

Prevalence and Antibiotic Susceptibility Pattern of Bacterial Agents Involved In Lower Respiratory Tract Infections in Abeokuta, Ogun State, Nigeria

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ABSTRACT: This study determined the prevalence and antibiotic susceptibility of bacterial agents involved in lower respiratory tract infections in patients in Abeokuta metropolis between June-December, 2011. Out of the 165 sputum samples, 40(24.24%) were positive for bacterial cultures. The result shows that LRTI were more prevalent in males than in females. Among the isolates, *Klebsiella pneumoniae* 28(70.0%) was the most isolated organism, *Streptococcus pneumoniae* 7(17.5%) was next, followed by *Escherichia coli* 3(7.5%) and *Pseudomonas aeruginosa* 2(5.0%). Age group 31-40 years had the highest prevalence 9(22.5%) of LRTI while, age group 11-20 and 61-70 years had the least 2(5.0%). The result of the sensitivity test indicates that Gram-positive and Gram negative isolates showed highest sensitivity to Ceftazidime, Levofloxacin, Augmentin and Ceftriaxone, while high resistance was recorded for antibiotics such as Ampicillin, Amoxicillin, Cloxacillin, and Cotrimoxazole. This observation poses a serious public health problem.

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1. INTRODUCTION

- 1) Lower respiratory tract infections (LRTIs) are among the most common infectious diseases affecting humans worldwide (Carroll, 2002). They are important causes of morbidity and mortality for all age groups, and each year approximately 7 million people die as a direct consequence of acute and chronic respiratory infections (Ozyilmaz et al, 2005). Acute respiratory infections (ARI) and Tuberculosis were two of the six leading causes of death across all ages (World Health Organization, 2003). Out of the total acute respiratory diseases, 20–24% of all deaths are accounted for by Lower Respiratory Tract infection (LRTI) (Gauchen et al., 2006).
- 2) It is notable that respiratory tract infections cause more disease and death than other infections in the United States, and there has been reported little change in mortality for more than five decades (Mizgerd, 2008). In Nigeria, LRTIs continue to be the major cause of morbidity (Egbagbe EE, Mordi, 2006). Age, gender, and season are factors that have been implicated to affect the prevalence of LRTIs (Erling, 1999). Respiratory tract infections impose a serious economic burden on society,

ranging from reduced output in workplaces to frequent prescription by physicians of antibiotics, even when the causative agents of infection is not bacteria (Jafari *et al.*, 2009). The causative agents of community acquired lower respiratory tract infections are not well recognized, although it is traditionally taught that most are caused by viruses and atypical pathogens (Gauchan *et al.*, 2006).

- 3) A better understanding of the pathogens that cause these infections is recognized as a requirement which should allow a logical approach to treatment (Creer *et al.*, 2006). There is the need, particularly in developing countries like Nigeria, for timely diagnosis of the major microbial causes of the respiratory infections in the community, and the administration of appropriate therapy based on the antibiotic susceptibility test of the causative agent in order to prevent further spread of the pathogen, which might otherwise lead to complications (Gauchan *et al.*, 2006). However, in recent years, there has been a dramatic

rise in antibiotic resistance among respiratory pathogens (Imani *et al.*, 2007). For instance, antibiotic resistance of Pneumococci to penicillin in the US before 1987 was < 1%, but, in 1997, the overall resistance was put at 48.8% (Imani *et al.*, 2007). The consequences of increased drug resistance are far reaching since bacterial infection of lower respiratory tract is a major cause of death due to infectious disease (Kumari *et al.*, 2007). Current knowledge of the organisms that cause LRTIs and their antibiotic susceptibility profiles are therefore necessary for the prescription of appropriate therapy.

- 4) This study was conducted to determine the prevalence of lower respiratory tract infections in patients attending Federal Medical Centre in Abeokuta Ogun State, Nigeria, as well as to have knowledge of the current antimicrobials sensitive to LRTI pathogens.

2. MATERIALS AND METHODS

2.1. Study Population

The study was conducted on 165 patients attending Federal Medical Centre Abeokuta, Ogun State, Nigeria, between June and December, 2011.

2.2. Sample collection

Samples of sputum for bacteriological culture examination were collected after informed consent from patients presenting with LRTI (as defined by a new or increasing cough, productive sputum, chest pain, fever, anorexia, haemoptysis, headache and weight loss) into wide-mouthed sterile containers and transported to the laboratory.

2.3. Bacteriological Analysis

Before culture, Gram-stained smear of every specimen was first examined microscopically. The pathogens were isolated using suitable bacteriological media such as MacConkey Agar, Blood Agar and Chocolate Agar (Collee *et al.*, 1996). Samples that showed pure growth of isolate in a count of $\geq 10^5$ cfu/ml of specimen after overnight incubation (at 37°C for 18-24 hours) were identified microbiologically according to standard laboratory and biochemical method (Cheesbrough, 2004; Reisner *et al.*, 1999).

2.4 Antibiotic susceptibility Testing

Antibiotic susceptibility was determined by the agar diffusion technique as described by Baker and Breach (1980). Isolates were considered as sensitive or resistant to an antibiotic according to the diameter of inhibition zone size interpretative

chart (Clinical and Laboratory Standard Institute, 2006).

3. RESULTS ANALYSIS

Out of the 165 sputum samples, 40(24.24%) were positive for bacterial cultures. Table 1 show the prevalence of LRTI among age group. Age group 31-40 years had the highest prevalence 9(22.5%) of LRTI while, age group 11-20 and 61-70 years had the least 2(5%).

Table 1: The prevalence of LRTI among age group

Age group (Years)	Number of patients	No. Positive	Percentage (%)
0-10	10	3	7.5
11-20	13	2	5.0
21-30	36	7	17.5
31-40	35	9	22.5
41-50	29	6	15.0
51-60	18	5	12.5
61-70	12	2	5.0
71-80	12	6	15.0
Total	165	40	100.0

Table 2 shows the prevalence of LRTI by Gender. Out of 67 males enrolled in this study, 17 (25.37%) were positive for LRTI, while a total of 98 females enrolled gave 23(23.47%) LRTI. The result shows that LRTI were more prevalent in males than in females.

Table 2: Prevalence of lower respiratory tract infections by Gender

Gender	Number examined	Number with positive growth	Percentage (%)
Female	98	23	23.5
Male	67	17	25.4
Total	165	40	24.2

Among the isolates, *Klebsiella pneumoniae* 28(70.0%) was the most isolated organism, *Streptococcus pneumoniae* 7(17.5%) was next, followed by *Escherichia coli* 3(7.5%) and *Pseudomonas aeruginosa* 2(5.0%) as shown in Table 3.

Table 3: Bacterial agents in lower respiratory tract infections

Bacteria	Males (%)	Females (%)	Total (%)
<i>S. pneumoniae</i>	3(42.9)	4(57.1)	7(17.5)
<i>Klebsiella sp</i>	12(42.9)	16(57.1)	28(70.0)
<i>Escherichia coli</i>	1(33.3)	2(66.7)	3(7.5)
<i>P. aeruginosa</i>	1(50.0)	1(50.0)	2(5.0)
Total	17(42.5)	23(57.5)	40(100.0)

The antibiotic sensitivity pattern of the isolates is shown in Tables 4. The most effective antibiotic for *K. pneumoniae* was Ceftazidime 24(85.7%), followed by Gentamycin 23(82.1%), Augmentin and Ofloxacin 19(67.9%) while high resistance was recorded for Amoxicillin, Cloxacillin and Ampicillin. For *P. aeruginosa*, the most effective antibiotics were Ceftazidime, Cefuroxime and Levofloxacin while 100.0% resistance was recorded for antibiotics such as Ampicillin, Amoxicillin, Cloxacillin and Cotrimoxazole. The most effective antibiotic for *E. coli* are Ciprofloxacin and Levofloxacin (66.7%), while 100.0% resistance was recorded for Ampicillin, Amoxicillin, Cefuroxime, Cloxacillin, Cotrimoxazole, Erythromycin and Tetracycline. Augmentin, Cefuroxime, Ceftazidime and Levofloxacin were the most effective antibiotic for *S. pneumoniae*, while the organism was resistant to Ampicillin (71.4%).

Table 4: Antibiotics Susceptibility patterns of lower respiratory tract infections

Isolates	No.		Antibiotics pattern (%)														
			AMP 10µg	AMX 25µg	AUG 10µg	CEF 30µg	CAZ 30µg	CXM 30µg	CIP 5µg	CXC 5µg	COT 25µg	ERY 15µg	GEN 10µg	LEV 5µg	OFL 5µg	STR 10µg	TET 30µg
<i>Klebs sp</i>	28(70.0)	S	5(17.9)	2(7.1)	19(67.9)	17(60.7)	24(85.7)	14(50)	19(67.9)	2(7.1)	2(7.1)	17(60.7)	23(82.1)	21(75)	19(67.9)	19(67.9)	17(60.7)
		R	23(82.1)	26(92.9)	9(32.1)	11(39.3)	4(15.3)	14(50.0)	9(32.1)	26(92.9)	26(92.9)	11(39.3)	5(17.9)	7(25.0)	9(32.1)	9(32.1)	11(39.3)
<i>S. pneum</i>	7(17.5)	S	2(28.6)	3(42.9)	7(100.0)	7(100.0)	7(100.0)	4(57.1)	6(85.7)	3(42.9)	3(42.9)	3(42.9)	7(100.0)	7(100.0)	3(42.9)	5(71.4)	4(57.1)
		R	5(71.4)	4(57.1)	0(0.0)	0(0.0)	0(0.0)	3(42.9)	1(14.3)	4(57.1)	4(57.1)	4(57.1)	0(0.0)	0(0.0)	4(57.1)	2(28.6)	3(42.9)
<i>E. coli</i>	3(7.5)	S	0(0.0)	0(0.0)	1(33.3)	1(33.3)	1(33.3)	0(0)	2(66.7)	0(0.0)	0(0.0)	0(0.0)	1(33.3)	2(66.7)	1(33.3)	1(33.3)	0(0.0)
		R	3(100.0)	3(100.0)	2(66.7)	2(66.7)	2(66.7)	3(100)	1(33.3)	3(100.0)	3(100.0)	3(100.0)	2(66.7)	1(33.3)	2(66.7)	2(66.7)	3(100.0)
<i>Pseudo sp</i>	2(5.0)	S	0(0.0)	0(0.0)	1(50.0)	1(50.0)	2(100.0)	2(100)	1(50.0)	0(0.0)	0(0.0)	1(50.0)	1(50.0)	2(100.0)	1(50.0)	1(50.0)	1(50.0)
		R	2(100.0)	2(100.0)	1(50.0)	1(50.0)	0(0.0)	0(0.0)	1(50.0)	2(100.0)	2(100.0)	1(50.0)	2(100.0)	0(0.0)	1(50.0)	1(50.0)	1(50.0)
Overall	40(100.0)	R	33(82.5)	35(87.5)	13(32.5)	14(35.0)	6(15.0)	20(50.0)	12(30.0)	35(87.5)	35(87.5)	19(47.5)	10(25.0)	9(22.5)	16(40.0)	15(37.5)	18(45.0)
		S	7(17.5)	5(12.5)	27(67.5)	26(65.0)	34(85.0)	20(50.0)	28(70.0)	5(12.5)	5(12.5)	21(52.5)	30(75.0)	31(77.5)	24(60.0)	25(62.5)	22(55.0)

Data are expressed in number of susceptible isolates (percentage susceptibility).

Abbreviations: OFL = Ofloxacin, CIP = Ciprofloxacin, GEN = Gentamycin, TET = Tetracycline, AUG=amoxicillin/clavulanate, COT = Cotrimoxazole, CXC = Cloxacillin, CXM = Cefuroxime, ERY = Erythromycin, CAZ = Ceftazidime, AMP= Ampicillin, Amx= Amoxicillin, STR=Streptomycin, CXM= Cefuroxime, CEF=Ceftriaxone, LEV= Levofloxacin.

4. DISCUSSION

Out of 165 sputum samples analyzed, 40(24.2%) were positive for cultures leaving a greater negative result of 125(75.76%). This finding is similar to studies carried out by Hosker (1994) and Gauchan et al. (2006), who also reported negative result of 60.0% and 56.4% respectively. This negative result may be attributed to viral or other etiological agents (Gauchan et al., 2006). In this study, 25.37% males were positive for LRTI, while 23.47% females were positive for LRTI.

The result shows that LRTI were more prevalent in males than in females. Humphrey et al. (2010), in their study of prevalence of pneumonia and lower respiratory tract infection, reported a high prevalence in males than females. According to Doddann-navar (1885) as reported by Gauchan et al. (2006), the reason for the high risk in males of LRTI is attributable to decreased local immunity in the respiratory tract due to

smoking, use of tobacco, alcohol consumption etc.

Out of the 40 bacterial isolates, Gram-negative organisms were the highest of the isolates, accounting for 33(82.5%), while Gram-negative had 7(17.5%). This findings correlates well with earlier study that reported Gram-negative bacteria isolates to be higher than Gram positive bacterial isolates (Suyami and Shrestha, 1995; Gauchan et al., 2006). Among the bacterial isolates, *K. pneumoniae* 28(70%) was the most common isolate followed by *S. pneumoniae* 7(17.5%), *Escherichia coli* 3(7.5%) and *P. aeruginosa* 2(5%). *S. pneumoniae* was the only Gram positive isolate obtained in this study whereas *K. pneumoniae* was predominant of Gram-negative isolate. The finding in this work was in contrast to the study of Gauchan et al. (2006) and Jafari et al. (2009) who reported *Klebsiella* sp as the second predominant Gram negative bacterial isolates. In a study carried out by Dorobat et al. (2007) on the incidence and resistance pattern of pathogens from LRTIs; *Haemophilus influenzae* (34.65%) was the most prevalent Gram negative organism followed by *Pseudomonas aeruginosa* (17.7%), *H. parainfluenza* (15.9%) and *K. pneumoniae* (8.6%).

The prevalent Gram positive isolate was *Staphylococcus aureus* (54.1%), followed by *S. pneumoniae* (45.9%). Jafari et al. (2009) identified *Pseudomonas* sp 52(27.6%) as the most prevalent bacterial isolate while *Klebsiella* sp 30(16%) ranked third. Shailaja et al. (2004) had earlier reported *K. pneumoniae* (32.26%) as the most prevalent bacterial isolate followed by *S. pneumoniae* (25.81%). They identified risk or susceptibility to infections with encapsulated organisms such as *S. pneumoniae* to be highest. The differences observed in the prevalence of bacterial isolates in studies elsewhere is attributable to age, season, the type of population at risk, and other factors (Collee and Watt, 1990).

The sensitivity tests indicated that the isolates were resistant to one or more antibiotics, although generally, a low percentage of the isolates were sensitive to the antibiotic tested. The result of the sensitivity test indicates that Gram-positive and Gram negative isolates showed highest sensitivity to Ceftazidime, Levoxin, Augmentin and Ceftraxone, while high resistance was also recorded for antibiotics such as Ampicillin, Amoxicillin, Cloxacillin, and Cotrimoxazole. This observation poses a serious public health problem. The pattern of antibiotic resistance recorded in this study among *P. aeruginosa*, *K. pneumoniae* and *E. coli* isolates is consistent with results obtained from other developing countries (Gauchan et al., 2006; Kumari et al., 2007). Although *P. aeruginosa* has been shown to be resistant to many

antimicrobial agents, Levoxin was shown to be the most potent quinolone against the pathogen in this study which is not in consistent with earlier report of Walker, 1999, that reported Ciprofloxacin as the most potent quinolone against the pathogen.

Resistance to ampicillin and cloxacillin by respiratory tract pathogens in this study is of concern. This implies that these drugs are no longer feasible in the treatment of most bacterial infections. Imani et al. (2007) reported a 100% resistance of *H. influenza* and *Moraxella catarrhalis* to ampicillin, while *S. Pneumoniae* showed 94.1% resistance. Frequent prescription by physicians of antibiotics, even when the causative agents of infection is not clear (Jafari et al., 2009) further aggravates the problem of antibiotic resistance. The use of suboptimal and long duration regimens in the case of *S. pneumoniae* increases the opportunity for acquisition and/or amplification of resistant strains (Gauchan et al., 2006).

5. CONCLUSION

The level of antibiotic resistance observed in this study is a serious public health problem and hence, brings to light the need for timely and proper diagnosis of the major microbial causes of the respiratory infections, in order to administer the appropriate therapy based on antibiotic susceptibility test of the causative agent. This study revealed that there has not been any significant change in the pattern of bacterial pathogens involved in LRTI. Mass literacy campaign on the need to seek medical attention when necessary and judicious use of antibiotics is thus recommended in order check out for the emergence of drug resistance pathogens. There is also the need for further studies on antibiotic resistance using different antibiotic with a view to identifying one with which LRTI pathogens are almost 100.0% susceptible to.

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