

## Drug Resistance Patterns of Bacterial Pathogens from Adult Patients with Pneumonia in Arba Minch Hospital, South Ethiopia

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### Abstract

**Background:** Community-acquired pneumonia (CAP) is associated with high mortality. Drug resistance is common in countries where the alternative treatments are limited and available drugs are misused. In resource limited countries like Ethiopia; it is wise to determine antimicrobial susceptibility pattern of common bacterial pathogens of CAP. The objective of our study was to determine antimicrobial susceptibility pattern of common bacterial pathogens of CAP among adult patients visiting Arba Minch Hospital.

**Methods:** A cross sectional study conducted at Arba Minch Hospital, Southern Ethiopia from February to May 2013. Sputum specimens were collected; microbiological investigations and antimicrobial susceptibility testing were performed using standard procedures. Data was processed and analyzed with SPSS version 16.0. Results: Out of 170 cases, only 73 (42.9%) were culture positive. Majority of tested bacterial isolates (>86%) were sensitive to Ceftriaxone and Ciprofloxacin. Most *S. pneumoniae* isolates (60%) were resistant to Oxacillin. Most of *S. aureus* and gram negative bacterial isolates were resistance to Tetracycline (100%), Penicillin (83.3%), Ampicillin (50-100%), Doxycycline (50-100%), and Trimethoprim-sulfamethoxazole (83.3-100%). Multidrug resistance (MDR) was observed to most (60.3%) bacterial isolates.

**Conclusion:** Antimicrobial resistance including MDR was observed to a number of commonly used antibiotics, such as trimethoprim- sulfamethoxazole, penicillin groups and doxycycline. Hence, periodic monitoring of drug resistant pattern is essential for better management of CAP.

**Keywords:** CAP; Bacterial pathogens; Antimicrobial susceptibility pattern

### Introduction

Community-acquired pneumonia (CAP) affects 3–5 adults per thousand per year with a mortality of 7–14% in hospitalized patients [1]. It is associated with high mortality. About 5.6 million cases of CAP are reported in the United States each year, with an associated mortality rate of approximately 14% [2,3]. Despite the advent of potent antibiotic over the last decades, significant mortality is still associated with CAP [4]. Increased antibiotic resistance in frequently isolated bacterial pathogens from CAP patients has complicated the selection process of antimicrobial agents [5] and the clinical presentation is usually not specific enough to make a firm etiologic diagnosis [6]. The resistant strains of bacteria can quickly multiply and spread within a community where antibiotic use is common. Consequently, antibiotic resistance often results in various societal costs, including increased drug costs, additional health-service costs (such as laboratory tests and hospitalizations) and greater drug resistance-related morbidity and mortality, and productivity losses [7]. In resource limited developing countries like Ethiopia; it is wise to determine antimicrobial susceptibility pattern of bacterial pathogens. This might help for the management of the case in case of emergency and helps for the rational utilization of antimicrobial agents.

### Methods and Materials

During the period February to May 2013 a total of 170 adults (above 15 years old) with typical symptoms of the disease, such as productive cough, fever, chest pain and the presence of consolidate on the chest radiograph consistent with pneumonia was included in this study. Sputum samples were inoculated onto Blood, Mac Conkey, Manitol Salt agar (MSA) and Chocolate agar (Oxoid Ltd, UK) plates [8]. The bacterial isolates were then identified and subjected to antimicrobial susceptibility testing according to Clinical Laboratory Standards Institute (CLSI) recommendations [9,10]. The antibiotic discs used and their concentration were:- Ceftriaxone (CRO, 30 µg), Ciprofloxacin (CIP, 5 µg), Tetracycline (TE, 30 µg), Chloramphenicol (C, 30 µg), Erythromycin (E, 15 µg), Doxycycline (DO, 30 µg), Penicillin (P, 10 µg), Gentamycin (CN, 10 µg), Trimethoprim-sulfamethoxazole (TMP-SMX, 1.25+23.75 µg), Ampicillin (AMP, 10 µg) and Oxacillin (OXA, 1 µg) All antibiotic were obtained from Oxoid Limited, Basingstoke Hampshire, UK. A standard inoculum adjusted to 0.5 McFarland was swabbed on to Muller-Hinton agar (Oxoid Ltd. Basingstoke Hampshire, UK); antibiotic disc were dispensed after drying the plate for 3-5 min and incubated at 37°C for 24 hours. For *S. pneumoniae*, MHA supplied with 5% sheep blood and for *H. influenzae*, MHA chocolate agar was used. Quality control strains that were used include: *Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, and *Pseudomonas aeruginosa* ATCC 27853 [10]. Selected Socio-demographic characteristics like age and sex were obtained. Data were entered and analyzed using SPSS version

16.0 computer software. The proposal of this study was ethically approved by the Institutional Ethical Review Committee (IRC) of Arba Minch University. Permission was obtained from Medical director of Arba Minch Hospital. Written informed consent was obtained from each patient participated in the study.

## Result

A total of 170 adult patients clinically diagnosed to have CAP in Arba Minch Hospital were selected and participated in this study (Table 1). Of these, 95 (55.9%) were males and 75 (44.1%) were females.

The isolated bacteria were, *Streptococcus pneumoniae* 20 (11.8%), *Staphylococcus aureus* 18 (10.6%), *Pseudomonas aeruginosa* 12 (7.1%), *Klebsiella pneumoniae* 11 (6.5%), *Escherichia coli* 5 (2.9%), *Proteus mirabilis* 2 (1.2%), *Proteus vulgaris* 1 (0.6%) and *Haemophilus influenzae* 4 (2.4%).

Variables		Number (%)
Sex	Male	95 (55.9)
	Female	75 (44.1)
Age	15-25	23 (13.5)
	26-45	67 (39.5)
	46-65	63 (37)
	>65	17(10)

**Table 1:** Distribution of community-acquired pneumonia by sex and age (n=170)

Bacterial isolates	Drugs tested											
	No(%) resistance											
	No	CRO	CIP	TE	C	E	DO	P	CN	TMP-STX	AMP	OXA
<i>S. pneumoniae</i>	20	NA	NA	10 (50)	1 (5)	1 (5)	NA	NA	NA	1 (5)	NA	12 (60)
<i>S. aureus</i>	18	4 (22.2)	4 (22.2)	18 (100)	5 (27.8)	9 (50)	9 (50)	15 (83.3)	5 (27.8)	15 (83.3)	15 (83.3)	15 (83.3)
<i>P. aeruginosa</i>	12	1 (8.3)	1 (8.3)	NA	NA	NA	NA	NA	7 (58.3)	NA	NA	NA
<i>K. pneumoniae</i>	11	0	0	11 (100)	2 (18.2)	NA	1 (9.1)	NA	2 (18.2)	11 (100)	11 (100)	NA
<i>P. mirabilis</i>	2	1 (50)	1 (50)	2 (100)	2 (100)	NA	2 (100)	NA	2 (100)	2 (100)	2 (100)	NA
<i>P. vulgaris</i>	1	0	0	1	1	NA	1	NA	1	1	1	NA
<i>E. coli</i>	5	0	0	5 (100)	5 (100)	NA	5 (100)	NA	1 (20)	5 (100)	5 (100)	NA
<i>H. influenzae</i>	4	1 (25)	1 (25)	4 (100)	1 (25)	NA	NA	NA	NA	4 (100)	2 (50)	NA
Total	73	7 (13.2)	7 (13.2)	51(83.6)	18 (29.5)	10 (26.3)	18 (48.6)	15 (83.3)	18 (36.7)	39 (63.9)	36 (87.8)	27 (71.1)

**Note:** NA: Not applicable, CRO: Ceftriaxone, CIP: Ciprofloxacin, TE: Tetracycline, C: Chloramphenicol, E:Erythromycin, DO: Doxycycline, P: Penicillin, CN: Gentamycin, TMP- STX: Trimethoprim-sulfamethoxazole, AMP: Ampicillin and OXA: Oxacillin

**Table 2:** Drug resistance pattern of bacterial isolates from adult patients with Community-acquired pneumonia in Arba Minch Hospital, 2013

*Streptococcus pneumoniae* isolates showed relatively high resistance (60%) to Oxacillin (penicillin group representative) and all isolates were sensitive against Trimethoprim-sulfamethoxazole. High resistance rate *S. aureus* was observed to Tetracycline (100%), Oxacillin (83.3%), Ampicillin (83.3%), Penicillin (83.3%), Trimethoprim-sulfamethoxazole (83.3%), Erythromycin (50%) and Doxycycline (50%). *Pseudomonas aeruginosa* isolates showed that 50% resistant to Gentamycin. The antimicrobial testing of *K. pneumoniae* and *H. influenzae* isolates indicated that all isolates showed resistance (100%) to Tetracycline, Ampicillin and Trimethoprim-sulfamethoxazole. *Proteus* and *E. coli* isolates showed resistance to Tetracycline, Chloramphenicol, Doxycycline, Gentamycin, Ampicillin and Trimethoprim-sulfamethoxazole (Table 2).

Multidrug resistance was also observed to a number of antimicrobial agents (Table 3)

## Discussion

The importance of knowing susceptibility patterns of bacterial isolates in patients with Community-acquired pneumonia has been identified as a key step towards limiting unnecessary antibacterial prescribing and treating patients effectively, which was the main purpose of this study.

*S. pneumoniae*, which was the commonest isolate in this study, showed 60% resistant to oxacillin which is representative to penicillin group. This finding is comparable to studies conducted in USA (53%) [11] and Iran (30-57%) [12]. In this study, most tested *S. pneumoniae* isolates showed that 95% susceptible to trimethoprim-sulfamethoxazole, but studies conducted in Nigeria (100%) [13] and Kenya (54%) [14], showed high resistance rate of *S. pneumoniae* to trimethoprim-sulfamethoxazole. In addition, 95% of tested *S. pneumoniae* isolates were susceptible to chloramphenicol and erythromycin. These findings are comparable to a study conducted in Kenya (>97%) [14].

Bacterial Isolates	Resistance Antibiogram	No (%)
<i>S. pneumoniae</i>	OXA, TE	2 (10)
(n=20)	OXA, TE, C, E	1 (5)
<i>S. aureus</i> (n=18)	OXA, TE, P, AMP	2 (12.5)
	OXA, AMP, E, DO, TMP-STX	1 (6.3)
	P, TE, E, DO, TMP-STX	1 (6.3)
	OXA, AMP, TE, E, DO, TMP-STX	2 (12.5)
	OXA, AMP, P, TE, E, TMP-STX	1 (6.3)
	OXA, AMP, P, TE, DO, TMP-STX	1 (6.3)
	OXA, AMP, P, TE, DO, E, TMP-STX	1 (6.3)
	OXA, AMP, P, TE, DO, C, E, CIP, TMP-STX	1 (6.3)
	OXA, AMP, P, TE, C, E, CN, CRO, TMP-STX	2 (12.5)
	OXA, AMP, P, TE, C, E, CN, CRO, CIP, TMP-STX	4 (25)
<i>P. aeruginosa</i>	CN, CRO	2 (20)
(n=12)	CN, CRO, CIP	2 (20)
<i>K. pneumoniae</i>	AMP, TE, TMP-STX	5 (45.5)
(n=11)	AMP, TE, CRO, TMP-STX	2 (18.9)
	AMP, TE, CN, TMP-STX	2 (18.9)
	AMP, TE, C, TMP-STX	1 (12.5)
	AMP, TE, CN, CRO, TMP-STX	1 (12.5)
<i>P. mirabilis</i> (n=2)	AMP, TE, DO, C, CN, TMP-STX	1 (50)
	AMP, TE, DO, C, CN, CRO, CIP, TMP-STX	1 (50)
<i>P. vulgaris</i> (n=1)	AMP, TE, DO, C, TMP-STX	1 (100)
<i>E. coli</i> (n=5)	AMP, TE, DO, C, TMP-STX	3 (60)
	AMP, TE, DO, C, CN, TMP-STX	2 (40)
<i>H. influenzae</i> (n=4)	AMP, TE, TMP-STX	1 (33.3)
	AMP, TE, C, CIP, TMP-STX	1 (33.3)
Total (n=73)		44 (60.3)

**Table 3:** Multi-drug resistance Antibiogram of bacterial isolates from adult patients with Community-acquired pneumonia in Arba Minch Hospital, 2013

The second most causative agent *S. aureus* showed 77.8% susceptible to ceftriaxone and ciprofloxacin, and 72.2% to gentamycin and chloramphenicol. This result is comparable to studies conducted in Ibadan, Nigeria (66.7% ciprofloxacin and 66.7% gentamycin) [13] and Benin City, Nigeria (66.7% ceftriaxone, 66.7% ciprofloxacin, and 66.7% chloramphenicol) [15]. In addition 83.3% of tested *S. aureus* showed resistance to penicillin, ampicillin, oxacillin and trimethoprim-sulfamethoxazole; which is comparable to studies conducted China (88.7% resistance to penicillin) [16] and Nigeria

(resistance rate of 66.7% for penicillin) [13], but lower than study conducted in Nigeria (100% for trimethoprim-sulfamethoxazole) [13].

Most of tested gram negative bacilli isolates were sensitive (90%) to ceftriaxone and ciprofloxacin. These findings are comparable to studies conducted in Benin City, Nigeria (66-100%) [15] and Ibadan, Nigeria (60-100%) [13]. Majority of gram negative bacilli was resistance (100%) to tetracycline, chloramphenicol, doxycycline (except *K. Pneumoniae*, 90% susceptible), trimethoprim-sulfamethoxazole and ampicillin. Similar study conducted in Nigeria (60-100%) [15], supports these findings. The commonest causative agent among gram negative bacilli, *P. aeruginosa*, showed 58.3% resistance to gentamycin, which is comparable to study conducted in Nigeria (53.6%) [13]. However, it showed low resistance (8.3%) to ceftriaxone and ciprofloxacin; but study conducted in Nigeria (39.3% resistance for ciprofloxacin) [13], showed high resistance. *K. pneumoniae* and *E. coli* showed 100% resistance to tetracycline, ampicillin and trimethoprim-sulfamethoxazole. These findings are comparable to studies conducted in Benin City, Nigeria (100% resistance to tetracycline) [15] and Ibadan, Nigeria (100% resistance to trimethoprim-sulfamethoxazole) [13]. All tested *Proteus* species isolates were resistance (100%) to doxycycline, tetracycline, and ampicillin and trimethoprim-sulfamethoxazole. These findings are comparable to study conducted in Ibadan, Nigeria (100% resistance to trimethoprim-sulfamethoxazole) [13].

All *H. influenzae* isolates tested for antimicrobial sensitivity showed low resistance (25%) to ceftriaxone, ciprofloxacin and chloramphenicol. These findings are comparable to study conducted in Nigeria (chloramphenicol 30.3% and ciprofloxacin 26.1%) [13]. In most of tested *H. influenzae* isolates, high resistance rate to tetracycline (100%), ampicillin (50%) and trimethoprim-sulfamethoxazole (100%) were observed. These findings are similar with studies conducted in USA (47% resistance to ampicillin) [17] and Nigeria (93.7% resistance to trimethoprim-sulfamethoxazole) [13], but is not as high as that observed in other countries such as in China (>90% susceptibility to most antibiotics) [16]. The differences in antibiotic resistance patterns may be due to variations in the antibiotic prescribing habits in different geographical regions.

## Conclusion

In the present study, most bacterial isolates were susceptible to ceftriaxone and ciprofloxacin. However, antimicrobial resistance including Multidrug resistance was observed to a number of commonly used antibiotics, such as trimethoprim-sulfamethoxazole, penicillin group and doxycycline. Hence, it is important to periodically monitor the antibiotic resistance patterns to aid physicians to choose empirical treatments for better management of CAP.

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