International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Antibiotic Resistance Pattern of Isolates in Intensive Care Unit and Source of Nosocomial Infection in a Tertiary Care Hospital, Dhaka, Bangladesh

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Abstract: ***Background:*** ***Infections with resistance bacteria threatens the effectiveness of antibiotic treatment with increased morbidity, mortality and hospital costs. Rapid emergence of multi-drug resistance necessitates monitoring microbial isolates with their resistance pattern. During 2015-16, this study conducted in Square hospital ICU to see pattern of pathogens, their antimicrobial resistance and presence of MRSA, ESBL and CRE in nosocomial infections.*** ***Methods:*** ***Specimens from ICU patients processed for isolation, identification, tested antimicrobial resistance and production of ESBL, CRE and MRSA following standard methods. Admitted patients were monitored and data analyzed for pattern of hospital-acquired infections.*** ***Results:*** ***Of 2,447 pathogens, majority yielded from tracheal aspirates (37%) compared to others. Among pathogens, Klebsiella were 21.6%, E. coli 12%, Pseudomonas 9.9% and Acinatobacterspp 9.8%; while Staphylococci were 8.3%, Enterococci 3.4%, Pneumococci 2% and Candida were 13%. Overall 78% E. coli were resistant to multiple drugs; of which 82% resistant to cefuroxime, 75% to amoxiclav and ciprofloxacin each, 69% to cefixime, 67% to ceftriaxone and 66% to cefepime. Majority Klebsiella were resistant to common antibiotics, except meropenem (50%). About 40% Pseudomonas and Acinatobacter were resistant to common antibiotics except colistin and polymyxin B. About 58% of E. coli and 24% Klebsiella produced ESBL, with 48% resistant to carbapenem. Penicillin and amoxicillin resistance were 90% among gram positive bacteria and MRSA Producing Staphylococci was 47% with no resistance to vancomycin. Among 277 hospital-acquired infections, Ventilator associated pneumonia (VAP) was 56% followed by 23.1% UTI and 10.5% BSI.*** ***Conclusion:*** ***Emergence of MDR bacteria among ICU patients is a global problem as they contract hospital-acquired infections more commonly from foci within hospitals. Higher prevalence of MDR infection in ICU of SHL is not an exception. Challenges remain in treating patients with CRE, ESBL and MRSA infections. Strengthening antimicrobial stewardship, monitoring effectiveness of antibiotic usage and infection control program could reduce this critical problem.***

Keywords: Antimicrobial resistance, Hospital acquired infection, Intensive care unit.

1. Introduction

The Intensive Care Unit (ICU) is commonly known as the epicenter of infections, because of its patient populations both in the medical intensive care unit (MICU) and the surgical intensive care unit (SICU) who are extremely vulnerable and immunocompromised. Once immune-deficient state develops in patients, they are very much prone to colonize and harbor the opportunistic or virulent pathogens carrying antimicrobial resistant genes. These patients are slower in shedding out the pathogens and in combating the colonized or invading organisms in preventing disease development [1]. Besides, greater numbers of ICU patients are at high risk of acquiring infection through the use of multiple procedures including invasive devices that compromise normal flora of skin and mucosal barriers [2]. An estimate of the prevalence of Infection in European Intensive Care (EPIIC) is about 51% among 12,796 patients admitted in 1265 ICUs of 75 countries [3]. The ICU is thus considered as a factory for creating, disseminating and amplifying antimicrobial resistance[4] which not only creates a major problem in treating infections but also contributing in emergence of multi-drug-resistant (MDR) pathogens. The development of MDR infection adds the clinical and economic burden to the individual and to the hospital authority [5]. The possible reasons of rising antibiotic resistance underlies on their irrational use, inappropriate prescribing and self-medication through over-the-counter drugs that contributed increased consumption of non-prescribed antibiotics. These factors led to the selective pressure of antibiotics resulting ineffectiveness of those antibiotics with an increased morbidity and mortality [6]. In addition, ICU patients are exposed to a greater hazard of contamination and cross infection that contributes to the development of increasing antibiotic resistance. The antibiotic resistance pattern, however, is not a static phenomenon, thus necessitates regular monitoring and updating of antibiogram as the recent resistance pattern helps the physicians in selecting the appropriate antimicrobials for better case management [7].It is also required to guide the judicious uses of antibiotics throughout the institution and helps in developing the antimicrobial prescribing policy.

The ICU patients are thus at particular risk of acquiring hospital acquired infection (HAI) (also called nosocomial infections). This infection is usually develops 48 hours after hospital admission or after discharge that was not present at the time of admission [8]. The reported prevalence of HAI is about 30% in the USA [9]. The attributed pathogens of HAI are bacterial, viral and fungal microorganisms and the ICU patients are 5-10 times higher risks than those at general wards [10]. Currently, the most concerned resistant microorganisms in ICU are gram-positive methicillin-(oxacillin)-resistant Staphylococcus aureus (MRSA) and vancomycin-resistant Enterococci (VRE) [11]. Of the gram-negative bacteria, the resistance is usually due to extended-spectrum Beta-lactamases (ESBLs) and Carbapenem-resistant enterobactericeae (CRE) that includes Klebsiella pneumonia, Escherichia coli, Enterobacter and Proteus species. The prevalence of MDR in Pseudomonas and Acinatobacter are also high in ICU patients [12]. The EPIIC study reported about 50% MRSA isolates in Europe and 65% in America [3], while the National Nosocomial Infection Surveillance (NNIS, USA) study reported 27% fluoroquinolone-resistance in Pseudomonas and 18% to imipenem [13]. The National Healthcare Network (NHN) in Dhaka reported 43% MRSA and 20% ESBL producing Enterobactericeae [14,15]. The reported risk factors for infection and/or colonization with MRSA, ESBL, and CRE producing bacteria are the past exposure or prolonged ICU-hospitalization, prior and prolonged use of antimicrobials, indwelling devices, chronic underlying conditions, surgical wounds, mechanical ventilation, advanced age and cross-contamination [16].

Antibiotic resistance among pathogens in hospital ICUs worldwide has been increasing with varying degrees between the countries. A local surveillance program is thus required to generate local data set that would guide prudent use of antibiotics and in developing prescribing policy for guiding appropriate antimicrobial therapy in treating ICU infections [17, 18]. Routine surveillance using multi-samples (series) cultures will help physicians in selecting empirical therapy with higher success rate and thus save the last-line antibiotic agents. The general aim of this study was to collect and analyze data in order to update information on microbial pathogens and the antimicrobial susceptibility from the Square Hospital (SHL) ICU for a period of two years between January 2015 and December 2016; and the specific objective was to see the trend of antimicrobial resistance including the presence or absence of MRSA, ESBL and CRE in clinical isolates obtained from patients and define the main and common source and pattern of nosocomial infections. The SHL is a 450-bedded tertiary care hospital located at the centre of the Dhaka city, Bangladesh.

2. Materials & Methods

Study place and samples: This retrospective study was conducted in Microbiology Laboratory of Square Hospital Ltd (SHL) that processed the clinical samples for microbial culture from patients who were admitted in the ICU, SHL between January 2015 and December 2016.

Microbial isolates: Clinical specimens of blood, tracheal aspirates, sputum, urine, wound swab, pus and broncho-alveolar lavages obtained from ICU patients were processed for microbial culture, isolation, identification and antimicrobial susceptibility testing following standard method.[19] Briefly, all specimens were inoculated onto blood agar (BA), chocolate agar (CA) and MacConkey agar (MCA) plates, and were incubated at 37oC for 18-24 hours. Blood cultures were processed in an automated blood culture machine (Bact Alert 3D, bioMeriux, France) that signals positive growth which were then sub-cultured onto the above bacterial culture media. The positive growth of suspected pathogenic bacteria were further characterized for identification by standard microbiological procedures including colony morphology, Gram stain, biochemical reaction, serologic tests and antimicrobial susceptibility testing etc [19].

Antimicrobial susceptibility test (AST): The AST was carried out by Kirby-Bauer method[20] against a selected panel of antibiotics (Table-1) discs for gram positive and gram negative organisms. In brief, suspensions of the test organisms were made in Muller-Hinton broth, turbidity adjusted to McFarland 0.5 standards, incubated for 2 hours and then bacterial lawn was made on Mueller Hinton Agar (MHA) plate onto which the antibiotic disks were applied. The plates were incubated at 370C for 24 hours, screened and measured the diameter of zone of inhibition and interpreted as susceptible, intermediate and resistant according to Clinical Laboratory Standard Institute (CLSI) guidelines [20].

Table 1: List of antimicrobials used in the study

Name of Antimicrobials			
1	**Penicillin**	14	**Amoxiclav**
2	Amoxicillin	15	Levofloxacin
3	**Ceftriaxone**	16	**Cefixime**
4	Cefuroxime	17	Cefepime
5	**Cefoxitin**	18	**Amikacin**
6	Gentamicin	19	Tobramycin
7	**Ciprofloxacin**	20	**Pipercillin**
8	Cotrimoxazole	21	Pip-tazo
9	**Clindamycin**	22	**Meropenem**
10	Rifampicin	23	Collistin
11	**Linezolid**	24	**Polymixin B**
12	Vancomycin	25	Aztreonam
13	**Tetracycline**	26	**Minocycline**

Resistance biomarkers: The extended spectrum β-lactamase (ESBL) was detected in Enterobactericeae, such as, E. coli, Klebsiella, Enterobacter and Citrobacter after inoculating onto MHA media with amoxyclav disc in the centre while ceftazidime, ceftriaxone, cefixime and cefuroxime discs were placed peripherally at equi-distant away from amoxyclav disc. Formation of band between amoxyclav and any other discs were considered as ESBL positive [13,21]. These organisms were also regarded as Carbapenem Resistant Enterobactericeae (CRE) positive when zone diameter of meropenem was <19 mm [20]. For detecting MRSA, suspensions of S. aureus were inoculated onto MHA plate onto which cefoxitin disc was placed and zone diameter of <21 mm referred to cefoxitin resistance which was regarded as MRSA [15].

3. Results

During 2015-16, a total of 2,447 pathogens were isolated from seven (07) categories of samples collected from patients in Square hospital intensive care unit (ICU). The highest number of isolates were found from tracheal aspirates (37%) followed by sputum (24.8%), urine (15.7%) and blood (14.5%) and the isolates from wound swab, broncho-alveolar lavage and pus specimens were below 5% (Table 2).

Table 2: Categories of specimens submitted in 2015 -2016

Specimens	*Total Positive Growth*	*Percent (%)*
Tracheal aspirate	906	37.0
Sputum	607	24.8
Urine	384	15.7
Blood	355	14.5
Wound swab	89	3.6
Broncho-lavage	60	2.5
Pus	46	1.9
TOTAL	**2,447**	100.0

Distribution of 2,447 ICU patients by age and gender is shown in Table 3. The majority of patients were over 30 years of age (93.0%). By age group, the highest number of patients however, were above 60 yrs (58.2%), followed by 46-60 years (23.8%). Of total isolates recovered from patients irrespective of the age group, 56.3% were yielded from males and 43.7% from females with male: female ratio being 1.3:1.

Table 3: Distribution of patients by Age and gender

Age	*Male N (%)*	*Female N (%)*	*Total N (%)*
0-15	2(0.1)	2(0.2)	4(0.2)
16-30	78(5.7)	99(9.3)	177(7.2)
31-45	157(11.4)	102(9.5)	259(10.6)
46-60	330(24)	253(23.6)	583(23.8)
>60	810(58.8)	614(57.4)	1424(58.2)
Total	***1,377 (56.3)***	***1,070 (43.7)***	***2,447 (100)***

The more commonly isolated microbial agents in this study are shown in Table 4. The gram negative organisms was more frequently isolated (63.7%), of which Klebsiella was found in higher number (21.6%) followed by E. coli (12%), Pseudomonas (9.9%) and Acinatobacter (9.8%). The other gram negative isolates such as Proteus, Stenotrophomonas andBurkholderia were less frequently isolated (1.9 to 2.5%).

Table 4: Frequency and type of Isolates in ICU: 2015-2016

Organisms	*Positive growth, (n=2447)*	*Percentage (%)*
Enterobactericeae		
E. coli	293	*12.0*
Klebsiella	528	*21.6*
Enterobacter	75	*3.1*
Proteus	47	*1.9*
Citrobacter	7	*0.3*
Serratia	10	*0.4*
Subtotal	*960*	*39.3*
Non-Enterobactericeae		
Pseudomonas	241	*9.9*
Acinatobacter	240	*9.8*
Burkholderiacephacia	56	*2.3*
Stenotrphomonas	60	*2.5*
Aeromonas	2	*0.1*
Subtotal	*599*	*24.5*
Gram Positive cocci		
Staph.aureus	202	*8.3*
CoagNeg Staph	203	*8.3*
Enterococcus sp	84	*3.4*
Strep pneumonia	49	*2.0*
Strep.sp	13	*0.5*
Subtotal	*551*	*22.6*
Fungus		
Candida	317	*13*
Aspergillus	20	*0.8*
Subtotal	*337*	*13.8*
Total	*2447*	*100*

Among the gram positive bacteria, both the Staphylococcus aureus and Coagulase negative Staphylococci together constituted 8.3%, while others such as, Enterococcus, Streptococcus pneumoniae and Streptococcus species were less commonly isolated (0.5 to 2 and 3.4% respectively). Of the fungal infection, Candida sp was the predominant isolates (13%) followed by Aspergillus (0.8%).

The tracheal aspirates and blood were the two predominant specimens (44.7%) obtained from ICU patients. The types of microbial pathogens isolated from tracheal aspirates and blood during the study period of two years (2015-16) is shown in Figure 1.

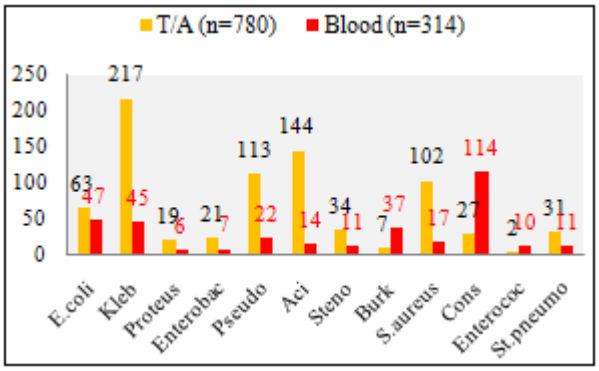

Figure 1: Pattern of microbial isolates from tracheal aspirates (T/A) and blood samples: 2015-16

A higher number of growth of both gram positive and negative organisms were found in tracheal aspirates than from blood; while Coagulase negative Staphylococcus (CoNS) was more frequently seen among blood isolates. Of total 780 tracheal aspirates, Klebsiella was the most frequently isolated (28%) followed by Acinatobacter (18%), Pseudomonas (14%) and Staphylococcus aureus (13%). Among the the total of 314 positive blood isolates the CoNS was found by the highest number (36%), followed by E. coli (15%) and Klebsiella (14%). The antimicrobial resistance pattern of common gram negative organisms obtained in this study is shown in table 5.

Table 5: Resistance pattern of common Gram negative organisms at ICU, SHL: 2015-16

Antibiotics	*E.coli (N= 293)*	*Klebs (N= 528)*	*Enterobac (N= 75)*	*Prot(N= 47)*	*Acinato (N= 240)*	*Pseudo (N= 241)*	*Steno (N= 60)*	*Burk (N= 56)*
Amoxiclav	75	81	59	68	-	-	-	-
Cefuroxime	78	82	60	62	-	-	-	-
Cefixime	69	79	32	28	-	-	-	-
Ceftriaxone	**67**	77	20	17	-	-	-	-
Cefepime	66	77	16	19	96	36	-	-
Gentamicin	33	50	13	25	89	47	-	-
Amikacin	14	53	09	25	92	37	-	-
Cotrimoxa	57	74	21	64	86	-	42	39
Ciprofloxa	75	78	17	25	-	-	-	-
Levofloxa	-	-	-	-	85	49	40	-
Tobramycin	-	-	-	-	90	48	-	-
Pipercillin	-	-	-	-	96	37	-	-
Pip-tazo	27	59	08	02	97	24	18	05
Meropenem	07	50	05	04	89	40	99	20
Collistin	00	0.6	00	-	0.8	00	-	-
Polymixin B	01	1.5	00	-	1.6	00	-	-
Minocycline	-	-	-	-	40	-	08	16
Ceftazidime	-		-	-	95	39	65	18

Resistant organisms are distributed in relative frequency (%).

The majority of the E. coli isolates (78%) were found resistant against cefuroxime; while 75% were resistant to both amoxyclav and ciprofloxacin followed by cefixime (69%), ceftriaxone (67%) and cefepime (66%). About 82% of Klebsiella isolates were resistant to cefuroxime, 81% to amoxiclav, 79% to cefixime, 78% to ciprofloxacin, 77% to both ceftriaxone and cefepime, 59% to piperacillin-tazobactam, 53% to amikacin and 50% to meropenem. The isolates of Acinatobacter species showed 97% resistance to piperacillin-tazobactam, 96% to cefepime and pipercillin, 89% to meropenem and gentamycin, 92% to amikacin and 90% to tobramycin. Both the Enterobacter and Proteus species showed around 60% resistance to amoxiclav and cefuroxime, while that of Pseudomonas, Stenotrophomonas and Burkholderia species showed low level resistance to different antibiotics; while Stenotrophomonas exceptionally showed 99% resistance to meropenem.

Table 6showed the resistance pattern of gram-positive isolates against various antibiotics during the study period of 2015-2016.

Table 6: Antibiotic Resistance exhibited by gram positive organisms in SHL: 2015-16

Antibiotics	*Staph. aureus (N= 202)*	*Coag. Neg Staph (N= 203)*	*Enterococcus sp. (N= 84)*	*Strept. pneumo (N=49)*
Penicillin	91	92	83	22
Amoxicillin	90	92	63	22
Ceftriaxone	-	-	-	02
Cefuroxime	47	61	-	-
Cefoxitin	47	62	-	-
Gentamicin	23	50	83	-
Ciprofloxacin	60	66	79	51
Cotrimoxazole	25	56	-	-
Clindamycin	-	-	-	39
Rifampicin	32	25	-	10
Linezolid	0.5	03	00	00
Vancomycin	00	00	00	00
Tetracycline	-	43	76	65

Resistant organisms are distributed in relative frequency (%).

Both Staphylococcus aureus and Coagulase negative Staphylococcus (CoNS) contributed >90% resistant against penicillin and amoxicillin, while Streptococcus pneumoniae showed lower resistance (22%). In contrast, Enterococcus isolates had 83% resistance to penicillin and 63% to amoxicillin. Staphylococcus aureus showed less resistance to cefuroxime, cotrimoxazole, gentamicin, rifampicin and linezolid and surprisingly about 100% showed sensitive to Vancomycin. Resistance rate of Coagulase negative Staphylococcus, and Enterococcus to different antibiotics were found high, but >60% of Streptococcus pneumoniae showed less resistance.

The figure 2 below showed the distribution and relative frequency of the isolates producing ESBL, CRE and MRSA which are usually considered MDR pathogens.

Among MDR organisms, ESBL, CRE and MRSA are found predominantly in the ICU during the study period of two years. Of ESBL producing bacteria, 58% were E. coli and 24% Klebsiella. No ESBL was detected in Acinatobacter. Most of the Acinatobacter (89%) were however, found positive for CRE followed by Klebsiella (48%). A lesser number of E. coli (5%) has shown to be CRE producer. The MRSA was detected (47%) among the 202 Staphylococcus aureus isolates.

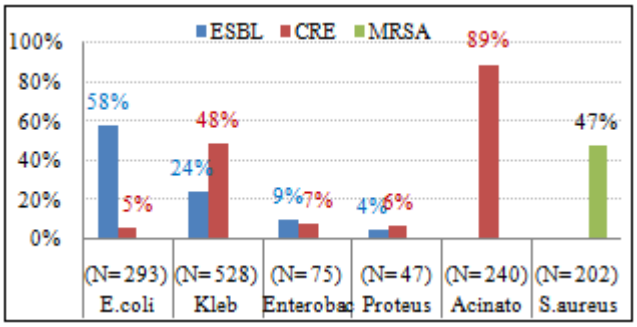

Figure 2: Frequency of ESBL, CRE and MRSA among gram-positive and gram-negative isolates

The study detected a total of 277 ICU-associated infections from different sources and devices during 2015-2016 (Figure 3). Among the important sources, ventilator associated pneumonia (VAP) was the highest in number (56%) followed by catheter associated urinary tract infection (23.1%), bloodstream infection (10.5%) and respiratory tract infections (7.9%). The rest of the patients and isolates were detected from surgical site infections (2.2%) and without catheter urinary tract infections (0.4%).

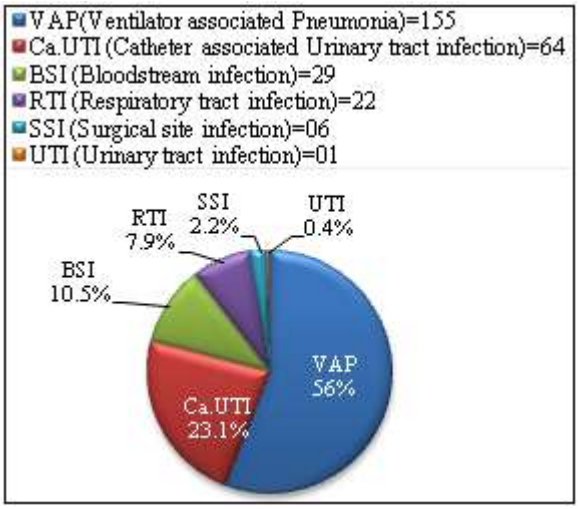

Figure 3: Pattern of Hospital Acquired Infection (HAI) in ICU by source during 2015-2016 (n= 277)

4. Discussion

Infection and antibiotic treatment have transformed modern medicine. However, sepsis is still a leading cause of hospital ICU admissions and makes up a significant number of intensive care stays. The ICU patients are usually immune-deficient. They acquired infection either from community source or infected after admissions. In our country, antibiotic prescribing policy is absent and rampant use of antibiotics is very common due to over-the-counter availability. Many of the patients are thus exposed to antibiotics before admission in ICU, or were administered after admission. Blood culture positivity is thus delayed due to presence of antimicrobial substances which has been associated with worse outcome for sepsis patients on inadequate empirical therapy. Such immune-deficient patients are critically ill and favour the emergence of multidrug-resistant pathogens by adopting one or other suitable mechanisms. Firstly, antibiotics may modify intestinal flora leading to colonization by the bacteria carrying resistant genes to important antibiotics, such as, cephalosporin, fluoroquinolone, vancomycin [22, 23];Secondly, degrading antibiotics by releasing beta-lactamase enzymes; thirdly, pumping out of the administered antibiotics and the fourth is by changing the antibiotic target molecule by the pathogens. Additionally, ICU presents an environment in which, antimicrobial resistance propagation is accelerated through the frequent and prolonged use of antibiotics, cross infections and transmission of resistant or MDR genes. However, associated drug resistance genes or its mechanism were not studied for this report.

Current study observed that more than half of all clinical isolates were obtained from respiratory samples (tracheal aspirates, sputum, broncho-alveolar lavage), and the remaining from urine, blood and wound swab or pus which mimics findings of another study [24].As like in many other countries, main source of respiratory tract infections in our ICU could be attributed to the most of patients who were on assisted ventilation. With regard to the clinical isolates, the present study is closely consistent with a US based study [25] that noted the gram-negative bacilli infections in ICUs predominated by Klebsiella (14.2%), E. coli (18.8%) and Pseudomonas (22.2%) including Acinatobacter. The most common gram-positive isolates reported from our ICU were Staphylococcus aureus, Coagulase-negative Staphylococcus, Enterococcus and Streptococcus pneumoniae as was documented earlier [26].

Antibiotic resistance and emergence of MDR is a global concern. The present study noted that gram negative bacilli encoded more resistance to fluoroquinolone specially among E. coli (75%), Klebsiella (78%) and Pseudomonas (49%), which is consistent with other reports [25, 27] and is reflecting an increasingly inappropriate usage of fluoroquinolone. It is also consistent with previous studies [25, 27] that showed comparatively less resistance among gram-negative bacilli to gentamicin, amikacin, pipercillin-tazobactam and meropenem. Acinatobacter species are usually inherits resistant to cephalosporin, penicillin and aminoglycoside [24].Carbapenem was the most active drug against Acinatobaterspp, but in recent years its increasing resistance creates limited treatment options in many institutes [28].A similar finding of about 89% Carbapenem resistant Acinatobacterspp noted in this study is a great concern and highly alarming. On the other hand, all gram positive cocci are still 100% sensitive to vancomycin, the only antibiotic remains in hand and to be preserved as the last-line therapy. In contrast, they were found highly resistance to penicillin and amoxicillin which is similar to other national studies [29, 30].

The great concern explicitly expressed in the present study with regard to the development of MDR organisms that included CRE positive Klebsiella, ESBL producing E. coli, MRSA producing Staphylococci and multi-resistant Acinatobacter. The KPC (Klebsiella pneumonia carbapenemase) producing Enterobacteriaceae specially by Klebsiella pneumoniae are noteworthy, because KPC beta-lactamases induce resistance to virtually all beta-lactam antibiotics; and many strains of Enterobactericeae were already reported to have induced resistance among many non-beta-lactam antibiotics as well [30].The two studies[31,32] on ESBL producing E. coli indicated a significantly higher rate in India than that in Bangladesh (72.3 vs 43.2%). The Indian study also reported 51.28% Enterobacter spp while Bangladesh one noted 39.5% Klebsiella as ESBL producers. The present study, however, in general found comparatively a lesser number of ESBL producing organisms. Note withstanding, still ESBL producing pathogens pose a threat as these enzymes encode more resistance against many classes of antibiotics leading to treatment failures. A comparable picture of MRSA (47%) was found between this study in Bangladesh and that of ICUs in Thailand [33].However, treatment of MRSA infected patient depends only on Vancomycin. Another concern is Acinatobacterspp that the most antibiotics becoming ineffective due to its increasing resistance to

ceftazidime (95%), amikacin (92%), meropenem (94%) and pipercillin-tazobactam (97%) which are consistent with surveillance study of antibiotic resistance pattern in ICUs in turk [34].

The present study noted that the most common HAI are the VAP-associated infections (56%) which are consistent with other studies [39], but the frequency of VAP associated reports varies between 9% to 18% and 21% [35-37]. The catheter-associated infections (23.1%) contributed among the most of nosocomial UTIs, while NNIS reported a 20-30% of nosocomial infections in ICUs due to UTIs [38].The frequency of blood stream infection in this study was 10.5% which is far less compared to 27% found in other study [37]. However, critically ill patients constitute major foci/reservoirs of multi-resistant organisms and shown to have attributed in spread of multidrug resistance among patients in ICUs, and had been a source of the majority outbreaks of nosocomial infections with MDR organisms. Broad-spectrum empiric antimicrobial therapy is usually found effective in severe infections of ICU patients who were infected by both the gram-positive and gram-negative bacteria. But the absence of information on drug resistance is an impediment to select appropriate alternative antibiotics to be administered in correct dosage and duration. It is noteworthy that the ICU patients are also at risk of acquiring invasive candidiasis because of their immunocompromised condition. Early antifungal therapy in these cases should be considered where appropriate.

Most of the pathogenic microorganisms isolated in this study were resistant against two or more of the commonly used antibiotics (MDR). In Bangladesh and the other resources-limited countries new and effective drug is hardly available, which creates an obstructing hurdle and difficulties in treating patients with MDR. In order to contain and overcome this problem, it is suggested to have routine surveillance for MDR pathogens and antibiotic susceptibility to generate a data base that could be useful in decision-making process of empirical therapy and in formulating antimicrobials prescribing policy for prudent and rational use of initial antimicrobial therapy while preserving the last-line antibiotic agents.

5. Conclusion

Infection In the ICU by both the MDR and non-MDR pathogens require longer stay in the hospital day and imposing not only economic burden but also a concern of added challenge of severe infections from ESBL, CRE, MRSA producing organisms. A concerned global commitment to the intelligent use of antimicrobials, better program of antibiotic stewardship, effective infection control and development of more alternative but effective antimicrobials are desperately needed.

6. Acknowledgement

We sincerely acknowledge and express our gratitude for the encouragement and support provided by the ICU authority and medical services of SHL, all staff of microbiology laboratory for helping in accumulating data. We greatly acknowledge the assistance provided in analyzing the data and repeatedly editing the manuscript in spite of extreme workload.

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