Original Research

Microbial Profile and Antibiotic Susceptibility Pattern of Infectious Agents Isolated from Patients Admitted to Intensive Care Unit of a Tertiary Care Center at Bihta

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Abstract

Objectives: Patients with critical illness are admitted in intensive care units (ICU). A right antibiotics given to these patients timely, will help in their recovery. This study was done with an aim to know the profile of microorganism in the ICU setting and their antibiotic susceptibility pattern.

Materials and methods: The study was conducted for 1 year period in a tertiary care hospital at Bihta, Patna. All the clinical samples received from various ICU's were subjected to culture and sensitivity by standard microbiological procedures.

Results: A total of 540 samples were received from various ICU's. The culture positive rate in ICU was 22.8%. The most common culture positive sample received was blood 59 (48%). Among culture positive samples, 68 (55.3%) were Gram negative bacteria (GNB), followed by 43 (35%) Gram positive cocci (GPC) and 12 (9.7%) fungal isolates. *Escherichia coli* 28 (22.8%) was the most common isolates among GNB. Among GPC, the most common isolates was Coagulase negative *Staphylococcus* species (CONS) 32 (26%). All fungal isolates were Non albicans *Candida* (9.8%).

Conclusion: This will help in making antibiotic policy of the ICU setting and will guide clinicians for empirical therapy. It will prevent misuse of antibiotics and helps to combat antibiotic resistance.

Keywords: ICU, GNB, GPC, Antibiotics, Antibiotic resistance.

Introduction

A patient who needs intensive treatment and continuous observation are kept in a specialized unitcalled ICU.[1] Apatient admitted in ICU has increased risk of developing healthcare associated infections. It is due toirrational use of antibiotic

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and invasive devices.[2] In developing countries,the healthcare associated infections among ICU admitted patients varies from 11-60%.[3] There is emergence and spread of antibiotic resistant pathogens in ICU setting all across the globe in last few years. There is very limited therapeutic options available for these pathogens leading to global threat.[4] In 2019, 1.27 million deaths were reporteddue to antimicrobial resistance globally.[5] A studyon antimicrobial resistance, reported that in India, more than 70% GNB were resistant to fluoroquinolones and third generation cephalosporins. Among the GPC,42.6% *Staphylococcusaureus* were reported as methicillin-resistant and 10.5% *Enterococcus faecium* as vancomycin-resistant.[6]

Material and Methods

Thisprospective study was conducted in a tertiary care hospital in Bihta, Bihar over a period of 1 year from July 2023 to June 2024. The study was done after getting approval by the clinical research ethics committee of Netaji Subhas Medical College and Hospital, Bihta, Patna via letter no : CREC/2023/33, dated 04/07/2023. Informed consent were obtained from patient's relatives before enrolling into the study. The samples were collected from various ICU's (Medical Intensive care unit{MICU}, Surgical Intensive care unit {SICU}, Pediatrics Intensive care unit {PICU} and Neonatal Intensive care unit {NICU}) and processed by standard procedure. The isolates were identified by standard techniques. The bacterial isolates were identified based on colony morphology, gram stain, motility and biochemical tests. Fungal isolates were identified by gram stain and germ tube[7]. The antimicrobial susceptibility pattern was determined by Kirby Bauer disc diffusion method according to CLSI 2023 guidelines[8].Statistical analysis: The data were entered in Microsoft Excel and SPSS software was used for statistical analysis. Descriptive data were analyzed statistically and expressed as percentage.

Results

During the study period, a total of 540 samples were received from various ICU's for culture and sensitivity. Among this, 123 (22.8%) samples were culture positive and 417 (77.2%) showed no growth. Male predominance 84 (68.3%) was seen as compared to female 39 (31.7%) in culture positive samples. Most of the culture positive samples 41 (33.3%) were from 0-1 year age group. (Table 1).

The most common clinical diagnosis in culture positive sample were sepsis 71 (57.7%) followed by respiratory tract infection 28 (22.8%), urinary tract infection 18 (14.6%) and head injury 06 (4.9%). In the culture positive samples, the most common underlying co-morbid condition were due to cardiovascular disease 66 (53.7%) followed by diabetes 18 (14.6%), chronic lung disease 17 (13.8%), chronic renal failure 12 (9.8%), and chronic liver disease 10 (8.1%).

TABLE 1: DISTRIBUTION OF CULTURE POSITIVE SAMPLES BASED ON DEMOGRAPHIC PROFILE (N = 123)

GENDER	NUMBER	PERCENTAGE
MALE	84	68.3%
FEMALE	39	31.7%
AGE GROUP	**NUMBER**	**PERCENTAGE**
0-1 Year	41	33.3%
>1-11 Year	04	3.3%
>11-18 Year	14	11.4%
>18-45 Year	25	20.3%
>45 YEAR	39	31.7%

Majority of culture positive samples were received from MICU 50 (40.7%), followed by NICU 40 (32.5%), SICU 27 (21.9%) and PICU 06 (4.9%) (Figure 1). The most common culture positive clinical sample received was blood 59 (48%), followed by respiratory samples 25 (20%), urine 22 (18%) and pus 17 (14%). (Figure 2).

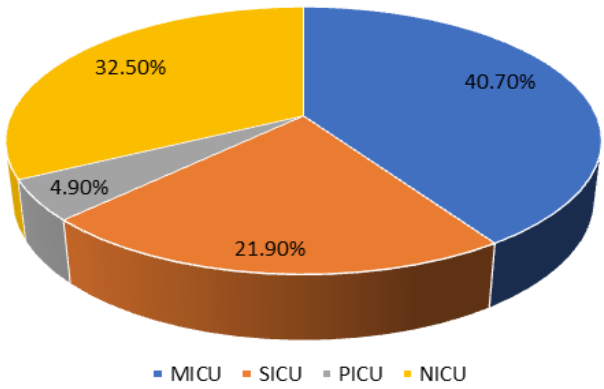

Figure 1: DISTRIBUTION OF CULTURE POSITIVE SAMPLES IN DIFFERENT ICU

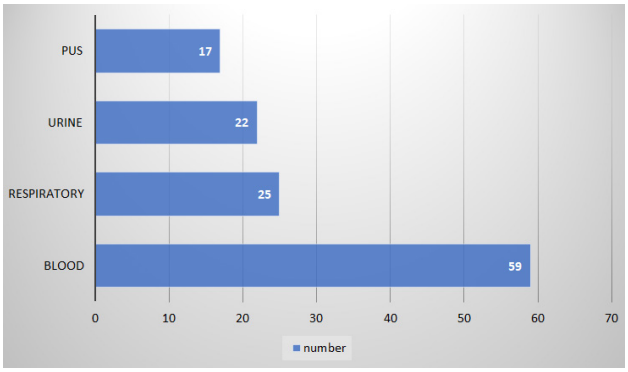

Figure 2: DISTRIBUTION OF CULTURE POSITIVE SAMPLES BASED ON TYPES OF SAMPLES

Among culture positive samples, 68 (55.3%) were GNB, followed by 43 (35%) GPC and 12 (9.7%) fungal isolates. *Escherichia coli* 28 (22.8%) were the most common isolates among GNB followed by *Acinetobacter* species 19 (15.4%) and *Klebsiella* species 12 (9.8%). Among GPC, the most common isolates were Coagulase negative *Staphylococcus* species (CONS) 32 (26%) followed by *Enterococcus* 06 (4.9%) and *Staphylococcus aureus* 05 (4%). All fungal isolates were Non albicans *Candida* (9.8%). {Table 2}.

TABLE 2: DISTRIBUTION OF BACTERIAL ISOLATES IN CULTURE POSITIVE SAMPLES (N = 123)

GRAM NEGATIVE BACTERIA		
1.	*Escherichia coli*	28 (22.8%)
2.	*Acinetobacter species*	19 (15.4%)
3.	*Klebsiella species*	12 (9.8%)
4.	*Pseudomonas aeruginosa*	08 (6.5%)
5.	*Proteus mirabilis*	01 (0.8%)
GRAM POSITIVE COCCI		
6.	CONS	32 (26%)
7.	*Enterococcus species*	06 (4.9%)
8.	*Staphylococcus aureus*	05 (4%)
FUNGUS		
9.	*Non Albicans Candida*	12 (9.8%)

All the GNB were 100% sensitive to colistin, except for the intrinsic resistant ones. *Escherichia coli* showed 100% sensitivity to colistin followed by Carbapenem (89%) and Aminoglycosides (67.9%). The highest sensitivity in *Klebsiella* species was seen in colistin 100% followed by tetracycline (75%) and Carbapenems (33.33%). *Proteus mirabilis* showed 100% sensitivity towards Carbapenems and Piperacillin Tazobactum. *Pseudomonas* species showed 100% sensitivity towards colistin, Piperacillin tazobactum followed by Carbapenems (87.5%) and Cefepime (62.5%). Colistin (100%), followed by minocycline, cotrimoxazole (26.3% respectively) and Piperacillin tazobactum (21%) sensitivity was reported in *Acinetobacter* species. {Figure3,4,5,}. In this study, the production of extended-spectrum β-lactamases (ESBLs) was reported to be 10% in *Escherichia coli* and *Klebsiella* species.

Among GPC, 25 (78%) isolated CONS were methicillin resistant. Highest sensitivity in CONS was seen in vancomycin (100%), followed by linezolid (93.6%) and tetracycline (78%). Methicillin resistant was 4 (80%) in *Staphylococcus aureus*. It showed 100% susceptibility to vancomycin, linezolid and gentamicin. *Enterococcus* species was 100% sensitive to vancomycin, linezolid. {Figure6}. Among all bacteria isolated from urine sample 100% sensitivity was seen for nitrofurantoin, except for the intrinsic resistant ones.

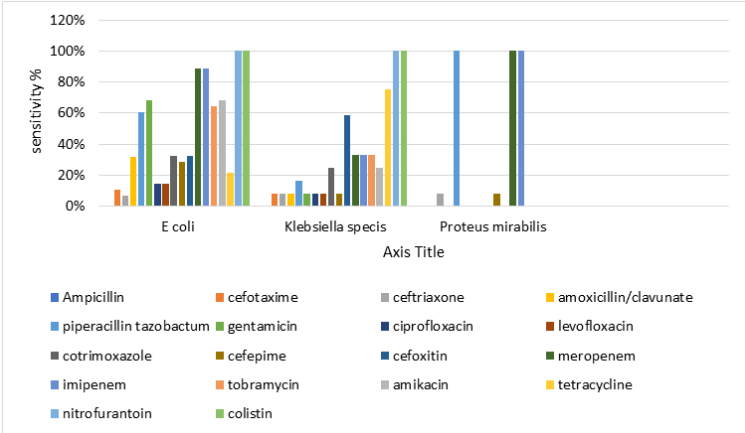

Figure 3 : Percentage sensitivity to antimicrobial agents shown by members of Enterobacteriaceae family isolated from various ICU

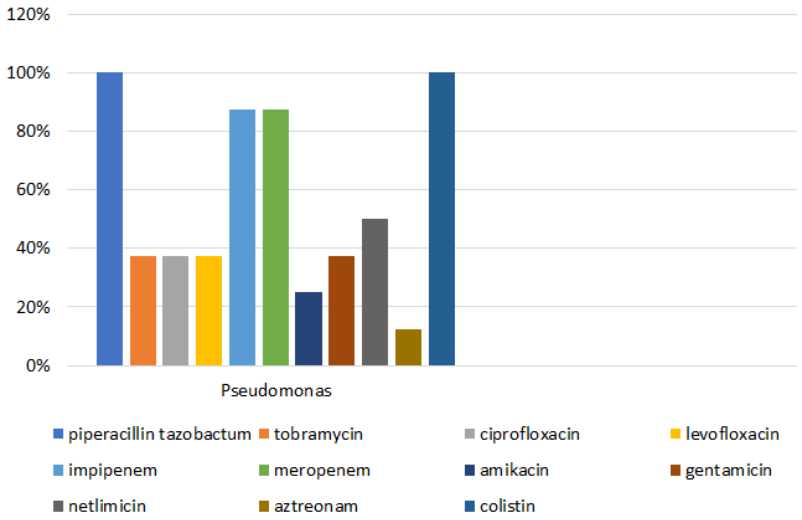

Figure 4 : Percentage sensitivity to antimicrobial agents shown by Pseudomonas species isolated from various ICU

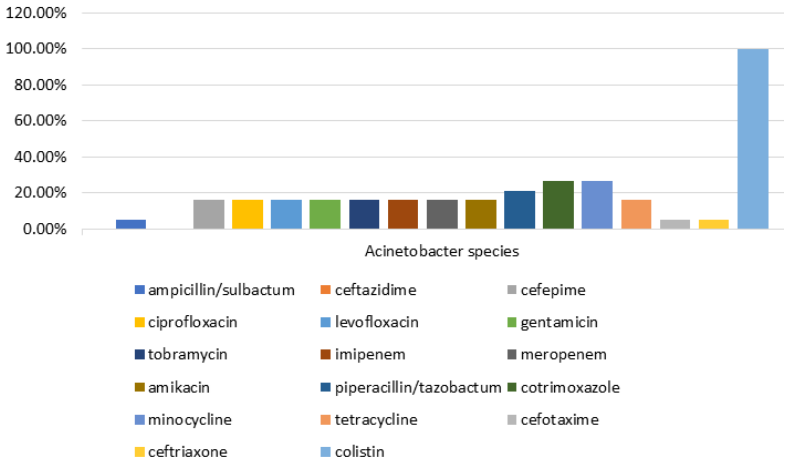

Figure 5: Percentage sensitivity to antimicrobial agents shown by *Acinetobacter* species isolated from various ICU

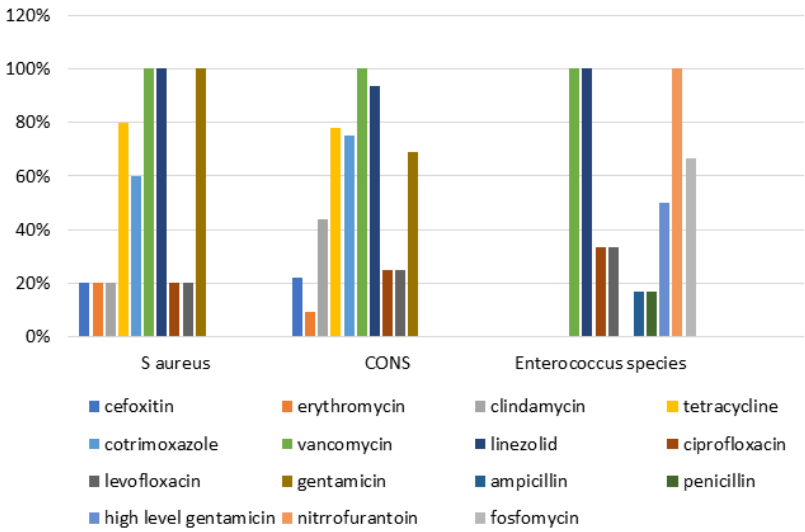

Figure 6: Percentage sensitivity to antimicrobial agents shown by Gram positive cocci isolated from various ICU

Discussion

The culture positive rate was 22.8% from samples received from various ICU's. On the contrary Savanur SS *et al*[9] showed a high 76% culture positive rate from their ICU's samples. This difference may be due to our center being a tertiary care hospital, where patients get admitted after taking incomplete course of antibiotics from general practitioners.

Majority of culture positive samples were received from MICU 50 (40.7%) in this study. Similar findings were reported by N. Chidambaram *etal*[10] in their study. They reported 53.19% culture positive samples were from MICU.

Among GNB, *Escherichia coli* (22.8%) was the predominant organism isolated from ICU. This is in accordance with study of Chandi DH *etal*[11] where they reported *Escherichia coli* (23.8%) as the frequently isolated organism from their ICU samples.

In this study, CONS (26%) was most frequently isolated GPC.Similar observation was reported by Bhatnagar R *etal*[12]in their study.

The rate of *Candida* species isolated was 9.8% in this study. It is in accordance with study of Saxena S *et. Al.*[13] where they reported 6% isolates as *Candida* species. All *Candida* isolates in our study were Non albicans *Candida*. It is in accordance with study of Horn DL *etal*[14] where they reported Non albicans *Candida* isolated was higher than that of *Candida albicans*.

All the Non fermenting GNB showed a lower susceptibility to the third generation Cephalosporins and β-lactam/β-lactamase inhibitor combinations. In study by Bhat *etal*[15]and Nazneen *etal*[16], they reported similar findings.

ESBL was reported to be 10% in *Escherichia coli* and *Klebsiella* species in this study. Similar findings have been reported by Gautam G *etal*[17] in their study. They reported 16% ESBL in *Escherichia coli* and *Klebsiella* species.

Acinetobacter species in this study showed a higher resistance to cephalosporins, carbapenem, aminoglycoside and quinolones. This finding is accordance with study of Moolchandani K*etal*[18], Sheth KV*etal*[19]. In this study *Acinetobacter* species showed 15.8% susceptibility towards meropenem, aminoglycosides and quinolones. This is similar with the study of Moolchandani K *etal*[17] who reported susceptibility of *Acinetobacter* species towards meropenem (16.5%), aminoglycosides (15.5%), quinolones (13.5%) respectively.

This study showed a higher methicillin resistant in *S aureus* (80%) and CONS (78%). A study by Kumar A *etal*[20] has also reported a higher prevalence of methicillin resistant. The increased prevalence of MRSA and methicillin-resistant CONS strains reported nowadays may be due to overuse of third-generation cephalosporin as suggested by Vanitha *etal*[21].

Linezolid resistant to CONS was reported to 6.4% in this study. This is much higher than study of Chaturvedi P *etal*[22]where they reported 2.5% CONS as linezolid resistant. This difference may be due to indiscriminate use of linezolid in recent years. Saxena S *etal*[13]reported that consumption of linezolid was more for gram positivecocci.

In our hospital, under the aegis of infection control program, we frequently train ICU's staffs regarding hand wash and proper aseptic collection of samples. There is established procedure for environmental cleaning and restricted entry of visitors to ICU.

Limitation

Due to lack of resources, Non Candida species could not be identified up to species level and antifungal susceptibility could not be done. This study findings is based on a single tertiary care hospital ICU's so the findings cannot be generalized to other hospital ICU's. Patient's clinical information like history of antibiotic used prior to their hospital admission was not available.

Conclusion

In our study the most effective antibiotic against GNB were Carbapenems and for GPC were Linezolid and Vancomycin. The knowledge of microorganism profile and their antibiotics susceptibility pattern will help in making antibiotic policy of our ICU setting. It will guide the clinicians in giving empirical therapy to patient admitted in ICU, thus preventing the misuse of antibiotics. Strict Infection control measures such as hand hygiene, personal protective equipment,

isolation protocols, environment cleaning and their implementation in the ICU is necessary to reduce drug resistance.

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Conflict Of Interest: Nil

References

1. 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
2. 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
3. Banerjee B, Mondal S, Eshwara VK, Mukhopadhyay C, Varma M. Hospital Acquired Bloodstream Infection by Multi Drug Resistant Organisms-Alarming and Challenging Issue in the Intensive Care Units at Present Era. J Pure Appl Microbiol. 2020;14(4):2595-2601.
4. Chandi DH, Patil P, Bankar N, Damke S, Jain K. Antimicrobial Resistance Pattern of Bacterial Pathogens in Intensive Care Unit (ICU) of Tertiary Care Hospital. Indian Journal of Forensic Medicine &Toxicology, 2020;14(4):6396-6401.
5. C.J.L. Murray, K.S. Ikuta, F. Sharara, L.R. Swetschinski, G.R. Aguilar, A.P. Gray *etal*. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet, 399 (10325) (2022), pp. 629-655.
6. Sumanth Gandra, Jyoti Joshi, Anna Trett, Anjana SankhilLamkang, and Ramanan Laxminarayan. 2017. Scoping Report on Antimicrobial Resistance in India. Washington, DC: Center for Disease Dynamics, Economics & Policy.
7. Collee JG, Fraser AG, Marmion BP, Simmons A, editors. Mackie & McCartney's Practical Medical Microbiology. 14th edition. New Delhi : Elsevier; 2012. 95-111.
8. Clinical and laboratory standards institute (2023). Performance standards for antimicrobial sensitivity testing. 33rd edition, CLSI supplement M100-s23, CLSI, Wayne.
9. SavanurSS , Gururaj H. Study of Antibiotic Sensitivity and Resistance Pattern of Bacterial Isolates in Intensive Care Unit Setup of a Tertiary Care Hospital. Indian Journal of Critical Care Medicine, 2019; 23(12):47-555.
10. N. Chidambaram, G. Ambujam, Reena Rajan, G. Sasikala, V. Anandi. Antimicrobial Profile of Clinical Isolates in Intensive Care Unit at a Tertiary Care Hospital. International Journal of Medical Research & Health Sciences, 2019, 8(2): 160-166.
11. Chandi DH, Patil P, Bankar N, Damke S, Jain K. Antimicrobial Resistance Pattern of Bacterial Pathogens in Intensive Care Unit (ICU) of Tertiary Care Hospital. Indian Journal of Forensic Medicine & Toxicology, October-December 2020, Vol. 14, No. 4 : 6396-6401.
12. Bhatnagar R, Patel P. Study of antimicrobial resistance pattern in blood isolates from critical care unit at a Tertiary Care hospital, Udaipur, Rajasthan, Indian Journal of Microbiology Research, January-March, 2018;5(1):61-65.
13. 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. Journal of Infection and Public Health 12 (2019); 695–699.
14. David L. Horn, DionissiosNeofytos, Elias J. Anaissie, Jay A. Fishman, William J. Steinbach, Ali J. Olyaei, Kieren A. Marr, Michael A. Pfaller, Chi-Hsing Chang, Karen M. Webster. Epidemiology and Outcomes of Candidemia in 2019 Patients: Data from the Prospective Antifungal Therapy Alliance Registry. *Clinical Infectious Diseases*, Volume 48, Issue 12, 15 June 2009, 1695–1703.
15. Bhat V, Gupta S, et al. Bacteriological profile and antibiotic susceptibility patterns of clinical isolates in a tertiary care cancer centre. Indian J Med Paediatr Oncol 2016;37:204.
16. Nazneen S, Mukta K, et al. Bacteriological trends and antibiotic susceptibility patterns of clinical isolates at Government Cancer Hospital, Marathwada. Indian J Cancer 2016;53:583-586.
17. Gautam G, Satija S, Kaur R, Kumar A, Sharma Divakar, Dhakad MS. Insight into the Burden of Antimicrobial Resistance among Bacterial Pathogens Isolated from Patients Admitted in ICUs of a Tertiary Care Hospital in India. Canadian Journal of Infectious Diseases and Medical Microbiology. 2024;24:1-8
18. Moolchandani K, Sastry AS, Deepashree, Sistla S, Harish BN, Mandal J. Antimicrobial Resistance Surveillance among Intensive Care Units of a Tertiary Care Hospital in Southern India. Journal of Clinical and Diagnostic Research. 2017 Feb, Vol-11(2): DC01-DC07.

19. Sheth KV, Patel TK, Malek SS, Tripathi CB. Antibiotic sensitivity pattern of bacterial isolates from the intensive care unit of a tertiary care hospital in India. Tropical Journal of Pharmaceutical Research. 2012;11(6):991-99.

20. Kumar A, Raj N, Singh S, Das A, Singh V, Sen M, Agarwal J. A Retrospective Observational Study of the Microbial Etiology and Antimicrobial Susceptibility Patterns of Blood Cultures From ICU Patients at a Healthcare Facility in North India. 2024; Cureus 16(3): e57356.

21. Vanitha Rani N, K. Gopal, V. Narendra, V. Sunil, T. Palani. A retrospective study on blood stream infections and antibiotic susceptibility patterns in a tertiary care teaching hospital. International Journal of Pharmacy and Pharmaceutical Sciences. 2012; 4(1):543-548.

22. Chaturvedi P, Pandey A. Linezolid Resistant clinically Significant Isolates of Coagulase Negative Staphylococci: An Emerging Therapeutic Concern. Indian Journal of Public Health Research & Development, March 2020, Vol. 11, No. 03