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ORIGINAL ARTICLES

Community acquired pneumonia in Port Harcourt Rivers State of Nigeria

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Abstract

Background: Community acquired pneumonia (CAP) is a major cause of death world wide. Knowledge of the likely pathogens and their sensitivity/resistance pattern can help in the choice of antibiotic therapy and improve outcome.
Objective: To identify the seasonal variation; age and sex distribution; bacteriology; antimicrobial sensitivity pattern of isolates; haematological data; radiology and clinicaloutcome of community-acquired pneumonia (CAP) in adult patients admitted to hospital in Port Harcourt, Nigeria.
Design: Prospective study.
Setting: University of Port Harcourt Teaching Hospital, and Braithwaite Memorial Hospital, Port Harcourt, Rivers State.
Patients: Adults admitted to the hospitals with CAP between 1 May 2002, and 30 April 2003.
Interventions: A diagnostic strategy using regular collection of sputum samples for gram stain, bacteriological culture and chest radiography were done. Blood cultures were done in severe cases. Antibiotic sensitivity testing was done on the positive cultures.
Results: During a 12 month period, 54 patients aged 16 to 82 years (mean 38.1 years) were evaluated. A total of 944 medical admissions were seen during the same period. This gives a prevalence rate of 5.7%. Twenty six classes of bacteria were isolated from the sputum of 23 patients (yield, 42.6%). *Streptococcus pneumoniae*, the most common pathogen, was isolated in nine cases (34.6%), followed by *Klebsiella pneumoniae* which was present in eight (30.8%). Other isolates included, *Escherichia coli*, four cases (15.4%), *Pseudomonas aeruginosa*, three cases (11.5%), and *Staphylococcus aureus*, two cases (7.7%). The commonest radiological pattern was lobar consolidation (49.9%) with no Distinct pattern associated with any conventional bacterial pathogen. The isolates showed good sensitivity to the newer and more expensive antibiotics (quinolines and cephalosporines) with marked resistance to the older and cheaper ones. However, clinical responses to benzyl penicillin and gentamycin were found to be good. Out of 54 patients evaluated, four (7.4%) died.
Conclusion: *Streptococcus pneumoniae* and *Klebsiella* were common aetiological organisms of CAP in Port Harcourt. Treatment of CAP with benzyl penicillin remains an appropriate first line choice in this environment while the more expensive quinolines and cephalosporines can be used as backups.

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Introduction

Community-acquired pneumonia (CAP) remains a leading cause of death in both developing and developed countries. Furthermore it may continue to represent an important threat to patients in future as the number of patients at risk (elderly people and those with comorbid conditions) increase.[1] Estimates of annual incidence vary between 1% and 12%.[2] In the USA, four million episodes are reported annually, with 64 million days of restricted activity, 39 million days of bed confinement and 10 million days of work loss, with

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billions on dollars spent annually caring for the patients.[1] Though data on prevalence-based burden of illness study is lacking in Africa, the situation may not be different.

The World Health Organization (WHO) estimates that respiratory tract infections in general are responsible for more than four million deaths worldwide each year with over one million occurring in sub-Saharan Africa.[3] In six black African countries, pneumonias were the commonest respiratory disease requiring medical admissions.[4]

Community and hospital based studies have identified bacteria as the predominant cause of pneumonia in adults with *Streptococcus pneumoniae* being responsible in as many as two third cases. Other common causative organisms are *Haemophilus influenzae; Mycoplasma pneumoniae; Staphylococcus aureus; Streptococcus pyogenes; Neisseria meningitides* and other gram-negative rods.

The therapeutic treatment of these respiratory infections has continued to present serious medical and public health problems because of the ease with which these organisms acquire resistance to antibiotics.[1,2] At the same time, early institution of antimicrobial therapy is associated with improvement in morbidity and mortality.[6] It is therefore necessary to identify the common causative organisms of CAP in ones locality and identify their antimicrobial susceptibility as this will be a major guide to early management, especially in health centres in rural areas and private clinics where facilities for proper investigation are non-existent.

In Port Harcourt, the capital of Rivers State which is a major city in a densely populated Niger Delta region, there are no published studies on the aetiology of CAP and the possible first line antibiotic susceptibility. This study was, therefore, undertaken for that purpose.

Materials and Methods

This study was carried out at the University of Port Harcourt Teaching Hospital (UPTH), a tertiary Federal institution and the Braithwaite Memorial Specialist Hospital (BMH) owned by the Rivers State Government. Both hospitals are located in Port Harcourt, and serve as referral hospitals for Rivers State and other adjoining states of the Niger Delta region which include Bayelsa, Delta, Abia, Imo and Akwa Ibom. Ethical approval for the study was obtained from the ethics committees of the two hospitals. Informed consent was obtained from the patients.

All patients aged 15 years and above admitted into the casualty wards and the medical wards of UPTH and BMH with a provisional diagnosis of pneumonia between 1 May 2002 and 30 April 2003 were evaluated for inclusion. Symptoms would have been present for not more than 14 days prior to presentation and should consist of at least two of the respiratory symptoms of cough with or without sputum production; breathlessness; chest pain; haemoptosis and fever. In addition, there should be radiological evidence of consolidation on posterior-anterior and/or lateral chest radiograph.

Patients whose illness had lasted for more than 14 days or those who developed pneumonia while on admission in the medical wards for some other condition or who refused to give consent were excluded. Cases of chronic obstructive pulmonary disease (COPD), pulmonary tuberculosis or human immunodeficiency virus (HIV) infection were also excluded.

Patients with productive cough were asked to produce the sputum samples in the mornings, before meals, or not less than one hour after their last meal and after rinsing the mouth with water.

Sputum cultures were done on blood agar, chocolate agar and MacConkey agar and incubated aerobically at 37° C for 18 to 24 hours. Sensitivity testing was done using disc diffusion methods with commonly available antibiotics. Following overnight incubation, the culture was examined for areas of no growth around the discs (zone of inhibition). The antimicrobial sensitivity pattern for the different bacterial isolates were documented.

Patients adjudged to have severe disease at presentation respiratory rate more than 30/min, confusion, hypotension and multilobar involvement on chest radiograph, had two 10ml of venous blood withdrawn from two different venopuncture sites for blood culture, in addition to sputum examination. Such samples were collected within 24 hours of presentation and cultured aerobically in thioglycollate broth and anaerobically in typticase soy broth for seven days.

Patients with pleural effusion demonstrated clinically and or radiologically had percutaneous trans-thoracic pleural aspiration done using 21G needle. The aspirate was sent for microscopy (Gram's stain) and was cultured on blood, Mac Conkey and agar plates.

All patients at presentation had 5mls of blood obtained for full blood count and erythrocyte sedimentation rate estimation.

Statistical Methods: All data obtained were entered into a prepared questionnaire and analyzed using the statistical package, Epi-Info version 6, produced by the WHO in collaboration with the Centre for Diseases Control and Prevention. Mean, standard deviation, analysis of variance, tables and figures were used where appropriate.

Results

Fifty four episodes of confirmed community-acquired pneumonia were studied. One patient was admitted twice in the course of the study, with each episode treated independently. A total of 944 medical admissions were seen during the period. This gives a prevalence rate of 5.7%.

Month of Presentation.
The highest number of monthly admission was noticed in March, with 10 cases (18.5%) seen. The least number of admissions were in the months of September and December one case each. No admission was recorded for the month of November. Thirty eight of the admissions were between February and June (70.4%). Table I shows the months of presentation.

Table I: Cases of CAP according to month presentation.

Month of Presentation	No. of Cases (%)
January	2 (3.7)
February	7 (912.9)
March	10 (18.5)
April	8 (14.8)
May	5 (14.8)
June	3 (9.2)
July	5 (5.5)
August	5 (9.2)
September	1 (1.8)
October	4 (7.4)
December	1 (1.9)
Total	**54**

Age and Sex.
The age of the patients ranged from 16 to 82 years with a mean of 38.1 (SD.17.62) years. The peak age groups were 20 to 29 years.(42.6%).
There were 30 males (55.6%) and 24 females (44.4%), giving a male: female ratio of 1.3:1.
Table II shows the age and sex distribution of the patients.

Table II: Age-sex distribution of patients.

Age Group (Years)	Males	Females	Total (%)
10-19	2	3	7 (12.9)
20-29	13	10	10 (18.5)
30-39	2	2	8 (14.8)
40-49	5	2	5 (14.8)
50-59	3	2	3 (9.2)
60-69	4	3	5 (5.5)
70-79	1	1	5 (9.2)
80-89	0	1	1 (1.8)
Total	**30 (55.6%)**	**24 (44.4%)**	**54**

Haematology.
Twenty one patients (38.9%) had haemoglobin concentration in the range of 10 to11.9 gm/dl while 24 patients (44.5%) and nine patients (16.6%) had haemoglobin concentrations less than 10 g/dl and above 12 g/dl respectively. The mean haemoglobin concentration for females was 9.1 g/dl (SD 1.64) with a range of 6.5 to 13 g/dl and for males; the mean concentration was 11.2 g/dl (SD 2.03) with a range of 7.6 to 16 g/dl. There was significant difference in the haemoglobin values of males and females (p value=0.0015).
Table III shows the haemoglobin profile of the patients.

Table III: Haemoglobin profile of the patients.

Hb (gm/dl)	Males	Females	Total (%)
6.5 - 7.9	1	6	7 (12.9)
8.0 - 9.9	6	11	17 (31.6)
10 - 11.9	16	5	21 (38.9)
12 - 13.9	5	2	7 (12.9)
>14	2	0	2 (3.7)
Total	**30**	**24**	**54**

The mean total white cell count of the patients was 8.5 x $10^{9/L}$ (SD 3,8 x $10^{9/L}$) with a range of 2.2 to 16.7 x $10^{9/L}$.
The mean neutrophil count was 66.7% (SD 14.8) with a range of 24 to 90%, while the mean lymphocyte count was 32.8% (SD 14) with a range of 10 to 72%.
The mean erythrocyte sedimentation rate obtained for 50 patients was 64.6mm/hr (SD 50.3). The results of four patients could not be traced.
Table IV showed the distribution of the total white cell count.

Table IV: Distribution of total white cell count (wbc).

wbc ($x10^9$)	Total (%)
2 - 3.9	6 (11.2)
4 - 11.0	38 (70.3)
11.1 - 18.0	10 (18.5)
Total	**54**

Radiology.
Chest radiograph done at presentation showed that 27 patients (49.9%) had lobar consolidation, 10 (18.5%) had multiple lobes involvement and 17 (31.6%) had patchy (bronchopneumonic) consolidation.
Table V shows the frequency of the radiographic consolidations.

Table V: Radiological in the patients.

Radiographic consolidation	No. of Cases (%)
Lobar	27 (50%)
Multiple lobes	10 (18.5)
Patchy	17 (31.5)
Total	**54 (100)**

Bacteriology.

Sputum culture specimens were obtained in the 54 patients evaluated. Of the 54 patients, 31 (57.4%) had no identifiable microbial agent isolated. In the 23 patients with identifiable pathogens, *Strep. pneumoniae* was the predominant pathogen isolated (34.6%). Three of these patients had mixed infection, with *Strep. pneumoniae* and *Klebsiella pneumoniae* isolated in two patients, and *Strep. pneumoniae* and *P. aeruginosa* isolated in one patient.

Table VI shows the organisms isolated from sputum, including mixed infection.

Table VI: Organisms cultured from the sputum of patients.

Organisms cultured	No. of isolates (%)
S. pneumoniae	9 (34.6)
K. pneumoniae	8 (30.8)
E. coli	4 (15.4)
Pseudomonas aeruginosa	3 (11.5)
S. aureus	2 (7.7)
Total	**26 (100)**

Table VII: Antimicrobial susceptibility pattern of the individual bacterial isolates (including mixed infections).

Bacterial isolates	No. of strains tested	Cipro	Amp	Strep	Clox	Amy	Amc	Cefz	Ceft	Chlo	Ery	Gen	Oflo	Pen	Pet	Tet	Cot	Cef
E. Coli	4	3 (75)	0	2 (50)	1 (25)	0	0	3 (75)	3 (75)	0	2 (50)	4 (400)	3 (75)	0	1 (25)	1 (25)	1 (25)	2 (50)
K. Pneumoniae	8	6 (75)	1 (12.5)	2 (25)	2 (12.5)	0	3 (37.5)	4 (50)	4 (50)	2 (25)	2 (25)	7 (87.5)	5 (62.5)	0	2 (25)	2 (25)	0	7 (87.5)
P. Aeruginosa	3	3 (100)	0	1 (33.3)	0	0	1 (33.3)	1 (33.3)	3 (100)	0	0	3 (100)	3 (100)	0	0	0	0	1 (33.3)
S. Peumoniae	9	1 (11.1)	3 (33.3)	0	2 (22.2)	3 (33.3)	4 (44.4)	5 (55.6)	5 (55.6)	6 (66.7	6 (66.7)	2 (22.2)	8 (88.9)	3 (33.3)	1 (11.1)	1 (11.1)	0	8 (88.9)
S. Aureus	2	1 (50)	0	0	1 (50)	0	2 (100)	2 (100)	2 (100)	1 (50)	2 (100)	0	1 (50)	0	0	0	0	1 (50)

Keys

Cipro - Ciprofloxacin	Clox - Cloxacillin	Cefz - Ceftzidime	Ery - Erythromycin	Pen - Penicillin	Cot - Cotrimoxazole
Amp - Ampicilin	Amx - Amoxyllin	Ceft - Ceftriaxone	Gen - Gentamycin	Pef - Pefloxacin	Cef - Cefuroxime
Strep - Streptomycin	Amc - Amoxyllin/ Clavulanate	Chlo- Chloramphenicol	Oflo - Ofloxacin	Tet - Tetracycline	

All the four isolates (100%) of *E. Coli* were sensitive to gentamycin (Table VII), 3 (75%) to ciprofloxacin, ceftazidime, ceftriaxone and ofloxacin, two (50%) to cefuroxime and streptomycin. A single isolate was sensitive to pefloxacin, tetracycline, co-trimoxazole and cloxacillin. There were no isolates sensitive to ampicillin, amoxicillin, amoxicillin/clavulanate, chloramphenicol and penicillin G.

Seven (87.5%) of the eight isolates of *Klebsiella pneumoniae* were sensitive to gentamycin and cefuroxime, six (75%) to ciprofloxacin, five (62.5%) to ofloxacin, and four (50%) to ceftazimide. Two isolates were sensitive to streptomycin, chloramphenicol, erythromycin, pefloxacin and tetracycline, while one isolate was sensitive to ampicillin and cloxacillin. All isolates were resistant to amoxicillin/Clavulanate. For *P. aeruginosa*, all three isolates were sensitive to ciprofloxacin, ceftriaxone, gentamycin and ofloxacin, with no isolate sensitive to ampicillin, cloxacillin, amoxicillin, chloramphenicol, erythromycin, penicillin G, pefloxacin, tetracycline and cotrimoxazole.

Out of the nine isolates of *Strep. Pneumoniae* tested, eight (88.9%) were sensitive to cefuroxime and ofloxacin, six (66.7%) were sensitive to chloramphenicol and erythromycin and five (55.6%) to ceftriaxone and ceftazimide. All were resistant to amoxicillin/clavulanate, amoxicillin, ampicillin, penicillin G, cloxacillin, gentamycin, ciprofloxacin, pefloxacin, tetracycline streptomycin and cotrimoxazole.

All two isolates of *Staphylococcus aureus* were sensitive to amoxicillin-clavulanate, ceftazidime, ceftriaxone and erythromycin. A single isolate was sensitive to ciprofloxacin, cloxacillin, chloramphenicol, ofloxacin and cefuroxime. No isolate was sensitive to ampicillin, streptomycin, amoxicillin, gentamycin, penicillin G, pefloxacin, tetracycline and co-trimoxazole.

Table VIII: Susceptibility of the total (26%) bacterial isolates to the individual anti microbial agents.

Antimicrobial agents	No. of sensitive isolates %
Ofloxacin	20 (77)
Cefuroxime	19 (73.2)
Ceftriaxone	16 (61.6)
Gentamycin	16 (61.6)
Ceftazimide	15 (57.8)
Ciprofloxacin	14 (53.8)
Erythomycin	12 (46.2)
Amoxicillin/Clavulanate	10 (38.5)
Chloramphenicol	9 (38.5)
Streptomycin	5 (19.3)
Ampicilin	4 (15.4)
Cloxacillin	4 (15.4)
Tetracycline	4 (15.4)
Amoxillin	3 (11.6)
Penicillin	3 (11.6)
Pefloxacin	3 (11.6)
Cotrimoxazole	1 (3.9)

Combining the results of the antimicrobial sensitivity of the 26 bacterial isolates tested showed that 20 (77%) of the isolates were sensitive to ofloxacin; 19 (73.2%) to cefuroxime; 16 (61.6%) to ceftriaxone and gentamycin; 15 (57.8%) to ceftazidime; 14 (53.8%) to ciprofloxacin (Table VIII). Only one isolate (3.9%) showed sensitivity to co-trimoxazole with three (11.6%) sensitive to penicillin G, amoxicillin, pefloxacin, four (15.4%) to ampicillin, cloxacillin, tetracycline, five (19.3%) to streptomycin, nine (38.5%) to chloramphenicol and 10 (34.7%) to amoxicillin/clavulanate.

None of the blood cultures isolated any pathogens after seven days of incubation.

There were eleven (20.4%) patients with pleural effusions (one empyema and 10 serous effusions). No pathogen was isolated from the culture of the effusions.

Clinical Outcome

All patients at presentation were started empirically on Benzylpenicillin. Those who did not show clinical improvement after 72 hours were changed to another antimicrobial agent, based on the result of the sputum examination. Of the 54 patients seen in this study, one absconded, four (7.4%) died, 40 (74.1%) were well and were discharged, while nine (16.7%) were still symptomatic three weeks after admission. Table IX.

Table IX: Clinical outcome three weeks following admission.

Outcome	No. of patients (%)
Absconded	1 (1.8)
Died	4 (7.4)
Discharged	40 (74.1)
Still symptomatic	9 (16.7)
Total	**54**

Discussion

The admission rate of patients in the study was twice as high at the end of the dry season as in the middle of the rainy season. This seasonal variation is similar to that reported in Zambia[7] and Ethiopia[8] but slightly different from that reported in Northern Nigeria[9,10] where most of the patients were present during the dry season and the dusty cold harmattan period between October and February. This difference between the north and south of this country may probably be due to the different climate of those areas.

Pneumonia is a disease of young adults in sub-saharan Africa as was also noted in this study where the peak age group was 20 to 29 years (42.6%). Additionally, increasing number of cases were seen in those over 60 years of age (19%), a possible reflection of the co-existing illnesses (comobidity) such as *diabetes mellitus*, renal insufficiency, congestive heart failure and chronic liver disease prevalent in that age group and known to be risk factors for pneumonia. It is possible that in the near future pneumonia will become a disease of the elderly in this environment, as in the western, industrialized countries.

There are variable proportions of patients in which the cause of pneumonia is identified. This ranges from 16.5% to 98% depending on the diagnostic specificity of the method used. In this study, pathogens were identified in 23 (42.6%) patients. *Strep. pneumoniae* remained the predominant pathogen in this study, as in other studies, though the incidence is somewhat lower. This may be due to prior anti-microbial use. It has also been reported that most of those cases of unknown aetiology may actually be due to *Strep. pneumoniae.*[11] Gram-negative pathogens were found to be the most common group responsible for pneumonia in this study, as was reported decades earlier by Sofowora and Onadeko in South West Nigeria.[12] Gram-negative pathogens as causes of pneumonia had been associated with certain risk factors: severe disease; comorbid respiratory disorders; prior antimicrobial therapy and use of sputum examination.[13,14] It had been established that when sputum examination is used in determining aetiology of pneumonia, gram-negative pathogens are reported in excess, as mixed pathogens, even when lung aspirate culture from the same patients yielded only a single pathogen.[15] This may account for the high

number of gram-negative pathogens isolated in this study that utilized sputum examination. Some workers, however, did not report similar findings using sputum examination.[5,9] Comorbid respiratory disorders, debilitation, alcoholism and intravenous drug abuse have also been associated with gram-negative pathogens. Gram-negative pathogens especially *Klebsiella pneumoniae* are isolated predominantly in healthy young adults in Africa unlike the western countries.[11] Prior antimicrobial therapy as a risk factor for the development of pneumonia due to gram-negative pathogens has been reported.[6,16] In this study about 59% of the patients admitted to prior antibiotic usage before presentation which is within the range of 35 to 88% reported in other studies in Nigeria and Africa.[9,7] *Haemophilus influenzae* was not isolated as a cause of pneumonia, even though it is ranked among the top five common aetiologies of CAP worldwide.[17] Earlier studies had indeed shown that *Haemophilus influenzae* is not commonly isolated in patients with CAP in this environment.[9,12] This may be due to prior antibiotic therapy, as earlier suggested, before admission or to the fastidious nature of the organism such that it is easily overgrown by other pathogens in sputum culture, especially if there is a delay in sample processing of more than four hours. *Staph. aureus* was isolated in two (3.7%) cases, which is similar to the 3 to 10% formed in other studies.[18,19] *Staph. aureus* is usually associated with severe disease, as was found in this study.

An interesting finding in this study is the resistance of the isolates to the older and commonly used antibiotics in this environment. The common first-line antibiotics in many health care facilities in sub-Saharan Africa are ampicillin; chloramphenicol; erythromycin; gentamycin; penicillin; tetracycline and co-trimoxazole. However, available second-line drugs vary within localities but often include amikacin; amoxicillin/clavulanate; cefuroxime; ciprofloxacin and nalidixic acid.[20] This resistance to first-line antibiotics had shown increasing prevalence in the last 15 years.[20,21]

What makes this finding troubling is the increased resistance of the isolates to pefloxacin, a fluoroquinolone and second-line drug. While there is accumulating evidence of the efficacy of fluoroquinolones in the treatment of pneumonia,[18] treatment failures have already been reported with fluoroquinolones.[22] The resistance of most isolates to pefloxacin, and *Strep. pneumoniae* to ciprofloxacin may be a reflection of the general abuses of these drugs in the treatment of febrile illnesses wrongly attributed to "typhoid" in this environment. Ikeh in Jos also reported that while 85% of methicillin resistant *Staph. aureus* were sensitive to ofloxacin, only 45% were sensitive to pefloxacin.[23] This resistance may extend to other fluoroquinolones if no effective drug policy is put in place, as these drugs are increasingly being marketed in their generic forms and as a result become cheaper and affordable.

The beta-lactamase inhibitory property of clavulanate in amoxicillin/clavulanate could explain its better potency compared to the other penicillins as was observed in this study.

Erythromycin, a macrolide, is not effective against *Klebsiella* and *Pseudomonas*, but has good activity against the other pathogens.

The implication is that erythromycin should not be given empirically as monotherapy in patients admitted for pneumonia except where it is established that *Staphylococcus pneumoniae* is the causative pathogen.

Combining results of susceptibility testing showed increased sensitivity of the isolates to fluoroquinolones (except pefloxacin), cephalosporins and gentamycin, which is a reflection of the high number of gram-negative pathogens isolated in this study. Gram-negative pathogens (*Eneterobacteriaceae* and *Pseudomonas aeruginosa*) have been shown to have high susceptibility to the cephalosporins, fluoroquinolones and aminoglycosides.[1,6,14] These drugs, except gentamycin, are expensive and may not be readily available in some of our rural communities, making their use as first line therapy for pneumonia difficult to implement in rural areas.

All the patients in this study were all started on benzylpenicillin, with most of them improving on it despite the *in vitro* resistance of most of the isolates to penicillin. This shows that *in vitro* resistance does not translate to *in vivo* resistance as previously documented.[24,25] Studies have shown that strains of *Strep Pneumoniae* in sub-Saharan Africa do not show full resistance to benzylpenicillin, and that response to benzylpenicillin could still be obtained if high doses are administered.[5,7,9] Treatment failure with benzyllpenicillin had been attributed to the presence of other pathogens.[5,25,26]

Not all patients in this study were able to mount leucocyte responses to pneumonia,
which raises the question of whether the probably widespread suboptimal nutrition in this environment is an important factor in predisposing people to pneumonia and blunting the immune response to infection. Further studies on the relationship between nutritional state, immune response, and bacterial infection would help clarify the picture and provide a factual basis on which to plan effective primary health care schemes aimed at reducing the incidence of bacterial pneumonia.

The radiological abnormalities of patients in this study are not different from earlier studies, with lobar consolidation being the predominant finding.[5,7,9] No distinct radiographic pattern could be ascribed to any conventioned bacterial pathogen. Pleural effusion as a complication of pneumonia was observed in 20.4% of the patients in this study. Other workers in Nigeria, Guinea and Ethiopia have reported values of 14 to 22.7%.[8,12,26] However, the radiographic abnormalities of the patients show that patients whose pneumonias were due to *E. Coli, Pseudomonas aeruginosa* and *Staphylococcus aureus* presented predominantly with

lobar consolidation, similar to those with unknown aetiology. *Klebsiella pneumoniae* patients had predominantly patchy consolidation while the two cases attributed *to Staphylococcus aureus* presented with multiple lobe consolidation. Findings were, however, not statistically significant (p=0.164).

The mortality of hospital-treated pneumonia in African series is 5 to 23%,[6,7] and is consistent with the finding in the study with a mortality of 7.4%. It is also similar to that of more developed countries, but with younger adults dying than the elderly.

Conclusion

This study demonstrates that pneumonia is common at the end of the dry season. It occurs mainly in young adults. *Streptococcus pneumoniae* is the most common pathogen responsible for CAP, while gram-negative bacilli (*Enterobacteriaceae* and *Pseudomonas aeruginosa*) form the commonest group of conventional bacteria isolated. Increasing indiscriminate use of broad spectrum antibiotic in the community may be responsible for the high number of cases in which no aetiologic pathogens were isolated.

While *in vitro* resistance of the isolates was demonstrated against the older and cheaper antibiotics (except gentamycin), with increased susceptibility to the newer and more expensive drugs (cephalosporins and fluoquinolines), *in vivo* response to benzylpenicillin was found to be very good in most of the patients. This confirms that benzyl penicillin is still a relevant first line drug in the management of pneumonia in this environment.

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