCs were Coagulase Negative *Staphylococcus aureus*, *Enterococci* spp and *Streptococcus pyogenes* accounting for 4.9%,4.9% and 1.63% respectively.Out of 52 Gram Negative bacilli, *Pseudomonas aeruginosa* was the predominant isolate with 16 (13.11%) followed by *Klebsiella pneumoniae* 14(11.4%), *E. coli 1*2 (9.83%), *Acinetobacter baumanni* 6(4.91%) *and Citrobacter* spp 4(3.2%). Out of 24 Candida species, 14 were *Candida albicans* which accounted to be 11.47% and 10 *Non albicans candida* accounted to be 8.19%.

Table 3 : Antibiotic sensitivity pattern of Gram negative bacilli

SN	**Drugs**	***Pseudomonas aeruginosa* (N=16,100%)**	***K. pneumoniae* (N=14,100%)**	***E. coli* (N=12,100%)**	***Acinetobacter* spp (N=6,100%)**	***Citrobacter* spp (N=4,100%)**
1.	Ampicillin	5(31.25%)	5(35.71%)	3(25%)	-	1(25%)
2.	Amoxiclav	6(37.5%)	8(57.14%)	6(50%)	-	2(50%)
3.	Amikacin	11(68.75%)	7(50%)	5(41.66%)	3(50%)	1(25%)
4.	Ceftazidime	6(37.5%)	6(42.85%)	4(33.33%)	2(33.33%)	4(100%)
5.	Cefotaxime	8(50%)	8(57.14%)	7(58.33%)	4(66.66%)	4(100%)
6.	Ciprofloxacin	10(62.5%)	6(42.85%)	8(66.66%)	5(83.33%)	-
7.	Gentamicin	7(43.75%)	7(50%)	8(66.66%)	2(33.33%)	-
8.	Piperacillin Tazobactam	10(62.5%)	6(42.85%)	5(41.66%)	5(83.33%)	2(50%)
9.	Tobramycin	9(56.25%)	10(71.42%)	6(50%)	2(33.33%)	2(50%)
10.	Imipenem	13(81.25%)	12(85.71%)	12(100%)	4(66.66%)	4(100%)
11.	Meropenem	12(75%)	11(78.57%)	10(83.33%)	5(83.33%)	3(75%)

Most of gram-negative bacilli showed higher sensitivity to carbapenems, ciprofloxacin and tobramycin. Ceftazidime and cefotaxime showed 100% sensitivity to *Citrobacter* spp and showed low resistance to *Pseudomonas, Klebsiella* and *E.coli*. Overall amoxiclav showed only 50% sensitivity to Gram negative bacilli.

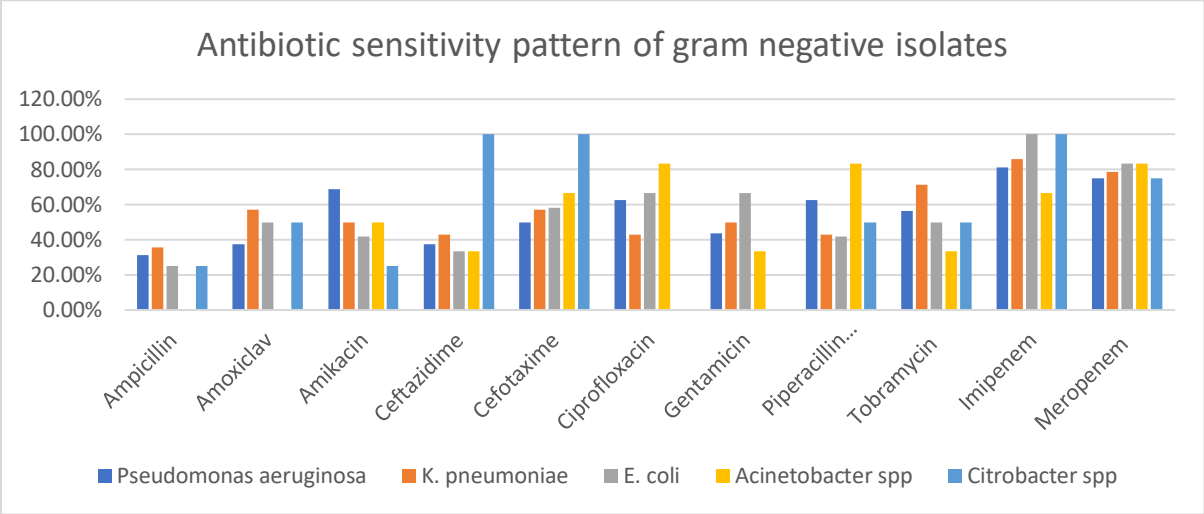

Fig. 3 : Antibiotic sensitivity pattern of gram negative isolates

Table 4: Antibiotic sensitivity pattern of Gram-positive cocci

SN	Drugs	*Staphylococcus aureus* (N=32, 100%)	*CONS*(N=6,100 %)	*Enterococci* spp (N=6,100%)	*Streptococcus pyogenes* (N=2,100%)
1.	Amikacin	23(71.87%)	6(100%)	-	-
2.	Cefoxitin	4(12.5%)	5(83.33%)	-	-
3.	Ciprofloxacin	20(62.5%)	5(83.33%)	2(33.33%)	-
4.	Clindamycin	21(65.62%)	4(66.66%)	-	-
5.	Cotrimoxazole	20(62.5%)	2(33.33%)	-	2(100%)
6.	Erythromycin	17(53.12%)	3(50%)	2(33.33%)	-
7.	Gentamicin	19(59.37%)	3(50%)	HLG -2(33.33%)	1(50%)
8.	Linezolid	26(81.25%)	4(66.66%)	4(66.66%)	2(100%)
9.	Penicillin	5(15.62%)	2(33.33%)	-	1(50%)
10.	Teicoplanin	25(78.12%)	5(83.33%)	5(83.33%)	2(100%)
11.	Vancomycin	32(100%)	6(100%)	6(100%)	2(100%)

S. aureus isolates showed 100% sensitivity to vancomycin, 81.25% sensitivity to linezolid and 78.12% sensitivity to teicoplanin. There was moderate sensitivity to clindamycin (65.62%), ciprofloxacin (62.5%) and low sensitivity to penicillin (15.62%). There was higher prevalence of methicillin resistant *S. aureus* (MRSA) with 87.5% leaving only 4 samples sensitive to cefoxitin.
Enterococcus species showed high sensitivity to vancomycin (100%) and teicoplanin (83.33%). All *Streptococci* species were sensitive to vancomycin, linezolid, cotrimoxazole and teicoplanin. Coagulase-negative *staphylococci* were sensitive to vancomycin was (100%) and amikacin (100%).

Out of total 12 *E. coli* isolates 2 (16.66%) were found to be ESBL producers whereas ESBL production was reported up to be 4 (28.57%) out of 14 in *K. pneumoniae* isolates.

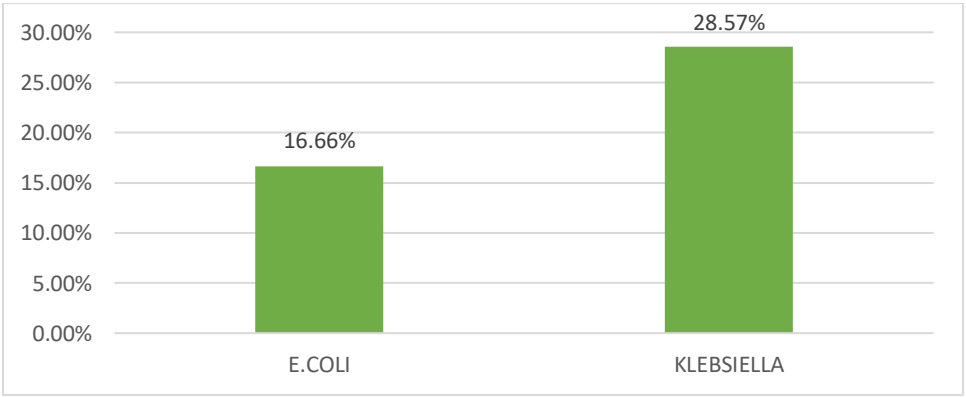

Fig. 4 : ESBL Production in *E.coli* and *Klebsiella pneumoniae.*

Discussion

Out of 2322 suspected cases, 5.25% of Culture positivity was seen which coincided with Asmita Ashok Patil et al .[11] While Laxmi Kant Khanal et al [12] and Shrestha S et al [13] showed a little higher of 10.3% and 13.3% respectively. A study revealed that the prevalence of BSI was 14.6% (range, 3.4 to 38.2%) in Africa, 2.9% (range, 2.1 to 19.2%) in Europe, 7.3% (range, 2.9 to 15.6%) in America and 7.3% (range, 2.0 to 48.4%) in Asia.[14]In present study, 1625 (69.99%) were males, while 697 (30.01%) were females. The infection rate was 67.3% in males and 32.7% in females. Mohanty et al [15] also reported higher infection rate among males.

The positivity rate is high among 21-30 years age group which is in concordance with Wasihun AG et al.[16] It is followed by 31-40 years age group. The mean age of study population was found to be 27.61%. MICU have sent highest number of samples followed by SICU and NICU.

Infections due to Gram Negative Bacilli pose a great problem in health care facilities and ICU's which were the predominant 52 isolates in our study accounting to 42.59%, following which Gram-positive cocci accounted for 46 (37.75%) isolates which is similar to study by Palewar et al .[17] and Samuel et al.[18]*Candida* species were seen in 19.66% of cases.Out of 46 Gram Positive Cocci, 32(26.22%) were *Staphylococcus aureus* with mostly accounting for Methicillin Resistant *Staphylococcus aureus* (87.5%). Other GPCs were Coagulase Negative *Staphylococcus aureus*, *Enterococci* spp and *Streptococcus pyogenes* accounting for 4.9%,4.9% and 1.6% respectively. Similar finding was noted by Birru et al [19] and Vlieghe et al .[20] In both of these studies *S. aureus* was the most common isolate among Gram-positive organisms. High level gentamicin is found to be resistant in *Enterococci* spp.

S. aureus isolates showed 100% sensitivity to vancomycin, 81.25% sensitivity to linezolid and 78.12% sensitivity to teicoplanin. Even in Roy et al [21] and Mehta et al [22] the strains were sensitive to vancomycin. *S. aureus* is known to be antibiotic-resistant, especially methicillin-resistant *S. aureus* (MRSA) infections have been the main cause of mortality and economic burden worldwide.[23] There was higher prevalence of methicillin resistant *S. aureus* (MRSA) with 87.5% which is little higher than Palewar et al [17] (66%) and Banik et al (41%). [24]

There was moderate sensitivity to clindamycin (65.62%) and low sensitivity to penicillin (15.62%). All enterococci species were sensitive to vancomycin.Out of 52 Gram Negative bacilli, *Pseudomonas aeruginosa* was the predominant isolate with 16 (13.11%). It was followed by *Klebsiella pneumoniae* 14(11.47%), *E. coli 12* (9.83%), *Acinetobacter baumanni* 6 (4.91%) *and Citrobacter* spp 4(3.27%). Most of gram negative bacilli shows higher sensitivity to carbapenems and ciprofloxacin which simulates Atul Garg et al [25] and Mukta et al.[26] Ceftazidime and cefotaxime were sensitive to *Citrobacter* spp and shows low resistance to *Pseudomonas* spp, *Klebsiella* spp and *E.coli* in concordance with Gupta et al .[27] Overall amoxiclav shows only 50% sensitivity to gram negative bacilli.

ESBLs have been detected in many gram-negative species. But *K. pneumoniae* is still the most frequently reported producer of these enzymes. *K. pneumoniae* has become increasingly common, especially in intensive care units (ICUs) and other high-risk hospital areas .[28] Out of total 12 *E. coli* isolates 2 (16.66%) were found to be ESBL producers whereas ESBL production was reported up to be 4 (28.57%) out of 14 in *K. pneumoniae* isolates. These findings are similar to Subha et al .[29]

Candida species accounted to 19.66% which is less than to Hajjeh et al [30] and Nawaf Alkharashi et al .[31]

Conclusion

BSIs remain an important cause of morbidity and mortality. The accuracy of blood culture identification in the microbiology laboratories and prompt targeted therapeutic intervention improves patient outcomes. Regular antibiotic susceptibility surveillance, evaluation and periodic review of the antibiotic policy of the hospital as well as the encouragement of rational antibiotic use will reduce the development of microbial resistance. The antimicrobial stewardship programme is a boon in this era of antibiotic resistance and needs to be followed ubiquitously.

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References

1. Bailey and Scott's Diagnostic microbiology: A textbook for isolation and identification of pathogenic microorganisms. In 15th edition Edited by Forbes BA, Sahm DF, Weissfeld AS. St. Louis: The Mosby Company; 2002: pg 953.
2. Viscoli C. Bloodstream Infections: The peak of the iceberg. Virulence. 2016;7(3):248-251. doi:10.1080/21505594.2016.1152440
3. C. Fleischmann, A. Scherag, N. K. J. Adhikari et al., "Assessment of global incidence and mortality of hospital-treated sepsis. Current estimates and limitations," American Journal of Respiratory and Critical Care Medicine, vol. 193, no. 3, pp. 259–272, 2016.
4. Nannan Panday RS, Wang S, van de Ven PM, Hekker TAM, Alam N, Nanayakkara PWB. Evaluation of blood culture epidemiology and efficiency in a large European teaching hospital. PLoS One. 2019 Mar 21;14(3):e0214052. doi: 10.1371/journal.pone.0214052. PMID: 30897186; PMCID: PMC6428292.
5. Garey KW, Rege M, Pai MP, Mingo DE, et al. Time to Initiation of Fluconazole Therapy Impacts Mortality in Patients with Candidemia: A Multi-Institutional Study. Clinical Infectious Diseases. 2006;43(1):25-31.
6. Kotgire, Santosh & Hatkar, Sunil. (2017). Aerobic bacteriological profile and its antimicrobial sensitivity pattern from blood culture specimens in a tertiary care hospital. Annals of Pathology and Laboratory Medicine, Vol. 04, No. 01, January - February, 2017 4.10.21276/apalm.2017.988.
7. Koneman EW, Allen SD, Janda WM, Schreckenberger PC, Winn WC Jr. Koneman's Color Atlas and Textbook of Diagnostic Microbiology. 7th ed. Philadelphia. Lippincott Williams & Wilkins; 2006.
8. World Health Organization. Manual for the laboratory identification and antimicrobial susceptibility testing of bacterial pathogens of public health concern in the developing world. WHO/CDS/CSR/RMD/, 2003, 6. Available online at http://www.who.int/csr/resources/publications/drugresist/WHO_CDS_CSR_RMD_2003_6/en/.
9. Collee JG, Miles RS, Watt B. Tests for the identification of bacteria. In: Collee JG, Fraser AG, Marmion BP, Simmons A, editors. Mackie and McCartney Practical medical microbiology. 14th ed. London: Livingstone, 1996: 131-49.
10. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing. Informational Supplement. 31st ed. Wayne, PA, USA: Clinical and Laboratory Standards Institute; 2019. p. M100.
11. Patil, Dr. Asmita Ashok and Dr. Pratibha J. Dalal. "Bacterial profile and resistance pattern of bacterial isolates from blood culture – a five year study in tertiary care teaching hospital" European journal of pharmaceutical and medical research 2016,3(6), 563-567.
12. Khanal LK. Bacteriological profile of blood culture and antibiogram of the bacterial isolates in a tertiary care hospital. International Journal of Health Sciences and Research 2020; 10(8):10-14.
13. Shrestha, S., Amatya, R., Shrestha, R. K., & Shrestha, R. (2014). Frequency of Blood Culture Isolates and their

Antibiogram in a Teaching Hospital. Journal of Nepal Medical Association, 52(193), 692–696.
14. Marchello, C. S., Dale, A. P., Pisharody, S., Rubach, M. P. & Crump, J. A. A systematic review and meta-analysis of the prevalence of community-onset bloodstream infections among hospitalized patients in Africa and Asia. Antimicrobial. Agents and Chemotherapy. 2019;64(1):e01974
15. Mohanty, A., S. Singh T, A. Kabi, P. Gupta, P. Gupta, and P. Kumar. "Bacteriological profile and antibiotic sensitivity pattern of hospital acquired septicemia in a tertiary care hospital in north east india". Asian Journal of Pharmaceutical and Clinical Research, 2017; 10(11):186-9.
16. Wasihun AG, Wlekidan LN, Gebremariam SA, et al. Bacteriological profile and antimicrobial susceptibility patterns of blood culture isolates among febrile patients in Mekelle Hospital, Northern Ethiopia. Springerplus. 2015;4:314.
17. Palewar M, Mudshingkar S, Dohe V, Kagal A, Karyakarte R. Bacteriological profile and antibiogram of blood culture isolates from a tertiary care hospital of Western India. J Datta Meghe Inst Med Sci Univ 2020;15:261-5.
18. Samuel SO, Fadeyi A, Akanbi AA 2nd, Ameen NB, Nwabuisi C, Onile BA. Bacterial isolates of blood cultures in patients with suspected septicaemia in Ilorin, Nigeria. African Journal of Medicine and Medical Sciences. 2006;35(2):137-141.
19. Birru M, Woldemariam M, Manilal A, et al. Bacterial profile, antimicrobial susceptibility patterns, and associated factors among bloodstream infection suspected patients attending Arba Minch General Hospital, Ethiopia. Sci Rep. 2021;11(1):15882.
20. Vlieghe et al. Bloodstream infection among adults in Phnom Penh, Cambodia: Key pathogens and resistance patterns. PLoS ONE 2013;8(3):e59775.
21. Roy I, Jain A, Kumar M, Agarwal SK. Bacteriology of neonatal septicaemia in a tertiary care hospital of northern India. Indian Journal of Medical Microbiology 2002; 20: 156-9.
22. Mehta M, Dutta P, Gupta V. Antimicrobial Susceptibility Pattern of Blood isolates from a teaching hospital in North India. Japanese journal of infectious disease 2005; 58:174-6.
23. Otto M. MRSA virulence and spread. Cellular Microbiology. 2012;14(10):1513–21.
24. Banik A, Bhat SH, Kumar A, Palit A, Snehaa K. Bloodstream infections and trend of antimicrobial sensitivity patterns at Port Blair. Journal of Laboratory Physicians 2018;10:332-7.
25. Atul Garg, S Anupurba, Jaya Garg, RK Goyal, MR Sen Bacteriological Profile and Antimicrobial Resistance of Blood Culture Isolates from a University Hospital. Jour of Ind Acad of Clin Med 2007; 8(2): 139-4.
26. Mukta Sawargaonkar, Nazneen Siddiqui, Joson Mathew and Arvind Gaikwad. 2019. Bacteriological Profile of Blood Stream Infections Along with their Antibiogram at Government Cancer Hospital, Aurangabad. International Journal of Current Microbiology and Applied Sciences 2019; 8(5):2082-2091.
27. Gupta, A., Sharma, S., Arora, A. et al. Changing Trends of in Vitro Antimicrobial Resistance Patterns in Blood Isolates in a Tertiary Care Hospital over a Period of 4 Years. Indian Journal of Medical Sciences 2010;64 (11); 485-92.
28. Tumbarello M, Spanu T, Sanguinetti M, et al. Bloodstream infections caused by extended-spectrum-beta-lactamase-producing Klebsiella pneumoniae: risk factors, molecular epidemiology, and clinical outcome. Antimicrobial Agents and Chemotherapy. 2006;50(2):498-504.
29. Dr.Subha.M, Dr.A.Vijayalakshmi, Dr.J.Rajeswari, Bacteriological Profile and Antimicrobial susceptibility pattern of Blood Culture Isolates from a Tertiary Care Teaching Hospital, South india, International journal of scientific research 2018;7(2):1.
30. Hajjeh RA, Sofair AN, Harrison LH, et al. Incidence of bloodstream infections due to Candida species and in vitro susceptibilities of isolates collected from 1998 to 2000 in a population-based active surveillance program. Journal of Clinical Microbiology. 2004;42(4):1519-1527.
31. Alkharashi N, Aljohani S, Layqah L, et al. Candida Bloodstream Infection: Changing Pattern of Occurrence and Antifungal Susceptibility over 10 Years in a Tertiary Care Saudi Hospital. The Canadian Journal of Infectious Disease and Medical Microbiology. 2019:2015692.

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