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Correlation of antimicrobial consumption and resistance among covid patients admitted to ICU in Lahore, Pakistan

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ABSTRACT

Background and Objectives: Antimicrobial resistance is a global problem and the leading cause of death and morbidity among patients admitted to medical intensive care units. In addition to correlating antibiotic consumption and antibiotic resistance with ICU demographic data, the study aims to ascertain whether clinical indications result in the recommendation of particular antibacterials for different patients admitted to the critical care unit. Another objective of the study is to determine whether the use of antibiotics and microbial infections is associated with the recovery or death of the patient who was brought to the medical critical care unit.

METHODOLOGY: The study was conducted in a tertiary care hospital in Lahore. The study subjects were 100 people who were admitted in ICU. All the samples were collected after the permission of the hospital administration and consent from the patients were also taken before taking the samples. According to clinical doubt, lab samples were collected and tested for responsible organism and for their antibacterial susceptibility.

RESULTS: E. coli (32%) and Klebsiella pneumoniae (17%) were the most prevalent pathogens. The most resistant strains of Klebsiella pneumoniae were to amoxycillin (12.0%) and ampicillin (13.3%). Most E. coli was resistant to both ciprofloxacin (16.8%) and ampicillin (19.8%). The most frequent diagnoses were CKD and UTI (21.4%), with E. coli accounting for 50% of these cases. In the intensive care unit, about 17 different kinds of antibiotics were utilized. Of all the antibiotics, quinolones, carbapenem, aminoglycosides, and fluoroquinolones were the most used. Liver failure and brain injuries result in the least amount of healing, whereas pyelonephritis causes the most.

CONCLUSION: Present study provided a useful data on clinical implication of antibiotic use in ICU patients especially with comorbidities. These data indicated that critical care patients in ICUs are disproportionately vulnerable to antimicrobial resistance, according to the data.

KEYWORDS: Antimicrobial resistance pattern, co morbidity, Intensive care unit, antibiotic susceptibility.

INTRODUCTION

The discovery of the many antibiotics represents a significant global and medical accomplishment. Their application has significantly decreased morbidity and mortality. Unfortunately, because of their extensive use, multi-drug infections have emerged, and the most effective antimicrobials have become less effective. Antimicrobial resistance is a worldwide issue that threatens the effectiveness of treating a variety of illnesses, impacts many hospitalized patients in the ward, and most likely poses a major risk to patients admitted to the intensive care unit (1).

As the last resort for patients whose treatment has failed owing to AMR, many intensive care units have turned become sinks for multidrug-resistant (MDR) infections (1). Nevertheless, the development, advancement, and emergence of antibiotic resistance pose a threat to the effectiveness of these antibiotic preventive regimens.

(1). Due to the use of several medications, prolonged hospital stays, costly antibiotics, and more lab testing, antimicrobial resistance also becomes a financial burden. Antimicrobial resistance was predicted to cost $55 billion annually in the United States alone (2). Governments, healthcare providers, experts, and the public are all responsible for taking steps to control the AMR problem. Limiting factors for AMR include

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examination, mindfulness, information, and forward-looking data (3).

Gram-negative bacteria like K. pneumonia are responsible for 15% of infections in patients admitted to intensive care units (2). Infection is common in patients hospitalized to intensive care units, and the mortality rate ranges from 25% to 80% (3). A patient who is admitted to critical care is more likely to develop drug resistance. Antimicrobial resistance in critical care unit patients is caused by a number of circumstances. Approximately 50% of ICU patients had a hospital-acquired infection, according to prospective research conducted in 1265 ICUs across 75 countries (4). Acinetobacter is becoming more widely acknowledged as a significant contributor to hospital-acquired infections (5). The successful use of intrusive equipment, the use of medications, and the initiation of empirical antibiotic treatment without culture and antimicrobial susceptibility testing are some of the variables that result in a reduction in immunity and several nosocomial infections(6).

METHODOLOGY

The study was carried out in a Lahore tertiary care facility. Two hundred and fifty samples were collected from the infected persons suffering from sepsis, pneumonia, Covid-19, infection of urine, and infection within blood, admitted to ICU of tertiary care hospital, Lahore. The samples included urine (44), Sputum (55), bedsores swab (34), CVP Tip (02), Blood Culture (20), Pus Swab (02), Tracheal Aspirate (52), Drain (01), Pleural Fluid (01) and Broncho-alveolar Lavage (39). Every sample was collected under sterile conditions. All samples were inoculated on different agar according to the nature of the specimen(2). After streaking the samples, samples were placed incubator for 18-24 hours at 37°C.

At first, growth characteristics of isolated bacteria were observed on agar plates and gram staining was carried out(3). For the identification of clinical isolates two criteria were used. First one was the macroscopic and second was the microscopic identification(4). Furthermore, biochemical test and API were used for the identification of the clinical isolates at species level(5).

Following the organism's isolation and identification, the Kirby Bauer disk diffusion assay was used to screen for antibiotic susceptibility. The assay was easy to use, standardized, and appropriate for determining antimicrobial activity (6). For this, standard commercial antibiotic disks were utilized. Using a sterile cotton swab, the test organism's inoculum was generated in accordance with 0.5 McFarland standards and inoculated three-dimensionally into a muller hinton agar (MH) agar plate (HiMedia®).

DISCUSSION

Of the 250 individuals that were enrolled in the trial, 40% were female and 60% were male. ICU data were dispersed based on the patients' age group, gender (male or female), the beginning of infection symptoms, and the co-morbidities these critically sick patients were dealing with. According to the study, most of the bacterial cultures were taken from patients who had kidney failure, followed by those who had liver failure, heart disease, cystitis, and other illnesses. The most frequent pathogens were E. coli (32%), followed by Salmonella (1%), Klebsiella pneumoniae (17%), and Klebsiella oxytoca (1%).

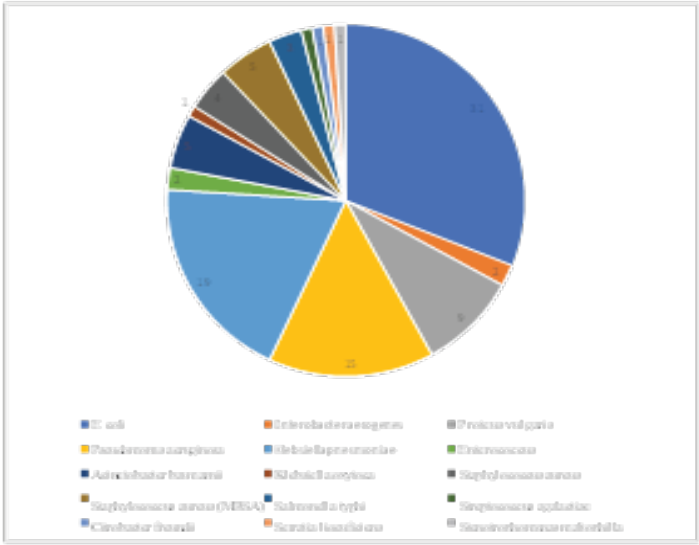

Figure 1: Distribution of clinical isolates among patients admitted in ICU

When the zone of inhibition surrounding any of the extended-spectrum disks manifested a discernible extension towards the antibiotic disk, the isolate was deemed sensitive in accordance with CLSI recommendations. The majority of GNI were least susceptible to ceftriaxone and cefepime (1.1%) and 0.005%, respectively, and most sensitive to imipenem and meropenem (11.9%). Other GNI showed the least sensitivity to imipenem and meropenem (6.25%) and the highest sensitivity to amikacin and gentamicin (12.5%). Most GPIs were susceptible to ciprofloxacin (11.1%), gentamycin (11.1%), and linezolid (11.1%).

Most of the GNI were resistant to ampicillin (19.8%) and ciprofloxacin (16.8%) and least resistant to amikacin (1.09%) and imipenem (1.09%). Other GNI were most resistant to ampicillin (13.3%) and amoxycillin (12.0%) and least resistant to colistin and ceftazidime.

Table 1(a): Antibiotics Susceptibility of GN isolates.

Antibiotic	Code	Concentration (µg)	Zone values		Sensitive and Resistance percentage	
			Resistance(mm)	Susceptibility (mm)	Sensitive	Resistance
Linezolid	LZD	30	<=20	>=23	15.6	5.93
Azithromycin	AZM	15	<=15	>=28	1.42	6.24
Colistin	CT	10	<=10	>=11	1.43	1.78
Gentamycin	CN	10	<=12	>=15	7.68	12.8
Ciprofloxacin	CIP	5	<=19	>=23	9.08	14.8
Fusidic acid	FD	10	<=28	>=30	3.12	1.92
Vancomycin	VA	30	<=16	>=18	12.4	3.86
Penicillin	P	10	<=28	>=30	2.27	8.02
Amikacin	AK	30	<=14	>=29	14.7	16.8
Cefoxitin	FOX	30	<=14	>=22	9.12	4.12
Clindamycin	DA	2	<=14	>=22	5.91	1.40
Doxycycline	DO	30	<=12	>=16	2.96	1.22
Erythromycin	E	15	<=15	>=21	1.39	11.4
Ceftazidime	CAZ	30	<=12	>=16	1.80	1.01
Ceftriaxone	CRO	30	<=19	>=23	1.81	2.45
Ampicillin	AMP	10	<=13	>=17	6.31	1.93
Cefoxitin	FOX	30	<=21	>=22	1.80	4.18
Oxacillin	OX	1	<=17	>=18	3.18	14.8
TMP/SMX	SXT	10	<=10	>=16	2.40	9.18
Levofloxacin	LEV	5	<=12	>=16	2.80	6.54

Table 1(b): Antibiotics Pattern of Gram-Positive Isolates

Antibiotic	Code	Concentration (µg)	Zone values		Sensitive and Resistance percentage	
			Resistance(mm)	Susceptibility(mm)	Sensitive	Resistance
Amikacin	AK	30	<=14	>=17	11.6%	4.32%
Ceftriaxone	CRO	30	<=19	>=23	6.13%	9.68%
Ciprofloxacin	CIP	5	<=15	>=21	7.31%	9.16%
Colistin	CT	10	<=10	>=11	10.6%	2.55%
Gentamicin	CN	10	<=12	>=15	9.42%	5.37%
Imipenem	IPM	10	<=15	>=23	10.5%	2.58%
Meropenem	MEM	10	<=13	>=23	9.75%	2.84%
Nitrofurantoin	NIT	300	<=14	>=17	1.80%	2.02%
Piperacillin	PIP	20	<=17	>=21	8.23%	2.45%
Amoxycillin	AMC	30	<=13	>=18	1.50%	17.3%
Ampicillin	AMP	10	<=13	>=17	3.16%	18.1%
TMP, SMX	SXT	10	<=10	>=16	3.60%	8.35%
Fosfomycin	FOS	50	<=12	>=16	1.20%	3.90%
Sulbactam	SCF	105	<=15	>=21	7.41%	2.32%
Levofloxacin	LEV	5	<=13	>=17	5.23%	5.84%
Tazobactam	TZP	110	<=17	>=21	1.53%	1.09%
Tabromycin	TOB	10	<=12	>=15	2.06%	1.21%
Cefixime	CFM	5	<=15	>=19	2.06%	2.95%

The patient diagnosis was made through the proper channel. The most common diagnosis was CKD, along with UTI (21.4%), which was caused mainly by E. coli (50%), followed by the Klebsiella pneumoniae (20%). The second most diagnosed patient was sepsis and hematuria (19.1%), caused mainly by E. coli (52.9%), followed by Klebsiella pneumoniae and Proteus species 11.8% 11.7%, respectively. The least common diagnosis was BSI (1.11%), caused mainly by Klebsiella pneumoniae (100%). The BSI followed by the lung abscesses (1.07%) caused mainly by the Klebsiella pneumoniae. (100%).

Different medications are administered to various patient types with various conditions in the medical intensive care unit. Carbapenem and cephalosporin were the most often recommended medications for UTIs, or sepsis with hematuria, whereas fosfomycin was the least frequently prescribed medication (3.70%). Aminoglycosides (16.0%) were the most often recommended medication in CKD, while glycopeptides (4.0%) were the least. Carbapenem was the most used medication in pancreatitis cancer and ascites (53.7%), whereas glycopeptide was the least used (7.70%). Quinolones were the most often recommended medication for pyelonephritis, whereas fosfomycin was the least. Teicoplanin (10.0%) was the least common antibiotic prescribed for CLD, whereas fluoroquinolone (55.0%) was the most common. The most common medication used for septicemia and pneumonia was carbapenem (50.0%), whereas aminoglycoside (16.5%) was the least common.

Table 2: Clinical isolates from various Samples

Diagnosis of Patients	Percentage	Isolates	Percentage
Acute coronary Syndrome	2.20%	*Klebsiella pneumoniae* *Pseudomonas aeruginosa*	50% 50%
UTI, Sepsis, Hematuria	19.1%	*E. coli* *Streptococcus* *Klebsiella pneumoniae* *Enterococcus* *Enterobacter* *Citrobacter* *Proteus*	52.9% 5.88% 11.8% 5.89% 5.88% 5.88% 11.7%
Abscesses, Endocarditis	12.8%	*Staphylococcus aureus*	100%
1Diabetic Wound	6.50%	*Pseudomonas aeruginosa* *Staphylococcus aureus* *MRSA* *Enterobacter* *Proteus*	16.7% 16.6% 33.3% 16.7% 16.7%
Cystitis, hematuria,	3.30%	*Proteus* *E coli*	66.4% 33.6%
CKD, UTI	21.4%	*Pseudomonas aeruginosa* *MRSA* *E. coli* *Citrobacter freundii* *Acinetobacter* *Klebsiella pneumoniae* *Proteus*	5.0% 10% 50% 5.0% 5.0% 20% 5.0%
Septicemia, Pneumoniae	6.48%	*Proteus* *Klebsiella pneumoniae* *Acinetobacter baumanni* *Pseudomonas aeruginosa*	20% 40% 20% 20%
Diagnosis of Patients	**Percentage**	**Isolates**	**Percentage**
Cellulitis, Burn Patient	1.08%	*Pseudomonas aeruginosa*	100%
Food Poisoning	1.11%	*Salmonella*	100%
CLD	4.30%	*E. coli* *MRSA*	60% 40%
Heart Stroke, DM	1.17%	*Pseudomonas aeruginosa*	100%

Regarding diagnosis, almost 60% of patients had pneumonia and COVID-19, followed by aspiration, diabetes, ischemic heart disease, chronic obstructive pulmonary disease, and hypertension. Meningoencephalitis, sepsis, and UTI were also diagnosed, along with various co-morbidities. These days, the leading causes of illness and death are COVID-19 and pneumonia. Three patients died from sepsis, one patient died from a UTI, and 23 patients died from pneumonia.

This study includes Covid-19 individuals with PCR confirmation. Data from 100 patients was gathered, 52 of them were male and 48 of whom were female. Most patients with greater co-morbidities and complications were over 45. Patients experienced a variety of symptoms upon admission to the hospital. SOB, fever, cough, sore throat, vomiting, loose stool, and body aches are the most typical symptoms experienced by critically ill patients. The symptoms of patients with various co-morbidities were more complex.

Throughout their hospital stay, the patients' recuperation was documented. By visiting the intensive care unit, the patient's recuperation and demise were documented. Most deaths are from head injuries (80%) and CLD (60%), including cellulitis, burn patients, pancreatic cancer, ascites (55%), and pancreatic cancer (46%). The cases of pyelonephritis rigors (5%) and cystitis, hematuria (6%), both resulted in a slight mortality. In contrast, most of the recovery happens in cases of cystitis with hematuria (94%) and pyelonephritis and rigors (95%). The lowest recovery rates were 20% for head injuries and 40% for CLD cases.

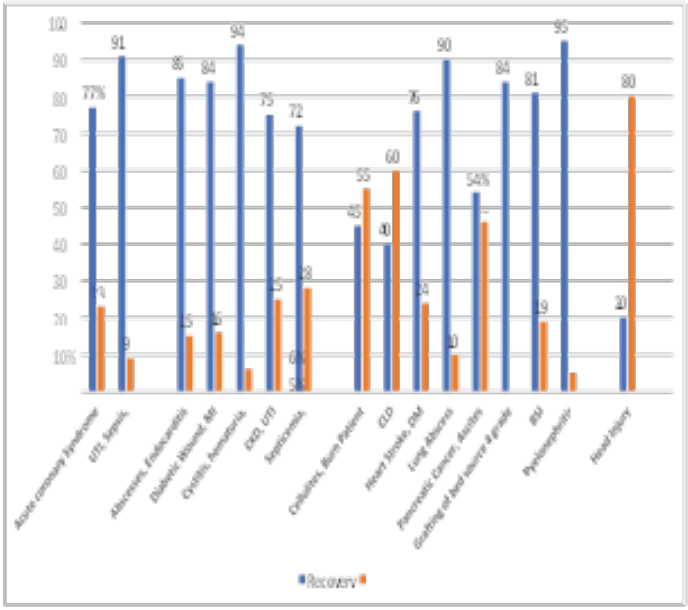

Figure 2: Mortality and recovery of the patients

DISCUSSION

The most often recommended medications for hospitalized patients, particularly those in critical care, are antibiotics. Using the right antibiotics in critical care units with few prescriptions is crucial for infection control, length of hospital stay, cost reduction, and acceptable quality of care. Patients who needed treatment and monitoring after being admitted to the intensive care unit of a tertiary care hospital were the subjects of this study. The purpose of this study was to examine the pattern of antibiotic usage and identify the factor contributing to the rise in antibiotic resistance in connection to antibiotic use.

E. Coli, the most prevalent bacterium in the intensive care unit, exhibited ciprofloxacin (16.8%) and ampicillin resistance (19.8%). In that instance, imipenem and meropenem were the most successful antibiotics. Most of the E. coli (11.9%) exhibited strong sensitivity to imipenem and meropenem. Both GPIs and GNIs are often treated with imipenem and meropenem. According to a different investigation on ICU uropathogens, E. coli was extremely vulnerable to imipenem, meropenem, and nitrofurantoin (6). The most prevalent bacterium, according to a study of medication sensitivity and bacteriology profiles on patients in intensive care units in tertiary care hospitals in Ahmadabad, was Acinetobacter spp. [30.9%], followed by Klebsiella spp. (29.8%) and Pseudomonas aeruginosa (22.9%) (7).

Pseudomonas was the most often found organism in the medical intensive care unit, followed by Klebsiella pneumonia, according to a study on microbial infections and antibiotic resistance patterns in patients admitted to the medical ICU at a tertiary care hospital (6).

Most of the gram-positive bacteria were resistant to vancomycin (15.2%) and penicillin (15.4). The gram-positive bacteria were treated with ciprofloxacin, gentamicin, and linezolid. Most of the gram-negative bacteria exhibited two or more antibiotic resistance, which is concerning because it may soon result in high rates of death and morbidity. The control of gram-negative bacteria will also be impacted by this. A study conducted in London found a similar outcome (7). Pseudomonas spp. (29.1%) and Acinetobacter spp. (27.5%) were the most prevalent organisms in another study of patients in intensive care units (8).

These results are consistent with ours since we found that E. coli was the most prevalent bacterium (31%), followed by Klebsiella pneumoniae (19%) and Pseudomonas aeruginosa (15%). Stenotrophomonas maltophilla, Citrobacter freundii, Serratia liqeuficiens, and Streptococcus agalactiae have the lowest (1%).

CONCLUSION

Overall, this study indicates that antibacterial medication use is extremely high. Our figures will be somewhat impacted because this study was limited in the number of participants it included. To handle this

issue, however, particular antimicrobial policies of hospitals and intensive care units are required.

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Authors Contributions:

Tousif Haider, Muhammd Usman andTaha Sahar: Substantial contributions to the conception and design of the work. Design of the work and the acquisition.

Alia Bibi and Muhammad Kamran: Drafting the work. Final approval of the version to be published.

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