Original Article

Antibiotic Susceptibility Pattern of Common Organisms against Doxycycline

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Objective : The current study was conducted to determine the antibiotic susceptibility patterns of commonly isolated organisms to doxycycline and compare the results with those obtained from cefuroxime, cefixime, and cefpodoxime.

Methods : Kirby-Bauer disc diffusion method recommended by the Clinical and Laboratory Standard Institute was used to assess the antibiotic resistance of 40 clinical isolates obtained from various sources such as skin, pus, sputum, bronchoalveolar lavage, and blood. The susceptibility of these isolates to different antibiotics was determined using disc diffusion. Additionally, the Minimum Inhibitory Concentration (MIC) values were measured using the E-Test and Agar dilution methods. To compare the levels of drug resistance, the Chi-square test was utilized.

Results : The results revealed that doxycycline exhibited the highest overall sensitivity, with 95% of the isolates being susceptible. Gram-positive isolates demonstrated a higher sensitivity rate of 97% to doxycycline compared to gram-negative isolates,which showed a sensitivity rate of 89%. In contrast, cefixime showed limited effectiveness, with only 13% of isolates being susceptible. Gram-positive isolates displayed a low sensitivity rate of 3%, while gram-negative isolates exhibited a slightly higher sensitivity of 44%. Cefuroxime and cefpodoxime demonstrated moderate sensitivity rates, with 23% and 15% of isolates being susceptible, respectively. Gram-positive isolates displayed a sensitivity rate of 26% for cefuroxime and 6% for cefpodoxime, while gram-negative isolates exhibited a sensitivity rate of 11% for cefuroxime and 44% for cefpodoxime.

Conclusion : Doxycycline had higher disk diffusion and agar dilution sensitivity (95%) than cephalosporins (Cefixime, Cefuroxime, and Cefpodoxime), indicating stronger broad-spectrum action. The resistance rates of cephalosporins ranged from 75% to 85%. Nearly 65% of cephalosporin-resistant isolates were responsive to doxycycline, demonstrating higher effectiveness. Doxycycline stands out as an effective treatment option for various infections, including skin, upper respiratory tract, and blood infections.

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Key words **: Doxycycline, Disk Diffusion method, Minimum Inhibitory Concentration, Cephalosporins, In-vitro study.**

Antibiotic resistance has become a global public health concern, posing significant challenges to the treatment of bacterial infections. The emergence and spread of multidrug-resistant pathogens have led to limited therapeutic options and increased morbidity and mortality rates[1]. Consequently, continuous monitoring of antibiotic susceptibility patterns is crucial to guide appropriate empirical therapy and combat the growing threat of antimicrobial resistance[2].

Doxycycline, a member of the tetracycline class of antibiotics, has been widely used in the treatment of various bacterial infections[3]. It exhibits a broad spectrum of activity against both gram-positive and gram-negative bacteria, including some atypical pathogens. Doxycycline's mechanism of action involves the inhibition of bacterial protein synthesis by binding to the 30S ribosomal subunit[4]. It is known for

Editor's Comment :

- Conducted under controlled laboratory conditions, the in vitro technique consistently demonstrated the Doxycycline's potent activity. Toxicity was not observed even at higher doses.
- These promising results indicate the potential for repurposing Doxycycline as an affordable and accessible treatment option for infectious diseases, especially in resource-limited regions.
- Doxycycline should be considered as a first-line treatment option especially for skin and respiratory infections, particularly when dealing with S aureus and S epidermidis isolates.

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its favorable pharmacokinetic profile, including excellent tissue penetration and a long half-life, making it an attractive choice for the treatment of many infections[1].

Cephalosporins, another class of antibiotics, have also been extensively used in clinical practice. They are bactericidal agents that target bacterial cell wall synthesis by binding to Penicillin-binding Proteins (PBPs). Cefuroxime belongs to the second generation of cephalosporins, while cefixime and cefpodoxime are part of the third generation[4]. These drugs exhibit a broad spectrum of activity against many gram-positive and gram-negative bacteria[5].

Several studies have investigated the antimicrobial susceptibility patterns of doxycycline and cephalosporins individually. However, limited research has compared the susceptibility profiles of these antibiotics against commonly encountered bacterial pathogens[6]. Understanding the comparative efficacy of these antibiotics is essential for selecting appropriate treatment regimens, especially in areas with a high prevalence of multidrug-resistant organisms[7,8].

The study design involved collecting clinical isolates from various sources. Standard microbiological techniques were employed to identify the isolated organisms, and the antibiotic resistance levels were determined following the guidelines set by the Clinical and Laboratory Standards Institute (CLSI).

This was done by using either the disc diffusion or broth microdilution methods[9]. Data on the zone of inhibition or Minimum Inhibitory Concentration (MIC) was recorded and analyzed statistically[10].

This study aimed to assess the antibiotic susceptibility patterns of commonly isolated organisms against doxycycline and compare use it with the cephalosporins cefuroxime, cefixime, and cefpodoxime. By evaluating the susceptibility of these antibiotics against a range of bacterial isolates, we can better understand their effectiveness and make informed decisions regarding empirical therapy.

Materials and Methods

Materials (Kindly provide Materials details)

Methodology

The antibiotic resistance profile of 40clinical isolates obtained from the skin, pus, sputum, bronchoalveolar lavage, and blood was determined using the Kirby-Bauer disc diffusion technique[2]. This was done in line with the recommendations made by the Clinical and Laboratory Standard Institute (CLSI). Additional Minimum Inhibitory Concentration (MIC) values were determined with the use of the E-Test and the agar dilution procedure[11]. Among 40 clinical isolates, 70% (n=28) were isolated from Skin infections/Pus, 20% (n=8) were isolated from upper respiratory infections ie, sputum and bronchoalveolar lavage and 10% (n=4) were isolated from blood specimens. A significant threshold of less than 0.05 was set for the P test, and the Chi-square test was employed to compare the levels of resistance among the different antibiotics.

Results

Disk Diffusion Method :

The study evaluated multiple drugs against 40 kinds of isolates consisting of different microorganisms.

Cefixime (5 mcg) —

Cefixime exhibited varying levels of effectiveness against the tested isolates. *S aureus (MRSA)* showed limited susceptibility to cefixime, with zone sizes ranging from 4 mm to 14 mm. *S. aureus*(MSSA) strains displayed better susceptibility, with zone sizes ranging from 6 mm to 22 mm. *S. epidermidis MR, Moraxella catarrhalis,* and *S. typhi* isolates showed varying susceptibility, with zone sizes ranging from 2 mm to 26 mm. However, some isolates of *S. epidermidis, H influenza, Acinetobacter baumanni, Streptococcus mitis, Enterococcus faecium,* and *E. coli* showed no zone of inhibition, indicating resistance to cefixime.

Cefuroxime (30 mcg) —

Among *S. aureus* strains, both MRSA and MSSA, cefuroxime showed significant effectiveness. The zone sizes ranged from 18 mm to 36 mm, indicating susceptibility of the isolates to cefuroxime. S. epidermidis MR, S. epidermidis and Moraxella catarrhalis isolates exhibited varying levels of susceptibility, with zone sizes of 14 mm, 18 mm and 20 mm, respectively. Notably, *H. influenza* and *Acinetobacter baumanni* isolates from sputum showed resistance to cefuroxime, ~~as~~ indicated by the absence of a zone. *Streptococcus mitis, Enterococcus faecium,* and some *S typhi* isolates also displayed resistance to cefuroxime, with no zone observed. On the other hand, *E coli* from sputum exhibited susceptibility to cefuroxime, with a zone size of 20 mm.

Cefpodoxime (10 mcg) —

Cefpodoxime exhibited varying effectiveness against the tested isolates. *S aureus* strains, both MRSA and MSSA, showed mixed susceptibility to cefpodoxime. MRSA isolates had zone sizes ranging from 2 mm to 24 mm, indicating a mixed response to cefpodoxime. MSSA isolates displayed zone sizes ranging from 4 mm to 22 mm, also indicating a mixed response. *S. epidermidis MR* and *Moraxella catarrhalis* isolates exhibited resistance to cefpodoxime, as indicated by

the absence of a zone. Additionally, *H influenza, Acinetobacter baumanni, S typhi, Enterococcus faecium,* and *Streptococcus mitis* isolates showed resistance to cefpodoxime, with no zone observed. On the other hand, *S epidermidis* and *E coli* isolates displayed susceptibility to cefpodoxime, with zone sizes of 10 mm and 20 mm, respectively.

Doxycycline (30 mcg) —

Doxycycline exhibited overall effectiveness against the tested isolates. Both MRSA and MSSA strains of *S. aureus* displayed susceptibility to doxycycline, with zone sizes ranging from 16 mm to 36 mm. *S epidermidis MR, Moraxella catarrhalis, S typhi, Acinetobacter baumanni, Streptococcus mitis, Enterococcus faecium,* and *E coli* isolates also showed susceptibility to doxycycline, with zone sizes ranging from 20 mm to 36 mm. *H influenza* and *S. epidermidis* isolates exhibited mixed susceptibility, with zone sizes ranging from 10 mm to 36 mm. However, some isolates of *S epidermidis* and *H influenza* showed lower zone sizes, indicating decreased susceptibility.

Doxycycline API (30 mcg) —

Doxycycline API exhibited overall effectiveness against the tested isolates. Both MRSA and MSSA strains of *S aureus* displayed susceptibility to doxycycline API, with zone sizes ranging from 16 mm to 24 mm. *S epidermidis MR, Moraxella catarrhalis, S. typhi, Acinetobacter baumanni, Streptococcus mitis, Enterococcus faecium*, and *E coli* isolates also showed susceptibility to doxycycline API, with zone sizes ranging from 20 mm to 26 mm. *H influenza* and *S epidermidis* isolates exhibited mixed susceptibility, with zone sizes ranging from 10 mm to 22 mm. However, some isolates of *S. epidermidis* and *H. influenza* showed smaller zone sizes, indicating limited susceptibility.

Table 1 demonstrates the comparison of sensitivity. Out of the total isolates tested 95% (n=38) were sensitive to doxycycline. Among the gram-positive bacteria subset, 97% showed sensitivity, while among the gram-negative bacteria subset, 89% exhibited sensitivity. The results were significantly different ($p<0.05$) when compared to cephalosporins.

The susceptibility rates of different antibiotics were assessed for bacteria are depicted in Tables 1 and 2. Comparison of sensitivity among different specimen types of doxycycline demonstrated high efficacy, with susceptibility rates of 93% for the skin and tissue samples, 88% for respiratory samples, and 100% for blood samples. Cefpodoxime showed relatively lower susceptibility rates across all specimen types, indicating potential limitations in treating infections in these areas. The p-value ($p>0.05$) indicates a statistically significant difference in antibiotic sensitivity among the specimen types.

MIC :

SRL01 (*S aureus MRSA*) from a skin swab in Table 3 and 4 exhibited a very high resistance with a value greater than 256 mcg/ml when treated with cefixime. Similarly, SRL24 (*S aureus MRSA*) from a swab also demonstrated a high resistance with a value greater than 256 mcg/ml. Also, SRL30 (*S epidermidis MR*) from pus, SRL31 (*S epidermidis MR*) from a skin abscess, and SRL40 (*H influenza*) from sputum were resistant to cefixime with values of more than 256 mcg/ml.

Similarly, in the case of cefuroxime, isolate SRL02 (*S aureus MSSA*) from a skin swab exhibited susceptibility with a value of 0.5 mcg/ml. SRL25 (*S aureus MRSA*) from a skin swab also showed susceptibility, but with a higher value of 24 mcg/ml. However, SRL30 (*S epidermidis MR*) from pus demonstrated high resistance to cefuroxime, with a value of 128 mcg/ml.

For cefpodoxime, SRL02 (*S aureus MSSA*) from a skin swab displayed susceptibility with a value of 0.125 mcg/ml. In contrast, isolating SRL25 (*S aureus MRSA*) from a skin swab in the second table demonstrated high resistance with a value greater than 256 mcg/ml.

Analyzing the antibiotic Doxycycline, isolate SRL02 (*S aureus MSSA*) from a skin swab showed susceptibility with a value of 0.38 mcg/ml. SRL25 (*S aureus MRSA*) has a skin-swab-inhibited susceptibility but with a slightly higher value of 0.5 mcg/ml. Notably, an isolate of SRL30 (*S epidermidis MR*) from pus demonstrated high susceptibility with a value of less than 0.016 mcg/ml.

When Doxycycline API was tested using the agar dilution method, SRL02 (*S. aureus MSSA*) from a skin swab, was found to be susceptible at 0.5 mcg/ml. Similarly, isolating SRL25 (*S aureus MRSA*) from a skin swab in the second table exhibited susceptibility, but with a lower value of 0.125 mcg/ml. Isolate SRL30 (*S epidermidis MR*) from pus also demonstrated susceptibility, but with a value of 16 mcg/ml.

The analysis of antimicrobial susceptibility revealed significant differences in sensitivity rates among the tested antibiotics. Doxycycline exhibited high overall sensitivity, with 95% of isolates being sensitive. Cefixime showed low sensitivity rates, with only 13% of isolates being sensitive. Cefuroxime and cefpodoxime also demonstrated relatively low sensitivity rates. The statistical analysis confirmed a

Table 1 — *Disk Diffusion Data*

Sl No	Isolate ID	Isolate	Specimen Source	Cefixime (5 mcg)	Cefuroxime (30 mcg)	Cefpodoxime (10 mcg)	Doxycyline (30 mcg)	Doxycycline API (30 mcg)
1	SRL01	S.aureus (MRSA)	Skin Swab	4 mm	18 mm	6 mm	22 mm	22 mm
2	SRL02	S.aureus (MSSA)	Skin Swab	22 mm	36 mm	22 mm	22 mm	20 mm
3	SRL03	S.aureus (MRSA)	Skin Swab	22 mm	32 mm	24 mm	26 mm	22 mm
4	SRL04	S.aureus (MSSA)	Skin Swab	6 mm	22 mm	12 mm	22 mm	16 mm
5	SRL05	S.aureus (MSSA)	Skin Swab	12 mm	28 mm	12 mm	24 mm	22 mm
6	SRL06	S.aureus (MSSA)	Skin Swab	16 mm	36 mm	18 mm	22 mm	22 mm
7	SRL07	S.aureus (MSSA)	Skin Swab	4 mm	14 mm	6 mm	20 mm	22 mm
8	SRL08	S.aureus (MSSA)	Skin Swab	4 mm	18 mm	6 mm	24 mm	18 mm
9	SRL09	S.aureus (MSSA)	Skin Swab	No Zone	10 mm	6 mm	34 mm	24 mm
10	SRL10	S.aureus (MSSA)	Skin Swab	No Zone	6 mm	4 mm	28 mm	24 mm
11	SRL11	S.aureus (MSSA)	Skin Swab	6 mm	No Zone	No Zone	22 mm	22 mm
12	SRL12	S.aureus (MSSA)	Skin Swab	No Zone	12 mm	No Zone	22 mm	22 mm
13	SRL13	S.aureus (MSSA)	Pus	14 mm	24 mm	18 mm	22 mm	22 mm
14	SRL14	S.aureus(MRSA)	Pus	No Zone	8 mm	2 mm	16 mm	16 mm
15	SRL15	S.aureus(MRSA)	Pus	No Zone	8 mm	No Zone	22 mm	22 mm
16	SRL16	S.aureus(MRSA)	Skin Swab	No Zone	12 mm	No Zone	34 mm	28 mm
17	SRL17	S.aureus(MRSA)	Skin Swab	No Zone	8 mm	4 mm	24 mm	22 mm
18	SRL18	S.aureus(MRSA)	Skin Swab	No Zone	12 mm	4 mm	24 mm	24 mm
19	SRL19	S.aureus (MRSA)	Skin Swab	4 mm	12 mm	6 mm	22 mm	22 mm
20	SRL20	S.aureus (MRSA)	Skin Swab	4 mm	14 mm	6 mm	30 mm	20 mm
21	SRL21	S.aureus (MRSA)	Skin Swab	No Zone	8 mm	No Zone	22 mm	22 mm
22	SRL22	S.aureus (MRSA)	Skin Swab	No Zone	8 mm	No Zone	26 mm	22 mm
23	SRL23	S.aureus (MRSA)	Skin Swab	14 mm	26 mm	14 mm	22 mm	21 mm
24	SRL24	S.aureus (MRSA)	Skin Swab	No Zone	6 mm	No Zone	36 mm	24 mm
25	SRL25	S.aureus (MRSA)	Skin Swab	No Zone	10 mm	2 mm	22 mm	21 mm
26	SRL30	S. epidermidis (MR)	Pus	No Zone	14 mm	No Zone	26 mm	26 mm
27	SRL31	S.epidermidis (MR)	Skin Abscess	2 mm	No Zone	No Zone	10 mm	2 mm
28	SRL32	S.epidermidis	Pus	6 mm	18 mm	10 mm	20 mm	20 mm
29	SRL33	Moraxella catarrhalis	Sputum	10 mm	20 mm	18 mm	24 mm	22 mm
30	SRL37	S.aureus MSSA	Sputum	8 mm	36 mm	18 mm	24 mm	22 mm
31	SRL40	H.influenza	Sputum	No Zone	No Zone	No Zone	36 mm	22 mm
32	SRL41	Acinetobacter baumanni	Sputum	No Zone	No Zone	No Zone	18 mm	16 mm
33	SRL42	S.typhi	Blood	20 mm	22 mm	22 mm	24 mm	20 mm
34	SRL43	S. typhi	Blood	26 mm	20 mm	22 mm	24 mm	20 mm
35	SRL44	S.typhi	Blood	22 mm	20 mm	20 mm	22 mm	20 mm
36	SRL45	Acinetobacter baumanni (Sputum)	Sputum	No Zone	No Zone	No Zone	22 mm	22 mm
37	SRL46	Streptococcus mitis	Bronchoalveolar Lavage	No Zone	No Zone	No Zone	20 mm	20 mm
38	SRL47	H.influenza	Sputum	No Zone	No Zone	No Zone	12 mm	10 mm
39	SRL48	Enterococcus faecium	Blood	No Zone	No Zone	No Zone	22 mm	24 mm
40	SRL54	E.coli	Sputum	20 mm	20 mm	20 mm	22 mm	20 mm

significant variation in sensitivity rates among the tested antibiotics ($p > 0.05$).

The sensitivity rates of four antibiotics (doxycycline, cefixime, cefuroxime, and cefpodoxime) were assessed based on Minimum Inhibitory Concentration (MIC) thresholds (Fig 1). Doxycycline (95%), cefuroxime (23%), and cefpodoxime (15%) were the three most sensitive drugs overall (Tables 2 & 4). However, cefixime showed the lowest sensitivity rate (13%) (Table 4). Significant differences were observed in sensitivity rates between the tested antibiotics. These findings highlight

Table 2 — *Statistical Analysis*

Comparison of Sensitivity				
Antibiotic	Overall Sensitivity (n=40)	Gram Positive Sensitivity (n=31)	Gram Negative Sensitivity (n=9)	p-alue
Doxycycline(30mcg)	38(95%)	30(97%)	8(89%)	
Cefixime(5mcg)	6(15%)	2(6%)	4(44%)	p<0.05
Cefuroxime(30mcg)	12(30%)	8(26%)	4(44%)	
Cefpodoxime(30mcg)	6(15%)	2(6%)	4(44%)	

Comparison of Sensitivity among different specimen types					
Specimen Type	Doxycycline (30mcg)	Cefixime (5mcg)	Cefuroxime (30mcg)	Cefpodoxime (30mcg)	p-value
Skin/Soft Tissue(n=28)	26(93%)	2(7%)	7(25%)	2(7%)	
Respiratory(n=8)	7(88%)	1(13%)	1(13%)	1(13%)	p<0.05
Blood(n=4)	4(100%)	3(75%)	3(75%)	3(75%)	

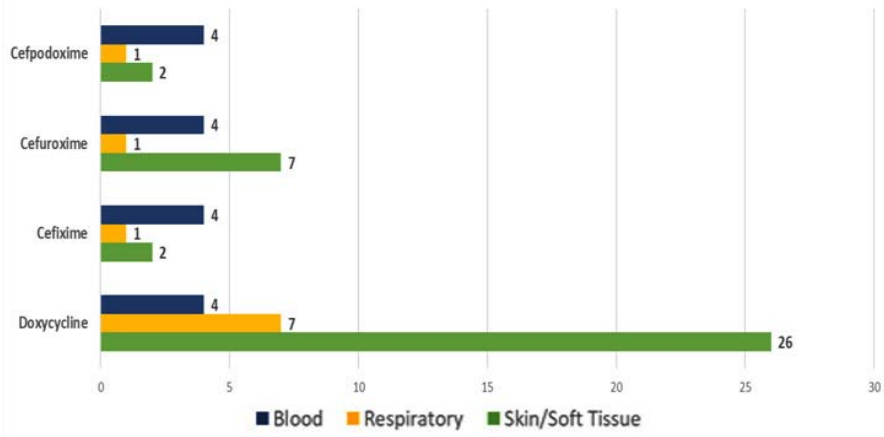

Fig 1 — Antibiotic Sensitivity Among Different specimen types

the variable susceptibility patterns among isolates and emphasize the need to consider clinical guidelines when interpreting these results (Tables 3&4).

Discussion

The present study aimed to investigate the antibiotic susceptibility profile of clinical isolates to commonly used antibiotics. A total of 40 isolates were included in the analysis, and their sensitivity to doxycycline,

Table 3 — *MIC Results*

Sl No	Isolate ID	Isolate	Specimen Source	Cefixime mcg/ml	Cefuroxime mcg/ml	Cefpodoxime mcg/ml	Doxycyline mcg/ml	Doxycycline API mcg/ml - Agar Dilution Method
1	SRL01	S.aureus (MRSA)	Skin Swab	>256	6	>256	1	0.5
2	SRL02	S.aureus (MSSA)	Skin Swab	8	0.5	0.125	0.38	0.5
3	SRL03	S.aureus (MRSA)	Skin Swab	1	0.38	0.25	0.25	0.5
4	SRL04	S.aureus (MSSA)	Skin Swab	16	2	12	0.38	0.5
5	SRL05	S.aureus (MSSA)	Skin Swab	48	0.5	12	1	0.125
6	SRL06	S.aureus (MSSA)	Skin Swab	3	0.75	4	0.38	0.125
7	SRL07	S.aureus (MRSA)	Skin Swab	>256	4	>256	0.25	0.125
8	SRL08	S.aureus (MRSA)	Skin Swab	>256	12	>256	0.125	0.125
9	SRL09	S.aureus (MSSA)	Skin Swab	>256	>256	>256	0.5	0.125
10	SRL10	S.aureus (MRSA)	Skin Swab	>256	40	>256	0.25	0.125
11	SRL11	S.aureus (MRSA)	Skin Swab	>256	>256	>256	0.125	0.125
12	SRL12	S.aureus (MRSA)	Skin Swab	>256	54	>256	0.25	0.125
13	SRL13	S.aureus (MSSA)	Pus	24	1.5	12	0.25	0.125
14	SRL14	S.aureus (MRSA)	Pus	>256	>256	>256	2	2
15	SRL15	S.aureus (MRSA)	Pus	>256	>256	>256	0.5	0.125
16	SRL16	S.aureus (MRSA)	Skin Swab	>256	>256	>256	<0.016	0.125
17	SRL17	S.aureus (MRSA)	Skin Swab	>256	24	>256	0.25	0.125
18	SRL18	S.aureus (MRSA)	Skin Swab	>256	12	>256	0.016	0.125
19	SRL19	S.aureus (MRSA)	Skin Swab	>256	54	>256	0.15	0.125
20	SRL20	S.aureus (MRSA)	Skin Swab	>256	12	>256	0.25	0.125
21	SRL21	S.aureus (MRSA)	Skin Swab	>256	48	>256	0.25	0.125
22	SRL22	S.aureus (MRSA)	Skin Swab	>256	>256	>256	0.25	0.125
23	SRL23	S.aureus (MSSA)	Skin Swab	4	1	3	0.25	0.125
24	SRL24	S.aureus (MRSA)	Skin Swab	>256	>256	>256	0.25	0.125
25	SRL25	S.aureus (MRSA)	Skin Swab	>256	24	>256	0.5	0.125
26	SRL30	S. epidermidis (MR)	Pus	>256	128	>256	<0.016	0.125
27	SRL31	S. epidermidis (MR)	Skin Abscess	>256	>256	>256	24	16
28	SRL32	S.epidermidis	Pus	24	1.5	6	0.25	2
29	SRL33	Moraxella catarrhalis	Sputum	12	0.5	2	0.125	0.5
30	SRL37	S.aureus MSSA	Sputum	24	4	4	0.5	2
31	SRL40	H.influenza	Sputum	>256	>256	>256	0.125	0.25
32	SRL41	Acinetobacter baumanni	Sputum	>256	>256	>256	0.5	1
33	SRL42	S.typhi	Blood	0.5	4	0.35	1.5	0.5
34	SRL43	S. typhi	Blood	0.25	6	0.125	0.75	0.5
35	SRL44	S.typhi	Blood	<0.015	4	0.25	0.5	0.5
36	SRL45	Acinetobacter baumanni	Sputum	>256	>256	>256	4	<0.125
37	SRL46	Streptococcus mitis	Bronchoalveolar Lavage	>256	>256	>256	2	<0.125
38	SRL47	H.influenza	Sputum	>256	>256	>256	4	<0.125
39	SRL48	Enterococcus faecium	Blood	>256	>256	>256	0.25	<0.125
40	SRL54	E.coli	Sputum	0.75	4	0.5	0.5	0.5

Table 4 — *Statistical Analysis*

Comparison of Sensitivity				
Antibiotic	Overall Sensitivity (n=40)	Gram Positive Sensitivity (n=31)	Gram Negative Sensitivity (n=9)	p-alue
Doxycycline (MIC<4ug/ml)	38(95%)	30(97%)	8(89%)	**p<.05**
Cefixime (MIC<1ug/ml)	5(13%)	1(3%)	4(44%)	
Cefuroxime (MIC<4ug/ml)	9(23%)	8(26%)	1(11%)	
Cefpodoxime (MIC<4ug/ml)	6(15%)	2(6%)	4(44%)	
Comparison of Sensitivity among different specimen types				
Specimen Type	Doxycycline (MIC<4ug/ml)	Cefixime (MIC<1ug/ml)	Cefuroxime (MIC<4ug/ml)	Cefpodoxime (MIC<4ug/ml) p-value
Skin/Soft Tissue (n=28)	26(93%)	1(4%)	8(29%)	3(11%)
Respiratory (n=8)	7(88%)	1(13%)	1(13%)	1(13%) p<0.05
Blood (n=4)	4(100%)	3(75%)	3(75%)	3(75%)

cefixime, cefuroxime, and cefpodoxime was evaluated[4,12]. The results provided valuable insights into the effectiveness of these antibiotics against the tested isolates and shed light on the variation in susceptibility patterns among gram-positive and gram-negative organisms[12]. Doxycycline demonstrated notable effectiveness in skin and respiratory samples, showing larger zone sizes against S aureus (MSSA) and S epidermidis MR isolates compared to cefuroxime, cefixime, and cefpodoxime. Its broad-spectrum activity against various bacteria, both Gram-positive and Gram-negative, contributes to its superior performance.

A recent study observed a new radiopharmaceutical of 99 mTc-doxycycline that was developed for accurate infection diagnosis of *S aureus*. In vitro and in vivo studies demonstrated high radiolabeling yield, binding to bacterial cells, stability, accumulation at infection sites, and renal excretion[13]. Another study investigated the effects of doxycycline on influenza virus infection and its underlying mechanisms[7]. The findings revealed that doxycycline can weaken the pathogenicity of the virus by inhibiting matrix metalloproteinases present in neutrophils[14].

The findings of this study revealed that doxycycline exhibited the highest overall sensitivity of 95% among the tested antibiotics. This suggests that doxycycline can be considered a potential therapeutic option for the treatment of infections caused by the tested isolates. Furthermore, when examining the sensitivity patterns based on the gram stain classification, gram-positive isolates demonstrated a higher susceptibility rate (97%) to doxycycline compared to gram-negative isolates (89%). This disparity in susceptibility may be attributed to differences in the cell wall structure and mechanisms of antibiotic resistance between gram-positive and gram-negative bacteria[12].

In contrast to the favorable results observed for doxycycline, cefixime showed limited effectiveness, with only 13% of isolates being susceptible[3]. This suggests that cefixime may not be the most suitable option for treating infections caused by the tested isolates. Gram-positive isolates exhibited a particularly low sensitivity rate of 3%, indicating that cefixime may not be effective against this group. However, gram-negative isolates showed a slightly higher sensitivity rate of 44%, suggesting potential utility for cefixime in treating certain gram-negative infections[11].

Cefuroxime and cefpodoxime, two other antibiotics evaluated in this study, demonstrated moderate sensitivity rates. Cefuroxime showed a susceptibility rate of 23%, while cefpodoxime showed a rate of 15%. Gram-positive isolates were more likely to be sensitive to cefuroxime (26%) than to cefpodoxime (6%), which suggests that cefuroxime may work better against gram-positive organisms. Gram-negative isolates, on the other hand, were more likely to be sensitive to cefpodoxime (44%) than to cefuroxime (11%), which suggests that cefpodoxime may be a better choice for treating gram-negative infections[4].

This study has limitations including a small sample size and a limited number of antibiotics evaluated the study did not investigate the efficacy of doxycycline in clinical situations or explore its precise mechanisms of action.

The study provides a comprehensive analysis of doxycycline's antimicrobial effectiveness across various skin and respiratory infections. Conducted under controlled laboratory conditions, the in vitro technique consistently demonstrated the drug's potent activity, even at higher doses without toxicity. These promising results indicate the potential for repurposing doxycycline as an affordable and accessible treatment option for infectious diseases, especially in resource-limited regions. A comprehensive understanding of antibiotic susceptibility patterns will aid in optimizing antibiotic therapy and combating the challenge of antibiotic resistance. Further research and randomized controlled trials are warranted.

Conclusion

The study provided valuable insights into the antibiotic susceptibility profile of clinical isolates. Doxycycline demonstrated the highest overall sensitivity, while cefixime showed very limited

effectiveness. Cefuroxime and cefpodoxime exhibited moderate sensitivity rates, with variations observed between gram-positive and gram-negative isolates.Considering the findings, doxycycline should be considered as a first-line treatment option especially for skin and respiratory infections, particularly when dealing with S. aureus and S. epidermidis isolates.

Conflict of interest : Dr Mangesh Tiwaskar is a Senior Consultant at Shilpa Medical Centre. Dr Rashmi Khadapkar is the technical expert at Agilus Diagnostic Ltd. Rest of the authors are employees at Dr Reddy's Laboratories.

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