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# ANTIMICROBIAL RESISTANT PROFILE OF BACTERIAL ISOLATES IN THE INTENSIVE CARE UNIT OF A TERTIARY CARE HOSPITAL IN BANGLADESH

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## ABSTRACT

**Background:** Infections with resistant strain are the leading causes of morbidity and mortality in intensive care unit (ICU).Patients admitted into the ICU usually have impaired immunity and are therefore at high risk of infections. Infections by multidrug resistant organisms constitute a major problem, limiting the choice of antimicrobial therapy. **Objectives:** This study was aimed at determining the antimicrobial resistance pattern of pathogens causing ICU infections in Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. The aetiological agents, prevalence and types of ICU infections were also determined. **Materials and Method:** An observational study was carried out from January 2019 to December 2019. Blood, Foleys catheter tip, central venous line and tracheal aspirateswere collected and sent to the Microbiology laboratory. All pathogens were isolated and identified by standard microbiological methods. Disk diffusion antibiotic susceptibility testing was performed and interpreted according to Clinical and Laboratory Standards Institute guidelines **Results:** Out of the 673 tested sample 31.64% showed growth of pathogens among which the most prevalent samples were tracheal aspirates (70.76%) followed by blood (21.26%). The predominant isolate was *Acinetobacterspp* (39.43%) followed by *Pseudomonas spp*(25.82%), *E coli* (13.61%), *Klebsiellaspp* (13.14%) and *Staphylococcus aureus* (7.98%)respectively. Most isolates were resistant to Amoxicillin, Cephalosporins and Quinolones group of Antibiotics. *E coli* showed 100% sensitive to Colistin **Conclusion:** High prevalence of multidrug resistant bacteria causing ICU infections. Application of more stringent infection control procedures and antimicrobial stewardship are recommended to combat this problem.

**KEYWORDS:** Intensive care unit, Antibiotic resistance, Infection control.

## 1. INTRODUCTION

Multi-drug resistant infection is one of the leading causes of death and morbidity among patients admitted in ICU, accounting a major burden on public health system of any country[1,2]

The rate of infections in the ICU is rising, mainly because of increasing use of invasive procedures which are performed in the ICU. Here the mortality rate is more than twice that of non-infected patients.[3] Sophisticated life support, antibiotic heavy use, prosthetic devices, indwelling catheters, intravenous fluid therapy, use of immunosuppressive therapy are the contributing factors leading to a spectrum of multi-drug resistant pathogens.[4]

Antimicrobial resistance has gained global concern, as one of the most pressing public health issues the world faces today, including Bangladesh and surrounding country.[5]

Heavy use and misuse of antibiotics partly due to incorrect diagnosis, irrational use, irregular consumption due to either wrong prescription or poor compliance all contribute to the widespread drug resistance among patients admitted in ICU.[6] The patterns of organisms causing infections and their antibiotic resistance pattern vary widely from one country to another, as well as from one hospital to other. Presently, Bangladesh lacks any local or national level surveillance program, to guide the stakeholders on actual prevalence of resistance.[7]

The aim of the present study was to identify the prevalence of predominantly isolated bacterial microorganisms and their drug resistance patterns for the

patients admitted in the ICU in a tertiary care hospital Bangladesh.

## 2. MATERIALS AND METHODS

**2.1 Study setting:** The clinical specimens for this study were collected from ICU patient of BSMMU Hospital from January 2019 to December 2019. A total of 673 samples were studied. Out of 673 samples, 221 samples of blood, 229 samples of Foley's catheter tips, 52 samples of central venous (CV) line and 171 samples of tracheal aspirate were collected for study.

The Centre for Disease Control and Prevention (CDC) defines ICU associated infections as those that occur after 48hrs of ICU admission or within 48 hrs after transfer from an ICU.[8] Clinical data related to these patients were retrieved from the records using a structured proforma. All patients who developed infections after 48 hours of hospitalization were considered to have ICU acquired infections.

In the present study the following signs and symptoms were considered: [9]

1. Fever ≥ 38ºC, leucocytes ≥ 10,000/cu mm.
2. New infiltrates on chest X-ray, persistent tracheal aspirates or secretions.
3. Turbid urine, suprapubic tenderness, dysuria and burning micturition, thrombophlebitis.

**Laboratory methods**

**2.2 Collection of CV catheter tip:[10]** After washing hands and disinfection with 2.5% chlorhexidine gluconate + 70% ethanol hand rub solution, sterile pair of gloves were put on. The catheter site was cleared of any blood using alcohol pledget. The fixation sutures were cut using a sterile no.-11 scalpel blade. The catheter was withdrawn using sterile forceps, directing it away from the skin. The distal 5 cm of the CV catheter was cut with a sterile pair of scissors and collected in a sterile test- tube. The test-tube was marked.

**2.3 Collection of Foley's catheter tip:[10]** Hand washing and disinfection was again done as described previously and a fresh pair of sterile gloves was put on. An assistant was asked to deflate the distilled water filled balloon with a sterile 10cc syringe maintaining aseptic precautions. After that the main operator took out the Foleys catheter in a sterile manner and the distal 5 cm of the catheter was collected in a sterile test-tube by cutting it with a sterile pair of scissors.

**2.4 Collection of blood culture samples:[10]** After hand washing and disinfection sterile gloves were again put on. Blood culture were drawn in every patient via peripheral vein- puncture sites. The vein- puncture sites were prepared with tincture of iodine or 0.25% chlorhexidine in 70% ethanol solution. The bottles were marked and were immediately sent to Microbiology laboratory.

**2.5 Tracheal aspirates:[11]** At least 1 ml of tracheal aspirate was aseptically collected in a sterile falcon tube with the help of suction catheter by attending physician using standard aspiration technique.Then the aspirated material was transported to the laboratory for microbiological study. All the steps including sample processing, smear preparation and culture were done in a Biosafety level 2.

Standard microbiological methods were used to isolate bacteria from the specimens.[12]

Antibiotic susceptibilities were done by Kirby-Bauer disc diffusion method.[13] Growth of three or more than three organisms in a single sample was considered as contaminated and so excluded from study. Sensitivity was tested for the following drugs: - Cefuroxime, Ceftazidime, Cefepime, Ciprofloxacin, Amoxicillin, Cephalexin, Imipenem, Meropenem, Vancomycin, Linezolid, Gentamicin, Piperacillin-Tazobactam, Colistin, Amikacin, Netilmicin, Ceftriaxone, Cefixime. It was interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines.[14]

**2.6 Statistical analysis:** Data analysis was done using the Statistical Package for the Social Sciences (SPSS), version 22 software.

## 3. RESULTS

During the 12-month study period, a total of 673 samples were analyzed, out of which 213(31.64%) samples were positive for growth of organisms. The growth positive samples included, blood 47(21.26%), Foley's catheter tips 40(17.46%), cv line tips 05(9.61%) and tracheal aspirates 121(70.76%)(Table 1).

Most frequently isolated bacteriawas *Acinetobacter spp* 84(39.43%), followed by *Pseudomonas spp* 55(25.82%), *E coli* 29(13.61%),*Klebsiella spp* 28(13.14%) and *Staphylococcus aureus* 17(7.98%) (Table-2).

Table-3 showed the antibiotic sensitivity pattern of major five bacterial isolates which revealed that all five bacteria were hundred percent resistant to amoxicillin and cephalexin. No resistance was observed in case of *E. coli* to Colistine. *S. aureus* was 100% sensitive to Vancomycin and Linezolid.*Pseudomonas spp* was 100% sensitive to Imipenem. The isolated bacteria showed a very high rate of resistance to Cefuroxime, Ceftazidime, Cefixime and Ciprofloxacin.

**Table 1: Number of culture positive cases among different samples of study patients in ICU (n=673).**

| Name of Samples | No. of Samples | Culture Positive n(%) |
|---|---|---|
| Blood | 221 | 47(21.26%) |
| Foley's catheter tips | 229 | 40(17.46%) |
| CV line | 52 | 05(9.61%) |
| Tracheal Aspirate | 171 | 121(70.76%) |
| Total | 673 | 213(31.64%) |

**Table 2: Frequency of microorganism isolated in various specimen among culture positive cases.**

| Organism | Specimen | | | | |
|---|---|---|---|---|---|
| | Blood n(%) | Catheter tip n(%) | Tracheal aspirate n(%) | CV line n(%) | Total n(%) |
| E coli | 13(27.65%) | 07(17.5%) | 08(6.61%) | 01(20%) | 29(13.61%) |
| Klebsiella spp | 12(25.53%) | 05(12.5%) | 11(9.09%) | - | 28(13.14%) |
| Pseudomonas spp | 07(14.89%) | 15(37.5%) | 31(25.61%) | 02(40%) | 55(25.82%) |
| Acinetobacter spp | 11(23.4%) | 13(32.5%) | 59(48.76%) | 01(20%) | 84(39.43%) |
| Staphylococcus aureus | 04(8.51%) | - | 12(9.91%) | 01(20%) | 17(7.98%) |
| Total | 47 | 40 | 121 | 05 | 213 |

**Table 3: Antibiotic resistant pattern of predominant microorganism isolated various samples of ICU patients.**

| Antibiotics | E coli n(%) | Klebsiella spp n(%) | Acinetobacter spp n(%) | Pseudomonas spp n(%) | Staphylococcus aureus n(%) |
|---|---|---|---|---|---|
| Amoxicillin | 63(100) | 102(100) | 108(100) | 99(100) | 24(100) |
| Cephalexin | 63(100) | 102(100) | 108(100) | 99(100) | 24(100) |
| Cefuroxime | 61(96.82) | 102(100) | 108(100) | 99(100) | 19(79.16) |
| Cefixime | 62(98.41) | 102(100) | 108(100) | 99(100) | 20(83.33) |
| Ceftazidime | 63(100) | 102(100) | 108(100) | 72(72.72) | 14(58.33) |
| Imipenem | 15(23.8) | 19(18.62) | 22(20.37) | 11(11.11) | 00 |
| Meropenem | 06(9.52) | 07(6.86) | 20(18.51) | 00 | 00 |
| Colistin | 00 | 09(8.82%) | 11(10.18) | 04(4.04) | - |
| Gentamicin | 41(65.07) | 57(55.88) | 69(69.69) | 82(75.92) | 19(79.16) |
| Amikacin | 23(36.5) | 39(38.23) | 51(51.51) | 69(63.88) | 18(75.0) |
| Piperacillin+ Tazobactam | - | - | - | 16(16.16) | - |
| Ceftriaxone | 43(68.25) | 59(57.84) | 57(57.57) | 108(100) | 14(58.33) |
| Netilmicin | 20(31.74) | 26(25.49) | 62(57.4) | 43(43.43) | 11(45.83) |
| Ciprofloxacin | 59(93.65) | 93(91.17) | 108(100) | 96(96.96) | 22(91.66) |
| Vancomycin | - | - | - | - | 00 |
| Linezolid | - | - | - | - | 00 |

## 4. DISCUSSION

Antibiotic resistance continues to rise and complicates empirical selection of antibiotics in the ICU. Our data indicate an alarming pattern of antibiotic resistance in the majority of ICU isolates. The high rate of ICU infections observed in this study could be due to different clinical profiles of the patients and the absence of a powerful hospital acquired infection control program.

Infection in ICU is associated with high mortality rate in the range of 10-60%.[1516,17] We found a prevalence of 31.64% of ICU acquired infections. Similar findings were recorded in other studies in Turkey, Brazil, Argentina and other countries where high rates of 26-39% infections were found.[18,19,20,21] Respiratory tract infections appeared to be the most common ICU infection followed by urinary tract and blood stream infections.[16,20,22]

Maximum number of organisms were isolated from tracheal aspirates in the present study. This is probably due to the fact that most of the critically ill patients in ICU had respiratory problems and/or they were on mechanical ventilator. Similar findings were observed in ICUs of Denmark[23] and Jamaica[24] where most of the organisms were isolated from respiratory secretions (49% and 50%, respectively). Erbay et al, Meric et al and some multicentered studies reported findings which is indistinguishable with our results.[15,19,20,25]

Acinetobacter spp was the commonest isolated organism (39.43%) in tracheal aspirates in our study. A study conducted in ICU of Dhaka city by *Hague et al* (2013) reported that the most common pathogen from tracheal aspirates was *Acinetobacter spp.*[26] Another study from Barai *et al* (2010)also found. *Acinetobacter spp.* as the second most common organism from all samples.[27]

The variety of pathogens in ICU may change from country to country with time and by hospital, type of ICU, and specific patient population.[28,29] In our study tracheal aspirates was the most common samples (70.76%), followed by blood (21.26%), Foley's catheter tips (17.46%) and CV line (9.61%). Similar findings were reported by Fatema K et al.[30]

About 50% of patients in ICU who are clinically suspected of having sepsis can be detected bacteriaemia through blood culture.[31] Although positive blood culture are reported to be common in many ICU infections constituting either the most common or second most common infection, it was however found 21.26 % in our study. This observation is agreed with the findings of Previsdomini et al.[32]

One of the most common ICU infections which is caused by urinary tract infections among which 70– 80% are attributable to use of an indwelling urethral catheter.[33,34] Our study showed that Foley's catheter tips related infection rate was 17.46% which is correlated with Bhatia et al.[35]

Central venous catheters are the most frequently used indwelling medical devices and have become necessary tools for the successful treatment of patients with chronic or critical illness in ICU. In our study, out of 52 patients, cultures of 05(9.61%) patients were found positive. A study done by Napalkov et al in a study done in USA reported 4% ofcatheter related infection.[36] While in Bosnia and Herzegovina, the infection rate was 6%.[37] and that of Bahrain was 9.7%.[38] Ahmed et al reported 12.96% positive cases of central venous catheter related infections in their study.[39]

Antimicrobial resistance is an important determinant of outcome for patients in ICU. In this day and age rate of resistance have increased for most pathogens associated with infection among the ICU patients.[40] This facts inconsequence's in extended hospital stay, increase in cost for treatment, and increase in morbidity and mortality. Regular microbiological surveillance should be done for implementation of better therapeutic strategies to reduce the high morbidity and mortality in the critical care setting. The present study was conducted as a part of surveillance about the prevalence of isolated bacteria and their antimicrobial resistance pattern in the ICU patients at a tertiary care hospital in Bangladesh.

The prevalence of antibiotic resistant organisms in our study population was high. These multidrug resistant organisms pose a serious concern in the ICU environment.[41] The emergence of resistant pathogens in the ICU environment has resulted in part from extensive and also inappropriate use of antibiotics and options for treating infections caused by these organisms are becoming limited.[42,43]

Prolonged use of Carbapenemin the treatment of nosocomial infection can favor the development of resistance to those antimicrobial agents. In our study, Carbapenem resistant rate has alarmingly increased for *Acinetobacter spp, E col, Klebsiella spp, and Pseudomonas spp.*A study from Birdem hospital in 2010 also reported imipenem resistant *Acinetobacter spp.* (>70%) and Klebsiella (>20%).[27] Jain & Khety(2012)also reported carbapenem resistant pseudomonas.[44] Emergence of Imipenem resistant strains in many parts of the world is alarming and a threat to the effective management of those organisms. All isolates were resistant to Cephalosporin and Amoxycillin (100%). This might be due to the selective influence of extensive usage of Cephalosporins and Amoxicillin. Ganneja *et al* (2011) also reported the similar findings.[45]

The Aminoglycosides were highly resistant to *Pseudomonas spp, Acinetobacter spp* and *E coli.Pseudomonas spp* demonstrated a high degree of resistance to the third generation Cephalosporins and the Aminoglycosides, which correlates with a study showing the emergence of antibiotic resistant *Pseudomonas spp* by Arora et al.[46]

In European ICUs, *Staphylococcus aureus* was the most frequently isolated organism (30.1%).[47] But in this study in ICU, number of *Staphylococcus aureus* is low. Similar finding was observed in Indian ICUs.[48] In our study 40% were methicillin resistant. Carvalho et al found 60% MRSA in an adult ICU of Bazil.[49] As Methicillin Resistant *Staphylococcus aureus* (MRSA) spreads through health-care personnel's, enforcement of the infection control policies is the key to control MRSA.[50]

*Staphylococcus aureus*was highly sensitive to Vancomycin and Linezolid, showed high degree of resistance to Cephalosporins (Table-III), which supports the claim of Shalini et al.[51]

Due to reemergence of MDR bacteria, Colistin has been started to reuse recently all over the world.[52] After the frequent use of Colistin, there have been reports of Colistin resistance strains within years.[53] In our study *Klebsiella spp.* (8.82%) was found to be resistant to colistin.*Pseudomonas spp*. and *Acinetobacter spp* were found to be resistant to Colistin with 4.04% and 10.18% respectively. In another study from Kuwait, 12% of Colistin resistance among *Acinetobacter baumannii* was observed.[54] These finding shows that restriction of Colistin use should be implemented to control the rate of Colistin resistance bacteria.

## 5. LIMITATIONS OF THE STUDY

There were some limitations in this study. Patients who were in the incubation period of nosocomial infections on discharge from the ICU, who manifest it after discharge, were not included in the current study. As

there were different and multiple antibiotics, it was quite difficult to do statistical analyses of all bacteria. Besides, samples like pus, wound swab, any drainage collection, CSF, pleural fluid and ascitic fluid were not included in the present study.

## 6. CONCLUSION AND RECOMMENDATION

The present study on the bacteriological profiles of the ICU infections showed that the rate of such infections is high. The risk of development of ICU infections were directly related to the duration of ICU stay and the duration of the use of the indwelling devices which needs careful prophylactic standards of microbiologic monitoring. [55] Resistance to antibiotics poses a serious and growing problem, because such resistant bacteria are becoming more difficult to treat. The empirical and the indiscriminate use of antibiotics should be avoided in order to curtail the emergence and the spread of drug resistance among patients admitted in ICU.

To improve the current healthcare preventive measures, strategies to health care funding coupled with better adherence to infection control procedures should be taken.[41,56] Approach to controlling antimicrobial resistance in ICU can also be ensured by the reduction of inappropriate antimicrobial prescribing through implementation of a functional antimicrobial stewardship programme.Surveillance of multicentered randomized strainsincluding those that evaluating rapid diagnostic should be carried out regularly to monitor the trends of antimicrobial resistance and meet this important challenge.

## 7. Ethics Approval and Consent To Participate

Ethical approval was not required to carry out this work as the bacterial isolates were collected as part of routine patient care investigation in the hospital.

## 8. Human and Animal Rights

No Animals/Humans were used for studies that are base of this research.

Consent for Publication: Not applicable.

Conflict of Interest: This article contents no conflict of interest.

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