International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 31, Issue 4, April 2025 **ijppr.humanjournals.com** ISSN: 2349-7203

Study on Antibiotic Resistant Pattern of Bacterial Isolates in Wound Infection in the Department of General Surgery

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Received: 2025-4-01 Revised: 2025-4-12 Accepted: 2025-4-20

ABSTRACT:

We aimed to study antibiotic resistant pattern of bacterial isolates in the Department of Surgery. This study involved the patients with infected wounds who had been treated with antibiotics at Government Cuddalore Medical College and Hospital (GCMCH). 40 patients were included in the study, the microbiological report showed that majority of bacterial growth were gram-negative organisms (79.7%) followed by gram-positive organisms (20.3%). In conclusion the bacterial pathogens mostly showed resistance towards Amoxyclav, Ceftriaxone and Co- Trimoxazole.

Keywords: Amoxyclav, Antibiotic resistant, wound infection, gram- positive, gram- negative, E. coli, MRSA, Klebseilla

1.IINTRODUCTION:

The term ‘antibiotic’ was coined from the word ‘antibiosis’ which literally means ‘against life’. Antibiotics had always been considered to be organic compounds produced by one microorganism which are toxic to other microorganisms[2].

In pursuance to this apparent necessity, antibiotics has been robustly defined as a chemically heterogeneous group of substances produced by a microorganism, or to a similar substance (produced wholly or partly by chemical synthesis)[4], which in low concentrations kills or inhibits the growth of other microorganisms. Whilst some antibiotics are able to completelykill other bacteria, some are only able to inhibit their growth[8]. Those that kill bacteria are termed bactericidal while those that inhibit bacterial growth are termed bacteriostatic. Penicillin was discovered by an English Bacteriologist, late Sir Alexander Fleming who accidentally obtained the antibiotic from a soil inhabiting fungus *Penicillium notatum* in 1928, and was able to show by experiments its antibacterial capability against laboratory cultures of numerous disease causing bacteria[10]. A few years after penicillin was first clinically tried on human, a new antibiotic, streptomycin was discovered in 1944 by another Microbiologist, Waksman. Streptomycin was also obtained from a soil inhabiting microorganism; in particular a soil bacterium, Streptomyces griseus. This new antibiotic has been of tremendous value especially in the treatment of tuberculosis caused by the bacterium Mycobacterium tuberculosis.

So far, about 2000 antibiotics have been discovered and characterized and only a relatively few number of this lot of them are currently used therapeutically, including those of fungal origin.

Most antibiotic drugs were discovered from soil-inhabiting microorganisms which include eubacteria (10% of isolated antibiotics), fungi (20%) and actinomycetes (70%).

Needless to say the search for microorganisms capable of producing compounds as potential source of new antibiotics still goes on unabated among pharmaceutical and clinical microbiologists, and other allied professionals, particularly as the emergence of pathogenic microorganism resistant to antibiotics also remains unabated (Centers for Disease Control and Prevention)[12].

1.1.WOUND INFECTION:

Wound infection remains an ongoing problem. Control measures against the common isolates and wound care may minimize infection.3 Rapidly emerging nosocomial pathogens and multi drug resistance necessitates the periodic review of isolation patterns and sensitivity in surgical practice.

1.2.SYMPTOMS:

Wound infections can also lead to symptoms, such as:

- warm skin around the wound
- yellow or green discharge coming from the wound
- the wound giving off an unpleasant odour
- red streaks on the skin around the wound
- fever and chills
- aches and pains
- nausea and vomiting

1.3.CAUSES:

Wounds become infected when bacteria enter and colonize the cut or wound. Common bacteria that may cause a wound infection include:

- *Staphylococcus aureus*
- *Pseudomonas aeruginosa*
- *Escherichia coli* (E. Coli).
- *Proteus mirabilis*
- *Acinetobacter baumannii/ haemolyticus*
- *Streptococcus*

1.4.ANTIBIOTIC RESISTANCE:

The development of resistance, for this reason, is acclaimed in many quarters as solely the result of the indiscriminate use of antibiotics, but bacterial drug resistance in itself is an adaptive response wherein bacteria begin to tolerate an amount of antibiotic that would ordinarily inhibit it[1]. Being able to resist an antibiotic is both an inherent and acquired characteristics of microorganisms. Inherent antibiotic resistance is best explained by the fact that bacteria must of course be resistant to their own product[5]. Bacteria with this type of resistance (inherent) form only a small group in the population. The major form of antibiotic resistance is the acquired type, and they constitute man's nightmare[7]. Bacteria with acquired resistance are those that were once sensitive to a given antibiotic but develop resistance over time through acquisition of resistant factors from the environment. For instance in the past, Staphylococcal strains were effectively controlled by the use benzyl penicillin because of their susceptibility to the antibiotic penicillin but some strains which are now resistant to the drug have since emerged. Bacterial resistance to antibiotics had been known and has been in existence long before penicillin was approved for public use. However, the enormity of the challenge of bacterial resistance to antibiotics was exacerbated in the 1950s and 1990s following numerous antibiotics treatment failures. Bacterial resistance to antibiotics has been variously reported to include two main forms of mechanisms:

i) Efflux pumps that eliminate the drug from the cell.

International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 31, Issue 4, April 2025 ijppr.humanjournals.com ISSN: 2349-7203

ii) Modifications of the cellular target of the antibiotic which hinders antibiotic's binding.

iii) Production of enzymes that are able to digest the antibiotic.

iv) Activation of an alternate pathway that bypasses drug action.

v) Down-regulation or elimination of transmembrane porins through which drugs enter the cell. This occurs particularly for Gram-negative bacteria.

vi) Over production of the target enzyme.

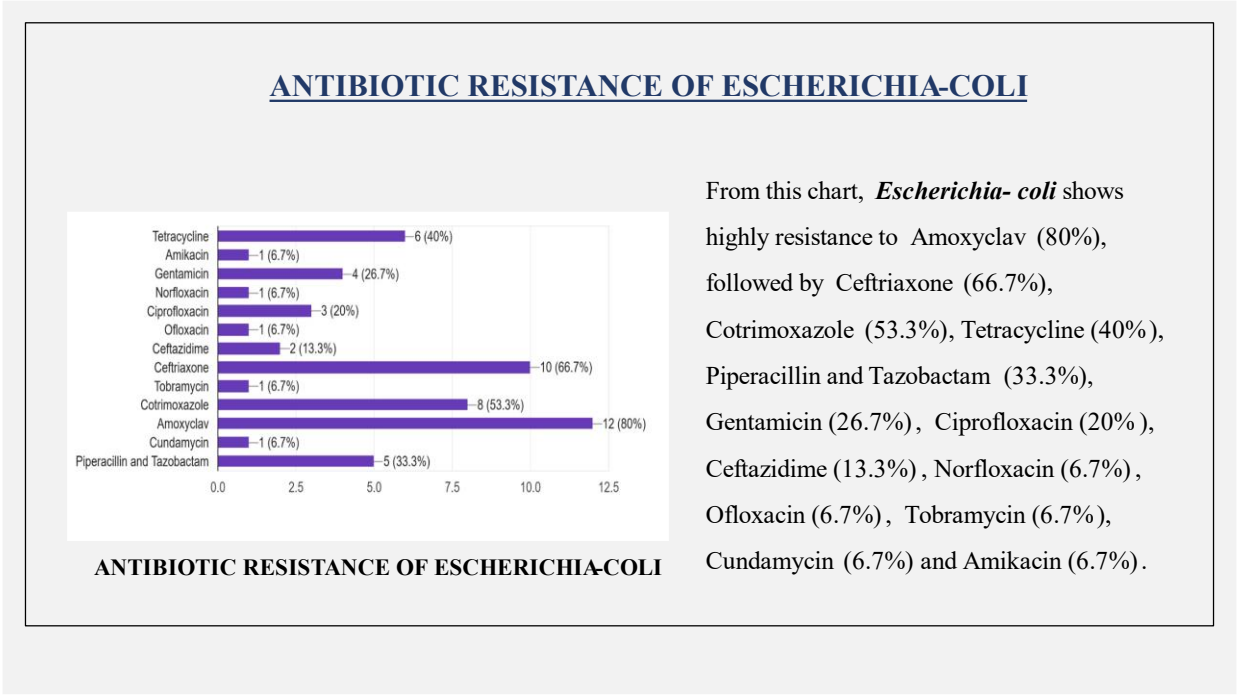
However, some studies have revealed in details several mechanisms through which bacteria become resistant to antibiotics.

2.MATERIALS AND METHODS:

2.1. General Data:

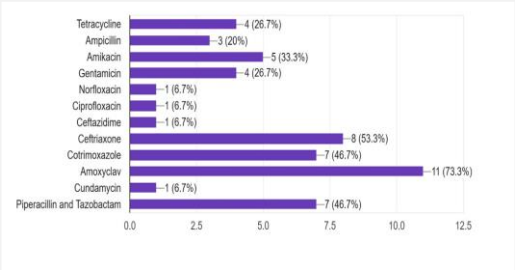
This prospective study was performed in the Surgery department at Government Cuddalore Medical College and Hospital, Tamilnadu, India. This study was carried out after Institutional Review Board and Ethics Committee clearance. The duration of the study was from September 1, 2024, to February 28, 2025. The main objective of this study was to study the antibiotic resistance pattern of bacterial isolates in wound infection. The inclusion criteria were patient with microbiologically proven wound infection were recruited for the study. The exclusion criteria includes 1) patient under age of 12 (paediatric patients), 2) intellectual or mental factors limiting communication.

2.2. Methods:



International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 31, Issue 4, April 2025 ijppr.humanjournals.com ISSN: 2349-7203

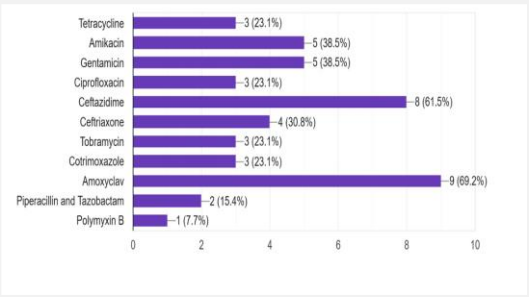
ANTIBIOTIC RESISTANCE OF KLEBSIELLA SPECIES



ANTIBIOTIC RESISTANCE OFKLEBSIELLASPECIES

From this chart, ***Klebsiella sp.*** shows highly resistance to Amoxyclav (73.3%) followed by Ceftriaxone (53.3%), Cotrimoxazole (46.7%), Piperacillin and Tazobactam (46.7%), Amikacin (33.3%), Gentamicin (26.7%) , Tetracycline (26.7%), Ampicillin (20%) , Norfloxacin (6.7%) , Ciprofloxacin (6.7%) , Ceftazidime (6.7%) and Cundamycin (6.7%).

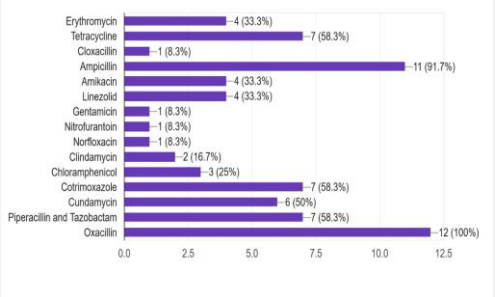
ANTIBIOTIC RESISTANCE OF PSEUDOMONAS SPECIES



ANTIBIOTIC RESISTANCE OF PSEUDOMONAS SPECIES

From this chart , ***Pseudomonas sp.*** shows highly resistance to Amoxyclav (69.2%) followed by Ceftazidime (61.5%) , Amikacin (38.5%), Gentamicin (38.5%), Ceftriaxone (30.8%), Tetracycline (23.1%) , Ciprofloxacin (23.1%) , Tobramycin (23.1%) , Cotrimoxazole (23.1%) , Piperacillin and Tazobactam (15.4%) and Polymyxin B (7.7%).

ANTIBIOTIC RESISTANCE OF MRSA



ANTIBIOTIC RESISTANCE OF MRSA

From this chart, **MRSA** shows highly resistance to Oxacillin (100%) followed by Ampicillin (91.7%), Tetracycline (58.3%), Piperacillin and Tazobactam (58.3%), Cotrimoxazole (50%), Cundamycin (50%), Amikacin (33.3%), Erythromycin (33.3%), Linezolid (33.3%), Chloramphenicol (25%), Clindamycin (16.7%), Gentamicin (8.3%), Nitrofurantoin (8.3%) and Cloxacillin (8.3%).

International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 31, Issue 4, April 2025 ijppr.humanjournals.com ISSN: 2349-7203

3.RESULT:

Out of 40 patients, Cefotaxime (65%) was the most frequent antibiotic used to treat infected wounds followed by Ciprofloxacin (62.5%), Piperacillin and Tazobactam (55%), Metronidazole (45%) and Amikacin (40%).

Table 1: Socio-demographic characteristics of patients with wound infections

Characteristics	Frequency (n=40)	Percentage (%)
Gender		
Male	29	72.5
Female	11	27.5
Age (In years)		
21-30	3	7.5
31-40	5	12.5
41-50	6	15
51-60	15	37.5
61-70	8	20
71-80	2	5
81-90	1	2.5

Table 2: Types of wounds

Wound type	Frequency (n=40)	Percentage (%)
DM foot ulcer	25	62.5
Cellulitis	6	15
PTRA	5	12.5
Post traumatic ulcer	3	7.5
Traffic accidents	1	2.5
Hollow viscous perforation	1	2.5

Table 3: Types of bacterial isolates

Gram negative isolates	Number (%)	Gram positive isolates	Number (%)
E.coli	15 (25.4)	*MRSA*	12 (20.3)
Klebsiella	14 (23.7)		
Pseudomonas	13 (22)		
Proteus mirabilis	5 (8.4)		
Total isolates (%)	**47 (79.6)**	**Total isolates (%)**	**12 (20.3)**

Table 4: Antimicrobial resistance pattern of Gram Positive bacterial isolate

Bacteria isolated	Number of pathogens (%)														
	GEN	E	PIT	AK	COX	C	NOR	COT	OX	TE	AMP	LZ	CIP	CD	NIT
MRSA (n = 12)	1 (8.3)	4 (33.3)	7 (58.3)	4 (33.3)	1 (8.3)	3 (25)	1 (8.3)	7 (58.3)	12 (100)	7 (58.3)	11 (91.7)	4 (33.3)	12 (40)	2 (16.7)	1 (8.3)
Total (n = 12)	1 (8.3)	4 (33.3)	7 (58.3)	4 (33.3)	1 (8.3)	3 (25)	1 (8.3)	7 (58.3)	12 (100)	7 (58.3)	11 (91.7)	4 (33.3)	12 (40)	2 (16.7)	1 (8.3)

KEY: GEN: Gentamicin; E: Erythromycin; PIT: Piperacillin and Tazobactam; COX: Cloxacillin; AK: Amikacin; C: Chloramphenicol; NOR: Norfloxacin; COT: Cotrimoxazole; OX: Oxacillin; TE: Tetracycline; AMP: Ampicillin; LZ: Linezolid; CIP: Ciprofloxacin; CD: Clindamycin; NIT: Nitrofurantoin.

Table 5: Antimicrobial resistance pattern of Gram negative bacterial isolates

Bacteria isolated	PIT	GEN	AK	CAZ	NOR	COT	CRO	TE	AMP	CIP	AC	PMB
E.coli (n = 15)	5 (33.3)	4 (26.7)	1 (6.7)	2 (13.3)	1 (6.7)	8 (53.3)	10 (66.7)	6 (40)	3 (20)	3 (20)	12 (80)	-
Klebsiella (n = 14)	7 (46.7)	4 (26.7)	5 (33.3)	1 (6.7)	1 (6.7)	7 (46.7)	8 (53.3)	4 (26.7)	3 (20)	1 (6.7)	11 (73.3)	-
Pseudomonas (n = 13)	2 (15.4)	5 (38.5)	5 (38.5)	8 (61.5)	-	3 (23.1)	4 (30.8)	3 (23.1)	-	3 (23.1)	9 (69.2)	1 (7.7)
Proteus mirabilis (n = 5)	2 (50)	2 (50)	2 (50)	-	-	2 (50)	3 (75)	1 (25)	-	-	2 (50)	-
Total (n = 47)	16 (34)	15 (31.9)	13 (27.6)	11 (23.4)	2 (4.2)	20 (42.5)	25 (53.1)	14 (29.7)	6 (12.7)	7 (14.8)	34 (72.3)	1 (2.1)

KEY: −: zero; PIT: Piperacillin and Tazobactam; GEN: Gentamicin; AK: Amikacin; CAZ: Ceftazidime; NOR: Norfloxacin; COT: Cotrimoxazole; CRO: Ceftriaxone; TE: Tetracycline; AMP: Ampicillin; CIP: Ciprofloxacin; AC: Amoxyclav; PMB: Polymyxin B.

4.DISCUSSION:

- In our study, **40 patients** were included based on selection criteria. Gender wise distribution shows that **male 29 (72.5%)** had the higher risk of wound infections than **female 11 (27.5%).**

- Age wise distribution showed that the wound infections were more common in the age group **between 51 – 60 years old (37.5%).**

- G**ram-negative organisms 47 (79.7%)** were more frequently isolated from the infected wounds, followed by **gram-positive organisms 12 (20.3%)**.

- From the wounds of 40 patients, **59** bacterial pathogens were isolated with average of 1.47 organisms per patient. From this, ***E. coli*** was the most predominant pathogen isolated from **15 (25.4%)** samples following ***Klebsiella sp.* 14 (23.7%), *Pseudomonas sp.* 13 (22%), *MRSA* 12 (20.3%),** and ***Proteus mirabilis* 5 (8.5%)**.

5.CONCLUSION:

❖ Most of the bacterial isolates shown susceptibility towards Amikacin, Ciprofloxacin, Gentamicin and Piperacillin and Tazobactam.

❖ Most of the bacterial isolates shows resistance towards Amoxyclav, Ceftriaxone and Cotrimoxazole.

❖ Males (72.5%) presented more with wound infections than female (27.5%) and the most prevalent age group was 51 – 60 years (37.5%).

❖ The majority of bacterial growth were gram-negative organisms (79.7%) followed by gram-positive organisms (20.3%) and the presence of only one species (62.5%) in the wound was the most common nature of the wounds.

❖ The antibiotics which were more commonly used for treating wound infected patients were Cefotaxime (65%) following Ciprofloxacin (62.5%), Piperacillin and Tazobactam (55%), Metronidazole (45%) and Amikacin (40%).

ETHICAL CLEARANCE:

This study was approved by Institutional Human Ethics Committee, Number: IHEC/1255/2025 dated 22 Nov 2024, and permitted by the Member Secretary, Institutional Human Ethics Committee, Rajah Muthiah Medical College, and Hospital, Annamalai University. The registration number of IEC is EC/NEW/INST/2020/1249. Participants' informed consent was not required. No human participants were used in this investigation, and there was no consent process.

ACKNOWLEDGMENT:

The authors would wish to extend their gratitude to Aayisha Ali A, M.Sc. (Biostatistics) and Warren Chanda, M.Sc. (Microbiology) for their contribution to statistical support.

DATA AND MATERIALS AVAILABILITY:

The corresponding author and the hospital's microbiology department have all relevant data, which they can provide upon reasonable request.

FUNDING:

None of the authors received funding to conduct this study nor the submission of this manuscript.

AUTHOR CONTRIBUTIONS:

Conceptualization and methodology including data collection: SP,PV , SMMR; Writing – Original draft preparation and literature search: SP,PV , SMMR; Writing – review and supervision SP,PV, SMMR. The final manuscript has been read and approved by all the authors.

CONFLICT OF INTEREST:

The authors affirm that the publishing of this paper is free of conflicts of interest.

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International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 31, Issue 4, April 2025 **ijppr.humanjournals.com** ISSN: 2349-7203

Betsy Deen, Juling Zhang, Anna Maruta, Christiana Kallon, Peng Liu, Haja Ramatulai Wurie, Joseph Sam Kanu, Gibrilla F Deen, Mohamed Samai, Foday Sahr, Emmanuel Firima

How to cite this article:
Suji.P et al. Ijppr.Human, 2025; Vol. 31 (4): 223-230.

Conflict of Interest Statement: All authors have nothing else to disclose.

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