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Clinical Profile of Intensive Care Unit (ICU) Patients with Infections and Antibiotic Response in a Tertiary Care Hospital

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ABSTRACT

Background: *The study on the clinical characteristics of ICU patients with infections and their treatment responses makes numerous important observations. Clinical observations and laboratory findings provide an overview of the patient's condition, laying the groundwork for the development of an organized microbiological diagnostic approach. In intensive care units (ICUs), where patients are critically ill, immunocompromised, and frequently undergoing invasive procedures and long-term antibiotic treatment, healthcare-associated infections (HAIs) pose a serious public health risk. Multidrug-resistant (MDR) infections are becoming more common, which makes infection control more difficult by raising morbidity, mortality, length of hospital stay, and the financial strain on healthcare systems. However, little hospital- based data are available to inform targeted infection control measures and antibiotic stewardship initiatives. Thus, the present study aims to understand the clinical profile of ICU patients with infections and Antibiotic Resistance.*

Materials and Methods: *Patients who acquire illness with or without device-associated support are included. The patient's personal data, including age and gender, will be documented in addition to a comprehensive medical history and any co-occurring conditions. A patient with an IV line, Foley's catheter, central line catheter, or mechanical ventilator is attached to a device. According to reports of positive lab culture, the Vitek 2 compact method is used in microbiology labs to test for antibiotic sensitivity and identify bacterial growth from samples taken under aseptic precaution. Additionally, they will receive a thorough clinical evaluation.*

Results: *The most prevalent comorbidities among the 76 ICU patients (mostly older) in the study were diabetes mellitus (68.4%) and hypertension (59.2%). Of these patients, 53.9% were male and 46.1% were female. The most common diagnosis was urosepsis (51.3%), and the clinical impact of device-related infections was highlighted by nosocomial infections as ventilator-associated pneumonia (1.3%), hospital-acquired pneumonia (3.9%), CAUTI (3.9%), and CLABSI (6.6%). Particularly in cases of urosepsis; Escherichia coli, the most commonly isolated pathogen (39.5%). Based on sensitivity testing, antibiotic therapy was changed for 55.3% of patients, while 44.7% of patients remained their original course of treatment. The majority of infections (76.3%) were obtained in the community, followed by hospital infections (23.7%) and medical device infections (19.7%). With a mortality rate of 11.8% and clinical improvement seen in 88.2% of cases, the results were mainly positive.*

Conclusion: *Many significant findings are made by the study on the clinical features of infected intensive care unit patients and how they respond to treatment. Most of those affected were elderly, males were clearly more prevalent, and comorbidities were common. Antibiotic sensitivity patterns showed concerning trends toward resistance. The significance of microbiological testing in directing treatment choices is shown by the fact that, in over half of the patients, empirical antibiotic medication had to be modified in response to culture sensitivity data. Overall, the clinical result was really good. Strong antibiotic stewardship, prompt culture-guided therapy, and focused interventions in intensive care units are vital for managing infections and lowering resistance, according to these data.*

Keywords: *Intensive Care Unit (ICU) patients, most prevalent comorbidities, clinical infections, aantibiotic resistance*

INTRODUCTION

ICU-specific microbial milieu offers an especially worrying situation, since pathogens persist, difficult-to-treat illnesses arise, and critically sick patients are more vulnerable.[1] Comorbidities, immunosuppression, and advanced age are common among ICU patients, who are routinely subjected to invasive procedures and the use of external medical devices. These components make them more

susceptible to colonization and hospital-acquired infections (HAIs), while also allowing ICU-associated microorganisms to completely exhibit their virulence and resistance mechanisms.

Multidrug-resistant (MDR) pathogens, in particular, cause considerable morbidity and mortality in ICU populations.[1] As a result, distinguishing between colonization and infection is critical, necessitating the use of consistent clinical and diagnostic techniques. Clinical microbiology is critical to this procedure because it allows for the rapid identification of infections and their antibiotic susceptibility profiles. Finally, comprehensive patient evaluations should incorporate local epidemiological data, best practices, and strong antimicrobial stewardship programs to improve infection control and treatment results.

The prompt detection of infectious processes in ICU patients demands a comprehensive examination. While clinical markers like fever and tachycardia are prominent, they lack specificity in the ICU setting. As a result, laboratory investigations are essential for supplementing clinical assessments. Key indicators, including white blood cell count (WBC), C-reactive protein (CRP), procalcitonin (PCT), pre- sepsin, and pro-adrenomedullin, can help confirm suspected infections. Elevation of these biomarkers increases the likelihood of infection, whereas normalization can inform judgments about antimicrobial therapy de-escalation. ICU environments may contain both hospital-acquired infections (HAIs) and community-acquired infections (CAIs), both of which require precise identification and interpretation by clinical microbiologists.[2]

Creating well-designed surveillance programs is one of the most effective ways to distinguish between colonization and infection. Passive surveillance strategies, which involve the periodic monitoring of retrospective laboratory data inside certain hospital units, are one example. This technique is low-cost, long-term viable, and provides detailed insights into pathogen kinds, resistance patterns, and therapy effects.[3,4,5]

More recent data from a 2019 single-center research in India showed a central line-associated bloodstream infections (CLABSI) rate of 4.3 per 1000 central line days.[6] In a global survey, low- and middle-income countries (LMICs) were shown to have significantly higher levels of antibiotic resistance, notably to third-generation cephalosporins and carbapenems.[7] According to reports from India, carbapenem resistance among Acinetobacter spp., Pseudomonas spp., and Klebsiella spp. is widespread, posing a significant challenge to infection control and antimicrobial stewardship initiatives.[8]

Thus, Healthcare-Associated Infections (HAIs) are a major public health concern, especially in intensive care units (ICUs), where patients are severely ill, immunocompromised, and commonly subjected to invasive operations and long-term antibiotic medication. The expanding prevalence of multidrug-resistant (MDR) pathogens complicates infection control by increasing morbidity, mortality, hospital stay time, and cost burden on healthcare systems. While worldwide surveillance data from high-income nations give important epidemiological insights, the burden and microbiological profile of HAIs in India's tertiary care hospitals are understudied. Studies show that CLABSI, CAUTI, ventilator-associated pneumonia (VAP), and surgical site infections (SSI) are more common in Indian ICUs, and organisms such as Klebsiella pneumoniae, Acinetobacter baumannii, and Pseudomonas aeruginosa are becoming more resistant to antibiotics. However, little hospital- based data are available to inform targeted infection control measures and antibiotic stewardship initiatives. Thus, the present study aims to understand the clinical profile of ICU patients with infections and Antibiotic Resistance.

AIM AND OBJECTIVES

- To assess the clinical profile of ICU patients with infection
- To categorize those under device related and non-device related diseases
- To determine the profile of the causative microorganisms, their drug sensitivity and resistance pattern in these patients

MATERIALS AND METHODS

A hospital based cross sectional study conducted in a tertiary care hospital at Puducherry in Intermediate Care Unit (IMCU) for a period of 20 months with a sample size of 76, Convenience sampling technique was followed. Patients above the age of 18 years both male and female in IMCU who develop disease with device (central line catheter, mechanical ventilators, Foley's catheter, IV line) and without device associated support, SOFA SCORE > 1, and with positive lab cultures – sputum, blood, tracheal aspirate, urine, blood, and catheter tip. Patients admitted in IMCU who have clinical infection but not microbial infection are excluded from the study and with SOFA scores < 1.

After receiving clearance from the SRC and IEC (No: 89/SVMCH/IEC-Cert/May23), all adults over the age of 18 who meet the inclusion criteria from the IMCU in Tertiary Care Hospital at Puducherry were enrolled in the study. Patients who acquire illness with or without device-associated support are included. Patient connected to a device using an IV line, Foley's catheter, central line catheter, or mechanical ventilator. Reports of positive lab culture, in microbiology labs, the Vitek 2 compact method is used to identify bacterial growth from samples obtained under aseptic precaution and to test for antibiotic susceptibility.

Every patient will be asked for their informed permission. Along with a thorough medical history and any co-occurring conditions, the patient's demographic information, including age and gender, will be recorded. They will also get a comprehensive clinical assessment. Lab analysis that includes culturing and sensitivity reports will be collected.

STATISTICAL ANALYSIS

MS Excel will be used to enter the data, and SPSS software (version 23.0) will be used for analysis. Lab culture reports and device-associated/non-device-associated infections are examples of categorical variables that will be represented in frequencies and percentages. The crucial parameters of mean and standard deviation will be used to express quantitative variables.

RESULTS

Table 1: Distribution of Patients based on Age and Gender

Distribution of Patients Based on Age			
Age in years	**Frequency**	**Percent**	**Cumulative Percent**
<=40	3	3.9	3.9
41-50	10	13.2	17.1
51-60	16	21.1	38.2
>60	47	61.8	100.0
Total	76	100.0	
Distribution of Patients Based on Gender			
Gender	**Frequency**	**Percent**	**Cumulative Percent**
Male	41	53.9	53.9
Female	35	46.1	100.0
Total	76	100.0	

The age and gender distribution of infected ICU patients is displayed in Table 1. The elderly made up the majority of those affected. In particular, 61.8% of the patients were older than 60, indicating a significant risk in this demographic. This may be brought on by comorbidities, age-related immunological decline, or extended hospital stays, all of which raise the risk of infections and their after effects, including antibiotic resistance. Patients between the ages of 41 and 50 made up 13.2% of the sample, while patients between the ages of 51 and 60 made up 21.1%. Significantly, just 3.9% of patients were 40 years of age or younger, suggesting that serious infections requiring intensive care unit hospitalization are rare in younger people. The gender distribution of ICU patients with infections and antibiotic response shows a small male predominance. Of the 76 patients, 41 (53.9%) were men and 35 (46.1%) were women.

Table 2: Distribution of Patients based on Risk Factors

Risk Factors	**Frequency**	**Percent**
DCLD	6	7.9
Diabetes Mellitus	52	68.4
Hypertension	45	59.2
CKD	18	23.6
CAD	15	19.7

Valvular Heart Disease	2	2.6
Cerebro Vascular Accident	4	5.2
Old Pulmonary Tuberculosis	5	6.6
Hypothyroidism	3	3.9
Carcinoma	4	5.2

The distribution of ICU patients according to pre-existing risk factors is displayed in table 2. The most common comorbidity in the study sample was diabetes mellitus, which affected 68.4% of patients. Hypertension came in second with 59.2% of cases. In addition, coronary artery disease (CAD) affected 19.7% of patients and chronic kidney disease (CKD) affected 23.6% of patients. Among the less common risk factors found were cancer and cerebrovascular accident (CVA) in 5.2% of the population, old pulmonary tuberculosis in 6.6%, and decompensated chronic liver disease (DCLD) in 7.9%. Valvular heart disease (2.6%) and hypothyroidism (3.9%) were the least often reported comorbidities.

Table 3: Distribution of Patients based on Diagnosis

Diagnosis	**Frequency**	**Percent**
Urosepsis	39	51.3
Sepsis	11	14.5
Community Acquired Pneumonia	7	9.2
Aspiration Pneumonia	18	23.6
Hospital Acquired Pneumonia (NV-HAP)	3	3.9
Ventilator Associated Pneumonia	1	1.3
Diabetic Keto Acidosis	3	3.9
Hyperosmolar Hyperglycemic Non-ketotic Coma	1	1.3
Metabolic Encephalopathy	2	2.6
Hepatic Encephalopathy	6	7.9
Acute Pulmonary Edema – Cardiogenic/Nephrogenic	5	6.6
ST Segment Elevation Myocardial Infarction	2	2.6
Non ST Segment Elevation Myocardial Infarction	3	3.9
Pulmonary Thrombo Embolism	4	5.3
Acute Respiratory Distress Syndrome	2	2.6
Multiple Organ Dysfunction Syndrome	1	1.3
Organo Phosphate Poisoning	1	1.3
Cerebro Vascular Accident	4	5.3
Central Line Associated Blood Stream Infection	5	6.6

Carcinoma	4	5.3
Bilateral Foot gangrene	1	1.3
Heart Failure with reduced Ejection Fraction	4	5.3
DIC- Disseminated Intravascular Coagulation	1	1.3
Dengue hemorrhagic Fever	3	3.9
Diabetic Foot Ulcer	1	1.3

The primary diagnosis for ICU patients who are admitted with infections are presented in table 3. 51.3% of the study group had urosepsis, which was the most prevalent diagnosis. Aspiration pneumonia (23.6%) and sepsis of unknown origin (14.5%) were next in line. Hepatic encephalopathy (7.9%), central line-associated bloodstream infection (6.6%), and community-acquired pneumonia (9.2%) were other noteworthy reasons. Among the less common conditions described were acute pulmonary edema (6.6%), pulmonary thromboembolism (5.3%), cerebrovascular accident (5.3%), heart failure with reduced ejection fraction (5.3%), and cancer (5.3%). Organo Phosphate Poisoning, Multiple Organ Dysfunction Syndrome, Hyperosmolar Hyperglycemic Non-Ketotic Coma, and Ventilator-Associated Pneumonia were all uncommon diagnoses, making up only 1.3% of cases.

Table 4: Distribution of Patients based on Specimen Used for Culture Test and Organism Causing infection

Distribution of Patients based on Specimen Used for Culture Test			
Specimen	**Frequency**	**Percent**	**Cumulative Percent**
Urine	37	48.7	48.7
Blood	13	17.1	65.8
Sputum	15	19.7	85.5
ET Tube	4	5.3	90.8
Central line	3	3.9	94.7
Peripheral line	1	1.3	96.1
Urine catheter	3	3.9	100.0
Total	76	100.0	
Distribution Of Patients Based On Organism Causing Infection			
Organism	**Frequency**	**Percent**	**Cumulative Percent**
E. coli	30	39.5	39.5
MSSA	3	3.9	43.4
K. pneumonia	23	30.3	73.7
P. aeruginosa	3	3.9	77.6
K .aerogenes	1	1.3	78.9
Enterococci faecalis	5	6.6	85.5
K. oxytoca	1	1.3	86.8
Proteus vulgaris	2	2.6	89.4
Enterobacter cloacae	1	1.3	90.7
Acinetobacter baumannii	5	6.6	97.3
MR-CONS	2	2.6	100.0
Total	76	100.0	

Table 4 depicts the distribution of patients based on specimen used for culture test and organism causing infection. The significance of nosocomial infections and the difficulties in infection control in intensive care units are underscored by infections like ventilator-associated pneumonia (1.3%), hospital-acquired pneumonia (3.9%), central line-associated bloodstream infections (CLABSI) (6.6%), and catheter-associated urinary tract infections (CAUTI) (3.9%). Acute coronary syndromes (STEMI and NSTEMI), pulmonary thromboembolism (5.3%), heart failure with reduced ejection fraction (HFrEF) (5.3%), stroke (5.3%), and hepatic encephalopathy (9.2%) were also prevalent. The significance of rigorous metabolic control in intensive care unit care was emphasized by the description of metabolic sequelae, including diabetic ketoacidosis, hyperosmolar hyperglycemic state, and metabolic encephalopathy.(Table 4)
Escherichia coli accounted for 39.5% of the 76 organisms recovered from ICU patients with diseases, making it the most common pathogen. This indicates that the main causative agent of ICU-acquired infections, particularly urosepsis, is E. coli. With 30.3% of isolates, Klebsiella pneumoniae was the second most prevalent bacteria, followed by Acinetobacter baumannii (6.6%). Urinary tract infections and bloodstream infections are frequently caused by Enterococcus faecalis (6.6%). Therapy is made more difficult by these organisms' well-known tendency for multidrug resistance Methicillin.
MSSA (3.9%) is frequently linked to infections of the circulation, respiratory system, and soft tissues. Pseudomonas aeruginosa (3.9%), Proteus vulgaris (2.6%), and a number of single isolates, including Klebsiella oxytoca, Klebsiella aerogenes, Enterobacter cloacae, and Methicillin-Resistant Coagulase-Negative Staphylococci (MR-CONS) and others, were among the less commonly isolated species.

Table 5: Sensitivity and Resistance of Meropenem

Organisms		**Meropenem**	
		Sensitivity	**Resistance**
E. coli	**Frequency**	13	1
	%	43.3%	3.3%
MSSA	**Frequency**	0	0
	%	0.0%	0.0%
K. pneumonia	**Frequency**	12	4
	%	52.2%	17.4%
P. aeruginosa	**Frequency**	1	1
	%	33.3%	33.3%
K .aerogenes	**Frequency**	1	0
	%	100.0%	0.0%
Enterococci faecalis	**Frequency**	0	0
	%	0.0%	0.0%
K. oxytoca	**Frequency**	0	0
	%	0.0%	0.0%
Proteus vulgaris	**Frequency**	1	0
	%	50.0%	0.0%
Enterobacter cloacae	**Frequency**	0	0
	%	0.0%	0.0%
Acinetobacter baumannii	**Frequency**	0	5
	%	0.0%	100.0%
MR-CONS	**Frequency**	0	0
	%	0.0%	0.0%
Total	**Frequency**	28	11
	%	36.8%	14.5%

The sensitivity and resistance profiles of several organisms to Meropenem in infected intensive care unit patients are displayed in Table 5. Of all the isolates, 14.5% were resistant to Meropenem, whereas 36.8% were susceptible. E. coli, one of the most commonly isolated species, had a low resistance rate of 3.3% and a moderate sensitivity rate of 43.3%, but Klebsiella pneumoniae showed emerging resistance with a

higher resistance rate of 17.4% and a sensitivity of 52.2%. Pseudomonas aeruginosa showed limited efficacy, exhibiting equal resistance and just 33.3% sensitivity. Serious concerns were raised in intensive care unit settings when it was shown that 100% of isolates of Acinetobacter baumannii were completely resistant to Meropenem. While there were fewer isolates, some species, such as Proteus vulgaris and Klebsiella aerogenes, were more sensitive

Table 6: Sensitivity and Resistance of Norfloxacin

Organisms		**Norfloxacin**	
		Sensitivity	**Resistance**
E. coli	**Frequency**	4	16
	%	13.3%	53.3%
MSSA	**Frequency**	0	0
	%	0.0%	0.0%
K. pneumonia	**Frequency**	2	7
	%	8.7%	30.4%
P. aeruginosa	**Frequency**	0	1
	%	0.0%	33.3%
K. aerogenes	**Frequency**	0	0
	%	0.0%	0.0%
Enterococci faecalis	**Frequency**	2	1
	%	40.0%	20.0%
K. oxytoca	**Frequency**	0	0
	%	0.0%	0.0%
Proteus vulgaris	**Frequency**	0	1
	%	0.0%	50.0%
Enterobacter cloacae	**Frequency**	0	0
	%	0.0%	0.0%
Acinetobacter baumannii	**Frequency**	0	0
	%	0.0%	0.0%
MR-CONS	**Frequency**	0	0
	%	0.0%	0.0%
Total	**Frequency**	8	26
	%	10.5%	34.2%

The sensitivity and resistance characteristics of various infections to norfloxacin in intensive care unit patients are shown in Table 6. The fact that just 10.5% of the isolates were susceptible to norfloxacin overall, and a noteworthy 34.2% were resistant, indicates that this antibiotic is not very effective in intensive care units. E. coli exhibited a high resistance rate of 53.3% and a poor sensitivity of 13.3% among the common pathogens, suggesting that it is largely ineffective against this organism. Similarly, Klebsiella pneumoniae demonstrated a high resistance rate of 30.4% and low sensitivity of 8.7%. Proteus vulgaris, Klebsiella oxytoca and Pseudomonas aeruginosa all displayed total resistance or no sensitivity, demonstrating Norfloxacin's declining efficacy against Gram-negative bacteria. Interestingly, Enterococci faecalis showed a little improved response, with 40% sensitivity, but 20% resistance remained.

Table 7: Sensitivity and Resistance of Nitrofurantoin

Organisms		**Nitrofurantoin**	
		Sensitivity	**Resistance**
E. coli	**Frequency**	18	5
	%	60.0%	16.7%
MSSA	**Frequency**	0	0
	%	0.0%	0.0%

K. pneumonia	**Frequency**	4	6
	%	17.4%	26.1%
P. aeruginosa	**Frequency**	0	1
	%	0.0%	33.3%
K. aerogenes	**Frequency**	0	0
	%	0.0%	0.0%
Enterococci faecalis	**Frequency**	3	0
	%	60.0%	0.0%
K. oxytoca	**Frequency**	0	0
	%	0.0%	0.0%
Proteus vulgaris	**Frequency**	1	0
	%	50.0%	0.0%
Enterobacter cloacae	**Frequency**	0	0
	%	0.0%	0.0%
Acinetobacter baumannii	**Frequency**	0	0
	%	0.0%	0.0%
MR-CONS	**Frequency**	0	0
	%	0.0%	0.0%
Total	**Frequency**	26	12
	%	34.2%	15.8%

The sensitivity and resistance patterns of nitrofurantoin against a number of bacterial isolates in intensive care unit patients are displayed in Table 7. Of all the isolates that were evaluated, 15.8% (12/76) were resistant to nitrofurantoin, whereas 34.2% (26/76) were sensitive. With 60.0% (18 isolates) responsive and only 16.7% (5 isolates) resistant, Escherichia coli had the highest sensitivity to Nitrofurantoin among the organisms, suggesting that it is a generally successful medication for E. coli urinary tract infections. Conversely, Klebsiella pneumoniae demonstrated heightened resistance (26.1%) and decreased sensitivity (17.4%), indicating that Nitrofurantoin is ineffective against this organism. Nitrofurantoin may be used to treat enterococcal infections, especially those affecting the urinary tract, according to the high sensitivity profile of other species, such as Enterococcus faecalis, where 60.0% of isolates were sensitive and none were resistant. Proteus vulgaris had one susceptible isolate (50%) and no resistance, but the sample size was too small to generalize. Notably, Nitrofurantoin demonstrated no activity (0% sensitivity) against MSSA, Pseudomonas aeruginosa, K. aerogenes, K. oxytoca, Enterobacter cloacae, Acinetobacter baumannii, and MR-CONS, indicating either intrinsic resistance or a non-urinary source of isolates for which this antibiotic is not typically effective.

Table 8: Sensitivity and Resistance of Amikacin

Organisms		**Amikacin**	
		Sensitivity	**Resistance**
E.coli	**Frequency**	23	4
	%	76.7%	13.3%
MSSA	**Frequency**	0	0
	%	0.0%	0.0%
K .pneumonia	**Frequency**	13	6
	%	56.5%	26.1%
P. aeruginosa	**Frequency**	1	1
	%	33.3%	33.3%
K. aerogenes	**Frequency**	1	0
	%	100.0%	0.0%
Enterococci faecalis	**Frequency**	0	0
	%	0.0%	0.0%
K. oxytoca	**Frequency**	1	0

	%	100.0%	0.0%
Proteus vulgaris	**Frequency**	1	1
	%	50.0%	50.0%
Enterobacter cloacae	**Frequency**	1	0
	%	100.0%	0.0%
Acinetobacter baumannii	**Frequency**	0	4
	%	0.0%	80.0%
MR-CONS	**Frequency**	0	0
	%	0.0%	0.0%
Total	**Frequency**	41	16
	%	53.9%	21.1%

The sensitivity and resistance profile of amikacin against a number of infections obtained from intensive care unit patients is displayed in Table 8. Amikacin showed promise as an empirical treatment, especially against some Gram-negative infections, with a relatively high sensitivity rate of 53.9% and a resistance rate of 21.1% overall. Amikacin seems to be a potential antibiotic for treating E. coli infections because of the bacteria's high sensitivity (76.7%) and low resistance (13.3%).

Amikacin may be useful however resistance is common, according to K. pneumoniae's intermediate sensitivity rate of 56.5% and resistance rate of 26.1%. Although these findings are based on fewer isolates, it is reassuring that K. aerogenes, K. oxytoca, and Enterobacter cloacae all showed 100% sensitivity and no resistance. K. aerogenes, K. oxytoca, and Enterobacter cloacae all showed 100% sensitivity and no resistance, which is encouraging, despite the fact that these results are based only on fewer isolates.

P. aeruginosa showed low sensitivity (33.3%) and equivalent resistance, confirming Amikacin's limited efficacy against this organism. Acinetobacter baumannii exhibited 100% resistance, MSSA, Enterococci faecalis and MR-CONS showed no sensitivity or resistance, which could indicate that they were not evaluated or are not appropriate targets for this treatment.

Table 9: Sensitivity and Resistance of Ceftriaxone

Organisms		**Ceftriaxone**	
		Sensitivity	**Resistance**
E. coli	**Frequency**	6	18
	%	20.0%	60.0%
MSSA	**Frequency**	0	0
	%	0.0%	0.0%
K. pneumonia	**Frequency**	8	13
	%	34.8%	56.5%
P. aeruginosa	**Frequency**	0	0
	%	0.0%	0.0%
K. aerogenes	**Frequency**	0	1
	%	0.0%	100.0%
Enterococci faecalis	**Frequency**	0	0
	%	0.0%	0.0%
K. oxytoca	**Frequency**	1	0
	%	100.0%	0.0%
Proteus vulgaris	**Frequency**	1	1
	%	50.0%	50.0%
Enterobacter cloacae	**Frequency**	1	0
	%	100.0%	0.0%
Acinetobacter baumannii	**Frequency**	0	1
	%	0.0%	20.0%
MR-CONS	**Frequency**	0	0
	%	0.0%	0.0%
Total	**Frequency**	17	34
	%	22.4%	44.7%

Ceftriaxone exhibits limited effectiveness against a range of pathogens isolated from intensive care unit patients, according to the data in Table 9. Overall, 44.7% of the isolates were resistant to ceftriaxone, compared to just 22.4% that were susceptible, indicating a high prevalence of antibiotic resistance in this clinical setting. E. Coli and Klebsiella pneumoniae, two of the most often isolated bacteria, have resistance rates of 60% and 56.5%, respectively, suggesting that ceftriaxone might not be a useful empirical treatment for these diseases. In line with their established resistance patterns, certain species, such as Pseudomonas aeruginosa, Enterococcus faecalis, Klebsiella aerogenes, and MR-CONS, showed no susceptibility to ceftriaxone. Even though isolates like Enterobacter cloacae and Klebsiella oxytoca showed 100% sensitivity, their small sample sizes limited their generalizability.

Table 10: Sensitivity and Resistance of Piperacillin

Organisms		**Piperacillin**	
		Sensitivity	**Resistance**
E. coli	**Frequency**	18	6
	%	60.0%	20.0%
K. pneumonia	**Frequency**	13	7
	%	56.5%	30.4%
P. aeruginosa	**Frequency**	2	1
	%	66.7%	33.3%
K. aerogenes	**Frequency**	1	0
	%	100.0%	0.0%
Enterococci faecalis	**Frequency**	0	0
	%	0.0%	0.0%
K.oxytoca	**Frequency**	1	0
	%	100.0%	0.0%
Proteus vulgaris	**Frequency**	2	0
	%	100.0%	0.0%
Enterobacter cloacae	**Frequency**	1	0
	%	100.0%	0.0%
Acinetobacter baumannii	**Frequency**	0	4
	%	0.0%	80.0%
MR-CONS	**Frequency**	0	0
	%	0.0%	0.0%
Total	**Frequency**	38	18
	%	50.0%	23.7%

The information in Table 10 presents a mixed picture of efficiency by demonstrating the sensitivity and resistance of various organisms to piperacillin. Although E. coli has a 20% resistance rate and a respectably high sensitivity of 60%, its use is called into question. Although K. pneumoniae has a moderate percentage of resistance (30.4%), over half (56.5%) of the bacteria are still sensitive to the drug. Notably, Proteus vulgaris, Enterobacter cloacae, K. aerogenes, and K. oxytoca all show 100% sensitivity to piperacillin, suggesting that it may be effective against these bacteria. The sensitivity of P. aeruginos and K. pneumoniae was 66.7% and 56.5%, respectively. However, 80% of strains of Acinetobacter baumannii are resistant, and none of them are susceptible, suggesting that piperacillin is only partially successful against this bacterium.

Table 11: Sensitivity and Resistance of Amoxycillin

Organisms		**Amoxycillin**	
		Sensitivity	**Resistance**
E.coli	**Frequency**	6	7
	%	20.0%	23.3%
MSSA	**Frequency**	0	0
	%	0.0%	0.0%
K. pneumonia	**Frequency**	4	4

	%	17.4%	17.4%
P. aeruginosa	**Frequency**	0	0
	%	0.0%	0.0%
K. aerogenes	**Frequency**	0	1
	%	0.0%	100.0%
Enterococci faecalis	**Frequency**	0	0
	%	0.0%	0.0%
Proteus vulgaris	**Frequency**	1	0
	%	50.0%	0.0%
Enterobacter cloacae	**Frequency**	0	0
	%	0.0%	0.0%
Acinetobacter baumannii	**Frequency**	0	0
	%	0.0%	0.0%
MR-CONS	**Frequency**	0	0
	%	0.0%	0.0%
Total	**Frequency**	11	12
	%	14.5%	15.8%

Sensitivity and Resistance of Amoxycillin was given in table 11. Of the isolates examined, Escherichia coli exhibited the highest frequency of Amoxycillin sensitivity, with six (20.0%) susceptible and seven (23.3%) resistant. Four isolates of Klebsiella pneumoniae (17.4% each) showed identical sensitivity and resistance. One isolate (50.0%) of Proteus vulgaris exhibited sensitivity but no resistance. MR-CONS, Pseudomonas aeruginosa, MSSA, Enterococcus faecalis, Klebsiella oxytoca, Enterobacter cloacae, and Acinetobacter baumannii were not shown to be resistant to amoxycillin in this study. Notably, just one isolate was affected, whereas Klebsiella aerogenes showed 100% resistance.

Table 12: Sensitivity and Resistance of Amoxyclav

Organisms		**Amoxyclav**	
		Sensitivity	**Resistance**
E. coli	**Frequency**	7	5
	%	23.3%	16.7%
MSSA	**Frequency**	0	0
	%	0.0%	0.0%
K. pneumonia	**Frequency**	3	6
	%	13.0%	26.1%
P. aeruginosa	**Frequency**	0	0
	%	0.0%	0.0%
K. aerogenes	**Frequency**	0	0
	%	0.0%	0.0%
Enterococci faecalis	**Frequency**	0	0
	%	0.0%	0.0%
K. oxytoca	**Frequency**	0	0
	%	0.0%	0.0%
Proteus vulgaris	**Frequency**	1	0
	%	50.0%	0.0%
Enterobacter cloacae	**Frequency**	0	1
	%	0.0%	100.0%
Acinetobacter baumannii	**Frequency**	0	0
	%	0.0%	0.0%
MR-CONS	**Frequency**	0	0
	%	0.0%	0.0%

Total	**Frequency**	11	12
	%	14.5%	15.8%

Sensitivity and resistance of Amoxyclav was depicted in table 12. Of all the clinical isolates tested, Escherichia coli exhibited the highest susceptibility to Amoxyclav, with 7 (23.3%) being responsive and 5 (16.7%) being resistant. Only three isolates (13.0%) were susceptible, whereas six isolates (26.1%) showed moderate resistance to Klebsiella pneumoniae. Interestingly, Proteus vulgaris had a 50.0% sensitivity rate and no resistance was found. It was shown that one isolate of Enterobacter cloacae was totally resistant. In this study, no sensitivity or resistance to Amoxyclav was observed in other species, including MSSA, Pseudomonas aeruginosa, Klebsiella aerogenes, Enterococcus faecalis, Klebsiella oxytoca, Acinetobacter baumannii, and MR-CONS.

Table 13: Sensitivity and Resistance of Fosfomycin

Organisms		**Fosfomycin**	
		Sensitivity	**Resistance**
E. coli	**Frequency**	2	0
	%	6.7%	0.0%
MSSA	**Frequency**	0	0
	%	0.0%	0.0%
K. pneumonia	**Frequency**	1	0
	%	4.3%	0.0%
P. aeruginosa	**Frequency**	0	0
	%	0.0%	0.0%
K. aerogenes	**Frequency**	0	0
	%	0.0%	0.0%
Enterococci faecalis	**Frequency**	0	0
	%	0.0%	0.0%
K. oxytoca	**Frequency**	0	0
	%	0.0%	0.0%
Proteus vulgaris	**Frequency**	0	0
	%	0.0%	0.0%
Enterobacter cloacae	**Frequency**	0	0
	%	0.0%	0.0%
Acinetobacter baumannii	**Frequency**	0	0
	%	0.0%	0.0%
MR-CONS	**Frequency**	0	0
	%	0.0%	0.0%
Total	**Frequency**	3	0
	%	3.9%	0.0%

Sensitivity and resistance of fosfomycin presented in table 13. Colistin fared better than any other tested isolates against a range of Gram-negative bacteria, as shown in Table 13. No resistance was detected, and K. pneumoniae and E. coli showed excellent sensitivity (3.3% and 4.3%, respectively). Additionally, there were no resistant isolates of Acinetobacter baumannii and the sensitivity was high (40.0%). Nonetheless, there was just one resistant isolate (50.0%) of Proteus vulgaris, suggesting that resistance may develop.

Table 14: Comparison of Antibiotics Used Before and After Sensitivity Test

Antibiotics used	**Initial**		**After Sensitivity test**	
	Frequency	**Percent**	**Frequency**	**Percent**
Meropenem	8	10.5	11	14.5
Nitrofurantoin	4	5.3	5	6.6
Piperacillin	40	52.6	30	39.5
Clindamycin	3	3.9	3	3.9

Azithromycin	3	3.9	0	0.0
Amoxyclav	1	1.3	1	1.3
Ceftriaxone	14	18.4	4	5.3
Cefotaxime	4	5.3	-	-
Linezolid	-	-	5	6.6
Colistin	-	-	3	3.9
Amikacin	-	-	6	7.9
Colistin	-	-	6	7.9
Cefoperazone/Sulbactum	-	-	1	1.3
Fosfomycin	-	-	1	1.3
Vancomycin	-	-	2	2.6

According to the data in table 14, sensitivity testing led to a considerable change in the patterns of antibiotic prescriptions. After sensitivity testing, the use of piperacillin, which was previously the most commonly used antibiotic (52.6%), decreased to 39.5%. Ceftriaxone use also dropped precipitously from 18.4% to 5.3%. Conversely, meropenem's usage increased from 10.5% to 14.5%, suggesting that it works well against species that are resistant to it. A shift toward broader-spectrum or last-resort medications was indicated by the introduction of several previously untested antibiotics after sensitivity testing, such as Linezolid (6.6%), Colistin (7.9%), Amikacin (7.9%), and Vancomycin (2.6%). In addition, drugs like azithromycin were stopped (from 3.9% to 0%) based on test findings.

Table 15: Distribution of patients based on Change in Antibiotic after Sensitivity test, type of infection, device/non-device related infection, outcome

Distribution of patients based on Change in Antibiotic after Sensitivity test			
Change in Antibiotic	**Frequency**	**Percent**	**Cumulative Percent**
Yes	42	55.3	55.3
No	34	44.7	100.0
Total	76	100.0	
Distribution of Patients Based on Type of Infection			
Type of Infection	**Frequency**	**Percent**	**Cumulative Percent**
Community Acquired	58	76.3	55.3
Hospital acquired	18	23.7	100.0
Total	76	100.0	
Distribution of Patients Based on Device/Non-Device Related Infection			
Device/non-Device	**Frequency**	**Percent**	**Cumulative Percent**
Device	15	19.7	19.7
Non-Device	61	80.3	100.0
Total	76	100.0	
Distribution Of Patients Based On Outcome			
Outcome	**Frequency**	**Percent**	**Cumulative Percent**
Improved	67	88.2	88.2

Dead	9	11.8	100.0
Total	76	100.0	

Table 15 show that out of the 76 cases studied, 55.3% (n=42) of the patients had their antibiotic therapy modified as a result of sensitivity testing, while 44.7% (n=34) remained on their original antibiotics. This suggests that more than half of the empirical medicines required adjustment, emphasizing the necessity of culture and sensitivity testing in guiding effective antimicrobial treatment. Among the 76 infections examined, 76.3% (n=58) were obtained in the community, whereas 23.7% (n=18) were acquired in a hospital setting. The prevalence of community-acquired illnesses shows that the majority of cases were caused by infections that originated outside of the hospital. Of the 76 infections studied, 19.7% (n=15) were device- associated, while 80.3% (n=61) were non-device-associated. This suggests that the majority of infections occurred regardless of medical device use. Among the 76 patients studied, 88.2% (n=67) saw clinical improvement, whereas 11.8% (n=9) died. This represents a generally favorable outcome in the majority of cases.

DISCUSSION

Age: 61.8% of the patients were over 60 indicates that this age group is at significant risk. Patients between the ages of 41 and 50 made up 13.2% of the sample, while patients between the ages of 51 and 60 made up 21.1%. Significantly, just 3.9% of patients were 40 years of age or younger, suggesting that serious infections requiring intensive care unit hospitalization are rare in younger people. In a similar vein, 25 instances in a study by Chetan et al., were older than 75, while 70 cases were between 45 and 59 years old. The mean age in a study by Sarvepalli et al., was 56.16±15 years old.[9,10]

Gender: The gender distribution of ICU patients with infections indicates a minor male predominance. Men made up 41 (53.9%) and women made up 35 (46.1%) of the 76 patients. This is comparable to the study by Sarvepalli et al. where 57.6% of the patients were male, and Chetan et al., where 141 cases were male and 59 cases were female.[10,9]

Risk Factors: People with infections are more likely to have comorbidities, as evidenced by the patient distribution in this intensive care unit study according to risk factors. With 68.4% of individuals affected, diabetes mellitus was shown to be the most prevalent risk factor, closely followed by hypertension (59.2%). Similar to this, type-2 DM (47.3%) and HTN (52.4%) were the two main co-morbidities in the Sarvepalli et al. study.[10]

In addition, coronary artery disease (CAD) affects 19.7% of people and chronic kidney disease (CKD) affects 23.7% of people. Seven.9% of the cases related to decompensated chronic liver disease (DCLD). Risk factors that were less common included respiratory problems like old lung disease, neurological illnesses such previous cerebrovascular accidents, and there was TB and other illnesses including carcinoma. According to a study by Chetan et al., 32 cases had chronic obstructive pulmonary disease, 21 cases had cerebrovascular accidents, 19 cases had chronic kidney disease, 17 cases had ischemic heart disease, 58 cases had diabetes mellitus, and 47 cases had systemic hypertension.[9]

Infecting Organisms: The most prevalent pathogen Escherichia coli is responsible for 39.5% of infections. Escherichia coli was the most prevalent pathogen (25%), followed by Klebsiella pneumoniae (15%) and Acinetobacter baumannii (13.6%), which is in line with the findings from Sanjeevan et al.[11] Gram-negative bacteria, such as Acinetobacter baumanii (13.8%), Escherichia coli (20%), Klebsiella pneumoniae (14.3%), Pseudomonas aeruginosa (9%), and Enterobacter aerogenes (5.1%), were also the most common in a research by Sarvepalli et al.[10].

Thirty-three percent of the infections in the study were caused by Klebsiella pneumoniae, the second most commonly isolated bacteria K. pneumoniae is a well-known opportunistic pathogen that is commonly connected to bloodstream infections and pneumonia that are acquired in hospitals. But in the study by Chetan et al., Klebsiella was the commonest organism isolated (30 cases, 28.85 %), followed by acinetobacter (25 cases, 24.04 %).[9]

Sensitivity and Resistance: In this study K. pneumoniae has a moderate resistance rate of 30.4%, however more than half (56.5%) remain susceptible to Piperacillin. Similarly, about 23.33% of Klebsiella isolates were resistant to Piperacillin tazobactam in the study by Chidambaram et al., Klebsiella pneumoniae had a higher sensitivity rate of 21.7% (5 isolates) and 4.3% resistance with Cefoperazone which is consistent with the findings of Chidambaram et al., where the sensitivity was 18.89%.[12]

Outcome: Among the 76 patients studied, 88.2% (n=67) saw clinical improvement, whereas 11.8% (n=9) died. This represents a generally favorable outcome in the majority of cases. This is consistent with the findings by Sarvepalli et al., 11.5% progressed to death. Similarly, in the study by Vincent et al., 25% died due to infections.[10, 13]

Due to weakened immunity, invasive procedures, and prolonged hospital stays, infections in the intensive care unit (ICU), whether acquired in the community or in a hospital, pose a serious risk to critically ill patients. Multidrug-resistant infections are common, especially in Gram-negative bacteria, which makes treatment more difficult and raises morbidity and mortality rates. A multidisciplinary approach involving early clinical assessment, the use of precise biomarkers, quick microbiological identification, and adherence to infection control procedures is required for effective infection therapy in the intensive care unit. Surveillance programs, both passive and active, are critical for identifying epidemiological patterns and directing antimicrobial management strategies. Finally, understanding the dynamic nature of ICU-related infections and implementing evidence-based protocols can greatly improve patient outcomes while lowering the burden of healthcare-associated infections.

CONCLUSION

Many significant findings are drawn from the study on the clinical features of infected intensive care unit patients and how they respond to treatment. The majority of those afflicted were elderly, with a noticeable male predominance and a high frequency of comorbidities such as diabetes, and hypertension—all of which contribute considerably to infection risk and antibiotic resistance. Similar to the frequency of Escherichia coli and Klebsiella pneumoniae as the main pathogens, uroepsis became the most frequent clinical diagnosis. Concerning resistance trends were shown by antibiotic sensitivity patterns, particularly against commonly used antibiotics like ceftriaxone, nitrofurantoin, and norfloxacin. Conversely, amikacin, colistin, and cloxacillin showed more efficacy, suggesting that these would be more practical empirical substitutes in the intensive care unit. Crucially, based on culture sensitivity findings, more than half of the cases required modifications to empirical antibiotic therapy, highlighting the vital need of microbiological testing in directing treatment choices. Overall, the clinical result was outstanding. In order to control infections and lower resistance, these results emphasize the vital necessity of prompt culture-guided therapy, effective antibiotic stewardship, and focused interventions in intensive care units.

REFERENCES

1. Ture Z., Güner R., Alp E. Antimicrobial stewardship in the intensive care unit. J. Intensive Med. 2022;3:244–253.

2. Princess I., Vadala R. Clinical Microbiology in the Intensive Care Unit: Time for Intensivists to Rejuvenate this Lost Art. Indian. J. Crit. Care Med. 2021;25:566–574. doi: 10.5005/jp-journals-10071-23810.

3. Kollef M.H., Shorr A.F., Bassetti M., Timsit J.F., Micek S.T., Michelson A.P., Garnacho-Montero J. Timing of antibiotic therapy in the ICU. Crit. Care. 2021;25:360. doi: 10.1186/s13054-021-03787-z.

4. Sy C.L., Chen P.Y., Cheng C.W., Huang L.J., Wang C.H., Chang T.H., Chang Y.C., Chang C.J., Hii I.M., Hsu Y.L., et al. Recommendations and guidelines for the treatment of infections due to multidrug resistant organisms. J. Microbiol. Immunol. Infect. 2022;55:359–386. doi: 10.1016/j.jmii.2022.02.001.

5. Cano M.E., Domínguez M.A., Ezpeleta C., Padilla B., Ramírez de Arellano E., Martínez-Martínez L. Cultivos de vigilancia epidemiológica de bacterias resistentes a los antimicrobianos de interés nosocomial [Epidemiological surveillance cultures in antimicrobial-resistant bacteria causing nosocomial infection] Enfermedades Infecc. Microbiol. Clin. 2008;26:220–229.

6. WHO, Antimicrobial resistance: global report on surveillance, World Health Organization, Geneva, 2014 6

7. Gandra, S · Mojica, N · Klein, EY · et al. Trends in antibiotic resistance among major bacterial pathogens isolated from blood cultures tested at a large private laboratory network in India, 2008–2014, Int J Infect Dis. 2016; 50:75-82

8. WHO (2012). WHO, Prevention of hospital-acquired infections - A practical guide, 2nd edition, in: W. H. Organization (Ed.)

9. Chethan Subramanya, Clinical Profile of Patients with Infection in Intensive Care Units in a Tertiary Care Hospital, J Evolution Med Dent Sci, 10(05), 2021.

10. Sarvepalli, A. K., & Dharana, P. K. (2017). Clinical profile, bacterial profile and outcomes in an intensive care unit of a tertiary care hospital in south India: one year study. International Journal of Advances in Medicine, 4(1), 156–161.

11. Sanjeevan, C.; Bhat, K. Sandhya. Antimicrobial resistance surveillance among patients with sepsis in intensive care units of a tertiary care center. Journal of Current Research in Scientific Medicine 8(2):p 129-134, Jul–Dec 2022.

12. N. Chidambaram, G. Ambujam, Reena Rajan, G. Sasikala and 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

13. Vincent JL, Rello J, Marshall J, Silva E, Anzueto A, Martin CD, Moreno R, Lipman J, Gomersall C, Sakr Y, Reinhart K; EPIC II Group of Investigators. International study of the prevalence and outcomes of infection in intensive care units. JAMA. 2009 Dec 2;302(21):2323-9.